

RADIO & TELEVISION NEWS

FEBRUARY
1957
35 CENTS

World's Leading Electronics Magazine

BALCONY OR ORCHESTRA—
WHICH LOUDSPEAKER?

THE STRATEGY OF
COLOR SERVICING

MINIATURE SCOPE
FOR THE HAMSHACK

A COMPACT 6 WATT
POWER AMPLIFIER

COMMON-SENSE
TROUBLESHOOTING

A FIELD-STRENGTH METER
THAT TESTS TUNERS

ELECTRONIC AGITATOR

45,000 MILES-PER-WATT
(See Page 37)





Answers Independent Service Dealers' Questions About "Captive Service"

What is "Captive Service"?

It is the repair work done by service companies owned by set manufacturers — companies established by them to handle the profitable TV and radio set maintenance on receivers of their own manufacture — work that otherwise would be handled by Independent Service Dealers.

Will "Captive Service" affect my volume of business as an Independent Service Dealer?

A conservative estimate by service association spokesmen indicates that in 1957 Captive Service Companies could do close to \$250,000,000 worth of TV and radio repair work.

Does Raytheon compete with me through a "Captive Service" organization?

No, indeed! Raytheon does not have a captive TV-Radio service organization — does not now manufacture TV or radio receivers.

Raytheon believes service is your business — serving you is Raytheon's.

How can I compete with the "Captive Service" organizations of big national companies?

Raytheon helps you do this. If you can qualify as a RAYTHEON Bonded ELECTRONIC TECHNICIAN, your service and parts guarantee is backed by a bond — a bond issued through Continental Casualty Company, one of the country's largest insurance companies. Here is real prestige for you. What's more, your work on all makes and models of sets is bonded.

Will becoming a Raytheon Bonded Dealer mean I'll lose my "independence"?

Not at all. You become one of a group of TV-radio technicians known from coast-to-coast as the best in the business, yet you retain your own "independence." The Raytheon Bonded Program is nothing new. It's a proven program Raytheon has provided for more than 11 years — that has successfully helped build premium customer business for Independent "Bonded" Service Dealers. It's Raytheon's investment in your future.

How does being a Raytheon Bonded Dealer help me compete with "Captive Service" companies?

- (1) Your TV-radio repair service is nationally advertised by Raytheon in TV Guide Magazine.
- (2) Western Union "Operator 25" is retained in 23,000 cities and towns by Raytheon to send customers to Raytheon Bonded Dealers.
- (3) You are bonded to service all makes and models of sets — a big advantage.

Will I have other advantages over "Captive Service" organizations?

Yes, you'll be using Raytheon TV and Radio Tubes. They are perfect for your replacement work because Raytheon Tubes are designed to give quality performance in all Television and Radio sets.

How do I get the whole story on the Raytheon Bonded Program?

Ask your nearest Raytheon Sponsoring Bonded Tube Distributor.



RAYTHEON MANUFACTURING COMPANY

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Raytheon makes all these { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.





Jack Dempsey

The former world's heavyweight boxing champion says: "I know the value of good training, and believe me, for 25 years, DeVry has been one of America's outstanding electronics training centers! The Employment Service is 'tops' too!"

THESE DEVRY TECH GRADUATES VERIFY WHAT DEMPSEY SAYS



NICK BARTON, Illinois, a DeVry graduate, now has his own business and tells us he is "literally snowed with work."

GEORGE D. CROUCH, California, was a retail store clerk. He took the DeVry program, and today is in business for himself.



EDWARD HAHN, Illinois. Now an electronics technician with Televiso, Inc. DeVry Tech training helped him prepare for his present position.

"If You Want to Make More Money Full or Part Time in TELEVISION RADIO • ELECTRONICS DeVry Tech Has An Answer," SAYS JACK DEMPSEY

NO TECHNICAL EXPERIENCE NEEDED— YOU CAN LEARN IN YOUR OWN HOME!

Great opportunities are found in Electronics—one of today's top fields. Good jobs in modern plants, TV — Radio studios, offices and laboratories await trained men who can build, install, operate and service Electronic equipment. And equally exciting are the possibilities for starting your own servicing shop. The coupon below will bring you full details — Free!

HERE'S HOW TO GET STARTED!

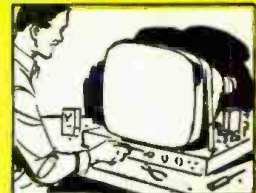
You can get Television-Radio-Electronics training right in your own home. You don't need previous technical experience, advanced education, or exceptional "aptitude." And the training DeVry Tech provides is "tops." What's more, DeVry helps you get started toward a job, or a servicing shop of your own!

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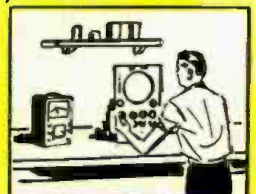
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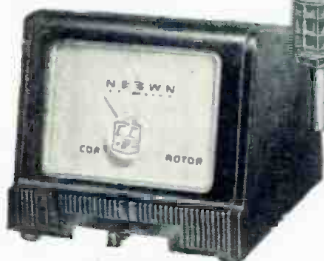
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AR-22



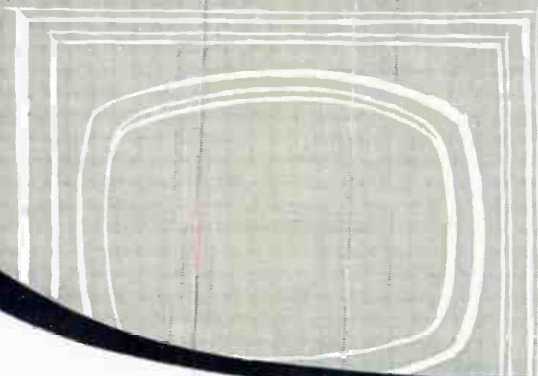
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CDR ROTORS

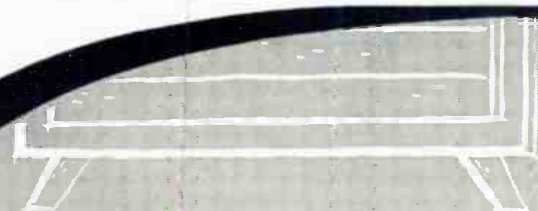


TR 11 and 12



AR 1 and 2

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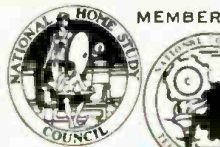
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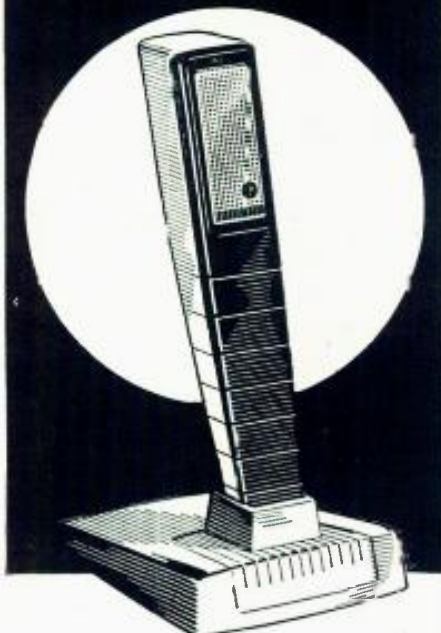
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Maximum versatility at a modest price. That's what you get in the E-V Model 927. Designed primarily for hand use, it comes complete with a heavy die-cast slip-in stand for desk use. Attractive, streamlined microphone case of sturdy die-cast metal and plastic in metalustre medium gray. It's omni-directional, has a 60 to 6,000 cps frequency response, can be used with any standard amplifier.

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For the **RECORD.**

RADIO—THIRTY YEARS AGO

THE first radio network was organized (*NBC*) and began broadcasting on November 15, 1926. This first network comprised 25 radio stations. Today *NBC* has grown to include 188 radio stations and 207 TV affiliates.

In retrospect we look back to the November, 1926 issue of this publication, then seven years old, to review the technology of the period: The use of vacuum tubes for radio reception was, at the time, replacing the crystal detector. The first cone-type loudspeakers (not dynamics) were reaching popularity and were available from several suppliers. Radio receivers had finally developed to the point where a single tuning dial could be ganged to an average of three variable condensers for tuning purposes.

Audio was receiving some attention, and a new transformer was offered at \$12 which, according to the "amplification curve," was somewhat flat between 500 and 4000 cycles. Response at that time was based on a musical scale. A feature article appeared in the November, 1926 issue titled, "Television en Route." It began with "The day of television is rapidly approaching; it will be with us very shortly." The article told how inventions by German scientists had removed the last difficulties in the field of "phototelegraphy" and went on to describe the apparatus.

Another feature titled, "Radio Is Making Us 'Ear-Minded,'" served to teach the listener to enjoy programs by hearing and not to continually look at the loudspeaker as a subconscious aid to the distinguishing of different volume levels in music. The service industry (and it could hardly be called that) was not without its "grafters," and an article revealed case histories where unscrupulous mechanics had already taken advantage of a gullible public. At the time one of the favorite tricks was for the technician (if you'll pardon the expression) to shake his head dolefully and look at the customer as the ammeter indicator pointed only to "3." Batteries of all descriptions were used commonly for the operation of radio apparatus in 1926. They included 1 $\frac{1}{2}$ -volt dry cells, single cell wet and dry "A" batteries, 48-volt storage "B" batteries, and 45-volt dry cell "B" batteries. Battery chargers were a necessity in the average home.

New products announced in November, 1926, included a shielded 6-tube receiver, a double-range receiver, a new variable condenser designed to obtain the greatest possible separation of stations, a console receiver having

ample space to house battery eliminators at sufficient distance from the set to escape any hum, a variometer-tuned receiver connected to a single dial, a talking book (loudspeaker in the form of an open book), a 7-tube neutrodyne, several cone speakers and an electrolytic rectifier B unit.

The home builder was giving serious attention to the design of portable sets. The staff of this magazine designed such a unit which they called a "superhet travelling companion." It would work well on all local stations using a loop antenna and was capable of some DX with an outdoor aerial. In contrast to present-day transistorized portables, the one described required the use of an "A" battery comprised of six 4 $\frac{1}{2}$ -volt batteries connected in parallel, four 22 $\frac{1}{2}$ -volt "B" batteries wired in series, and three 4 $\frac{1}{2}$ -volt flashlight cells used for the "C" battery. A small horn-type loudspeaker was included. Dimensions were 6 $\frac{1}{4}$ " x 13 $\frac{1}{4}$ " x 20" and the "portable" weighed about 34 pounds.

Our November, 1926 issue also reported on the Third Annual Radio World's Fair which was held in New York City during September of that year. Most of the receivers on exhibit employed from six to ten tubes, were totally shielded, and used loop aerials as a "collective agency." The absence from view of coils, condensers, and tubes was reported as being very novel. Considerable attention was also paid to the audio end with an emphasis on quality. Transformer-coupled audio amplifiers with the output stage designed for a power tube were in prominence. The newest designs permitted the set to operate directly from the electric light mains.

The hi-fi fan of 1926 could buy a cone speaker with "free-edge design," and some of the latest types had driving rods off-center to eliminate resonance points and prevent the creation of harmonics. Some of these speakers took the shape of an oval and ranged in diameter from 18 to 36 inches.

And what about tubes: one could buy the UX-120 at \$2.50, the storage battery or a.c. UX-171 for \$6, the storage power tube UX-112 for \$6.50, or the new super-power UX-210 for \$9 (we used this latter type in one of our first ham rigs, but with base removed and inverted into a jar containing mineral oil for cooling).

Radio has indeed come a long way since the immortal Will Rogers dispensed his home-spun philosophy over the air waves in 1926 to the shouting of Elvis Presley over the radios of today. O. R.

RADIO & TELEVISION NEWS

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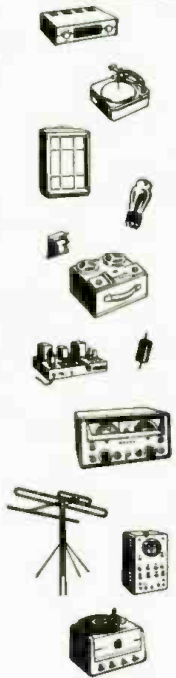
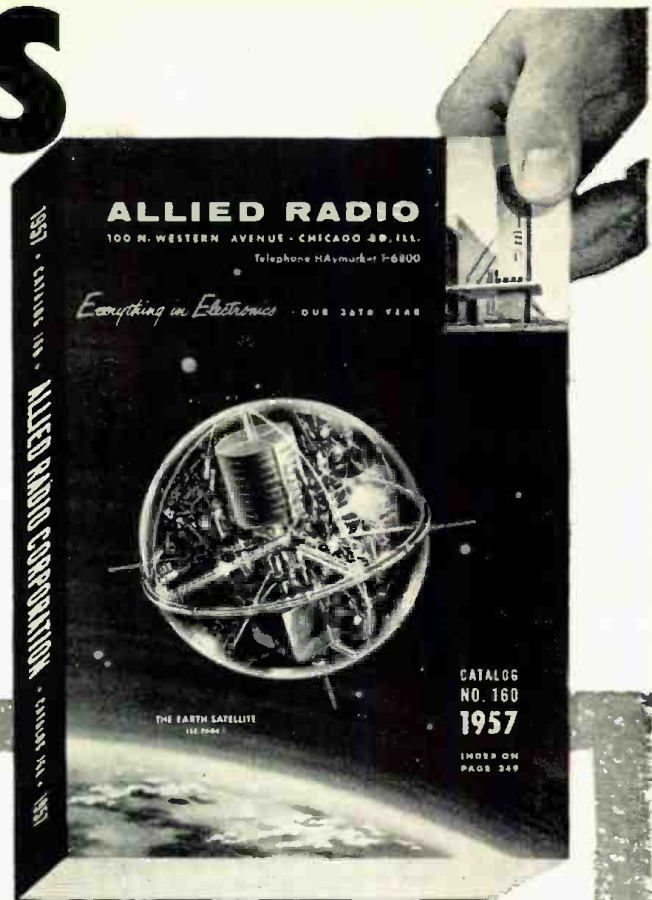


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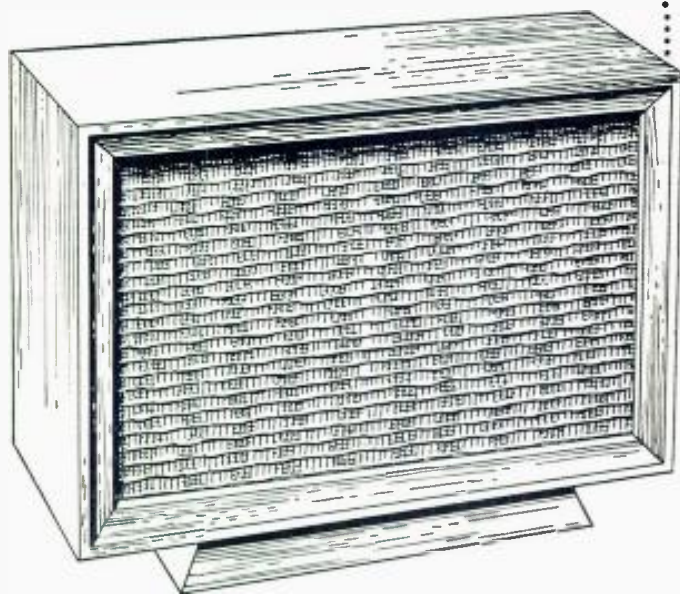
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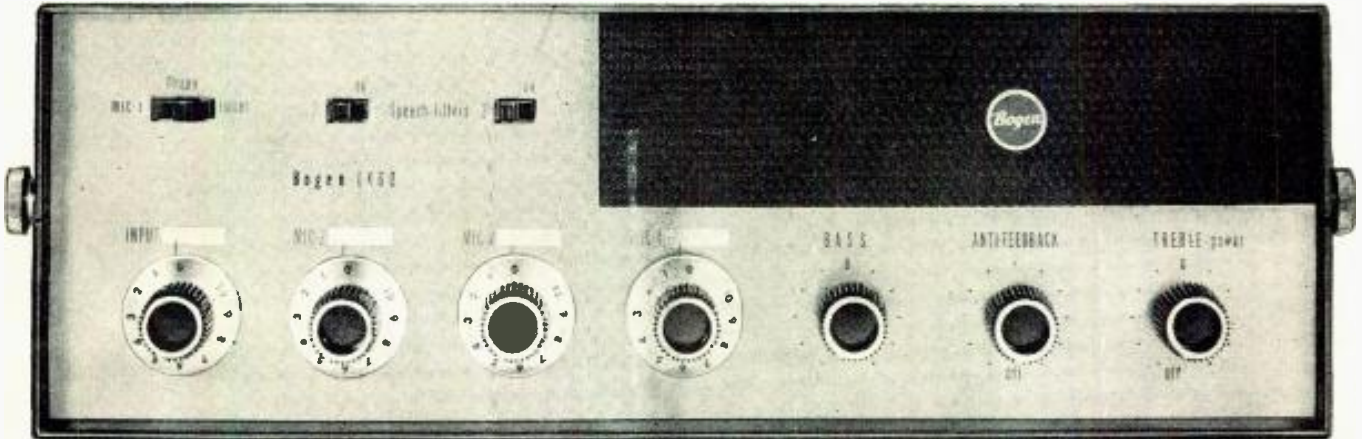
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4 Microphone Inputs (panel switch converts one microphone channel for phono or tuner), Built-In Remote Gain-Control Circuit, Exclusive Anti-Feedback Control, Speech Filters, Separate Bass and Treble Tone Controls
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Spot Radio News

★ Presenting latest information on the Radio Industry.

By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

THE RECENT DEVELOPMENT and widespread use of tropospheric scatter propagation, radio noise, modulation, and navigation techniques has prompted the Bureau of Standards to reorganize its radio-propagation engineering division in Boulder, Colorado, and divide the original two research sections into seven new units.

The new divisions will concentrate on data reduction instrumentation, modulation systems, navigation systems, radio noise, tropospheric measurements, radio-systems application engineering, and various tropospheric analysis.

Another new section at the Bureau will concern itself with sun-earth relationships. In a closely coordinated program engineers will study the sun and its effect on radio communication, and the use of solar and geophysical data to forecast short-wave radio communications conditions.

OVER-THE-HORIZON scatter propagation has also become the subject of an intensive study by the Air Research and Development Command; a program that, it is hoped, will provide answers to long-distance transmission problems on the ultra-high portion of the spectrum.

The probe will feature the use of two communications stations; a receiving station near Baltimore and a transmitting site 285 miles away in Verona, New York; there are no intervening repeater or booster stations along the 285-mile path. A few years ago transmission-reception over a 285-mile distance would have been considered impossible. The theory was then that line-of-sight distances of about 30 miles to the horizon was the maximum limit of signalling in the higher frequency bands.

In the scatter technique extremely large transmitting and receiving antennas are required. In addition, the transmitters must be high powered and extremely sensitive receivers must be employed. Signals radiated in a narrow, beam-like path are reflected or scattered from the troposphere and a portion of these scattered waves are received by another antenna beyond the horizon.

In the installation near Baltimore, a metal prefabricated building serves to house the receiving equipment, which is linked to a 28-foot diameter parabolic antenna on a 33-foot tower. At Verona, the antenna site, there is a 10,000-watt transmitter.

(Continued on page 16)

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Pennsylvania	Lancaster	WLAN-TV	21	512-518	17
Kentucky	Paducah	.....	6	82-88	58.3
Maine	Augusta	.....	10	192-198	316
Michigan	Port Huron	WHLS-TV	34	590-596	22.9
Texas	Bryan	KGTX-TV	3	60-66	60.3

New Call Letter Assignments

STATE	CITY	CALL	CHANNEL	FREQUENCY
Montana	Missoula	KMSO-TV (Formerly KGVO-TV)	13	210-216
New Jersey	Atlantic City	WHTO-TV (Formerly WFPG-TV)	46	662-668
Virginia	Arlington	WURL-TV	20	506-512
Wyoming	Riverton	WKRK-TV	10	192-198

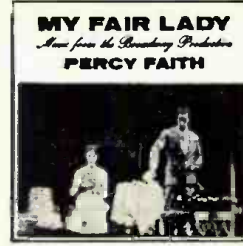
*ERP (effective radiated power, kw.)

FREE... ANY 3

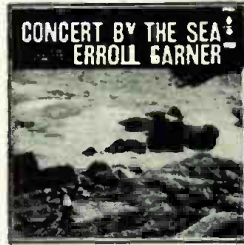
OF THESE SUPERB HIGH-FIDELITY

12" COLUMBIA LP RECORDS

If you join the Columbia Record Club now—and agree to accept as few as 4 selections during the coming 12 months



The most exciting high-fidelity performances



ever offered to new members



of the Columbia LP Record Club

© "Columbia", LP, ® Marcas Reg.

YES! You may have, FREE, ANY 3 of these best-selling 12" Columbia LP records. We make this unique offer to introduce you to the money-saving program of the Columbia Record Club—a program that selects for you each month the greatest works in every field of music—performed by the world's finest artists, brilliantly reproduced on Columbia LP records.

HOW THE CLUB OPERATES: To enjoy the Club's benefits—all the coupon, indicating which one of the four Club divisions best suits your musical taste: Classical; Jazz; Listening and Dancing; Broadway, Movies, Television and Musical Comedies.

Each month you will receive free the Club Magazine which describes the current selections in all four divisions. You may accept or reject the monthly selection for your division... or you may take records from other Club divisions... thereby assuring you the widest possible choice of recorded entertainment. Or you may tell us to send you NO record in any month.

Your only obligation is to accept as few as 4 selections from the almost 100 that will be offered during the next 12 months. The records you want are mailed and billed to you at only \$3.98 (original cast Broadway Shows somewhat higher), plus a small mailing charge.

FREE BONUS RECORDS GIVEN REGULARLY: The 3 records sent to you now represent an "advance" of the Club's bonus system—given to you at once. After you have fulfilled your membership obligation by purchasing four records, you will receive an additional free Bonus record of your choice for every two additional Club selections you accept. Bonus records are superb 12" Columbia LP records—the very best of the Columbia LP catalog—just like those shown here.

Indicate on the coupon which 3 records you want free, and the division you prefer. Then mail the coupon at once. You must be delighted with membership or you may cancel it by returning the free records within 10 days.

COLUMBIA LP RECORD CLUB
165 West 46th Street, New York 36, N. Y.

February, 1957

COLUMBIA LP RECORD CLUB,
Dept. 686, 165 West 46th St.,
New York 36, N. Y.

Please send me as my FREE gift the 3 records indicated here: (Select the records you want by checking the 3 boxes in the list at the right)
...and enroll me in the following Division of the Club:

- (check one box only)
- Classical Listening and Dancing
- Broadway, Movies, Television and Musical Comedies Jazz

Each month you will send me the Columbia LP Record Club Magazine which describes the records offered in all four Club divisions. I have the privilege of accepting the monthly selection in the division checked above, or any other selection described, or none at all. My only obligation is to accept a minimum of four records in the next 12 months at the regular list price plus a small mailing charge. After accepting 4 records, I will receive a free Bonus record for every two additional records I purchase. If not delighted with membership, I may cancel within 10 days by returning all records.

Name.....
(Please Print)

Address.....

City..... Zone..... State.....

CANADA: Prices slightly higher.
Address 11-13 Soho St., Toronto 2B

If you wish to have this membership credited to an established Columbia Records dealer, authorized to accept subscriptions, please fill in the dealer's name and address also.

Dealer's Name.....

Dealer's Address.....

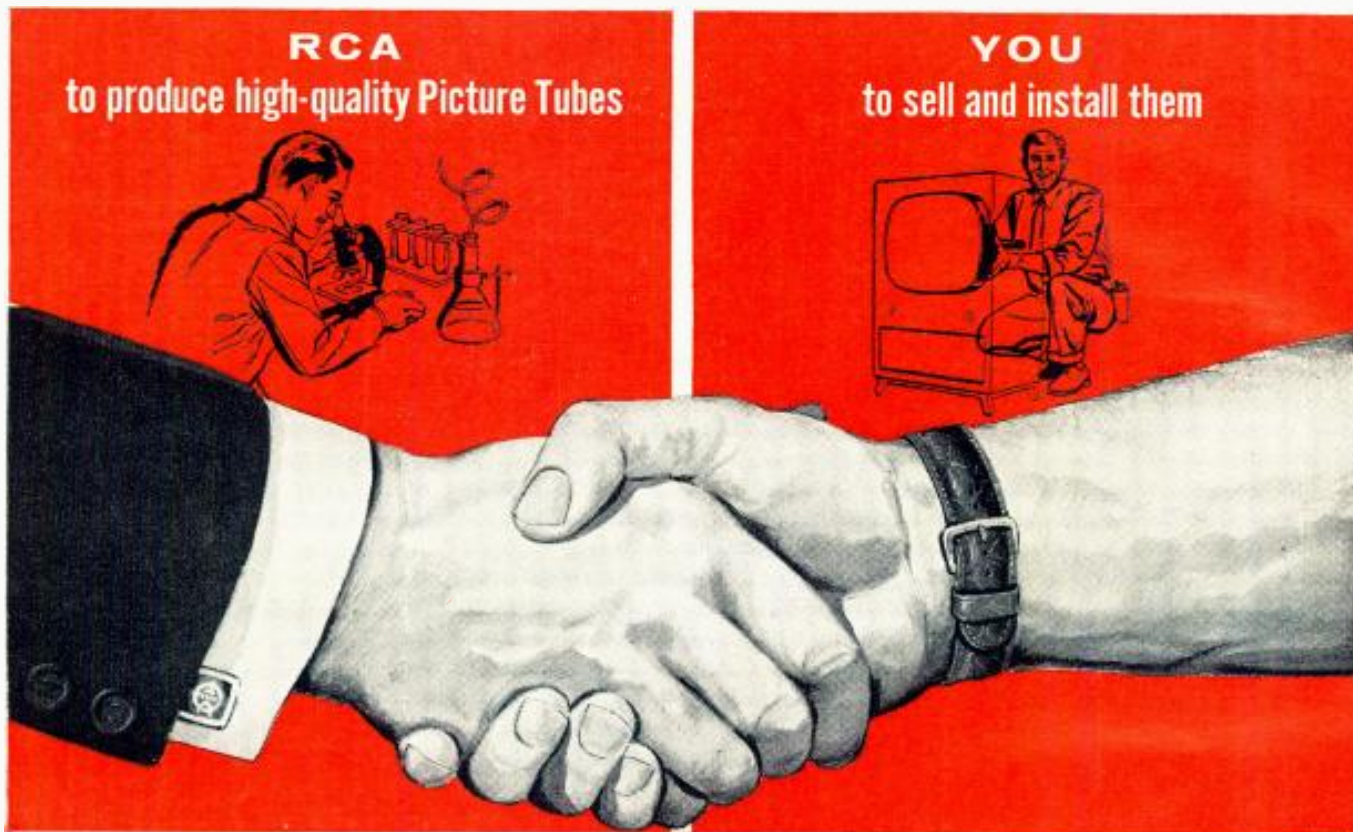
CHECK THE 3 RECORDS YOU WANT:

- | | |
|---|---|
| <input type="checkbox"/> Tchaikovsky: Nutcracker Suite: The Sleeping Beauty Ballet Philadelphia Orchestra, Ormandy, cond. | <input type="checkbox"/> Concert by the Sea Erroll Garner—recorded in an actual performance at Carmel, Calif.—playing 11 numbers—Red Top, Where or When, etc. |
| <input type="checkbox"/> Day Dreams Doris Day sings 12 popular songs—including <i>Sometimes I'm Happy</i> , <i>You Go To My Head</i> , etc. | <input type="checkbox"/> Levant Plays Gershwin 3 works—Rhapsody in Blue, Concerto in F, An American in Paris. |
| <input type="checkbox"/> King of Swing, Vol. 1 Benny Goodman and Original Orch., Trio, Quartet. <i>Ridin' High</i> , <i>Moonglow</i> —9 more. | <input type="checkbox"/> The Voice Frank Sinatra in 12 songs that first made him famous— <i>Lover</i> , <i>Fools Rush In</i> , etc. |
| <input type="checkbox"/> My Fair Lady Percy Faith and his Orchestra play music from this hit show. | <input type="checkbox"/> Rimsky-Korsakov: Scheherazade Philadelphia Orch., Ormandy, conductor. A superb performance of this exotic score. |
| <input type="checkbox"/> Brahms: Double Concerto: Variations on a Theme by Haydn; Tragic Overture Stern, violin; Rose, cello; N. Y. Philharmonic, Walter, cond. | <input type="checkbox"/> Music of Jerome Kern Andre Kostelanetz and his Orchestra play 20 Kern favorites. |
| <input type="checkbox"/> Songs from Walt Disney's Magic Kingdom—12 happy songs from famous Disney films. | <input type="checkbox"/> Jazz: Red Hot & Cool Dave Brubeck Quartet in <i>Love Walked In</i> , <i>The Duke</i> —5 more. |

49-3

IT TAKES TWO:

RCA and YOU



When the customer says, "Why?", "What?", "How Much?", don't just talk tubes, talk:

- QUALITY** Tell them how an RCA picture tube must pass well over 100 careful inspections before it's good enough for you—or your customer.
- ACCEPTANCE** Remind them that more people view TV shows on RCA picture tubes than on any other brand.
- BRAND NAME** Emphasize RCA—the name that's first in electronics.
- WARRANTY** The Warranty Card you give your customers says the tube is an RCA tube; it says it's factory-fresh; above all it says: "warranted for a year."

Today, your customers are well-informed TV viewers who demand the best in picture tube performance. These are the people who, week in and week out, read the RCA Silverama story in Life, TV Guide, the Saturday Evening Post. These are the people who see and hear the RCA Silverama quality story on NBC's network radio and TV shows. And these are the very customers who say "yes" to RCA. So, team-up with RCA. You'll know the difference, and your customers will see it—big and bright as life.

Silverama



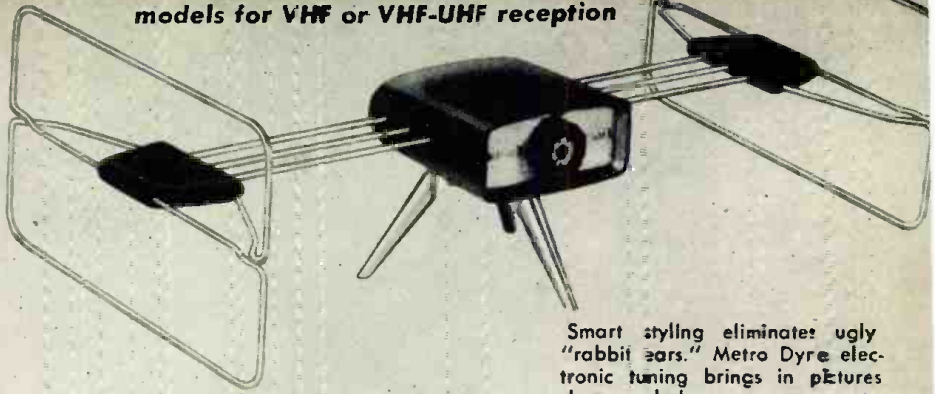
PICTURE TUBES

RADIO CORPORATION OF AMERICA

Tube Division • Harrison, N. J.

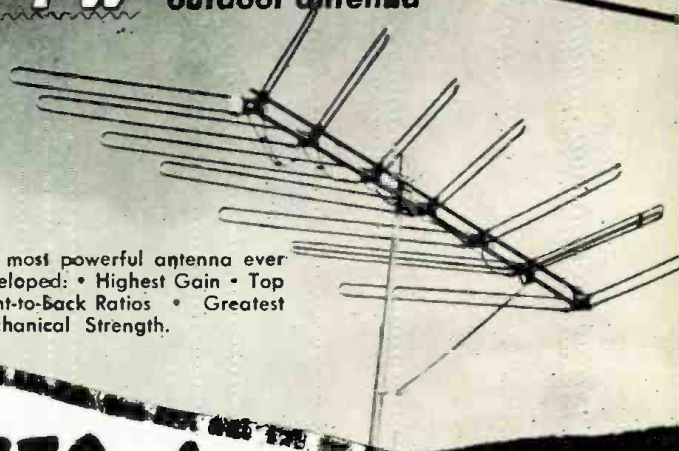
No antennas ever made can match the performance and sales appeal of these outstanding Channel Master models.

Showman indoor antenna
models for VHF or VHF-UHF reception



Smart styling eliminates ugly "rabbit ears." Metro Dyre electronic tuning brings in pictures sharp and clear.

T-W outdoor antenna



The most powerful antenna ever developed: • Highest Gain • Top Front-to-Back Ratios • Greatest Mechanical Strength.

MORE PROFITS for CHANNEL MASTER dealers

In every TV reception area Channel Master dealers are racking up new sales records with the most popular TV antennas on the market today. Superior products plus consistent consumer advertising is a double-barrelled profit combination you can't beat. When you feature the Channel Master line you always have that extra selling edge . . . that extra PLUS that means faster turnover . . . easier sales . . . bigger profits.

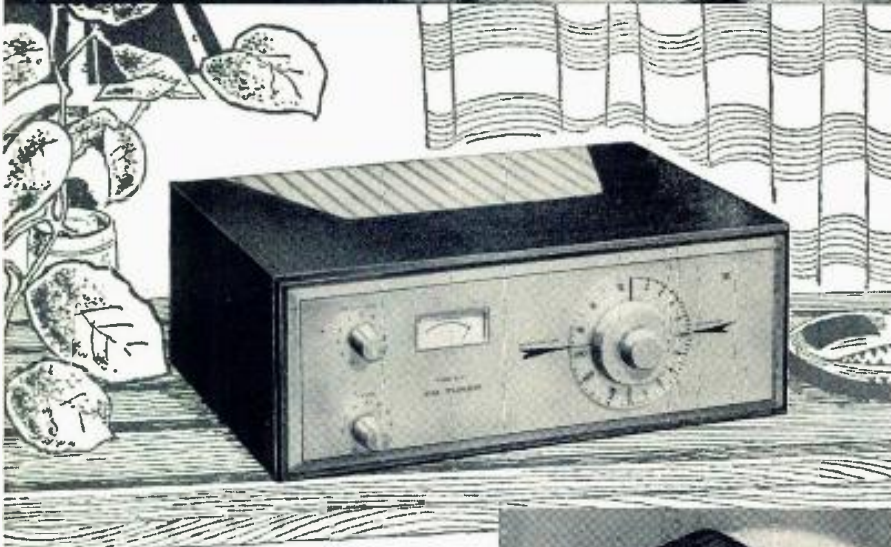
Isn't it time you called your Channel Master distributor?



Channel Master's massive national and local advertising program . . . establishes you as the local TV authority . . . is creating loads of new prospects right in your own selling area . . . and is opening millions of homes to antenna replacement.

(Continued from page 12)

Looks Different...
is Different!



H. H. Scott Model 310-B FM Tuner \$159.95
(Mahogany Case \$19.95)

Other H. H. Scott tuners from \$119.95. All prices slightly higher West of Rockies. All tuners meet FCC radiation specifications

Exclusive wide band design ...
new silver sensitive front end ...

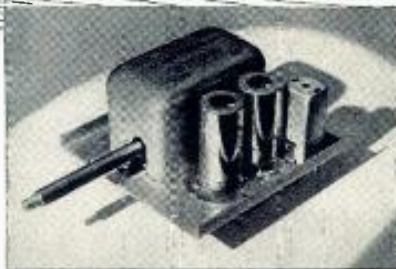
Most Sensitive ... Selective FM Tuner Ever Made!

High Fidelity Magazine says:

"The 310 seems as close to perfection as is practical at this time".

One look at all the features ... or.e listen to the superlative sound ... and you'll agree!

Wide band circuit design, heavy silver plating in the RF section, and three stages of full limiting make possible noise-free reception of even the weakest stations. Three IF stages insure maximum selectivity with virtual elimination of adjacent and co-channel interference.



Silver Sensitive Front End
Makes Distant Stations
Sound Close By!

H. H. Scott never compromise: on design. The front-end pictured above is a good example. Silver is one of the best conductors known, yet only H. H. Scott heavily silver-plates their cascode RF section for maximum gain and most reliable performance. This Scott exclusive assures a sensitivity of 2 microvolts throughout the entire FM Band.

Look at these many features and specifications that defy obsolescence:

- Sensitivity 2 microvolts on 300 ohm antenna terminals for 20 db of quieting (equivalent to 1 microvolt with matched 75 ohm antenna)
- Planetary drive tuning • Logging Scale
- Dynaural Interstation Noise Suppressor cuts out FM roar between stations • Illuminated Signal Strength and tuning meter • Separate tape recorder and multiplex outputs • 2 1/2 db capture ratio permits virtually noise free reception of stations only slightly stronger than interference on the same channel • Easily panel mounted, matches all H. H. Scott amplifiers • Dimensions in mahogany case 13 1/2 x 5 x 9 1/2.

AN IMPROVED WEATHER STATION, featuring a radiosonde, that is ejected from a plane to determine weather characteristics in inaccessible parts of the world has been developed by ARDC. The instrument, technically a weather-sensing radio transmitter, was designed by ARDC's Wright Air Development Center, and is said to be more accurate and adaptable than earlier types.

For several years, radiosondes have been used by the Air Weather Service to determine the weather characteristics over oceans and polar regions where permanent weather stations are not practical. The units, which are parachuted from airplanes, transmit a complete record of humidity, temperature, and air pressure until they hit the earth.

The improved model has been designed for use from altitudes up to 60,000 feet and at speeds up to Mach .98 (Mach 1 is the speed of sound) as compared to the 30,000-foot and Mach .43 limits on the older model. In addition, the designers say that the new unit is 95 per-cent reliable as compared to a previous reliability of 80 per-cent.

The radiosonde consists of two dry-cell batteries, a radio transmitter, and a parachute assembly; it is only 21 1/2 inches long, 5 inches in diameter, and weighs 9 pounds.

Radiosondes can be dropped manually from large aircraft or by remote control from an eight-unit dispenser in smaller craft where space is scarce. But the sondes must be designed so that the delicate transmitter will not be harmed by the shock of the unit hitting the airstream or by the parachute opening.

Six seconds after leaving the plane, the radiosonde parachute pops out of its housing, stabilizing the unit and lowering it gently toward the earth. Simultaneously, a 1-foot antenna automatically snaps downward and a short arm extends perpendicular to the radiosonde.

On the arm are located relative humidity and temperature-sensing elements and inside the container is an air-pressure bellows. These three devices immediately begin to sense temperature, humidity, and pressure and transmit this data by radio back to the plane.

Inside the plane a receptor picks up the signals, then decodes and records them. This record is evaluated by a technician who, in turn, radios the findings to a central weather station.

About 25,000 radiosondes are dropped each year by seven weather squadrons flying daily in the northern hemisphere. Data collected in this way is transmitted through a world-wide weather network within four hours after it is collected. This enables advance weather predictions to be made; in the case of California, for example, two to three days in advance.

The weather squadrons fly over areas of a (Continued on page 96)



H. H. Scott, Inc.
385 Putnam Avenue, Cambridge, Mass.
Export Dept: Telesco International Corp.
270 Park Avenue, New York 17, N. Y.

Mail Now For New Catalog

Rush me your new catalog RTV-70 and complete technical specifications on the new H. H. Scott line for '57.

NAME _____

ADDRESS _____

CITY _____ STATE _____

Electro-Voice

664 VARIABLE D* HIGH-FIDELITY CARDIOID DYNAMIC MICROPHONE



Outperforms Any Other P. A. Cardioid — Or Your Money Back!



It took an entirely new concept, Variable D, to do it, but here it is . . . a broadcast-quality microphone for

every P. A. installation . . . every personal tape recorder . . . every radio amateur rig. The high-fidelity "664" is such a revolutionary improvement in the field that we can guarantee it to outperform any other P. A. cardioid . . . or your money back!

Uniform cardioid polar pattern gives high front-to-back discrimination. You get smooth, peak-free response at all frequencies from 40 to 15,000 cps, no boominess from close talking.

Exclusive, indestructible Acoustalloy Diaphragm—a single moving element—withstands high humidity, temperature extremes, corrosive effects of salt air, and severe mechanical shocks. With the E-V "664" you are sure of dependable, long-life operation indoors and outdoors.



Unidirectional, the E-V Variable D cardioid "664" provides highly directional sound selectivity reduces pickup due to ambient noise and reverberation up to 50%. Proper microphone placement stops unwanted sounds, gives accurate, natural pick-up of voice and music. Highest sound level to feed-back ratio. The "664's" greater pick-up range doubles working distance over conventional microphones. Pop-proof filter minimizes wind and breath blasts.

*E-V Pat. Pend.

ASK A BROADCAST OR RECORDING ENGINEER ABOUT E-V MICROPHONES

Model 664. Variable D Super-Cardioid Dynamic Microphone. Uniform response at all frequencies from 40 to 15,000 cps. Output level, -55 db. 150 ohm and high impedance. Impedance changed by moving one connection in cable connector. Low impedance balanced to ground and phased. Acoustalloy diaphragm, shielded from dust and magnetic particles. Alnico V and Armo magnetic iron in non-welded circuit. Swivel permits aiming directly at sound source for most effective pick-up. Pressure cast case. $\frac{5}{16}$ "-27 thread. Satin chrome finish. 18 ft. cable with MC4M connector. On-Off switch. Size: $1\frac{1}{8}$ in. diam., $7\frac{3}{8}$ in. long, not including stud. Net wt: 1 lb. 10 oz. List Price \$82.50

Model 419. Desk Stand. Modern, sturdy design (extra). List Price \$10.00

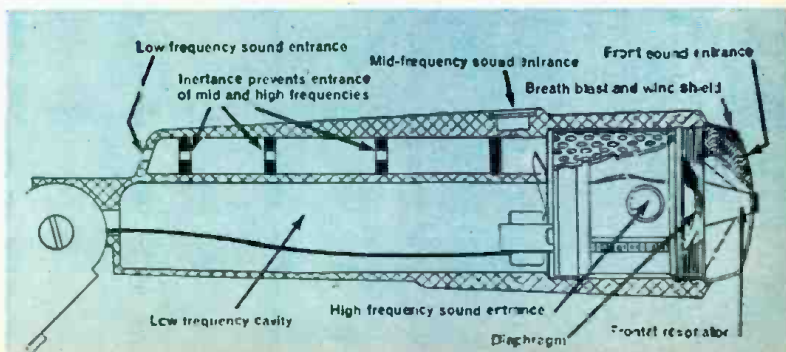
Write for: A. B. C.'s of Microphones, Dept. N72.

FOR PERFORMANCE! FOR VALUE!
NO FINER CHOICE THAN

Electro-Voice®

ELECTRO-VOICE, INC., BUCHANAN, MICH.

Canada: E-V of Canada Ltd., 1908
Avenue Road, Toronto, Ontario
Export: 13 East 40th Street,
New York 16, U.S.A. Cables: ARLAD



HOW MANY CAN YOU ANSWER "YES?"

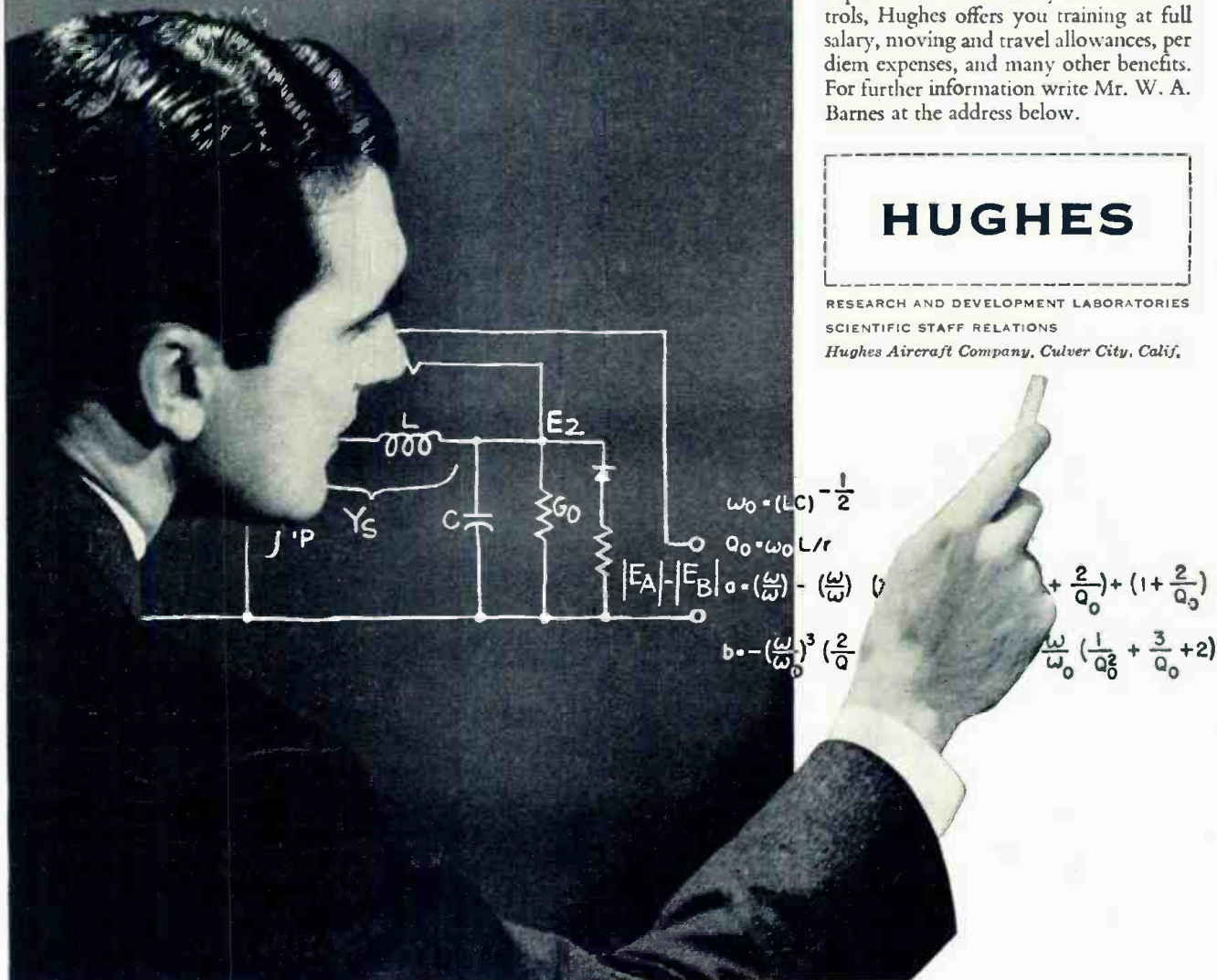
1. Do you wish to extend your experience in electronics systems?
2. Would you like to instruct others in advanced fire control systems and laboratory techniques?
3. Would you like to handle a responsible position representing a leading electronics organization?
4. Do you believe that you can accurately relate your findings and studies in technical language?
5. Are you interested in such devices as analog computers, digital computers, power supplies, transmitters, receivers, and microwave antennas?
6. Do you enjoy working with people?

If you can answer "yes" to four of the above questions and have an Electrical Engineering or Physics degree, chances are that you can qualify for one of the several engineering positions in the Hughes Field Engineering department.

In addition to giving you well-rounded experience in electronic systems and controls, Hughes offers you training at full salary, moving and travel allowances, per diem expenses, and many other benefits. For further information write Mr. W. A. Barnes at the address below.

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES
SCIENTIFIC STAFF RELATIONS
Hughes Aircraft Company, Culver City, Calif.





From the originator
of the 6BQ6GT • 6CU6 • 6DQ6

TIPS ON REPLACING HORIZONTAL AMPLIFIERS

No one tube satisfactorily replaces the 6BQ6GT, 6CU6, and 6DQ6 . . . or their heater-voltage variations. CBS knows because, foreseeing the need for each of these three families of horizontal amplifiers, CBS originated the 'BQ6, 'CU6, and 'DQ6. The latter two were designed: 1. With increasingly greater safety margins to combat high voltage and heat. 2. With improved sweep characteristics.

In general, replacement of each tube should be with the original type. But in some sets, larger, wider-angle picture tubes using higher voltages place overloads on the original horizontal amplifiers. Here replacement should be a step upwards at a time: 'CU6 for 'BQ6 . . . 'DQ6A for 'CU6. Following these rules will give reliable safety margins and neither too little nor too much sweep, especially important in receivers with no horizontal width control.

Another good rule is to replace them all with CBS tubes. The reason is logical. It's better to use CBS originals . . . because CBS has had more experience in making them better.



*Reliable products
through Advanced-
Engineering*

CBS-HYTRON, Danvers, Mass.
A Division of
Columbia Broadcasting System, Inc.



FROM DELCO RADIO come the **speakers** with highest performance. You trust them...so do your customers!

Engineering skills of Delco Radio and General Motors combine to offer a full line of speakers for home and auto radios, phonographs, TV, and Hi-Fi. National advertising behind the Delco Wonder Bar Radio develops a bigger service market for you! For fast service call your UMS-Delco Electronics Parts Distributor.

14 Standard Models: Designed and built to R.E.T.M.A. standards with heavily plated metal parts and Alnico-V magnets. Precision felted cones give uniform response over full operating frequency range. All are fully dustproof and dependable.

Dual-Purpose Hi-Fi Model 8007: A superior speaker for custom-built audio systems and for replacements in AM, FM, TV and phonograph sets. Size 8", 50 to 12,500 CPS frequency range; Alnico-V magnet; 10-watt power rating; 4.1 v.c. impedance; 1 $\frac{3}{16}$ " voice coil.

DELCO

W O N D E R B A R

RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA



A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE
Distributed by Delco Electronic Parts Distributors

A complete line of original equipment service parts from the

W O R L D L E A D E R I N A U T O R A D I O

RADIO & TELEVISION NEWS

Prepare for a Good Paying Job—Or Your Own Business

Learn PRACTICAL RADIO-TV
with **25 BIG KITS**

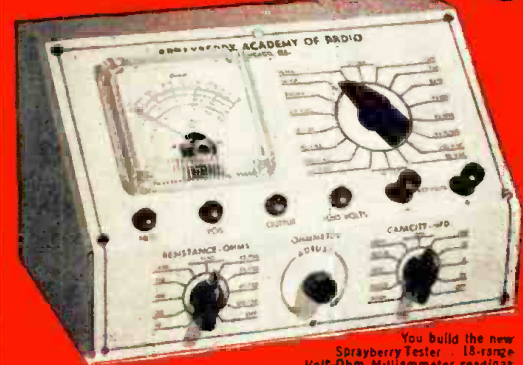
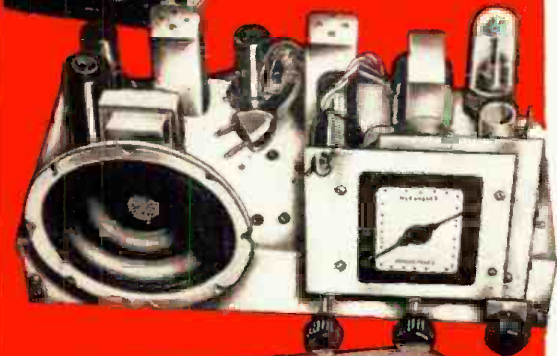
of equipment I send you while
you train with me . . . for valuable
shop bench experience . . .



Through the new Sprayberry Training
Television receiver, built and tested
in sections for greatest instruction
value.

I now offer this fine modern oscil-
loscope to help you learn Prac-
tice Television servicing.

You will build this powerful short-
wave and broadcast superhet radio
receiver for valuable shop instruc-
tion practice.



You build the new
Sprayberry Tester . . . 18-range
Volt-Ohm-Milliammeter readings
plus output meter and condenser
and resistor substitution selector.

In addition to modern lesson training, I also give you
plenty of home practice on actual Radio-Television
equipment . . . you will build and use the units shown
here plus many more. All this equipment is yours to
keep . . . keep everything you need to set up your shop.

"I Will Train You at Home in
RADIO-TELEVISION
On Liberal No Obligation Plan!"

New Equipment! New Lessons! Enlarged
Course! The true facts are yours in my
big new catalog . . . **YOURS FREE . . .**

JUST MAIL COUPON!

I can train and prepare you in as little as 10 months to step into the big opportunity Radio-Television service field. Train *without* signing a binding contract . . . without obligating yourself to pay any regular monthly amounts. You train entirely at home in spare hours . . . you train as fast or as slowly as you wish. You'll have your choice of **THREE SPRAYBERRY TRAINING PLANS . . .** planned for both beginners as well as the more experienced man. Get the true facts about the finest most modern Radio-Training available today . . . just mail the coupon for my big new 56 page fact-filled catalog plus sample lesson—both **FREE**.



Frank L. Sprayberry
President, Sprayberry
Academy of Radio

Train the Practical Way—with Actual Radio-Television Equipment

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My students are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

**See for Yourself... Make Your Own Decision
... Mail Coupon Today!**

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item I include in my training. With the facts in your hands, you will be able to decide. *No salesman will call on you.* The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO
111 North Canal Street, Dept. 25-H, Chicago 6, Illinois

Mail This Coupon for Free Facts and Sample Lesson



SPRAYBERRY ACADEMY OF RADIO
Dept. 25-H, 111 N. Canal St., Chicago 6, Ill.

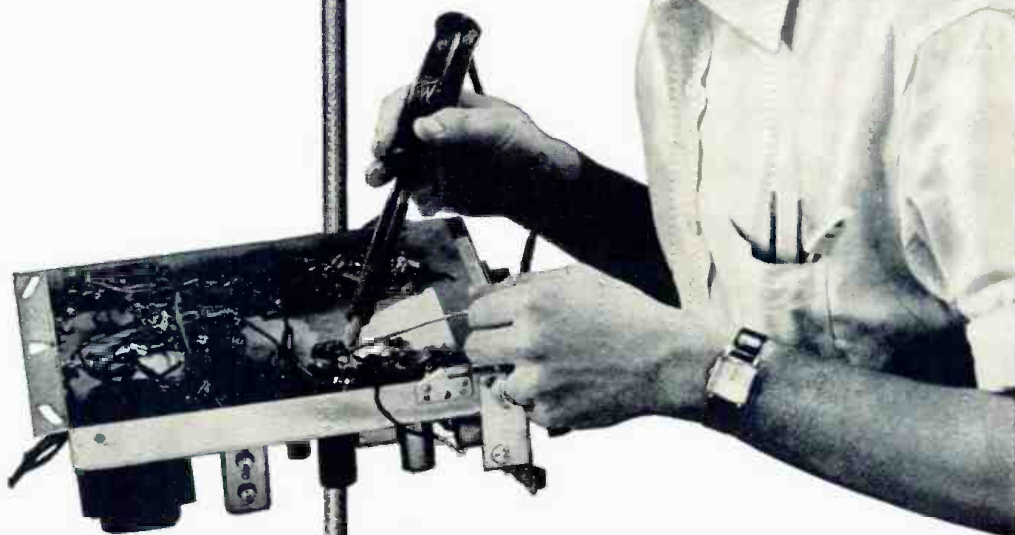
Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson **FREE**.

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

**If it's worth
engineers'
time...**



Belden
**ELECTRONIC
WIRE**
The complete packaged line
—easy to use. Be sure of
the right wire engineered
for the job.
There are 1001 Belden
wires for every Radio and
Electronic requirement.

**...it's worth
engineered
electronic wire**

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

Magnet Wire • Lead and Fixture Wire • Power Supply Cords, Cord Sets and Portable Cord • Aircraft Wires
Welding Cable • Electrical Household Cords • Electronic Wires • Automotive Wire and Cable

There's a 'pot of gold' waiting for you
at the end of this **COLOR TV Servicing** Rainbow!

Introducing RTTA'S Color TV Technician Course

(For men with previous radio & TV training)



L. C. Lane, B.S., M.A.
President, Radio-Television
Training Association
Executive Director, Pierce
School of Radio & Television.

Other RTTA Courses

covering all phases of Radio, FM and TV

Radio-FM-Television Technician Training

My Radio-FM-Television Technician Course is especially prepared for men with no previous experience or training. I have trained hundreds of men for successful careers in radio-television-electronics. Many of them had only a grammar school education and no previous experience whatsoever in the field.

Expert FM-TV Technician Training

My FM-TV Technician Course lets you take full advantage of your previous experience — either civilian or Armed Forces. **YOU CAN SAVE MONTHS OF TIME.** Train at home with kits of parts, plus equipment to build TV RECEIVER. ALL FURNISHED AT NO EXTRA COST!

Practical TV Studio Technician Course

(For men with previous radio & TV training)

I train you at home for an exciting to pay job as the man behind the TV camera. Work "on location" at remote pick-ups! Available if you want it . . . one-week course of practical work on TV studio equipment at Pierce School of Radio & TV, our associate resident school in New York City.

COMPLETE! DEPENDABLE!

RTTA offers you the most complete and practical Color Television Technician Correspondence Course. It includes the latest, up-to-the-minute data and procedures for the servicing and maintenance of all Color TV receivers and equipment. Be prepared — gain your share of those profits ahead! This course uses the same step-by-step approach found so successful in the teaching our other famous courses to thousands of men. Starting at the transmitter the lessons guide you through the development and transmission of the composite Color TV signal. With an overall view of how the receiver function each circuit is then analyzed in a simple, easy-to-follow manner that make learning fast and accurate.



Sylvania Now Sponsoring
RTTA's Color TV Technician Course

One of the nation's largest electronics manufacturers and marketers Sylvania Electric Products Inc. in its continuing effort to cooperate with independent service dealers is now sponsoring the RTTA Color Television Technician Course.

The Color Television Technician Course is being made available to authorized Sylvania Dealers throughout the 48 states who are interested in expanding their knowledge and experience in Color TV servicing.

4 THOROUGH LESSONS!

Color Television Technician Course

- 1 AN INTRODUCTION TO COLOR
- 2 FORMATION OF THE COLOR SIGNALS
- 3 THE CHROMA SIGNALS
- 4 GENERAL OPERATION OF THE COLOR TELEVISION RECEIVER
- 5 PICTURE TUBES FOR COLOR TELEVISION RECEIVERS — PART I
- 6 PICTURE TUBES FOR COLOR TELEVISION RECEIVERS — PART II
- 7 DETAILED OPERATION OF THE COLOR TELEVISION RECEIVER
- 8 THE CHROMINANCE CHANNEL
- 9 COLOR TELEVISION CIRCUITS — PART I
- 10 COLOR TELEVISION CIRCUITS — PART II
- 11 ADJUSTING THE COLOR TV RECEIVER
- 12 COLOR TV TEST EQUIPMENT
- 13 TROUBLESHOOTING THE COLOR TV RECEIVER
- 14 SERVICING PROCEDURE



SEND TODAY FOR YOUR ENROLLMENT

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President Dept. RT-2 B
RADIO-TELEVISION TRAINING ASSOCIATION
52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Without obligation, please LUSH me complete information on the course checked below.

(PLEASE PRINT PLAINLY)

Name _____ Age _____
Address _____
City _____ Zone _____ State _____

I AM INTERESTED IN:

- Radio-FM-TV Technician Course Color TV Technician Course
 FM-TV Technician Course
 TV Studio Technician Course

Radio-Television Training Association

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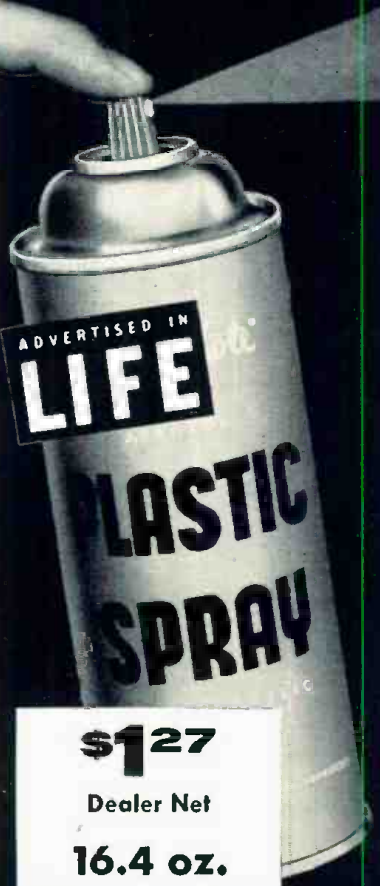
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To bring Spray Paint to
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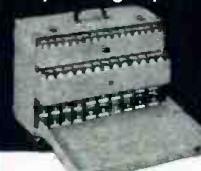


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The new Plasti-Kote X-11 acrylic
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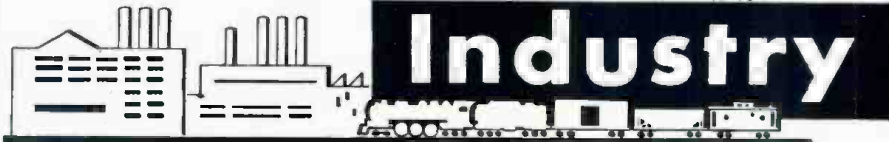
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Within the Industry



JOSEPH J. KEARNEY, formerly equipment and parts promotion manager, Tube Division, has been named manager, Distributor and Industrial Sales, of the newly created RCA Components Division.



In his new position, he will be responsible for establishing and administering sales programs for components, parts, and test equipment.

He joined the company in 1943 and has been with the War Contract Services Dept. and Tube Division. From 1951 to 1953, he acted as tube district manager for the company's East Central Region and in 1953 he was appointed manager, Battery Marketing.

* * *

CHARLES FENTON, president of the Fenton Company of New York and treasurer of the Institute of High Fidelity Manufacturers, passed away recently at the age of 51.

He had been active in Institute affairs since its inception and gave unstintingly of his time and talents to further the cause of the audio industry.

* * *

DAYSTROM, INCORPORATED announces that it has negotiated an agreement for the purchase of **FORD ENGINEERING CO. INC.**, Upland, Calif. Upon completion of the sale, the subsidiary will continue its operations and production at its two plants in Upland and will receive technical assistance from **DAYSTROM PACIFIC CORP.**, Santa Monica, Calif. . . .

INTERNATIONAL AUTOMATIC ELECTRIC CORPORATION has changed its name to **AUTOMATIC ELECTRIC INTERNATIONAL INCORPORATED** . . . Approval of terms for a merger between **MIDWESTERN INSTRUMENTS, INC.**, Tulsa, Okla., and **MAGNECORD, INC.**, Chicago, Ill., has been announced. The merger plans, which have been approved by both boards of directors, will be submitted to stockholders of the two companies for immediate action. Present plans are for operation of the subsidiary as a division of the parent firm, with an integration of personnel of both organizations . . .

PHILCO CORPORATION has purchased the **SIERRA ELECTRONIC CORPORATION** of San Carlos, Calif. It will be operated as a wholly owned division of the parent firm . . . **CORNELL-DUBILIER ELECTRIC CORPORATION** announced the acquisition of the substantial majority stock control in the **TOBE DEUTSCHMANN CORPORATION** of Norwood, Mass. The

policy is to continue manufacture of the line in its Norwood plant . . . Announcement has been made of the formation of **MADISON FIELDING CORPORATION**, 863 Madison Ave., Brooklyn, N. Y. The firm will manufacture equipment both in components and in finished units for the high-fidelity market . . .

HOWARD W. SAMS & CO., INC. announces the formation of a new Industrial Service Department. This new department will serve manufacturers of electronic and electro-mechanical equipment as well as Government agencies who require the preparation of any type of instruction manual covering technical equipment . . . **GENERAL ELECTRIC COMPANY** announces the creation of a new operating division, the Communication Products Department, which will absorb functions previously handled by the company's Communication Equipment Section. Products of the new department will include mobile radio, microwave radio relay, radio traffic coordination units, power line carrier equipment, terminal equipment, and other communication systems.

* * *

WALTER E. PEEK, formerly sales manager of Electronic Mechanical Products, has been appointed general sales manager of **Centralab**, a division of **Globe Union Inc.**



His new assignment covers all products: variable resistors, wave switches, packaged electronic circuits, semiconductors, piezo ceramics, special ceramics, ceramic capacitors, and distributor and export sales.

Mr. Peek has been with the company since 1953. Prior to his employment with this organization, he was with such firms as **Arvin Industries**, **Colonial Radio Corp.**, **General Instrument Corp.**, **Electronic Labs.**, and **P. R. Mallory** in engineering, production, sales, and management.

* * *

RETMA has requested all of its member companies to submit answers to a questionnaire pertaining to industry practices aimed at alleviating the shortage of engineers, scientists, and other technical personnel.

The industry survey is being conducted in order to fulfill a Department of Defense request that the electronics industry study the problems of technician shortages in the Armed Services and propose means by which the situation might be improved. A comprehensive report will be compiled

RADIO & TELEVISION NEWS

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We do NOT manufacture records.
 You are not limited as to selection.

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Note: There is a small postage and handling charge on all orders.

If you are a true record collector, be it classical, pop, or jazz... this club was designed for you. As a member you can get ANY L.P. ever recorded at actual **DEALERS COST**, that's a saving of **38%** off the current list price. If you purchase as few as one record a week you will save over \$75 a year.

The Nel-Kaye Record Club has been established for many years. Each year thousands of members take advantage of its unprecedented 38% saving. The membership fee is only \$10 for 2 years (less than 2c a day) and entitles you to the following:

- 1 One 10" or 12" LP record absolutely **FREE**, **ANY** record — **ANY** label—the choice is entirely up to you. (the value of this **FREE** record alone is actually worth the greater part of your \$10. membership fee.
- 2 During the 24 month period of your membership, you may purchase as many or as few records as you wish.
- 3 There are no restrictions of any kind. You may order any LP record—any label, major or minor — RCA, Decca, Columbia, Capital, Mercury, London, Westminster, Urania, Vox, Hayden Society, etc., any LP listed in any record Catalog. No exceptions—in short, any LP ever recorded.
- 4 Each month you will receive, absolutely **FREE**, a new record catalog worth 25¢, listing every LP ever recorded.
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★ Foreign Memberships accepted. ★

Special Offers at Dealer's Cost will be made from time to time to club members on all accessories such as diamond needles, tapes, record racks, Hi-Fi phonographs etc.

MONEY BACK GUARANTEE
 Full membership fee (less cost of Free membership record) refunded within 60 days if not completely satisfied.

Make checks payable to Dept. R-2
NEL-KAYE RECORDS, Inc. 1604 York Ave., New York 28, N. Y.
 I am enclosing \$10 check or money order covering two year membership in the "Nel-Kaye Record Club of the Year." This does not obligate me in any way. I may order as many or as few records of my choice as I wish.

My Free L.P. record choice is.....

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 ADDRESS.....
 CITY..... ZONE..... STATE.....

from the industry findings and submitted for Defense Department examination.

The two-stage survey is designed to obtain, in general terms, a quantitative analysis of programs which are already in use in the electronics industry, and submit any workable or proven practices which have been the most helpful in meeting the challenge of manpower shortages.

At the same time, RETMA believes that the survey will provide, for the first time, a library of comprehensive information on this vital subject, and will provide guide lines to member firms for the adoption and expansion of programs in this area to thus enable manufacturers to meet and solve the problem of manpower shortages.

* * *

ALLEN B. Du MONT, JR. has been appointed assistant division manager of the Receiver Division of *Allen B. Du-Mont Laboratories, Inc.*



In his new position, he will supervise product development from a technical and styling standpoint for television receivers, high-fidelity phonographs and combinations, and clock table, and portable radios. Other administrative duties will include plant and office layout, market and merchandising analysis, and leasehold improvements of wholly-owned subsidiaries.

He was formerly a divisional sales representative, assistant to the Tube Division manager, and has recently held posts in merchandising and administration with the Television Receiver Division.

* * *

F. D. EDES has been appointed assistant to the vice-president and general manager of *Raytheon Manufacturing Company's* Receiving and Cathode Ray Tube Operations. He will make his headquarters in Newton, Mass. . . .

ROBERT L. SHAW has been appointed general sales manager of the Radio and Television Division of *Sylvania Electric Products Inc.* . . . *Filtors, Inc.* has named **C. G. "SPEC" BARKER** sales manager of the company . . .

J. F. MAIER has been made administrator, Tube Industry Sales, *RCA Tube Division* . . . **RICHARD W. WALKER** is now vice-president in charge of manufacturing at *Transitron, Inc.*, a subsidiary of *Van Norman Industries, Inc.* He has taken permanent residence in Manchester, N. H. . . .

University Loudspeakers, Inc. has named **LAWRENCE J. EPSTEIN** director of Sales and Merchandising, and **CHARLES RAY** as Jobber Sales manager . . . The appointment of **HARLEY T. LITTERAL** as radio sales manager of the Radio and Television Division has been announced by *Sylvania Electric Products Inc.* . . .

GEORGE D. RICE has been elected a vice-president in charge of manufacturing and a mem-

(Continued on page 112)

How to Pass



Tells where to take FCC examinations, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examination.

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. . . and quickly.

every month our trainees get jobs like these:



Boyd Daugherty:

"I recently secured a position as Test Engineer with Melpar, Inc. A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."
Boyd Daugherty
105 Goodwin Ct., Apt. C
Falls Church, Va.



Irving Laing:

"You cover topics that were not presented by the Navy at the E. T. School . . . Your course has helped greatly to get my 2nd class FCC ticket. I am now a radio and T.V. engineer at WTVS and WDTR in Detroit, Michigan."
Irving L. Laing
15887 Robson
Detroit 27, Michigan

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WESTINGHOUSE:

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An FCC License can be your
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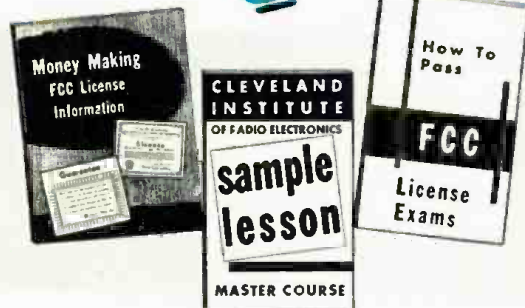
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Paul Reichert, West Salem, Ohio	2nd	10 weeks
Harold Phipps, La Porte, Indiana	1st	28 weeks
John H. Johnson, Boise City, Okla.	2nd	12 weeks
James Faint, Johnstown, Pa.	1st	26 weeks



Bob Thompson:

In a year and a half, he received his first class FCC license. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so he is adding technical "know-how" to his practical experience.

Bob Thompson
2135 Ironwood Drive
Nashville 14, Tennessee

James Glen:

When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
6929 Kumb Hill Road
Tacoma, Washington

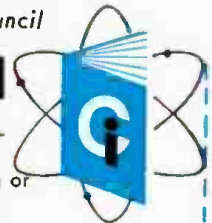


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Cleveland Institute of Radio Electronics

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Inc.
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*Plus many others

Do you need a Degree for success in Electronics?

“Not necessarily,” says Dick Brani, 33-year-old Field Engineering Instructor in Project Sage at IBM—Kingston, New York. “Oh, sure—I’m aware of my limitations to design electronic equipment even though I am qualified to maintain it. That’s the biggest advantage of a formal degree. The point is . . . there are many responsible management positions opening all the time in IBM for men like myself . . . and comparable positions elsewhere would probably require an engineering degree.”

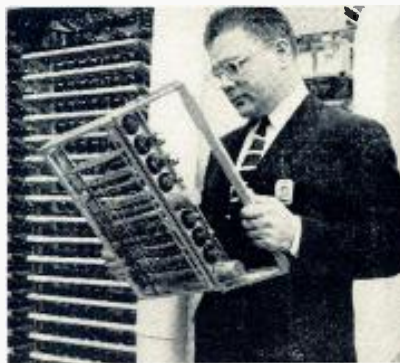
Some seven years ago, IBM took the initiative with respect to technical training within its own organization. It realized, even then, that a great number of intelligent and otherwise capable men were falling by the wayside merely because they lacked 4 years of college engineering. Statistics indicated that because of financial difficulty or improper high-school preparation, close to 50% of the potential engineers in the country became lost in the educational shuffle. While some people with less foresight ignored the fact or bemoaned it, IBM did something about it. Consequently, fellows like Dick Brani can now enjoy more satisfying, more rewarding work than ever before.

Great Interest in Mathematics. While Dick was attending Boys’ High in Brooklyn, his principal academic interest was mathematics. And, like many other young fellows of that era, Dick was realistic about his future.

He decided his best bet might be business accounting. When Dick graduated in 1940, he accepted a position with a New York banking firm. It was not until Dick entered the Army in 1943 that he had the opportunity to pursue a more advanced form of mathematics, an A.S.T.P. training program at Lehigh University. This all-too-brief experience convinced Dick that he should make his career in a field that was in some way related to electrical technology.

Postwar Education. Discharged with the rank of Staff Sergeant, Dick returned to Allentown, Pa., to marry a girl he had met while enrolled at Lehigh. During this period, he successfully supported his family and himself selling various lines of food. In the evening, however, Dick continued his study of radio, TV, and electronics at the Allentown Branch of the Temple Institute. In two years’ time, he graduated and secured an F.C.C. license. His technical career was beginning to take shape.

IBM Looks Especially Good. Glancing through an issue of *Time Magazine* one evening, Dick happened to read an article about Thomas J. Watson, Jr., the president of IBM. The story emphasized Mr. Watson’s great faith in the future of electronic computers . . . the wonderful promise it holds for the ambitious, intelligent young man. Some time later, Dick spotted a classified ad describing IBM’s association with Project Sage. Phil-



Brani trouble shooting Magnetic Drum Frame. Brani studies computer pluggable unit. Dick explains computer logic to a Systems Class.



33-year-old Dick Brani feels that technicians can grow into more responsible positions.

adelphia was one of the work locations available after training. That was all Dick Brani needed.

Asked to Become an Instructor. When Dick was three-quarters of the way through his nine month computer systems course, he was invited to remain at Kingston as an instructor. "It was like a bolt out of the blue," he recalls. "I knew I'd enjoy teaching, but I always thought it was out of the question. I accepted all right, and I can't tell you how much I've enjoyed helping these fellows and watching them grow within the organization. For instance, there's a fellow in my class right now whose education is limited to correspondence school. He's in the top third of his class, and has a real future with IBM—all because he has the native talent and is willing to work."

What Does Dick Brani Teach? "Actually, I teach three separate courses for technicians in field engineering. One is computer systems testing, which is for the more advanced student. This training lasts for 33 weeks—a long time, perhaps, but it's well worth it. Another is a program of 24 weeks' duration that deals with computer input-output units. Finally, I teach a course in computer units displays. This also lasts for 24 weeks. Each one of these courses is an education in itself." Experience has shown that IBM's educational programing is most successful. Men accepted receive their training

with no strings attached—no contracts. Upon graduation the road to success is wide open in *all* divisions of the corporation.

The World's Largest Electronic Computer. "This computer is really fantastic. It contains approximately 1,000,000 parts, and it's housed in a building 4 stories tall. Information is filtered in from Texas towers, picket ships, reconnaissance planes—even ground observers. Every object in the sky is analyzed. Then it checks each object against available traffic data and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against a 'baddie.' Only authorized personnel can make that decision."

What About Dick's Future? "Well, right now, I'm doing work that most technicians couldn't touch with a ten-foot pole. I know of few companies where technicians are actually doing engineering work. I guess it's a matter of approach. Both kinds of companies will get the job done, but IBM prefers to think in terms of the man, encouraging him to grow into more responsibility. You might say that IBM gets more out of the man, and in the final analysis, it seems a lot more efficient from the corporation's and employee's viewpoint. Personnel policy at all levels—management, engineering, or technical—is the same. The future is wide open."

Just recently, Dick bought a home in Saugerties, near Kingston, where his wife Betty and their three children, David, 9, Sharon, 7, and Paul, 3, enjoy a pleasant, contented life together. Occasionally, in the summertime, Dick plays softball with his co-workers. But his family is—and always will be—his predominant interest.

What About You? Opportunities in the Project Sage program of long-range national importance are still growing. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, valued at many thousands of dollars as a Computer Systems Engineer. If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training as a Computer Units Field Engineer, with opportunity to assume full engineering responsibility. *Assignment in area of your choice.* Every channel of advancement in the entire company is open. All the customary benefits and more. WRITE to: Nelson O. Heyer, Dept XXX, IBM, Kingston, New York. You'll receive a prompt reply.



At the Maintenance Console.



At home Dick plays with one of his three children.

February, 1957

Customer Engineers: opportunities are also available, locally, for servicing IBM machines, after training with pay. Consult your nearest IBM office.



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For complete information about this new and challenging field, write to:

Personnel Manager, Dept. N-16B
RCA Service Company, Inc.
Missile Test Project
P. O. Box 1226
Melbourne, Florida



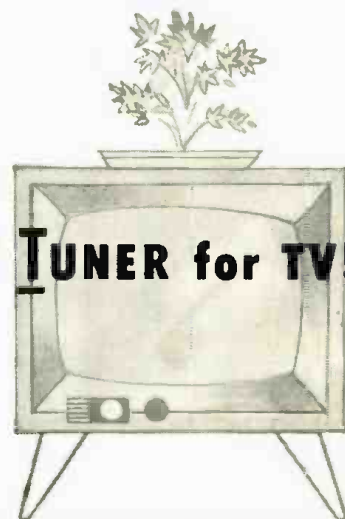
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Goes On Practically Any Set!

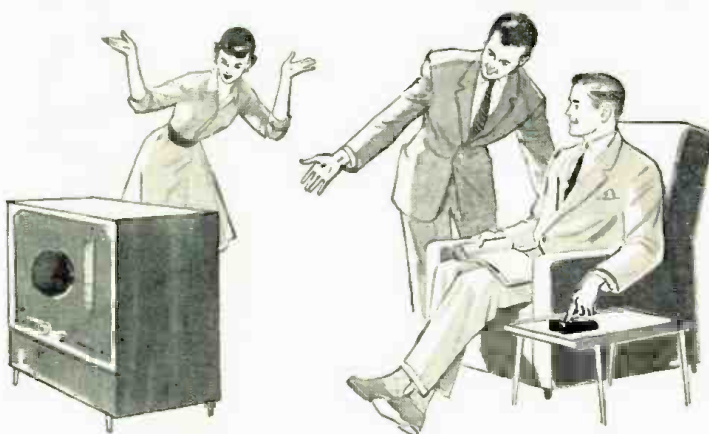
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Customers can install I-T themselves in less than 3 minutes! It's easy—no tools needed—no electrical connections. And, there's no service problem!

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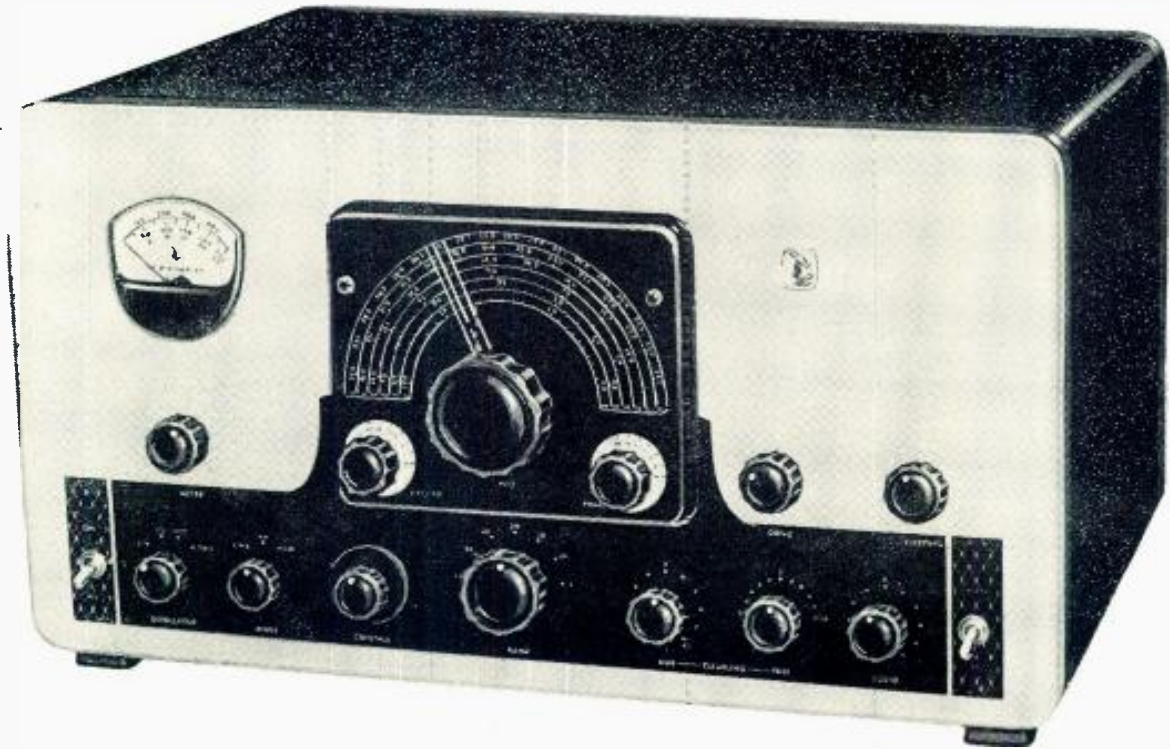
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COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. Tests all receiving tubes (& pic tubes with adapter). Composite indication of Gm, Gp & peak emission. Simultaneous sel. of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). New series-string voltages for 600, 450, 300 ma types. Sensitive 200 ua meter. 5 ranges meter sensitivity (1% shunts & 5% pot). 10 SIX-position lever switches: free-point connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merca tests. Direct-reading of inter-element leakage in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors; separate meter readings of collector leakage current & Beta using internal dc power supply.



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and Monochrome
DC to 5 MC LAB & TV
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KIT \$79.95
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• Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. VERT. AMPL.: sens. 25 rms mv/in; input 2-3 meg; direct-coupled & push-pull thruout; K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. SWEEP: perfectly linear 10 cps-100 kc (ext. cap for range to 1 cps); pre-set TV V & H positions; auto. sync. ampl. & lim. PLUS: direct or cap. coupling; bal or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equip. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in vol. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.



**NEW TV-FM
SWEEP GENERATOR
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KIT \$69.95
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Entirely electronic sweep circuit (no mechanical devices) with accurately-biased inductor for excellent linearity. Extremely flat RF output: new AGC circuit automatically adjusts osc. for max. output on each band with min. ampl. variations. Exceptional tuning accuracy: edge-lit hairlines, 330° scale. Swept Osc. Range 3-216 mc in 5 fund. bands. Variable Marker Range 2.75 mc in 3 fund. bands; 60-225 mc on harmonic band. Xtal-controlled Marker Osc., 4.5 mc xtal supplied. Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: 50-ohm term. output, scope horiz., scope vertical with isolation probe.

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#HF61A KIT \$24⁹⁵, WIRED \$37⁹⁵

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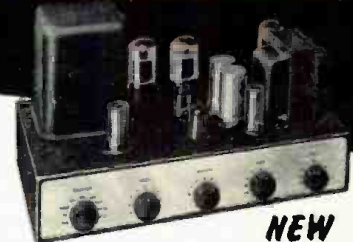
Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls one-piece brown enamel steel cabinet for lasting attractive appearance. Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization: 5 most common recording curves for LPs & 78s including RIAA. Low-distortion feedback tone controls: provide large boost or cut in bass or treble with mid-freq. & volume unaffected. Centralab pre-set circuit. Searor "Comcontrol" loudness control with concentric level control. 4 hi-level switched inputs (tuner, tv, tape, aux.) & 3 low-level inputs (separate front panel low-level input selector permits concurrent use of changer & turntable). Proper pick-up loading & attenuation provided for all quality cartridges. Hum bal. control. DC superimposed on filament supply. 4 convenience outlets. Extremely flat wideband freq. resp.: ±1 db 8-100,000 cps; ±0.3 db 12-50,000 cps. Extremely sensitive. Negligible hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.



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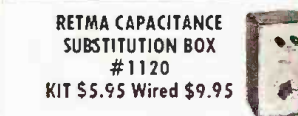
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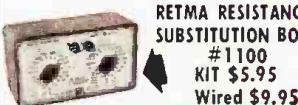
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Authors Hankinson and Fallgren tune up the tiny transistorized transmitter with a grid-dip meter prior to going on the air.

Transistorized Amateur Transmitter

45,000 Miles-per-Watt

By

GUS FALLGREN, W10GU & AL HANKINSON, W1OSF

Research Technicians, Missile Systems Div., Raytheon Manufacturing Company

YES, that's what we said: On .08 watt (6 volts at 13 ma.) to a Raytheon 2N113/CK761 transistor doubler stage, we worked OZ7BO in Denmark, about 3600 miles away. And, as simple math will show, 3600 miles \div .08 watt = 45,000 miles per watt!

It all started one lunch hour last September when the three of us—Gus (W10GU), Hank (W1OSF), and Dick Wright (W1UBC), a senior at Worcester Polytechnic who had a summer job with us at Raytheon—were kidding about low power. Dick said, "Let's go on 20 c.w. with transistors and work all continents." We laughed at this, all of us being medium-power DX hounds. But we talked it over through lunch as a joke project, and brought it up again that evening when the three of us met again at Gus's home.

None of us was a transistor expert so we called up a fellow Ham who is a transistor applications engineer. He thought that Raytheon 2N113/CK761's, readily available at parts suppliers, should do the trick. We obtained them a few days later, and that evening a breadboard rig crudely hawired together was ready for preliminary tests.

Since Gus has the only three-element wide-spaced beam on 20, there was no argument about where the rig would be fired up. With a "by guess and by gosh" measurement, we tapped the coax lead from Gus's beam directly onto the final tank and plugged the key into the jack.

The first note, clear and steady, blasted forth from the receiver—not

one of those chirpy notes that infest the 20-meter band but a note of pure d.c.

Feeling like characters in a science fiction thriller, we carefully scanned the band for a 599 plus 40-db-over signal. After a couple of false starts we decided to use Gus's big rig for the initial contact and then switch over to the small rig.

First call went out to W0VZB in Kansas City, Missouri. He came back to the big rig and then agreed to listen for the small rig. Out went the call—all 60 milliwatts flooding the airwaves. "Break" went W10GU and a 599 re-

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tiny .08 watt transmitter

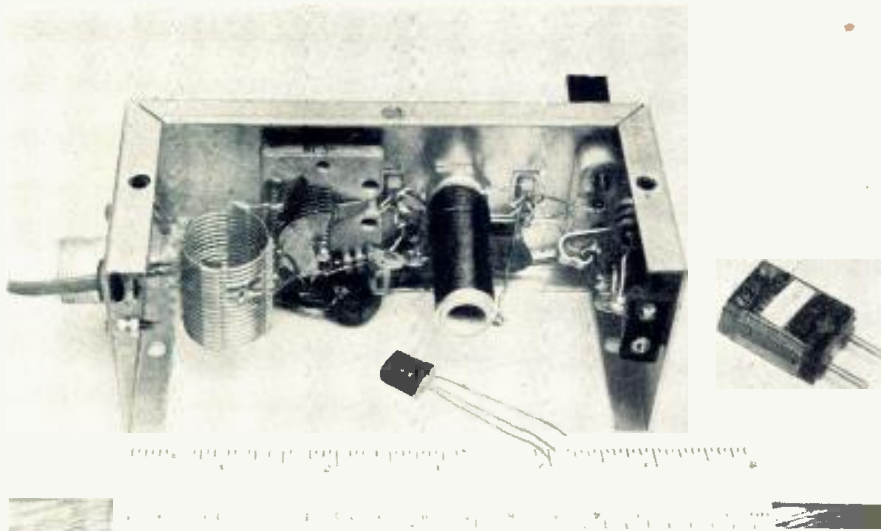
for your DX-ing. It is

transistorized and compact!



Gus Fallgren keys the transmitter whose power source is the battery shown.





Under-chassis view of transistorized transmitter. Note the simplicity of the construction. Output tank circuit is at left, oscillator tank just right of center.

port came back. This was too much! Like horse players, we decided to try "just one more." Again it worked, the QSO this time being with a K4 in Virginia. That did it—we were ready for the big venture. As far as we knew, no one had ever worked outside the continental U.S.A., but we were going to try.

Our call went out to a KV4 in the Virgin Islands but QRM was hashing up the band. Suddenly, KP4ZW in Puerto Rico broke in to tell us he was copying the small rig. He was the first DX contact. In the days that followed, Gus manned the rig morning and evening before and after work, and the following QSO's resulted: T12PZ, Costa Rica, report 439; OZ7BO, Denmark, 339; and G3AAM, England, 349.

At this point the big rig was out of a job—QSO's were coming in fast and easy with the transistor rig alone. All it took was plenty of listening and

making sure the frequency was clear except for the intended victim, who had to be someone calling CQ DX with a 599-plus-plus-plus signal.

Of course, plenty of credit goes to the beam which selected those nice fat signals. However, some contacts were made using an 80-meter doublet with tuned feeders, so the city cave-dweller need not despair.

Comments of operators worked cover the whole band from surprise to outright disbelief—from "wow!" to "ridiculous!" No one has failed to mention the sweet-sounding note. Signal strength reports have ranged from 239 to 579 at W8OCT. The score sheet for the first two weeks shows nine states, five countries (including the first transatlantic jump on record at the ARRL), and many duplicate contacts. Requests for schematics and construction data come in every day.

Meanwhile, with the able assistance

The complete transmitter is built into a case measuring 5" x 2 1/4" x 2 1/4". Parts are identified in the text but the layout is non-critical and can be changed.



of our friend the transistor applications engineer, we have been catching up on transistor theory and can now explain why the 2N113/CK761 transistors perform so well in our rig. These transistors are of the fusion-alloy germanium type. They were introduced by Raytheon over a year ago and have been widely used in portable receivers and medium-speed computers.

Three important factors in the design of high-frequency transistors are low collector capacitance, a high *alpha* cut-off frequency, and a low value for a parameter called "extrinsic base resistance."

Collector capacitance is simply the capacitance of the collector junction; it is ordinarily kept low by keeping the area of the collector junction as small as possible. In the 2N113/CK761, this value is about 12 μfd . at 6 volts.

Alpha cut-off frequency is defined as the frequency at which the current gain of the transistor has fallen to .7 of its very-low-frequency value. However, this is not necessarily the maximum usable frequency. The 2N113/CK761 has an average *alpha* cut-off frequency of about 10 mc., yet it operates successfully as a doubler final in our transmitter at 14 mc.

It is true that *alpha* cut-off frequency does affect efficiency, and that an *alpha* cut-off value four or five times our operating frequency of 14 mc. would theoretically give our rig increased efficiency. However, transistors with very high *alpha* cut-off frequencies are so much more expensive than the 2N113/CK761 that the improvement in efficiency is not worth the greater cost. Furthermore, an increase in *alpha* cut-off frequency in abrupt junction types like the 2N113/CK761 results in a reduction in the maximum voltage that can be applied. It may well be that more useful power can be obtained at 14 mc. from a unit like the 2N113/CK761 than from one having a higher *alpha* cut-off but a lower permissible power input.

Extrinsic base resistance, the third factor, is the series resistance of the semiconductor body between the point where the external connection is made to the transistor and the point inside the body where transistor action really occurs. It is called "extrinsic" because in a sense it is not a true (intrinsic) transistor characteristic. This series resistance causes a reduction in the input signal. It is only about 75 ohms in a 2N113/CK761 but may run as high as several hundred ohms in an audio-type transistor.

Although the output power has not been measured, the efficiency is probably not greater than 25%; hence 60 mw. is being dissipated within the transistor and 20 mw. is delivered as useful power.

The amount of power that a junction transistor can handle is mainly determined by the temperature rise of the junction and the maximum safe temperature. In the 2N113/CK761, the temperature rise in free air is specified as about .6° C per milliwatt and

the maximum temperature as 85° C. Applying these specifications to our rig, we get a temperature rise of 36° C for our 80 mw. input. Adding this to a room temperature of 28° C we get a maximum temperature of 64° C, which is well within the 85° C maximum specified.

There is additional latitude because of the intermittent nature of a c.w. transmission. Also, it is possible to strap down the transistors to a heat sink so as to lower the temperature rise to about .4° C per milliwatt, thus increasing the permissible dissipation by 50% for a given ambient temperature. However, there is another reason for approaching maximum temperature limits with caution. Although the 2N113/CK761's will stand junction temperatures of 85° C without damage, they will not necessarily operate in a circuit at this temperature.

Now for construction details. We'll skip the breadboard stage, for our original rig has been refined into a neater and more efficient transmitter using the same transistors and circuitry.

The entire unit is built in a standard 5" x 2¼" x 2¼" ICA "Flexi-mount" case. Bottom photo on facing page shows, right to left, the key jack, the crystal socket, a transistor socket for the oscillator section, the slug adjustment for the oscillator coil, another transistor socket for the doubler-final stage, the tuning knob for the output tank capacitor, and the antenna coax connector. The battery leads are brought out below the coax fitting in the lower left-hand corner. No further comments on component placement are needed, as nothing seems to be critical; you can adapt the layout to fit the components available.

For matching the antenna to the transmitter, we use 52-ohm coax—mainly because we had some on hand.

However, you will do well to wind the oscillator coil as indicated on the schematic. Don't attempt to build the oscillator separately and then check it out, as you may run into trouble from individual transistor variations. Build the entire transmitter, plug in the transistors, and you are ready to tune.

Tuning is a little different than with a regular tube transmitter, but if you follow directions you should find it simple. You will need a grid-dip meter or your receiver's "S" meter, a 0-25 milliammeter, and the simple r.f. indicator shown on the schematic. The r.f. indicator is easily constructed and is very handy for working with transistor transmitters. R_x is a carbon resistor which matches the line impedance—51 ohms for a 52-ohm coax, etc.

Here is the tuning procedure to be employed:

- Using either the grid-dip meter or the "S" meter, adjust the slug-tuned coil L_1 for maximum 7-mc. output. This step should give you no trouble, as transistor oscillators seem to oscillate easily.

- With the milliammeter inserted in the final stage collector lead, adjust

link L_2 for maximum current (12 to 15 ma.).

- Again using either the grid-dip meter or the "S" meter, adjust the final tuning capacitor for maximum 14-mc. output.

- You are now ready to select the tap for the collector. Using the grid-dip meter as an absorption wavemeter tuned to 14 mc. record the meter reading, then change the tap and hunt for a point where the output is maximum. Simple but effective! The best tap will be quite far down on the tank coil because of the low collector impedance.

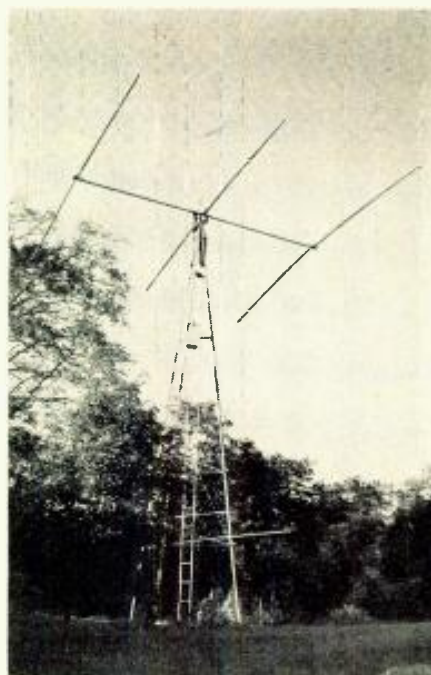
- Using the r.f. indicator, move up and down the final coil until the point of maximum output is found, and connect the antenna tap at this point.

Now that you have a working rig, any variations are up to you. One that we tried and discarded only for the sake of simplicity was the use of a 1-megohm potentiometer in place of R_1 and R_2 . With a pot in this location, you will have control over your drive and also your keying characteristics. We had no keying trouble whatsoever so we eliminated the pot.

Another possible refinement is to include a closed-circuit jack in the "high voltage" lead to the final. Then all you have to do to go on 20-meter phone is plug in a carbon mike of the F1 variety. We haven't given this any serious study but have worked locally on phone with excellent modulation reports.

As a final note, we are the cautious type so we limited our "high voltage" supply to 6 volts instead of operating the transistors at the maximum collector voltage permitted by the specifications.

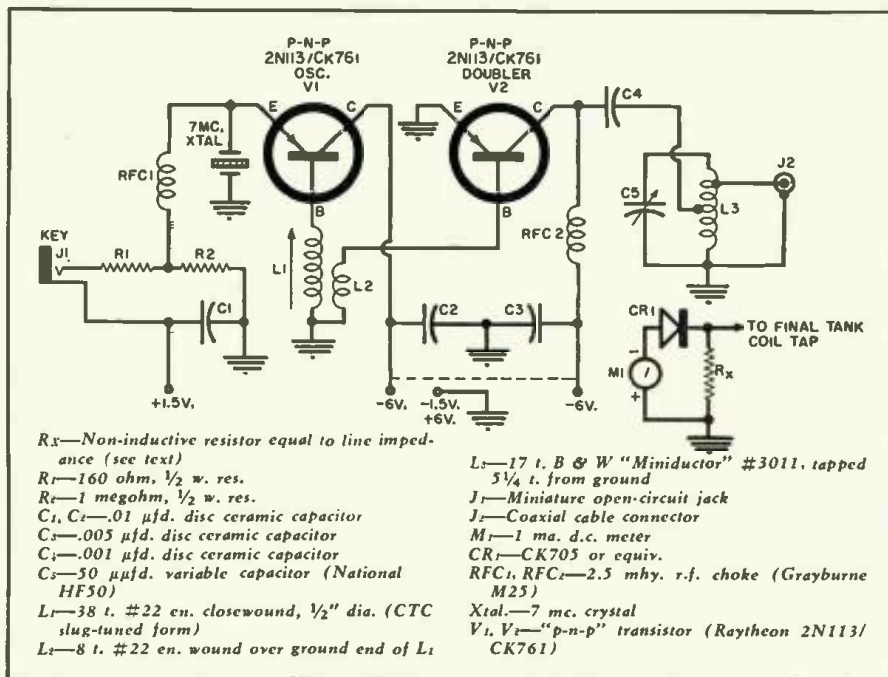
Take it from us, if you're tired of



The 20-meter, 3-element, wide-spaced rotary beam that was connected to the little rig for its record-breaking DX.

traffic handling and rag chewing at length, if you would like to work on the new frontiers of the radio art, build your own transistorized rig and get a load of thrills. We know, because we have worked all sorts of DX on regular rigs in our time. Gus has 140 countries confirmed, Dick has 101, and Hank has years of maritime mobile QSO's, yet the first DX on transistors topped all the thrills of the past. All except one—the day we received our ham tickets and made our first solid QSO's! —30—

Complete schematic diagram of the transistorized transmitter. Note that the oscillator and doubler transistor collector voltages can be tied together, as shown by the dotted line, after the initial tune up with the milliammeter has been completed. The circuit for determining the correct output tap and for tuning up the little transmitter is shown in the lower right-hand corner.



Dismantling and transporting a color set for shop work and bringing it back take much time and skill. Repair in the home when possible.

The Strategy of Color Servicing

The line between home and shop service shifts, but skilled technicians will take the changes in stride.



By ART MARGOLIS

A YEAR ago two service technicians were working side by side at the bench. Neither had seen a color set up until then.

"Do you think you'll have any trouble with color sets?" one asked.

"Maybe so," the other answered, "but get it on the bench in front of me, and I'll fix it!"

He was right. Since then, this pair has tackled quite a few color repair jobs. They weren't always easy, but there wasn't one set that didn't eventually get repaired.

While black-and-white experience is invaluable, a slightly modified viewpoint is needed for handling color work. Ideas of when to pull a chassis have had to be changed. Policies on quoting estimates and delivery dates must be revised. Some new delivery techniques have had to be learned and a closer liaison with the distributor and factory service branches established. With only a limited amount of color experience on which to base service policies for the shop, the writer decided to visit an organization where the art of servicing color television has had a chance to mature.

He picked the *RCA Service Company* in Trenton, N. J. There he met a top-notch color technician with plenty of ideas and two busy years of color servicing behind him. From the material supplied by this "old timer" and the author's own experience, it was possible to formulate a "strategy" for the independent TV service technician.

Cut Down Bench Work

It has always been a shop policy that if a black-and-white receiver didn't respond within the first hour, the chassis should be pulled into the shop. The pickup and delivery, although work, required only a token amount of manual labor. It proved easier to

solve tough repair jobs in the quiet, well-equipped security of the test bench rather than in the helter-skelter, customer-over-your-shoulder, test-equipmentless private home.

Unfortunately, this situation has been somewhat changed by the advent of color. Ironically, when working on the basically harder-to-fix color set, it is wise to ignore the "first hour" principle and go further. In fact, the rule should be to work on the set until absolutely stuck. Then, of course, the set must be pulled into the shop.

The trouble involved in taking the set apart, setting it up again on the bench, pulling it apart, setting it up still another time when it is returned, and finally executing an A to Z convergence, outweighs the inconvenience of working on your knees under adverse conditions.

As an example, consider the case of one 12" color set the shop was called on to service. It was installed

in an exclusive apartment house and the tenant lived on the ninth floor. The freight elevator was at the rear of the building and a sign near the front door advised that "Tradespeople must use freight elevator for pickup and delivery."

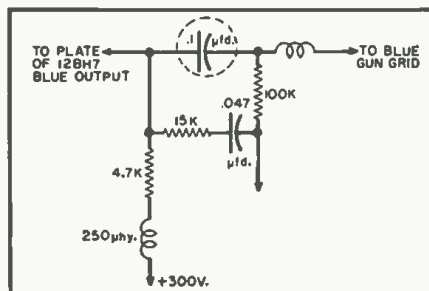
The set was turned on. A beautiful bright blue was in evidence with other colors unavailable. The color tube was checked but the picture remained blue. The chassis was pulled out on the floor but a series of resistance checks revealed nothing as to the possible cause of the trouble. Normally, at this point, our policy would have been to pull a black-and-white chassis, but the thought of the work involved in this particular pickup and delivery caused a momentary pause.

The checking was continued and it wasn't long until some "B+" was discovered on the blue gun grid. The .1 μ fd. capacitor in the grid leg, shown in Fig. 1, had changed value. Once out of the circuit, the capacitor measured about 800,000 ohms. It evidently shorted down even further when the set was on. A new capacitor brought back all three colors.

On another complaint, the picture was all green. The appropriate tubes were checked first and when that didn't help, the chassis was pulled out on the floor.

Voltages were checked in the 12BH7 G-Y demodulator and found to be correct except at the plate. Instead of having the usual +37 volts, there were about 200. A pair of 56,000-ohm "B+" dropping resistors in series with the plate (Fig. 2) had shorted down

Fig. 1. Leakage in this .1 μ fd. capacitor permitted "B+" from the plate of the blue output stage to overdrive the CRT's blue gun grid, overwhelming other colors.



in value. A new pair of resistors restored performance.

A 21" set was reported as having no color. The black-and-white picture was fine but on the colorcasts there wasn't a hint of hue. Checking voltages in this set revealed only one discrepancy. The "B+" was on the grid of the color killer instead of the normal -1 volt. The .01 μ fd. capacitor (Fig. 3) in the grid circuit had a dead short. A routine capacitor replacement licked this problem.

Don't Give Estimates

No technician can fix every set in the home and there are a goodly number of receivers which must be pulled into the shop. While in monochrome servicing past experience can be relied upon in estimating the cost and delivery date, in color such experience is lacking until a few "toughies" like the one to be described have been encountered.

The picture on this particular set had some color tones but they were weak. In addition, the 920-kc. beat (the difference between the intercarrier sound and the color oscillator) was extremely strong. The circuitry from the burst keyer through the video amplifiers to the color CRT was checked for several hours before it was decided that this chassis had to be pulled.

On the bench the technician sweated this one out with an assist from the whole staff. The time spent on this "dog" wasn't even calculated. Only by a tedious process of trial and error was the defect finally uncovered. For lack of anything else to do, it was decided to touch up all the solder joints with an iron. When the color take-off can was reached where it joined a 10,000-ohm resistor, the trouble ceased. A tight rosin joint at the point shown in Fig. 4 had been causing all the trouble.

Another hard one involved a 21" set on which the color picture was perfect when the set was first turned on. Then during the show, color sync would deteriorate intermittently. This showed up as a rainbow wave rolling vertically through the picture. The longer the set remained on, the greater the sync loss. A check of tubes was wasted effort, so the chassis was pulled. A static check-out of all components in the reactance circuit and the 3.58 mc. oscillator stage read good. A tedious substitute-and-wait process was begun. Then the 3.58 mc. crystal was changed.

The symptom now altered. The picture started a continuous sync roll instead of rolling intermittently. With re-alignment of the oscillator, the sync condition cleared up. The old crystal (Fig. 5) was good, however, its natural resonant frequency was slightly off the required oscillation. So, while the color sync signal held the oscillator somewhat in place, it didn't hold firmly enough, causing the instability.

All technicians will have to go through a similar "trial by fire" but the tough ones are the "experience

makers." They may actually cost the shop money but, in the long run, it will be money well spent. To cut down on these inevitable losses, use discretion in naming prices and delivery to customers. Instead of quoting an approximate price and delivery, tell the customer that he will be kept posted on progress. Fortunately, most color TV set owners go along with this approach.

Know Your Convergence

Probably the most-often-heard complaint regarding color TV is the three-gun picture tube. Overcoming the convergence bugaboo is the key to color TV servicing success. It is the one major hardship that sets color service work apart from other troubleshooting and repair jobs. If the A to Z setup is thoroughly mastered, convergence procedures can be handled by a top technician in about half an hour. This same trained man should be able to install a new color CRT, which includes a convergence job, in about an hour.

While such timing should be considered exceptional, it is a good target for the newcomer to shoot for. After some practice though, the newcomer should average about an hour on a convergence. That means the delivery of a color chassis will require normal monochrome time plus about sixty minutes. This is not too bad and most customers will not balk at the charge.

In factory service branches, a color CRT assembly is set up in the shop, thus it is only necessary to pull the chassis instead of the entire set. No doubt, this same technique can be adopted by the independents as soon as the volume of color servicing business warrants. One drawback, as far as the independent is concerned, is that rather than specializing in one brand, all makes and models will be handled, which complicates things.

Ask for Help!

If the technician encounters difficulty in servicing a color set, he should not hesitate to get in touch with the distributor or factory branch and ask for help. All of the manufacturers are anxious to get color "off the ground" and to this end they are spending plenty of money on lectures and literature for the independent technician.

Since the public's acceptance of color television will depend on the service they get on their sets, if the technician needs help—it's available. Here

Fig. 2. Defective "B+" dropping resistors passed too much voltage to the plate of the G-Y demodulator. Its overconduction resulted in a picture that was all green.

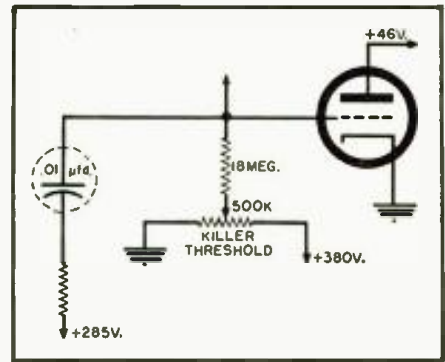
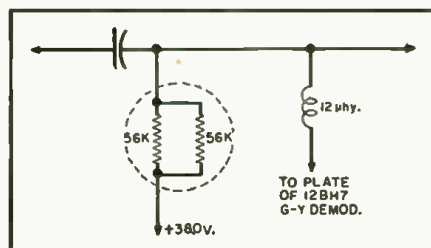


Fig. 3. Routine part replacement licked failure to produce color pictures caused by a constantly activated color killer.

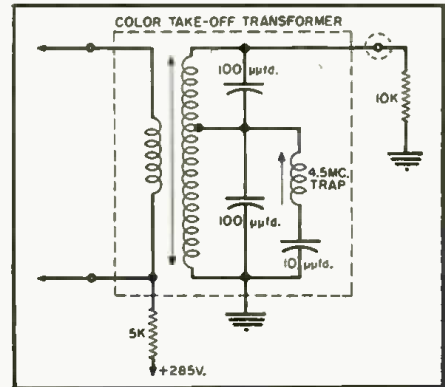


Fig. 4. The symptom, partial color loss, was unfamiliar. The defect responsible, a cold solder joint, was an old story.

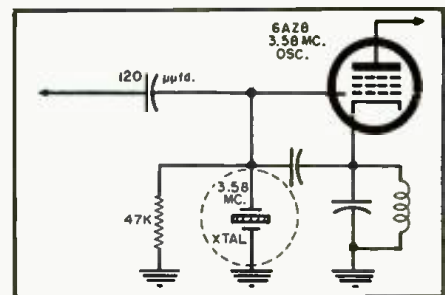


Fig. 5. Poor color sync—a rainbow rolling through the picture—resulted when a control crystal's resonance had shifted.

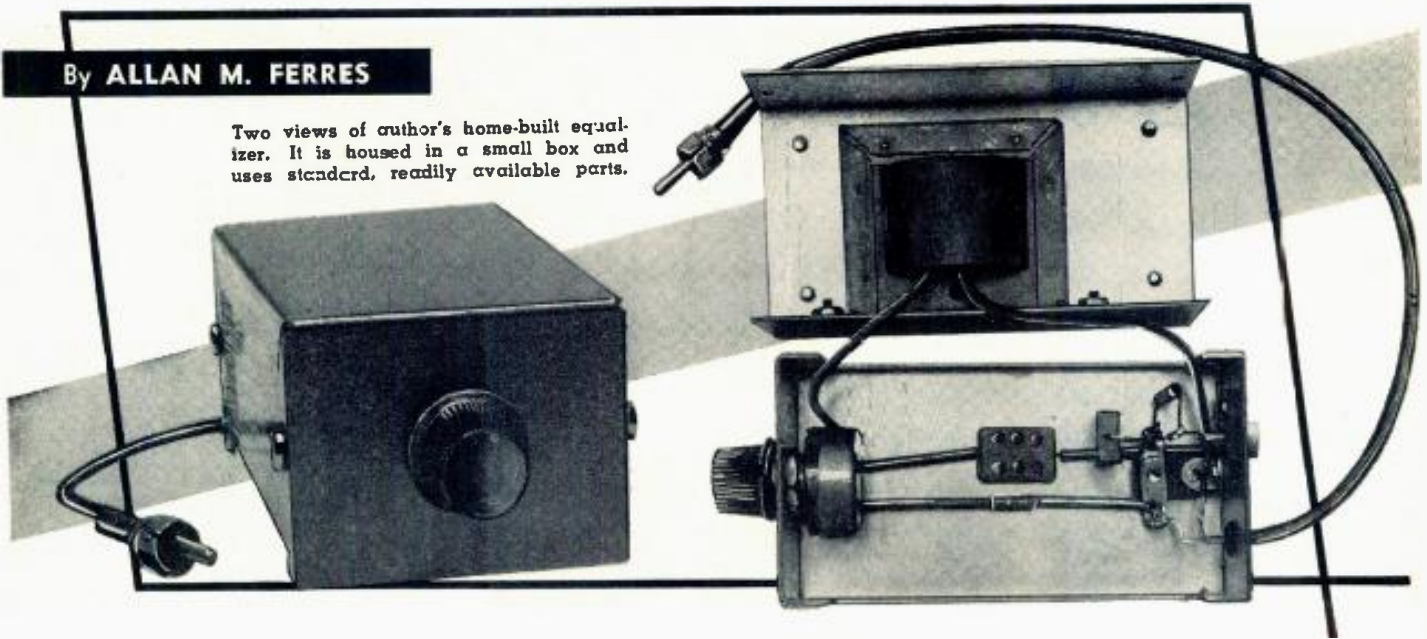
is a good case to illustrate the point.

One 21" color set was encountered that had no red in the picture. A seasick-looking blue-green picture showed on the screen. Turning up the red grid and screen pot provided no action. It proved to be open and after the pot was changed, the red returned and the picture lost its pallor. About a month later there was a callback on the same set. The "seasick" look had returned. The pot was again open but before installing a new one the manufacturer's distributor was contacted. The counterman knew all about this trouble since he had received a special memo on this from the factory as this had proved to be an "epidemic" condition. He advised increasing the ohmage and wattage on the pot and changing the other two screen pots at the same time. This eliminated the problem.

(Continued on page 152)

By ALLAN M. FERRES

Two views of author's home-built equalizer. It is housed in a small box and uses standard, readily available parts.



A Plug-in "Presence" Equalizer ★

Construction details on a simple and compact unit designed to boost mid-frequencies in hi-fi setup.

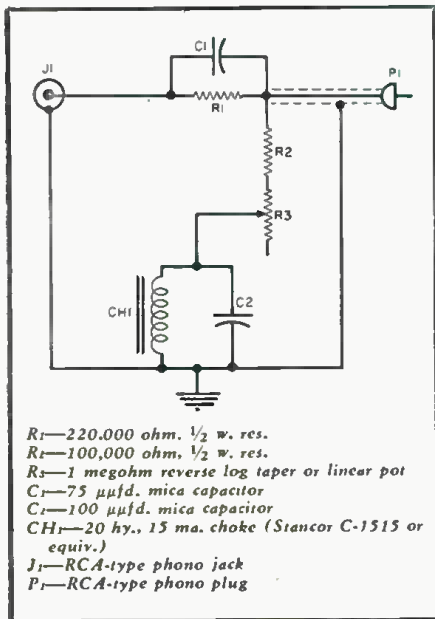


Fig. 1. Schematic of the equalizer unit.

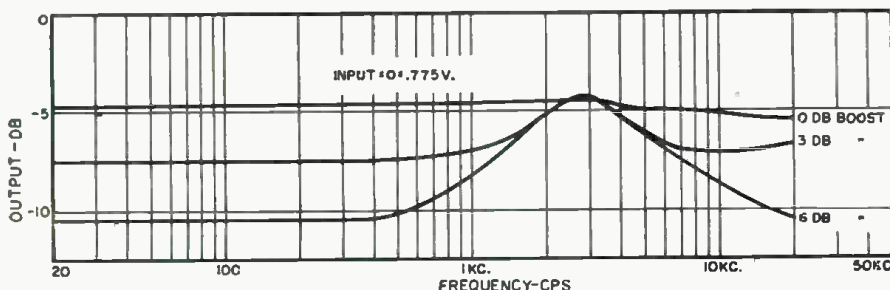
THE mid-range, or "presence," equalizer is an interesting addition to any home high-fidelity installation. It furnishes a boost of up to 6 db at 3000 cycles without affecting the response at the extreme ends of the frequency range. This type of equalization is often used in film and disc recording to emphasize solo voices and instruments. When used on speech reproduction, the articulation factor, or "understandability," is increased without producing the annoyance of excessive sibilance.

In a home reproducing system the presence equalizer will not produce as marked an effect as the bass or treble controls, but it will tend to highlight most solo instruments and for this reason it is a worthwhile attachment.

The presence equalizer described here is a simple device which can be attached to the existing equipment between the equalizing preamp and the power amplifier.

The circuit is simple and uses only a few standard, readily available parts.

Fig. 2. Frequency response curve of equalizer when input resistor of the power amplifier is about 500,000 ohms. See discussion in text.



As can be seen in the schematic, Fig. 1, the equalizer is basically a voltage divider, the series leg consisting of R_1 , shunted by C_1 , and the shunt leg, made up of a parallel tuned circuit, CH_1 - C_2 , in series with R_2 and R_3 . As CH_1 - C_2 is resonant at 3000 cycles, the impedance of the shunt leg is highest at this frequency and the loss in the voltage divider is minimum, furnishing the mid-range boost. The amount of the boost is controlled by the total value of R_2 and R_3 in series. The boost is 6 db when R_3 is set at minimum resistance and zero when set at maximum. C_1 is used to compensate for high-frequency losses caused by stray and cable capacities in the divider circuit.

The frequency response curves of Fig. 2 are obtained when the input resistor of the power amplifier is about 500,000 ohms, the usual value. If the input resistor is less than 470,000 ohms, it should be changed to this value. If the resistor is 1.0 megohm, a 1.0 megohm resistor can be connected across the output cable of the equalizer and no wiring change will be necessary in the power amplifier.

The length of the shielded leads to the preamp and the main amplifier should be kept as short as possible to reduce the chance of hum pickup and uncompensated high-frequency loss.

The construction of the presence equalizer can be seen in the photographs. CH_1 is mounted on the bottom section of the case and wired into the circuit with its flexible leads. The pot should be wired so that minimum resistance is obtained when the control shaft is in the full clockwise position. The winding-to-core capacitance of the Stancor C-1515 choke used in this equalizer causes the circuit to resonate

(Continued on page 184)

ELECTRONIC AGITATOR

For Color Film Processing

COLOR film processing calls for close attention to details. The three most important factors are: time, temperature, and agitation. Time and temperature are fairly easy to control. Correct agitation is time consuming and is generally taken care of by imprecise methods, i.e., a few shakes of the tank or reel every couple of minutes. Good mechanical agitation is necessary if accurate and consistent results are to be obtained.

The agitation should duplicate the manufacturer's instructions. In the case of *Ektachrome* film, the manufacturer recommends that the film be removed from the solutions and drained for five seconds; once each minute. Other color processes and black-and-white processing require different time cycles. With this flexibility in mind, the agitator described here has been made adjustable for any immersion period from 0-10 minutes and for a 5-30 second drain period. The agitator will operate reliably and continuously and free the processor from the inconvenience of hand agitation.

Construction is simple and inexpensive. The outside case, a 4" x 5" x 6"

By **ARTHUR ROSS, JR.**

Details on a compact and simple unit for the darkroom. Standard non-critical parts are employed.

steel utility box, and the inside, 4" x 5" x 1/4" plywood chassis, are faced by two 5" x 6" x 1/4" plywood panels. The builder may find it more convenient to construct the entire unit of plywood.

In the illustrated model, small strips of plywood, glued to the edges of the inner chassis, give sufficient thickness to accept 1/2" No. 6 wood screws which hold the outside panels to the chassis. The outside panels are then fastened to the metal box with 1/2" No. 8 wood screws or with sheet metal screws.

All the electronic circuit components are readily available at local ra-

dio parts dealers. The motor is available from *W. W. Granger, Inc.*, 118 S. Oakley Blvd., Chicago 12, Illinois.

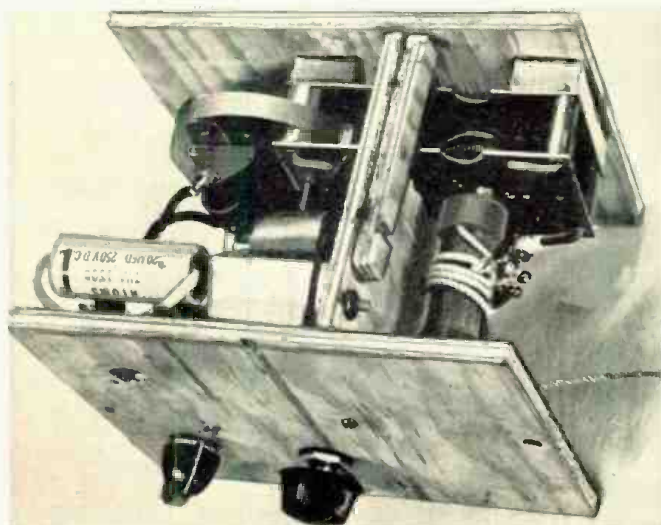
The timer consists of a simple a.c.-operated thyatron, which controls the motor through a relay. The circuit has coarse and fine timing controls operated from the front panel.

The timer cycle begins to operate when L_1 and L_2 are connected to the 117 volt a.c. line and the filament of the 2050 tube is energized through transformer T_1 . Rectification occurs in the grid-cathode circuit and a charge of the indicated polarity will
(Continued on page 138)

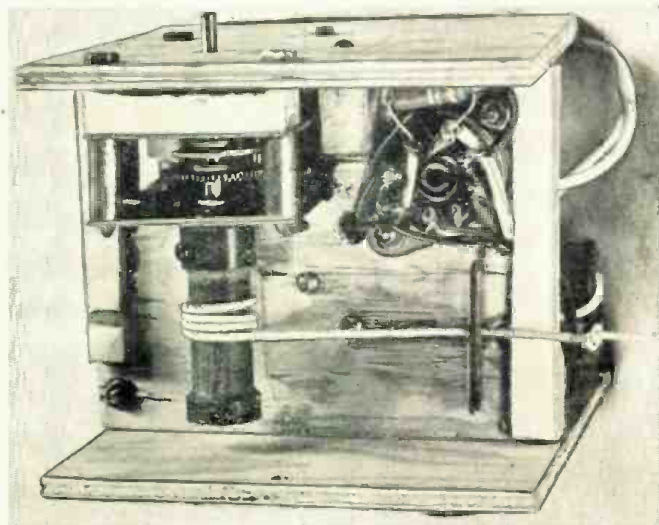


Over-all view of the home-built agitator. It is clamped to a shelf in darkroom so that controls are accessible at eye level.

Top view of the agitator showing the correct placement of the 8 r.p.m. motor. A more elaborate housing can be employed.



Side view of home-built unit showing the operating principle of the string guide and motor drum. Top of unit is to the left.



CHOOSING a loudspeaker system for your home is a highly subjective process. Some manufacturers have tried to reduce it to a science based on response curves, distortion analysis, etc., but they have never been able to eliminate a fundamental fact: *tastes differ*.

Catering to these tastes has been a major part of the author's work for over 15 years, first at the microphone controls of various broadcasting stations and more recently as a seller of high-fidelity equipment for the home.

As a hi-fi salesman, I see all types and must be prepared to suit them. Too many people, it seems to me, are afraid to trust their own taste and are looking for an objective standard to tell them which is the "best" loudspeaker. They are sometimes shocked when I tell them there is no "best"—the best loudspeaker is simply the one they like the best.

What is the "best" symphony? Or, for that matter, which is "best," a symphony, a string quartet, or an opera?

At this point, someone is sure to jump up and say, "But you're not comparing like objects. There may be room for a difference of opinion as to music types, but the best speaker is obviously the one that reproduces the music, whatever its type, most exactly like the original."

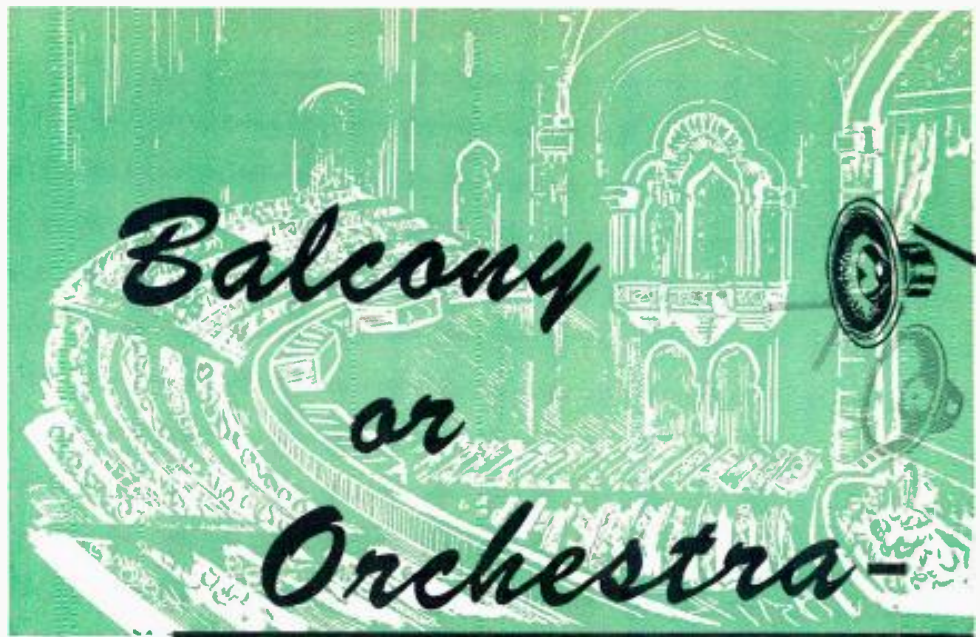
So that leads us to still another question: What, exactly, is the "original"? It is the sound heard at a particular point in the room (studio, auditorium, concert hall) in which the original performance took place. Is this what everyone wants to hear? Definitely not! Is it the "best" sound? That is where taste enters and science must bow out.

If you are one of those fortunate enough to be able to attend live symphonic performances regularly, where do you like to sit—in the orchestra? In the balcony? Up close? Far back? On the left hand side of the house or the right?

Wherever you choose to sit, you hear something different from what you hear in any other seat in the house. Orchestra and balcony seats differ widely in sound. So do left and right sides, or front and rear of orchestra. Yet where is the set of scientific standards which can tell you the "best" seat? It's all a matter of personal taste.

Myself, I like to sit in Box E or F of the San Francisco Opera House, where I get the blare of the brass full in my face, plus all the "liveness" of the vastness of the hall—the sounds bouncing back from wall to wall and blending together.

On the other hand, I encounter many people who like to sit downstairs, up close, where they can more easily pick out the individual instruments. Such a seat, on the few occasions I have occupied one, makes the music sound intolerably "dead" to me and lacking in brilliance. It completely spoils my enjoyment. Yet it en-



It all depends on where you want to "sit in the concert hall." Let your own preferences decide which is the best loudspeaker for your listening.

hances others'. This is where the element of personal taste comes in.

Perhaps you never noticed it before, but loudspeakers can "place" you in the auditorium. Irrespective of the record (or broadcast performance), some speakers will put you "down front, up close," others "orchestra, rear," and still others in the balcony, or, yes, my beloved Box E.

This effect is due to a combination of speaker qualities and recording acoustics. Modern orchestral recordings are almost invariably recorded with fairly "live" acoustics. This was not always the case.

Originally, in the early days of acoustic recording, it was necessary to use small, "dead" rooms as studios and to crowd the performing artists as close as possible to the inverse megaphone which applied the sound power of the music directly to the diaphragm which carried the cutting needle. There was no room for the subtleties of varying acoustic characteristics—and, indeed, the recording mechanism would have been totally insensitive to them.

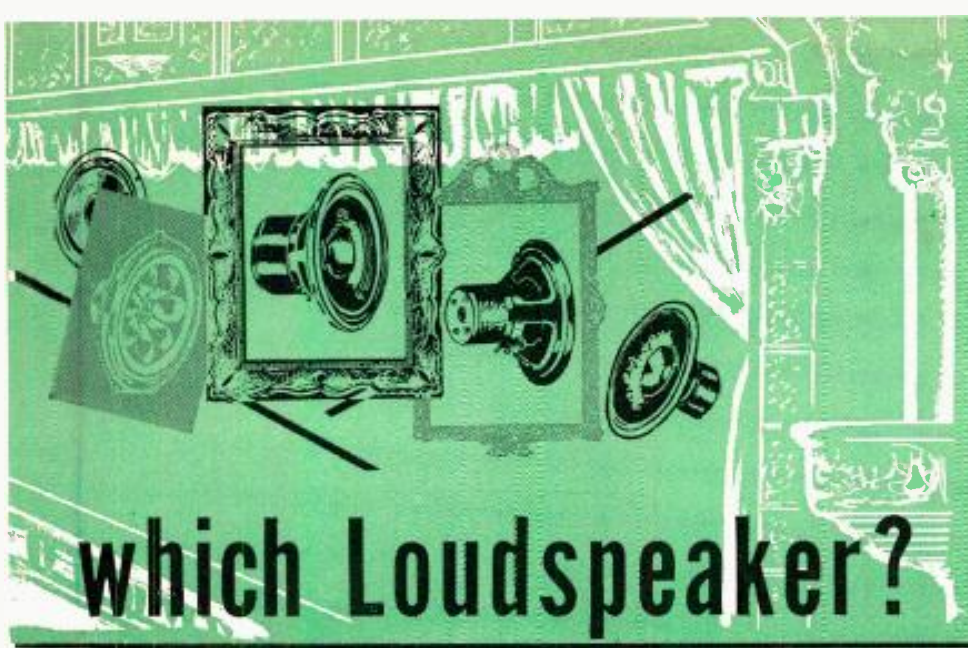
When electrical disc cutting revolutionized the recording process, there was no corresponding change in studio design. Old habits prevailed, and studios, though they grew bigger to accommodate large groups, remained dead in sound.

The Europeans preceded us in discovering the more natural quality of live studio acoustics. In the early thirties they produced some superb (for the times) recordings, while American companies continued in their old ways.

American broadcasting practice originally followed American recording practice as far as studio acoustic design went. But the broadcasters began to experiment much sooner with live acoustics. CBS, early in the thirties, was a pioneer in the development of "live end—dead end studios," in which orchestra and singers were placed at the end of a room treated to give "liveness," while the microphone was placed in the other end, treated for "deadness." This gave a certain blending to the sounds before they reached the microphone.

It was during this period that broadcasters began to experiment with what we at the microphone controls termed "audio perspective"—the *apparent* relationships of singer or orchestra to microphone as interpreted by the loudspeaker. Of course, we had only our control room speakers to interpret through, and I think most, if not all, of us failed to realize the difference that different speakers would make, not to mention the fact that there was not then the great variety of speakers available today!

The broadcaster made practical use of audio perspective to indicate characters in plays approaching or leaving or speaking from another room; and to "place" orchestra and solo instruments in relation to each other. Close-up mike technique gave intimacy; placing performers farther away gave added liveness and a feeling of "big time." With the former technique, we control engineers could make you, the listener, feel the program was for you alone. Remember Morton Downey? With the latter technique, you got the



By PHIL BERNHEIM

feeling that you were privileged to sit in the audience with many others, in a vast theater, watching the vaudeville antics of Bob Hope or hearing a Jolson or Cantor.

To bring the same feeling to orchestral recording—to place you in the hall with the symphony, rather than to bring the symphony into your home—modern recording technique utilizes the liveness of studios, theaters, and symphony auditoriums. The liveness comes, of course, from reverberation—sound bouncing around the studio walls before it hits the microphone to re-inforce, some milliseconds later, the sound reaching the microphone directly from the instruments.

The amount of reverberation on the record is fixed. But if, in spite of that, the amount reaching your ears can be controlled and varied, some interesting effects can be secured—effects that might be called “seat placement.” Oddly enough, your loudspeaker does just this.

Reverberation can, and does, take in all frequencies, but at different rates. That is, in a given auditorium there may be more reverberation of low frequencies than of high, or *vice versa*. When there is pronounced reverberation of low frequencies there is “boominess,” noticeable in many halls and auditoriums. When there is pronounced reverberation of high frequencies, there is “liveness,” or even, if carried too far, echo.

Single channel, or “monaural,” hearing tends to enhance, psychologically, the reverberant effects of a room. A microphone placed at a given point in a room, picking up and transmitting sounds through an amplifier and speaker to a listener in another room, will make the sound seem more “live” to the listener than it would were the listener himself, with both ears functioning, at the same point as the microphone.

To make a recording sound “natural,” then, requires very careful microphone placement so as not to exaggerate the reverberation of the recording studio or concert hall.

As a matter of practical concert hall and recording studio design, low-frequency reverberation is held down to prevent unpleasant boominess, but high-frequency reverberation is engineered in—up to a point—to enhance the pleasing “liveness.” Only—how much liveness is pleasing? That is what is arguable. I like a lot; Box E gives it to me. The “down front, up close” boys like comparatively little; the direct sound they get effectively drowns out most of the weaker reverberation.

If we are to control our recorded “seat” in the auditorium, the problem becomes largely one of controlling high-frequency reverberation effects. Actually, “control” with a given speaker is difficult, but different speakers, because of the unavoidably different ways in which they respond to the audio spectrum, seem to put us in different areas of the auditorium.

To be specific, for example, the *Jim Lansing* D-130 and D-131 put you “down close and up front.” It is significant that more musicians and conductors, in my experience, choose *Lansing* speakers than any other. They are used to hearing music while sitting in the midst of the orchestra, where reverberation is practically non-existent. They say that these speakers enable them to pick out the individual instruments better than any other.

A few months ago I attended a symphony concert and had to sit in the orchestra section, about mid-house and to the right. Next morning I set out to find the speaker in our rather extensive stock which most nearly reproduced the character of the sound I had heard the night before. It was *Electro-Voice's* SP-15.

My own favorite speaker system—the nearest thing to Box E I've found yet—is the combination of *Altec's* 802-C driver and 811B horn with any good woofer such as *Altec's* 803-A or *Stephens' 103-LX*.

Some other speakers and speaker systems are not so specific in their “seating” because of differing balances between the high and low ends of the audio spectrum. The *Jensen H-520* is very near to a good box seat, but the bass end is a little heavy for what one would hear up there.

For another “middle of the ground floor” seat, try the *University Master* 3-way system—but, again, for ideal balance something should be done to tame down the woofer in relation to the other two units.

One of the standing jokes in the industry is about the two hi-fi addicts who go to a live symphony concert. As they come out, one turns to the other and says, “But where was the bass?”

This is inspired by the current trend toward seeking heavier and heavier bass (having already been through the phase of higher and shriller highs) without regard to the naturalness of the balance.

A good case can be made for not attempting natural balance at all in a hi-fi system. The argument runs that, since completely natural reproduction is impossible anyway, why not just go hog-wild on any kind of electronic exaggeration—either in recording or in reproduction—that is pleasing to the listener.

That is a very valid argument, as far as I am concerned, as long as you recognize what you are doing and do not confuse it with naturalness—and as long as you do not insist that yours is the “best” way of doing it. Other people may certainly have different tastes.

If, on the other hand, you are seeking to come as close as possible to concert hall listening—or, at least, its emotional equivalent—then here is a new approach to the search for an ideal speaker system: where do you like to sit, and which speaker puts you there?

Viewed in this light, the choice of a speaker is indeed subjective rather than scientific, and there is no reason at all why the hi-fi fan, whether experienced or neophyte, should not trust his own taste, without seeking the false security of a scientific standard of what is “best.”

I have not mentioned speaker enclosures up to now, since enclosures affect only the bass end—or, at least, good enclosures do; bad ones may cause mid-range cancellation, as some of the bass-reinforcing ones do. The “placement effect” of a speaker, on the other hand, comes principally from its high and middle response, and the balance between them.

Since the object of listening to music is to enjoy it, choose the speaker system that gives you the most enjoyment, and let those who disagree go buy their own!

A Portable Thyatron Tester

By
W. PHILBROOK

Fig. 1. The Aletric thyatron tester.



A commercially available instrument uses several unique circuits to test specialized tube types.

THESE are receiving tube checkers of almost every conceivable variety on the market but there has been no portable, easily usable tester for thyatron tubes. Why this condition has existed is difficult to say because, with the volume of industrial electronic equipment in current use, there should be an excellent sales potential for such a device. Now a tester has been developed which not only permits the rapid and accurate checking of a thyatron tube's characteristics, but does so with a number of unique circuits. Before we examine these circuits, it may be desirable to review the basic operation of a thyatron tube.

Thyatrions are gas-filled tubes in which the flow of current is either at zero or at the saturation value. The grid voltage, usually negative, keeps them cut off until such time as it is desired to trigger them. At that time, the grid voltage is made relatively positive and electrons are thus permitted to flow from the cathode to the plate.

Once this movement starts, even in a minute degree, the molecules of gas enclosed in the tube tend to become positively ionized. This condition of positive ionization neutralizes the holding or controlling voltage on the grid. This action completely opens the dam, so to speak, to the electrons being emitted by the cathode and permits current to surge freely through the tube to the plate. Once this flow has started, the grid loses all control over the rate of flow and—as long as the plate voltage is kept above a cer-

tain critical minimum—all electrons leaving the cathode travel to the plate.

This, roughly, is how a thyatron tube operates. And to determine the operating condition of such a tube obviously requires a special type of tester. Let us therefore note the various thyatron features which are important and see how the tester shown in Fig. 1, made by the *Aletric Mfg. Co.* of Kenosha, Wis., accomplishes its testing function.

One of the first things to observe is that most thyatrions operate with alternating voltage on the plate (or anode). This is done so that the grid may resume control of the tube after it has been fired or triggered. There is no point in having a tube in the circuit over which no control at all is possible, and the simplest way to achieve this control is to apply a.c. to the plate. When the plate voltage goes negative, conduction ceases, the ionized gas de-ionizes, and the control grid is able to prevent the flow of electrons from cathode to plate. The tube is now ready for the next triggering pulse.

Hence, if you examine the schematic diagram of this tester, Fig. 2, you will see that a.c. voltage is brought to the plate from one of two points: either the variable-voltage transformer, T_1 , or the step-up transformer, T_2 . Voltages from 0 to 200 volts are obtainable from T_1 , while 0 to 3000 volts (peak) can be obtained from the secondary of T_2 . The purpose of the low a.c. voltage is to check thyatrions at their rated currents—in this case, either 1, 2.5, or 6 amperes. By using a low voltage and

proportionately low-valued resistors in the plate circuit, the wattage requirement and, with it, the heat dissipation can be kept within reasonable bounds. When checking 2.5 and 6 ampere tubes, even under these conditions, it is still necessary to place the plate load resistors in a separate box. If a higher plate voltage were used, the load resistances would be correspondingly higher and the wattage requirements would raise the cost of these units excessively. Hence, low plate voltages are used for certain tests where maximum rated anode currents are desired.

On the other hand, when a thyatron tube is being checked for its grid-plate characteristics, we can use a high plate voltage and employ high-valued load resistances in the plate circuit to keep the current down. In this test, it is simply a question of establishing "trigger points" or critical grid voltages, not to determine what the peak plate current is. More on this test presently.

The path of the a.c. voltage from T_1 to the plate of the thyatron tube to be checked can be readily followed from Fig. 2. The start can be made at T_1 . From the center tap, point B , the line leads to switch S_2 , which for the purpose of this test is turned to the a.c. position. From S_2 , the path goes to point C , then through S_{1-1} , which is now closed, to point D , then E , and finally through R_1 to the plate of the thyatron.

The other side of the circuit is completed from point A through S_{1-2} , which

is now closed, to *F* and from here to the center tap of the filament transformer, *T*₁.

Arc-Drop Test

Now, as a measure of tube reliability, a direct measurement is not made of the tube's peak plate current. Rather we measure the voltage drop across the tube when the latter is conducting at full current. This voltage is known as the *arc drop* and its value is sought because an increase in the arc-drop voltage is the most outstanding indication of the end of life of a thyratron tube. However, a single arc-drop reading in itself will not indicate the life factor; rather what is needed is a series of readings over a period of time to anticipate the end. See Fig. 3. The technique could, in a way, be compared to the predicting of weather conditions by taking comparative readings on a barometer.

It is suggested that a reading be taken after about every 400 hours of operation. As the arc-drop value begins to rise, a shorter interval should be observed—say every 200 hours as the tube approaches the end of its useful life.

To be most effective, the arc-drop reading permits the end of life to be predicted so that the tube can be removed from operation before costly work stoppage occurs. A reasonable amount of arc-drop may well establish the limits at which such tubes should be removed to prevent emergency shut-downs.

Once a tube is placed in operation, its arc-drop voltage will vary throughout its life. Typical variations are shown in Fig. 3. With tube "C" the rate of increase of the arc drop accelerates, but the curve is easily recognized. As a result, the tube can be replaced before this reading reaches its published limit. The steady linear rise with tube "B" is also easily recognized. As happens with some tubes, the limit is reached early with tube "A" but this condition is only temporary. The arc-drop voltage reduces below the limit again. However, the upward rise is soon resumed, so the tube should be changed the first time the limit is reached.

When measuring the arc-drop voltage, simply placing an a.c. voltmeter across the tube would produce an erroneous indication. This is because on one half-cycle, when the tube is conducting, we would be measuring the true arc-drop value; however, on the other half-cycle, when the tube is non-conducting, the meter would be subject to the full applied a.c. voltage. The average of these two readings would be much higher than the true arc-drop value.

In the *Alectric* tester, this difficulty is overcome by inserting the current coil of a wattmeter in series with the plate of the tube to be checked, while the voltage coil of the meter is placed across the tube, from plate to cathode. Since tube current flows only during one half-cycle, the wattmeter will be

affected only during this period. During the subsequent negative half-cycle, no plate current flows, the current coil is inactive, and the meter is not actuated. Furthermore, the plate circuit resistance is so chosen that only 1 ampere flows through the current coil. This permits the meter scale to be calibrated directly in volts representing the arc-drop voltage. Additional switches (*S*₃ and *S*₁) and load resistors (*R*₁₇ and *R*₁₈) permit tubes with plate currents up to 6 amperes to be checked. (Although 6 amperes is the maximum current available, tubes through the 16-ampere rating are tested at the 6-ampere level.)

Critical Anode Voltage

Another characteristic of a thyratron is its critical anode starting voltage. This test is made at a specified control-grid voltage, usually on the order of 4 volts positive on the grid. The anode voltage, which is d.c. now, is slowly increased from zero until the firing point of the tube is reached. This value can be compared to that given by the manufacturer. Most of the time, the tube-data sheet will list the anode starting voltage for an average tube of a given type and also for the tube within the type with the highest starting voltage.

The d.c. voltage required for this test is obtained from selenium rectifier *SR*₁, resistor *R*₄, and filter capacitor *C*₁. For the test, *S*₂ is placed in the d.c. position and the d.c. voltage developed across *C*₁ is fed, via *S*₁₋₁, to the anode of the thyratron tube to be tested. (*S*₁₋₁ is closed for this test.) The voltmeter is placed in the position indicated by the dotted lines from the

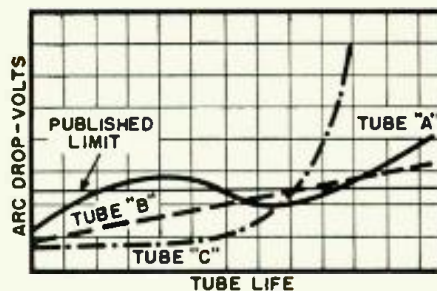


Fig. 3. The arc-drop voltage of a thyratron increases generally with the age of the tube, but may vary during life. It is an indication of tube condition.

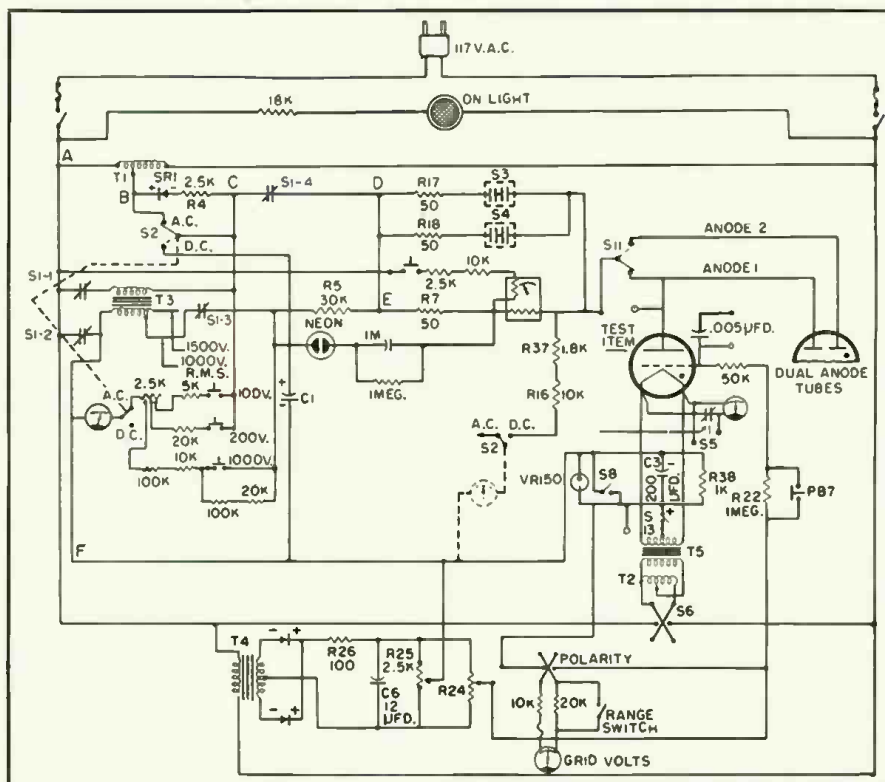
anode of the tube, through *R*₃₇ and *R*₁₆. Readings are taken on the low 100-volt scale, since the anode starting voltage seldom exceeds 50 or 60 volts when the control grid is 4 volts positive.

The necessary positive grid voltage for the thyratron is obtained from the network consisting of *T*₁, the two selenium rectifiers connected across *T*₁, *R*₂₆, *C*₆, *R*₂₅ and *R*₂₄. The control grid is directly connected to the center tap of *R*₂₅. The center arm of *R*₂₅ goes to the filament of the thyratron via a center tap on filament transformer *T*₅. When the movable arm of *R*₂₅ is exactly at its center position, there will be no difference of potential between the grid and filament. Turning the arm of *R*₂₅ in one direction produces a negative grid potential; rotating the arm in the opposite direction produces a positive grid voltage. This arrangement is simple and quite effective.

Critical Grid Voltage

To understand the purpose of the

Fig. 2. Complete schematic for the Alectric specialized thyratron tester.



next test, that of determining the critical grid voltage, let us refer to a tube characteristic chart. This is shown in Fig. 4 for a C3J tube, but it is typical in form for a wide variety of thyratrons. In the section of the graph labeled "No Breakdown In This Area," no combination of certain a.c. anode voltages on the left-hand side with certain negative grid voltages shown at the bottom will cause the tube to fire. To reach the firing point of a tube, we must move into the shaded area. Some tubes may have to be driven deeper into this area (meaning either higher plate voltages or less negative grid voltages) before they are triggered, but they should fire before they reach the extreme right-hand edge of the shaded section. If this does not occur, some defect or variation from normal is indicated and the tube should be replaced.

Beyond the shaded area and to the right of it, the control grid is generally so positive that almost any positive anode voltage will trigger the tube. Operation in this area is not sought because control of the tube is either difficult, variable, or impossible.

To test a thyatron tube for its critical grid voltage, high-valued a.c. anode voltages are required. These are obtained from the secondary of transformer T_s , where voltages having r.m.s. values to 1500 volts are available. In carrying out this test, S_{1-1} and S_{1-3} are closed, while S_{1-2} and S_{1-4} are open. Switch S_2 is in the a.c. position. The voltage developed across the secondary winding of T_s reaches the plate of the test thyatron via R_5 and R_7 . R_5 is purposely made high in value so that the anode current will be kept below 40 ma. This is done because there is no desire to check the ability of the tube to produce its peak current; rather, all we wish to do is determine its crit-

ical grid voltage at a certain anode voltage. By keeping the current low, it is possible to use a low-wattage, inexpensive resistor for R_5 . We obtain the same value for the critical grid voltage whether a large or a small current flows after the tube has been triggered.

Now to the test itself. It could be carried out by fixing the anode voltage at some value and then slowly reducing the negative grid voltage—making it more positive—until the tube fires. This would be done by slowly rotating R_{25} until the neon light in the plate circuit flickered on.

However, the same characteristic can be determined automatically because of the presence of C_3 and R_{25} . Initially, R_{25} is set until it is 4 volts positive with respect to the filament. The a.c. anode voltage is then slowly increased until the tube fires. When this happens, the surge of current through the circuit charges C_3 , counteracting the initial +4 volts on the grid. During the next positive half-cycle of a.c. anode voltage, the tube firing point is governed by the combined voltage from R_{25} and C_3 . This combination, after a few cycles, attains an equilibrium level which is the critical grid voltage for that value of applied anode voltage.

If we now change the anode voltage, by adjusting T_1 , then the total grid-to-filament voltage will re-establish itself at another equilibrium value which will represent the critical grid voltage for that anode voltage. For example, if the anode voltage is raised, the voltage across C_3 will increase, effectively making the grid-to-filament potential more negative than it was before. Conversely, if the anode voltage is lowered, the average voltage developed across C_3 will decrease.

In essence, the network formed by C_3 , R_{25} , and R_{22} swings the tube's operating point a minute distance above and below the firing point. The range is governed by the values of these components (*i.e.*, the over-all time constant). Here it is chosen so that the meter needle recording the critical grid voltage remains quite steady as the anode voltage passes through its positive and negative half-cycles.

Critical Grid Current

The final characteristic of the tube to be checked is the critical grid current. This is the infinitesimal grid current that flows as the critical grid voltage is approached. It starts at the grid and flows down through R_{22} when push-button PB_1 is opened. The voltage developed across R_{22} is negative on the grid side of the resistor and positive on the other side. Furthermore, this voltage adds to that provided by R_{25} and C_3 .

To see how this critical current itself is measured, note first that R_{22} is a 1-megohm resistor. Since the critical grid current is in microamperes, the value of voltage developed across R_{22} is equal to the grid current in microamperes. When PB_1 is closed, and the

system is set up so that the critical grid voltage is indicated automatically, then the value of the total grid voltage is revealed by the grid voltmeter. This meter is connected between the bottom of R_{22} (and hence is not affected by any voltage that may develop across R_{22}) and the center tap of the filament transformer. If, now, PB_1 is opened, the critical grid current will flow through R_{22} and develop several volts here. This will alter the total grid-to-filament potential and drive the grid more negative. To bring the over-all voltage back to the critical grid value point, the voltage across C_3 will decrease by an amount equal to that brought into the circuit by R_{22} .

This change in C_3 voltage will be reflected in the grid voltmeter reading since the latter, remember, measures both C_3 voltage and that developed by R_{25} . Thus, the change in reading on the grid voltmeter when PB_1 is depressed represents the critical grid current in microamperes.

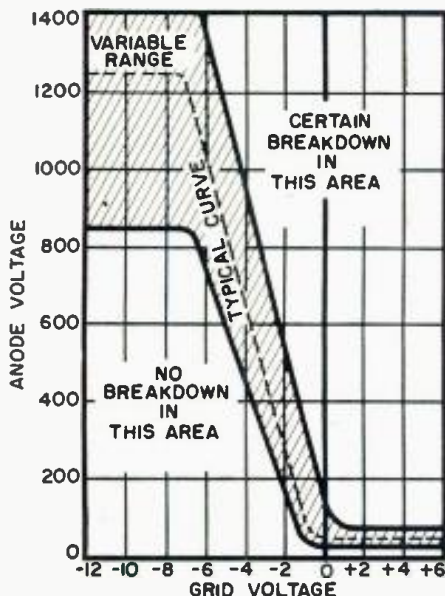
This covers the operation of the tester in general and the tests it performs. Some odds and ends still remain, such as the VR-150 which is placed in parallel with C_3 . This tube serves to protect C_3 when switch S_3 is first opened and C_3 is being charged initially. Voltage surges of a thousand volts or more frequently occur at this time. These would destroy C_3 unless the latter had a sufficiently high breakdown voltage value. Since C_3 possesses a high capacitance, using a unit with a high surge rating would be extremely costly. The difficulty is solved much more economically by having the VR-150 tube as protection.

In the anode voltmeter circuit at the left, four ranges are obtained using only three push-buttons. With all buttons open, the voltmeter is on its 2000-volt range. For the 1000-volt range, the button so marked is depressed. The same is true for the 100- and 200-volt ranges; that is, the desired range is brought in by depressing the associated button. The circuit is so set up that, when either the 1000- or 2000-volt ranges are in use, depressing the 100- or 200-volt buttons accidentally will have no effect on the meter.

This tester will also check phanotron tubes. These are tubes which are essentially thyratrons without a control grid. Hence, the tests are considerably simplified for them. Tests usually include arc-drop voltage, anode starting voltage, and an interelement short-circuit check.

The prime purpose of any tube tester or analyzer is to permit a decision to be made on the condition of the tube. It is not a practical matter to construct a tester like the conventional radio-tube tester where a meter reads "good" or "bad." In a thyatron, there are many factors other than the tube's ability to conduct a given quantity of current that determine its acceptance. That is why all of the foregoing tests are provided for and all should be performed if a true picture of condition is to be achieved. —50—

Fig. 4. Tube characteristic chart for the C3J, a typical thyatron, shows the range of combinations of grid and anode voltages that will cause firing, also the combinations of these voltages that will cause breakdown of the tube.



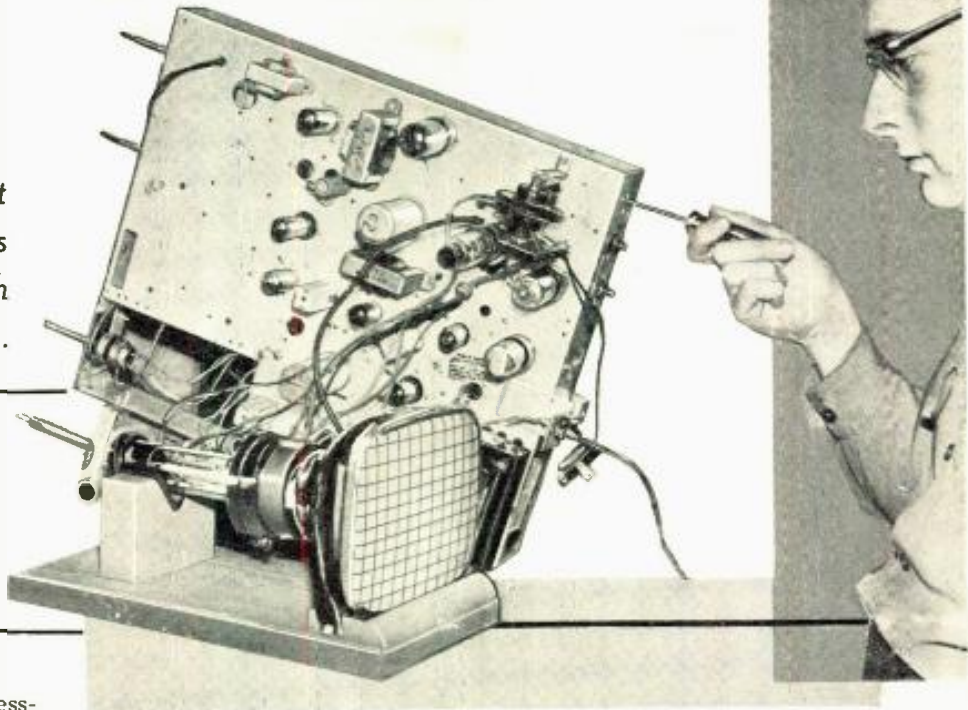
Portable 90-Degree Test CRT

By
JOHN T. JANS

Senior Applications Engineer
Sylvania Electric Products Inc.

Rectangular CRT test unit matches 90-degree sets to permit work on width and linearity problems.

Fig. 1. Where more convenient, the 8XP4 CRT used in the complete substitute test unit can be slid out of its box for use with the yoke assembly of the receiver.



IN THE wake of last year's successful introduction of the 5AXP4 substitution CRT, the Sylvania 8XP4 has recently made its appearance as a companion tube to provide conveniences, with some types of TV receivers, that the earlier tube does not. As was the case with its predecessor, it is a boon in situations where the service technician would otherwise be faced with such possibilities as dismantling an entire receiver or taking that receiver, cabinet and all, into the shop; especially in those cases where the picture tube is cabinet-mounted, separate from the chassis.

With the 8XP4 the service technician can provide a universal substitute for the picture-tube assembly to operate under the most stringent conditions. The 8XP4 is a 90-degree, rectangular, self-focus, non-ion-trap tube of small, handy 8-in. diagonal size. Therefore, a 90-degree receiver with narrow scan would show up narrow on the 8XP4. It would not overscan, as might be done if the tube were designed for use in 55- or 70-degree deflection circuits.

With this tube and a 90-degree yoke such as or similar to the Merit MDF 91, the service technician can build a substitute unit for the picture-tube assembly which will prove useful on almost every make TV receiver. Most 90-degree receivers have yokes with about the same impedance (12 millihenrys and 30 ohms in the horizontal winding, and 40 millihenrys and 50 ohms in the vertical) so this yoke will match satisfactorily nearly all makes of receivers using 90-degree picture tubes. Note the absence of a balancing capacitor in the horizontal windings of the yoke, as shown in Fig. 2. With the yoke in question, this should

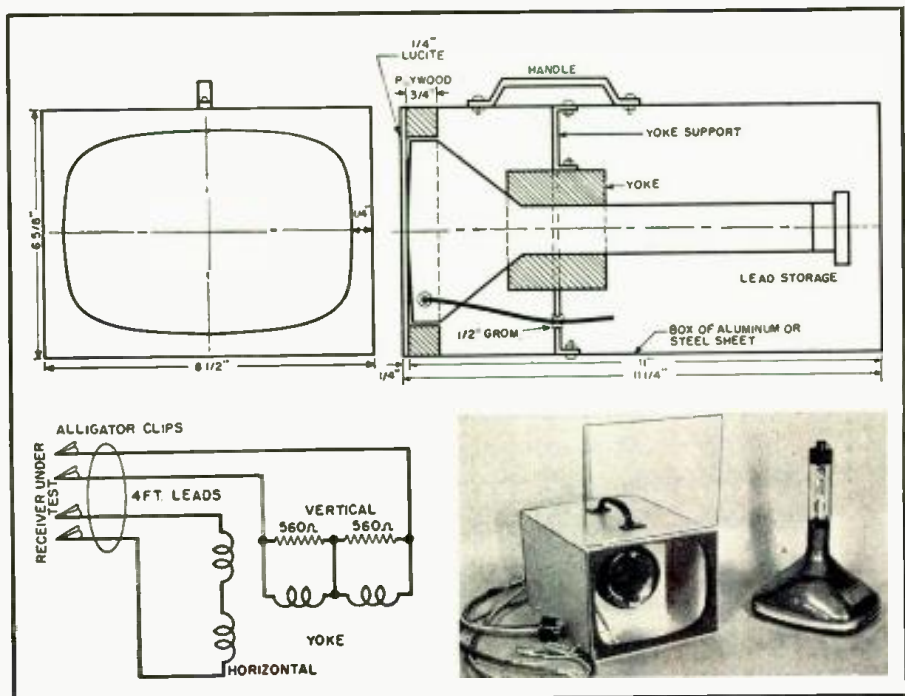
introduce no distortion of the picture or raster.

A large number of 70-degree receivers and many 55-degree receivers will also match this same yoke. However, on the latter types, the scan power supplied to the yoke will be low enough so the check tube will not scan fully. All that need be done is outline the limits of a picture from a 70-degree and a 55-degree receiver in good

operating condition on the face of the 8XP4 tube for use as a reference. This can be done with ordinary marking crayon. Then if a receiver using a 55-degree tube scans a picture large enough to fill the 55-degree outline, the receiver is scanning correctly.

Many receivers require a high-voltage filter capacitor to scan correctly. This capacitor is often supplied by the
(Continued on page 142)

Fig. 2. Dimensions, construction, and mounting details for the housing of the 8XP4 are shown immediately below. Alligator clips connect the matching yoke, discussed in text, to the receiver. Completed unit is shown at lower right.



Certified RECORD REVUE

By BERT WHYTE

WITH all the talk lately of stereophonic tape, one could rightfully assume that stereophonic sound *via* disc is a pretty dead issue. Emory Cook, pioneer in the stereo disc field has been virtually unheard from in this department for some time, and the general consensus seems to be that stereo on disc is impractical.

Well, friends, this may be how things appear on the surface but I have recently discovered that stereo on disc is very, very much alive! Yessir, there are more than a few engineers who are convinced that stereo on a disc is not only practical but that it offers advantages over tape. While I still personally feel that tape is the ideal stereo medium, the advocates have a few points on which they score heavily. One is ease of handling, to be sure, until someone comes up with a good inexpensive workable tape cartridge or magazine load affair, tape is more cumbersome. Another point is ease of duplication . . . the stereo discs can be pressed the same as any other discs. A very potent factor is price . . . the champions of the disc say that stereo discs can be sold as cheaply as present LP's. I have no doubt that all these problems with tape will or are being solved, but it will take time and that's what some people are counting on to exploit the discs.

Now lest someone say . . . "Bert must be goofy, cause there aren't any stereo discs", let me give you the word! It is true that the *double-track Cook* stereo disc is gradually disappearing, but I am not talking about those when I refer to stereo discs, but to the advent of the long heralded *monogroove* stereo disc! There are no less than four (count 'em) separate groups now feverishly working on this type of disc, who are known to me, and perhaps there are others. I cannot divulge their identity at this time, but I can tell you that it is a better than fair bet that at least two will be able to demonstrate these stereo discs at the next New York Hi-Fi Show!

Most seem to be taking the same technical approach or variations of it, namely the use of FM carrier for the second channel. In practice, the discs would be compatible on today's regular 1 mil pickups . . . if you don't have the extra equipment necessary for the stereo, the record will play in the normal fashion. The special equipment for the stereo playback would not be too extensive . . . naturally as with tape, one must have an extra amplifier and speaker for the second channel. Beyond that there is the pickup which is likely to be a pretty complex affair, and the FM carrier demodulator.

As far as I can learn the FM carrier may operate as high as 35 or 40 thousand cycles and the pickup requirements will be very demanding of extremely high lateral compliance and the stylus diameter will have to be no more than half a mil and possibly as small as three tenths of a mil in order to trace

these frequencies! As any knowledgeable audiophile is aware, there are only about two, possibly three, present day cartridges which meet the requirements of compliance and extended frequency response and only one pickup which is commercially available with a half-mil stylus. However it is generally felt that when confronted with this problem, the makers of the top quality cartridges will be able to meet the stringent specifications.

The demodulator is more or less straight electronics and presents no particular problems. As to the engraving of these frequencies on a disc in the first place, there are reportedly at least two cutters capable of response beyond 40,000 cycles. Admittedly, the fabrication of the pickup and the styli and the pressing of the record as well will be the big hurdle and it goes without saying that these discs will have to be played on a turntable with special arm, at least until someone comes up with a super-charger capable of tracking at very low stylus forces.

The stereo disc will not come easily . . . indeed some factor may turn up as it has in the past to torpedo the whole idea. Many years ago the great English record combine *EMI* patented a method of simultaneous "hill and dale" (vertical) and lateral recording, and *Western Electric* in this country fooled around with the same thing, but nothing has ever come of it. Much more recently it was reported that *London Records* had successfully demonstrated, in London, an FM carrier type stereo disc, but so far the official word is mum as to when and if these discs will be marketed. One thing is certain . . . if these stereo discs ever reach commercial fruition, the economic impact on the record market will be fantastic. It will, in essence, give disc recording a new lease on life, although oddly enough, I feel that tape will continue to expand.

Right now I'm from Missouri. . . I still think that tape has advantages over disc as far as stereo is concerned that are hard to deny. Of course I may be all wet on this next point, but in view of present knowledge the thing that intrigues me is how, even at the very low stylus force that will be employed, will the incredibly delicate tracery of 35 or 40 thousand cycles withstand the friction and wear of repeated playings without vanishing and thus destroy the second channel? This is a fascinating subject to be sure and I'll do my best to keep you up to date on developments. In the meanwhile, enough of my yak, and on to the new recordings of which there are many this month which are outstanding.

GLAZUNOV THE SEASONS BALLET L'Orchestre de la Societe des Concerts

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

du Conservatoire de Paris conducted by Albert Wolff. London LL1504. RIAA curve. Price \$3.98.

The only other recording of this charming work is the Desormiere reading on a *Capitol* disc, and this new *London* makes for an interesting comparison. Wolff does not espouse as lyrical approach to the score as does Desormiere, choosing instead to emphasize the rhythmic aspects. If he has not the delicacy some people might prefer, this is not a cardinal sin and he brings a great deal more fire and spirit to the work especially in the rousing and familiar finale, "Autumn". As usual with this conductor, *London* affords him magnificent sound. With the smooth, yet incisive strings, the mellow French woodwind . . . the splendid orchestral balance and an appropriately spacious acoustic frame, this is clearly superior to the earlier *Capitol* disc. Try this as a breather from the usual ballet repertoire.

BEETHOVEN SYMPHONY #6 ("PASTORALE") Berlin Philharmonic Orchestra conducted by Andre Cluytens. Angel 53550. RIAA curve. Price \$4.98.

What special qualities can this 19th "Pastorale" offer, over all the competing versions? A fair question certainly in these days of seemingly endless duplication. One cannot say this is a definitive version . . . yet it has qualities which will endear it to a great many people. Cluytens has not previously been noted for his affinity with Beethoven, but as heard here, he gives considerable evidence that he would not be over his depth with some of the other Beethoven symphonies. Cluytens essays tempi which are a mite on the slow side, but he doesn't drag his feet. His approach is essentially lyrical, but he does not subvert the rhythmic qualities in maintaining this mood. His view of the famous "Storm" is robust and vigorous, and we should not decry either Cluytens or indeed any other conductor if he cannot equal the intensity of the tempest stirred up by Toscanini.

Over-all, a pleasing performance, but to me the real value of this disc is the truly miraculous precision and polish of the Berlin Philharmonic. With the smoothly sumptuous sound afforded by *Angel*, the strings, especially first violins and cello, are an ear-filling delight. Woodwind and brass are on the same elevated plane and their balance in ensemble is just plain marvelous. The evidence of one's ears would seem to bear out the critical acclaim afforded the Berlin orchestra on their recent American tour. Summing up . . . one of the most satisfactory "6th's" in the catalogue, certainly one of the best sounding and worth owning if for no other reason than the virtuosity of the performers.

KACHATURIAN CONCERTO FOR PIANO AND ORCHESTRA

Leonard Pennario, pianist, with Concert Arts Symphony Orchestra conducted by Felix Slatkin. Capitol P8349. RIAA curve. Price \$3.98.

The sixth version of this work to appear, it has negative and positive values about equally distributed. Pennario easily copes with the technical demands of the work, and while his performance is competent, it lacks the sparkle and zip of the late William Kapell's reading . . . something which is needed to sustain interest in this rather overblown work. Slatkin conducts a good and knowing accompaniment to Pennario and the orchestra plays with considerable skill. As far as sound is concerned this is the prime virtue of this disc, being easily the most "hi-fi" of all the versions. Piano is sharp and clean, (Continued on page 162)

Realistic

High Fidelity

Audio Output Tubes

and Circuits

H. A. HARTLEY
Audio Consultant

IN PART 9 of this series I said that, ideally, the power required to drive horn-loaded, acoustic phase-inverter, and infinite baffle or closed box speakers should be 3, 6, and 11 watts respectively, but that practical considerations required these output powers to be raised to 7, 15, and 25 watts, if an adequate margin of safety was desired. Tubes age, lose their properties, or even may be grossly mismatched. The characteristics given by the makers assume a pure resistive load, and in any case are "average" values. It is not a practical proposition to design absolutely for ideal conditions when the components used are not perfect.

Before discussing the sorts of tubes that will give undistorted outputs of from 7 to 25 watts, I should like to make a "heretical" observation. We all know that negative feedback greatly improves an amplifier, both as to damping factor and distortion, and so feedback, used wisely or otherwise, is written into the constitution. Associated with this is usually a specification of fantastically low intermodulation distortion for the output the tubes are supposed to give, according to the tube manuals. These claims may be quite right, and I will agree that they can be proved right, but it calls for pretty good engineering, and tubes right on the top of their form. Now comes my heresy, for speaking as an engineer I ask "is this pretty good engineering absolutely necessary?" The reply can be that as a matter of satisfaction to the engineer it is necessary, and if a manufacturer has to produce the maximum results at the minimum cost it is also necessary and that is why he hires engineers to do the design work. But quite a lot of people like to build their own amplifiers, and I should like to emphasize that the semi-technical amateur is

Part 10. Practical recommendations on selection of tubes and circuits to be used. Last article in series.

really up against it when he tries to get the maximum possible from a given output stage.

It is much easier to design roughly for twice or three times the output you would normally require, use just a little feedback (to avoid any possibility of low-frequency instability) and keep the volume down, for your roughly designed amplifier will sound pretty bad if going all out. Put it this

EDITOR'S NOTE: This article concludes the present series "Realistic High Fidelity" by H. A. Hartley. From the many letters we have received on this series it is evident that our readers found it informative and interesting to learn of the opinions of one noted audio authority. We thank Mr. Hartley for his wholehearted cooperation during the preparation of these articles and for his many long and interesting letters of explanation concerning some of the points made. We hope that we will be publishing future articles by Mr. Hartley dealing with subjects in which our readers are most interested.

way—design for a 50-watt amplifier and call it a 25 and don't try and get more from it. Under these conditions it would have to be a fairly bad amplifier to sound other than good at ordinary room level.

Later on in this part I shall give the circuit of a 20-watt output stage of an amplifier I made and sold for some years. I don't make it any more, for I have enough to do with speakers alone, but that amplifier was produced in 1948 in response to an insistent demand for something better than usual. It was most carefully designed, and its 20 watts fed into one of my ordinary 215 speakers were enough to fill lecture theaters with an audience of 200. But . . . it was designed for home

use, and I suppose in the average home its peak output was on the order of 5 watts. Then it sounded very good indeed, and I am told even today that it sounds cleaner than many highly respected amplifiers incorporating all the latest developments. There is nothing mystically wonderful in the design; it is just working well within its possible maximum output, even when the output tubes are getting tired after many years' use.

This, however, is by the way, and no fit subject for engineers and would-be engineers. Let us seriously consider the selection of tubes for output powers of 7 to 25 watts. Seven watts can be obtained from a single tube, but the advantages of push-pull operation are so manifold that it is invariably used in high-fidelity amplifiers.

Selection of Tubes

The first decision is, therefore, that two tubes will be used in class A or AB push-pull, but there is no general agreement as to which tubes should be used, or how they should be used. It is an easy matter to skim through the data sheets in the tube manuals and note that some particular pair of tubes gives x watts at $y\%$ distortion, but to depend on this is rather like visiting a foreign country with no knowledge of the language beyond what you will find in a phrase-book. That will enable you to get around in a limited sort of way, but you won't get the utmost pleasure from your vacation abroad. So, if you want the best amplifier, you must learn a little of the language of electronics. Only then can you judge critically the various

circuits in the textbooks and magazines and the amplifiers shown to you in the dealer's store.

Some of what follows has formed the basis of many articles and textbooks over the past 30 years. I am sorry to have to put it in, for diagrams of tube characteristics have been repeated *ad nauseum*, but you must know how to get the right answer. I have cut out all the padding and got down to the skeleton; but the skeleton may have more bones than you thought. I think the comparative tables will enable you to determine the best tubes for your particular requirements without having to refer to other texts, and as some tubes *are* better than others, you should know wherein they are better.

The tubes considered are of two main types, those with plate or plate plus screen dissipation of 12 or 25 watts. Note the distinction between plate dissipation and output power; dissipation indicates the power consumed (d.c.) within the tube itself to produce audio power (a.c.) to drive the speaker. The ratio between the audio output power and the total d.c. input power, including the power dissipated within the tube, is the efficiency of the stage. This is rarely greater than 30-50%, so two tubes each of 12 watts dissipation are usually needed for 10 to 12 output watts and two 25-watt tubes for powers up to 25 watts. Higher efficiencies can be obtained by special techniques, which will be described in some detail later in this article.

Most people seem to want greater outputs than 10 watts, so my treatment of characteristics curves will be restricted to 25 watt tubes, but the

same basic principles apply to the smaller ones.

As to tubes that are available, it is a surprising thing that very few *are* available. In the old days British manufacturers had a wide range of triodes ranging from 12 to 250 watts plate dissipation, and some of them were very good, consistent, and reliable. Most of these have disappeared since the advent of the beam power tetrode. In the U. S. the 2A3 (now available in standard octal base as the 6B4G) is hardly ever used, and it is a sardonic commentary on audio usage that whereas the beam tube was developed to give greater stage efficiency, it is now *mis-used* by being triode connected to overcome the disadvantages of beam tubes, real or alleged, simply because the beam power tube has supplanted the triode. This development is not only illogical, it is also technically unsound, for the highly competent designers of tubes know how to design tubes for a specific purpose. The beam power tube is designed to be used as a beam power tube, a triode as a triode.

One real advance in output tube design is found in the Dutch *Philips-Mullard* EL34 and the American *Tung-Sol* 6550 pentodes. These are intended for "distributed load" or "Ultra-Linear" operation, but I am quite sure it won't be very long before some writer comes out with an amplifier design using these very same pentodes as triodes.

In Table 1 I have displayed side-by-side the characteristics of the more popular tubes. The parameters of single tubes are given so that you may assess the basic attributes of each type, while the power output and dis-

ortion of push-pull pairs gives you the data you require for various plate supply voltages. The table shows some interesting facts.

The KT66 made its appearance in the U. S. as a result of publicity given to the Williamson amplifier circuit. This circuit did not have any novel features, and the elaborate balancing controls included only contributed to getting the maximum undistorted output from an output stage of somewhat limited capabilities. There are other, and simpler, ways of getting the desired results. I have had my own opinion of the circuit—lack of stability—confirmed by many competent engineers, but it "caught on" because at the time it was described it seemed to behave better than many contemporary American amplifiers. In the process the tube specified by the author came to be endowed with special properties, but reference to the table (which has been compiled from the data issued by the manufacturers) shows that the 6L6 is a rather good match. It should be remembered that the 6L6 was not designed to work on plate voltages as high as 400, so its power output is somewhat limited; but the 807 has the same characteristics and can be used safely up to 600 volts. If you *must* build a Williamson amplifier then the tube to use is an 807. As an amplifier manufacturer in Britain before World War II I had experimented with precursors of the Williamson circuit and decided then the tube for me was the 807. In regular production, however, I used 6L6's as pentodes, for even 20 years ago it was well known by engineers that feedback over several stages was liable to introduce very-low-frequency instability through phase-shift. High performance amplifiers were best arrived at by using as few stages as possible, and this implied the utilization of the beam power pentodes. Feedback took care of the high output impedance.

Another suitable tube that should be mentioned at this point is the 5881. This can be considered to be a single-ended 6L6 with about 20 percent more plate dissipation. Plate voltages as high as 400 volts may be employed.

Table 1 also shows that as compared with the 6L6 or the KT66 the new power pentodes are a great step forward, either as pentodes or triodes. The transconductance is about twice as good as the prewar beam tubes, which means higher efficiency as an input voltage—power output converter. It also means greater power output for a given plate voltage. It would be unfair to say that the EL34 is better or worse than the 6550, for everything depends on the way it is used. The EL34 usage is described by the *Mullard Co.* as of the "distributed load" or "Ultra-Linear" type. To get the best out of these newer tubes involves special techniques, which will shortly be described.

The power output figures of Table 1 are without negative feedback. As I

Table 1. Data on 19-35 watt tubes, used singly (A) and in push-pull pair (B). For triode operation, screen grids are tied to plates through 100-ohm resistors.

Connected as:	6L6		KT66				EL34		6550							
	Pentode	Triode	Pentode	Triode	400	Triode	Pentode	Triode	Pentode	Triode						
Plate volts	250	250	250	250	400	250	375	250	250	....					
Screen grid volts	250	....	250	....	....	250	....	250	250	....					
Cathode bias res. (ohms)	170	490	160	315	600	120	370	....	....	....			
Peak a.f. grid volts	14	20	15	19	38	13.5	18.9	14	14	....					
Transconductance (μmhos)	6000	4700	6300	....	5500	11,000	8000	11,000	11,000	....					
Load res. (ohms)	2500	6000	2200	2750	4500	2000	3000	1500	1500	....					
Plate res. (ohms)	22,500	1700	22,500	1450	....	15,000	....	12,000	12,000	....					
Distortion (%)	10	6	9	6	7	10	8	7	7	....					
Power output (w.)	6.5	1.3	7.25	2.2	5.8	10	6	12.5	12.5	....					
(A)																
Connected as:	6L6		KT66				EL34			6550						
	Tetrode	Triode	Tetrode	Triode	Pentode	Triode	Triode	Pentode	Triode	Pentode	Triode	Pentode	Triode			
Plate volts	270	360	250	350	250	400	375	430	430	400	430	400	400	450	450	
Screen grid volts	270	270	250	275	375	425	425	300	275	450	
Peak a.f. volts (grid to grid)	28	41	36	70	40	80	59.5	45	77.5	58	64	53	46	96	92	
Load res. (ohms, plate-to-plate)	5000	9000	3000	4000	8000	2500	4000	3400	6600	6600	5000	10,000	4500	3500	3300	4000
Distortion (%)	2	4	3	4	6	2	3.5	5	.8	1.3	3	<1	4	3	2.5	2.5
Power output (w.)	18.5	24.5	15	17	30	4.5	14.5	35	20	37	16	14	41	55	70	28
(B)																

pointed out in Part 9, feedback cannot increase the power output of a tube but it can reduce the distortion. The figures in Table 1 for distortion can be reduced with feedback, but you cannot get more power output. If you use feedback, you will find that up to the figure given in the table, the power output for a pair of tubes contains less distortion with feedback, but the moment you go past that figure, the distortion with feedback will be greater than without. It is a characteristic of negative feedback that up to the optimum point of power output the gain in quality is substantial, but the moment you cross the threshold the results are terrible. The overload point is reached very suddenly.

If you fancy KT66's in push-pull triode operation you can't get more than 14½ watts at the maximum rated plate voltage advised for the tube. You can get more with 807's as triodes because the tube will just about stand 600 volts as a triode. Or you can use 6550's. But if you really want substantially higher powers than those shown in Table 1, then you must use four tubes in push-pull parallel. If you don't want to do that, then you must give up the idea of having a triode amplifier.

Output tubes with 12 watts plate dissipation are detailed in Table 2. The 6V6 you all know, and a pair is used in almost every 10-watt amplifier on the market. The KT61 is quoted because it is used in an imported British amplifier, although the tube was never designed for hi-fi amplifiers. Its very high transconductance is explained by its intended use immediately after the detector diode of a mass-produced radio set. It gives reasonable power output of a quality associated with such equipment. It does this very successfully, but is surpassed by the Mullard EL84, as can be seen at once by looking at the data for push-pull pairs. What Table 2 does show is that the triode addict is very badly served, for he cannot get more than 6 watts from a pair of any of them. The only 12-watt solution I know is the 25-year-old British PX4 triode, for which there is no American equivalent, but the tube is fitted with a British 4-pin base, has a 4-volt filament, and so calls for non-standard tube sockets and power transformers. A pair gives 13.5 watts with 2.5% distortion.

The two tables list nearly every output tube that can interest us (I did not include the 5881, a tube which I like, for its characteristics are similar, if a little better, than the 6L6). But we must also face the fact that these figures are for average tubes with a resistive load. In practice, the inductive load of a speaker system will result in less output for a given distortion or the same output for more distortion, although the discrepancy will not be as great with triodes as with tetrodes. But for a clearer idea of what really goes on inside a tube recourse must

Connected as:	6V6	KT61		EL84	
	Pentode	Pentode	Triode	Pentode	Triode
Plate volts.....	250	250	250	250	250
Screen volts.....	250	250	.....	250	.....
Peak a.f. grid volts.....	12.5	4.3	5.5	6	8.3
Transconductance (μmhos).....	4100	10,500	9800	11,300	.....
Load resistance (ohms).....	5000	6000	5000	5200	3500
Distortion (%).....	8	8	5	10	9
Power output (watts).....	4.5	4.3	.7	5.7	1.9
(A)					
Plate volts.....	285	275	350	300	300
Screen volts.....	285	275	.....	300	.....
Peak a.f. volts (grid-to-grid).....	38	16	23	28	28
Load resistance (ohms).....	8000	10,000	6000	8000	10,000
Distortion (%).....	3.5	6.5	2	4	2.5
Power output (watts).....	14	11.5	6	17	5.2
(B)					

Table 2. Comparative data pertaining to beam power pentodes with plate dissipations of 12 watts. Part (A) is for a single tube, part (B) is for a push-pull pair.

usually be made to the tube's characteristic curves as published in many tube manuals.

Characteristic Curves

I have no wish to use up a lot of space on this matter, for the material has been printed over and over again, but a few notes will not come amiss. Fig. 38 shows the plate voltages—plate current curves of a 6L6 connected as a triode, the sort of curves you see in the tube manuals. To these I have added a 25-watt dissipation curve to indicate the limit of the tube's handling capacity. The load line XOY has a gradient representing 2500 ohms, and to prove this I have extended it dotted to cut the voltage and current axes; you will notice it cuts the horizontal axis at 500 volts and the vertical at 200 ma., and 500 volts/0.2 amp = 2500 ohms.

If the distance OX, representing a signal swing from -15 to 0 volts on the grid, equals the distance OY, which represents a signal swing from

-15 to -30 volts, there will be no second harmonic distortion. If these two distances are not equal, there will be. If the ratio of OX to OY is 11 to 9, the distortion will be 5%, which is usually reckoned a suitable figure for second harmonic distortion (but 5% of third harmonic distortion would sound very bad indeed, our ears being what they
(Continued on page 168)

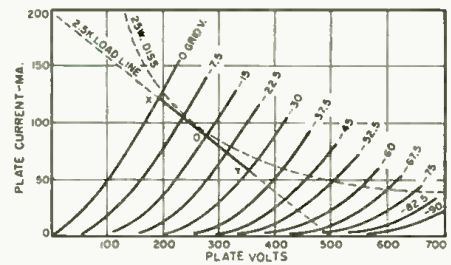


Fig. 38. Plate characteristics of the 6L6 connected as a triode. A 2500-ohm load line has been added to the curves along with a line denoting the maximum plate dissipation power of 25 watts.

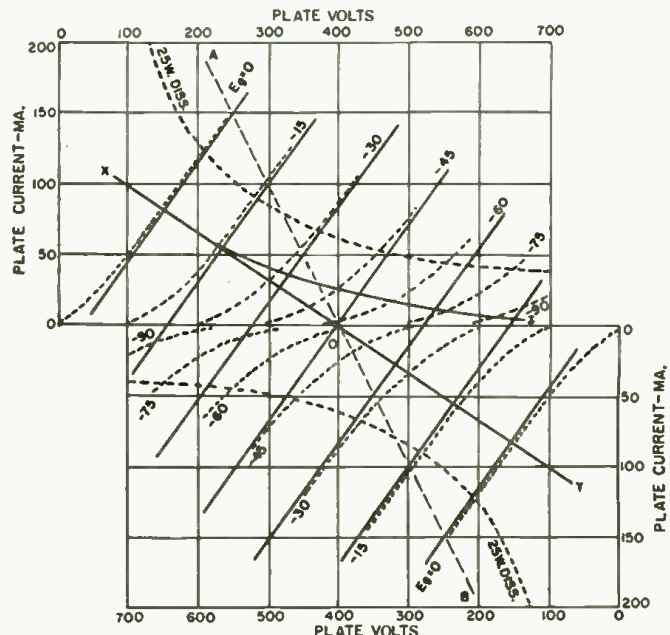


Fig. 39. Composite characteristics of a pair of 6L6's in class A push-pull. The point "O" is the operating point, through which passes the basic composite characteristic labeled "-45 volts" and marked as a solid line. Other composite characteristics are shown as solid lines. The load line XOY represents a load of 3000 ohms as recommended in Table 1. For the meaning of the load line AOB, representing a 10,000-ohm load, see text.

Sylvania

Color TV Circuits

By
WALTER H. BUCHSBAUM

Television Consultant
RADIO & TELEVISION NEWS

An unusual chassis layout, a new way of developing high voltage, and generous design margins are noted.

A TOTAL of 28 receiving tubes plus two selenium rectifiers, two crystal diodes, and the color picture tube make up the active elements of the new *Sylvania* color circuitry. There are 12 multi-purpose tubes of well known types such as triode-pentode and triode dual-diode combinations. In general, the tube complement and circuitry of the *Sylvania* color models are similar to the recently described *Hoffman* and *Emerson* receivers, as well as several others based on the 1956 *RCA* 28-tube design. However, one of the generally used tubes, the h.v. regulator, is not found in *Sylvania* color TV sets. In its place a completely different system is used, one which requires no h.v. adjustment by the service technician and thus simplifies the actual picture tube adjustment procedure.

The h.v. circuit shown in Fig. 2 differs considerably in its operation from most previously used flyback systems. From the plate of the 6CB5 horizontal-output tube, the positive pulse goes to the plate of the first 3A2 rectifier which supplies the 6-kilovolt focusing potential through a filter capacitor (C_2) and resistor voltage divider. The cathode of this tube is at approximately 6 kilovolts d.c. and connected directly to the plate of the 3A2 coupling diode. As a result, 6 kilovolts also appear at the cathode of that tube. The h.v. flyback pulse of about 20 kilovolts is applied through a capacitor (C_1) to the plate of the 3A3, which is also connected to the 6-kilovolt d.c. point. The

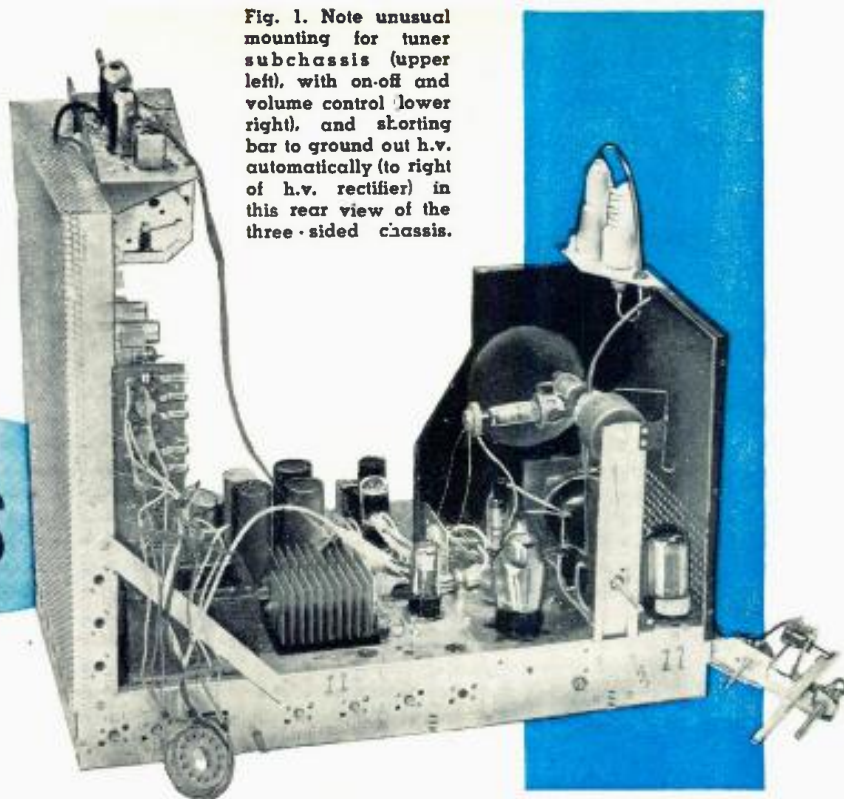
result of this arrangement is that the 3A3 rectifies the 20-kilovolt pulses in addition to passing the 6-kilovolt d.c., thereby providing a 26- or 25-kilovolt potential for the anode of the color picture tube.

The box marked "corona regulator" in Fig. 2 represents a glass-and-metal enclosed discharge tube of special design. Its operation is similar to that of a gas-type voltage regulator in that, when voltage impressed upon it increases, more current is passed through the tube. In the case of the corona-type tube the amount of corona, or discharge of electrons through the tube, depends on the voltage applied through the series-limiting resistors. It may be said that the tube is constructed to depend on controlled dielectric breakdown under the stress of increasing high voltage, so that the voltage drop over the breakdown path disposes of anything over the regulated value.

Among other technical features, *Sylvania* receivers use a 4-stage 41-mc. i.f. amplifier section in conjunction with intercarrier sound and a separate sound i.f. detector. The sound section, as seen in the block diagram of Fig. 3, consists of one limiter-driver, the 6T8 ratio detector—audio amplifier, and a 6W6 output tube.

From a designer's point of view, *Sylvania* color sets are well on the safe side in gain, bandwidth, and component performance. For example, there are two 6CL6 video amplifiers for the Y signal and the first of these

Fig. 1. Note unusual mounting for tuner subchassis (upper left), with on-off and volume control (lower right), and shorting bar to ground out h.v. automatically (to right of h.v. rectifier) in this rear view of the three-sided chassis.



stages also amplifies the color sub-carrier. This latter signal is then passed through still another amplifier for bandpass limiting before being applied to the demodulator driver amplifier. Demodulation is accomplished with the widely used high-level triode circuit described in detail in the March 1955 issue of *RADIO & TELEVISION NEWS*. To insure sufficient amplitude of the blue color difference signal, a separate stage of B-Y matrix amplification is provided.

The chassis arrangement consists of an L-shaped structure which surrounds the picture tube. While no printed circuitry is used in the first production runs, the entire chassis consists of three major subassemblies and a total of 8 plugs and jacks including a set of pin-jacks which connect the picture and screen grids of the color picture tube with the main chassis. All these assemblies can be of great help to the service technician in troubleshooting, especially since these points as well as some test points are clearly marked in the circuit diagram.

Unlike most other color sets, the *Sylvania* models do not provide controls under a sub-panel which both the viewer and the technician can adjust. In addition to channel selection and fine tuning there are only the "on-off," volume, tone, contrast and brightness controls available for monochrome adjustment. Used for color reception only, the hue and the color or chroma gain controls are at the front. All other adjustments are accessible either from the rear or top of the chassis. This arrangement has some advantages and some drawbacks.

The advantages include the fact that customer misadjustment of such tricky

controls as the a.g.c. level, color-killer bias, picture-tube screen grid, etc., is less likely. Circuit design is intended to avoid adjustment of any of the secondary controls and, in most instances, the set owner only has to worry about the few front-panel controls. One of the drawbacks is the fact that there are some locations where both strong and weak stations are received, and adjustment of the a.g.c. level and the color-killer bias controls is required by the set owner when switching stations. Furthermore, in some places, reception conditions change greatly with the seasons and again the set owner may need to change some of these controls himself.

A further disadvantage is the need of a mirror when adjusting any of the secondary controls. In this connection, we might advise the service technician never to use the set owner as observing reporter in place of a mirror. In most cases this will result not only in wholly wrong and confusing picture descriptions, but the customer is likely to become quite upset by the abilities of his set to produce monsters and weird wallpaper designs.

Fig. 1 shows the rear view of the Sylvania type #1-534-1 chassis which is used in both the console and the table model. This chassis fits around three sides of the picture tube assem-

bly which is shown in the cabinet in Fig. 4.

In this latter view a number of interesting and important mechanical features are apparent. The six pieces of tubing projecting from the rim of the tube to the deflection yoke are the adjustments for the six magnets of the field neutralizing assembly which surrounds the screen. Each is linked by a flexible shaft to move one of the magnets closer to or farther from the screen. This adjustment requires some skill, since a 180-degree rotation not only changes the distance, but also the polarity of the magnet, as shown in Fig. 5.

At the bottom and upper left hand corner of the cabinet view of Fig. 4, the plastic mating pieces for the front panel controls can be seen. The shafts of these controls coming from the chassis are knurled and do not pass through the cabinet to the front. Instead they are captured by the plastic retaining cups visible in Fig. 4 and their motion transmitted to the rim type knobs accessible at the front panel. At the upper left of Fig. 4, the mechanism which drives the tuner shaft by means of a lever action can be seen. The "on-off" switch and volume control assembly are shown as separate sub-assemblies at the right of Fig. 1.

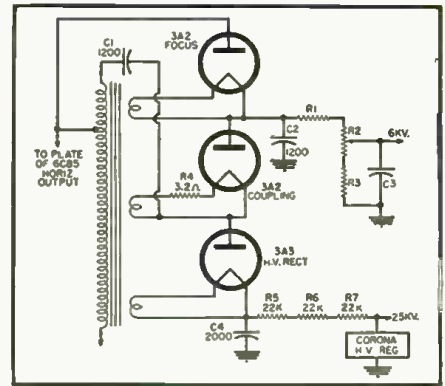
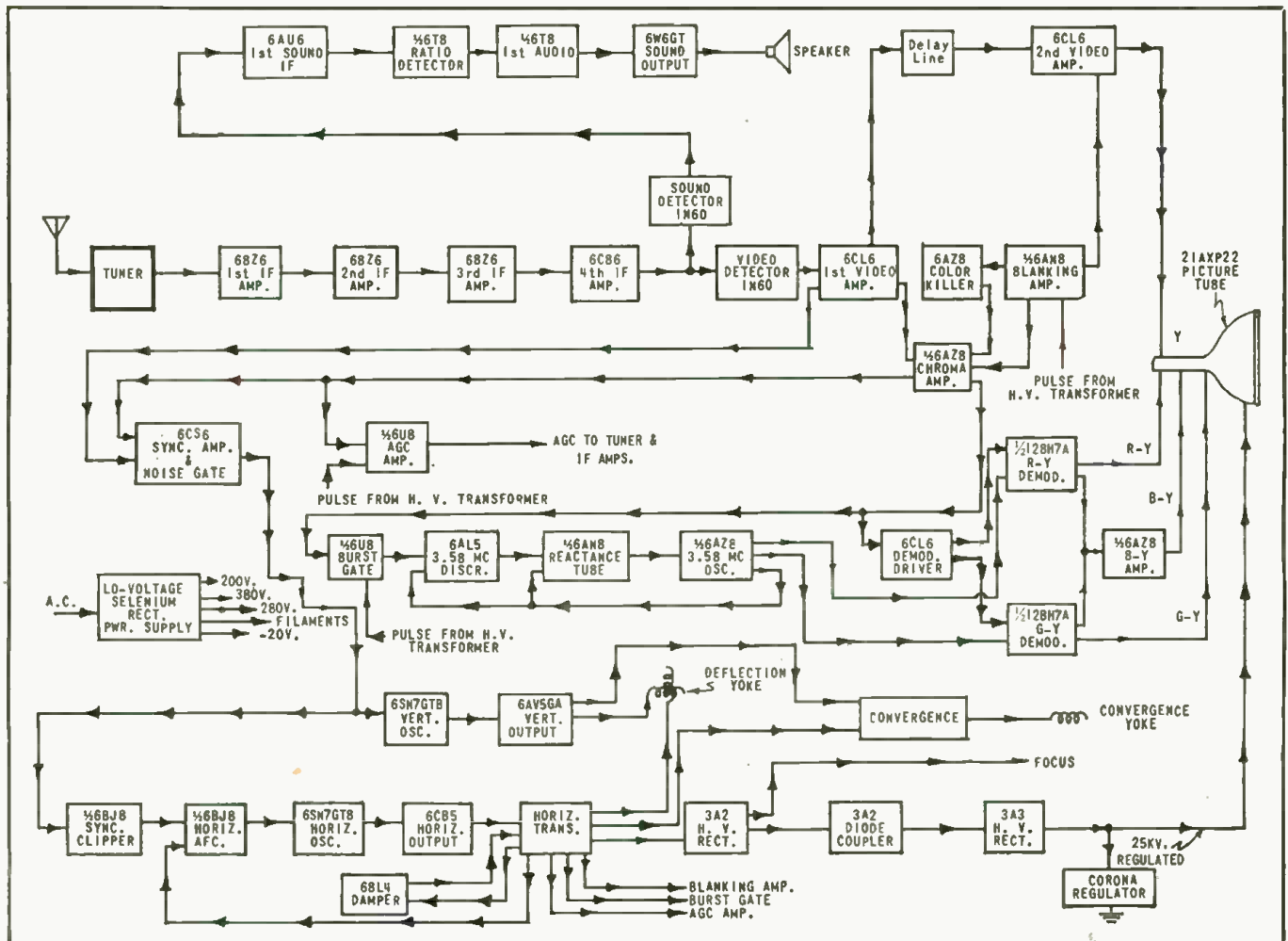


Fig. 2. Although it looks like a doubler or tripler at a hasty glance, this h.v. circuit uses another technique for developing the required 25,000 volts.

Fig. 1 also shows some other noteworthy features. The location and mounting of the turret tuner certainly is unusual, as is the simple but effective h.v. interlock. When the h.v. cover is removed as in Fig. 1, the wire spring visible at the right of the h.v. rectifier tube will pivot over to the cathode of the 3A3, thus shorting the h.v. to ground. The corona type discharge device which performs the function of the h.v. regulator in the Sylvania models is visible at the upper (Continued on page 78)

Fig. 3. Although there are no radical departures, generous design margins are typified by the retention of four i.f. stages.



A Field-Strength Meter that Tests Tuners

By **ROBERT G. MIDDLETON**
Chief Field Engineer, Simpson Electric Co.

This extra-duty piece of test equipment is useful on the bench as well as in signal-strength tests.



FIG. 1. Field-strength meter operates on u.h.f. as well as v.h.f., provides substitution test for suspected tuner, and will also recharge 6-volt battery.

Fig. 2. Rear chassis view shows output connection for front-end testing on the turned-up apron (right) behind tuner.

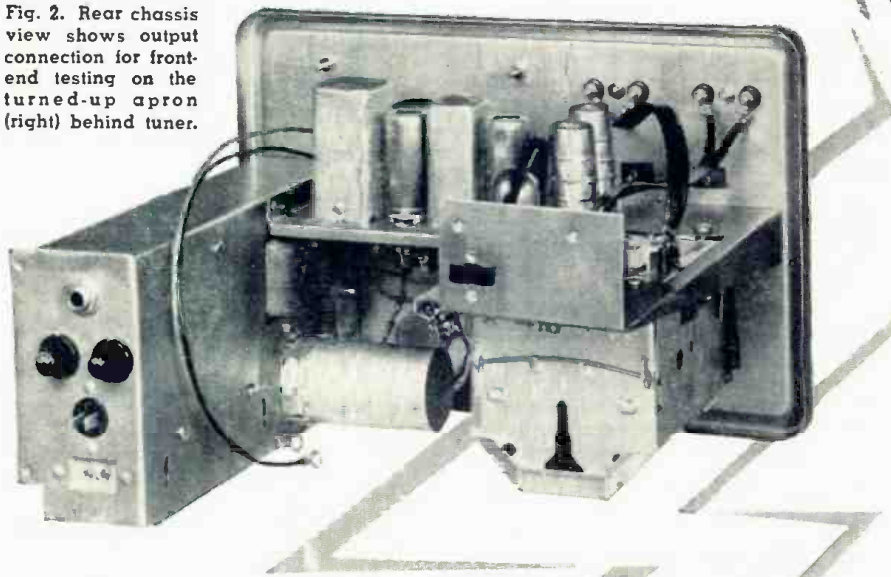
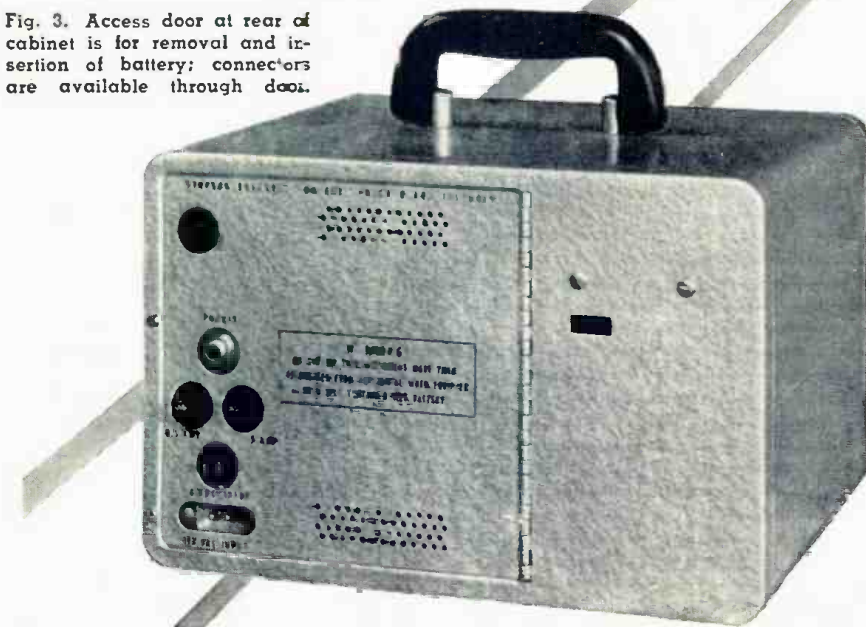


Fig. 3. Access door at rear of cabinet is for removal and insertion of battery; connectors are available through door.



THE ever-popular field-strength meter has been elaborated in function by *Simpson Electric Co.* so that tests of front-end performance can be made with it. Accordingly, field-strength meters are now useful at the bench, as well as in the field. Front ends can be tested for both u.h.f. and v.h.f. performance, as will be explained.

The external appearance of the versatile field-strength meter is shown in Fig. 1, from which it is seen that terminals are provided for either u.h.f. or v.h.f. input. The meter has a full-scale sensitivity of 50 microvolts, although the full sensitivity need be utilized only in the far-fringe areas. The dual tuning control is arranged for convenient and rapid adjustment on both u.h.f. and v.h.f. functions.

Note the battery-test position on the function switch, which provides direct indication on the meter scale of battery condition. The internal 6-volt storage battery can be recharged from the 117-volt power line by means of a built-in trickle charger, or can be recharged from the cigarette lighter on the dashboard of the service truck. The instrument also operates from a 117-volt power line, if desired. When the service truck is garaged, the car battery can be recharged overnight from the trickle charger of the instrument.

Fig. 2 shows the chassis construction of the field-strength meter. A *Standard Coil TE Series XT41C* tuner is utilized for high gain and low-noise performance on both u.h.f. and v.h.f. channels. The phone plug provides an audio outlet for monitoring of the sound signal with a headset, and the dual-prong outlet permits the internal battery (not shown) to be recharged from the generator in the service truck, or facilitates recharging of the car battery from the instrument. The standard 117-volt receptacle permits

the instrument to be operated directly from a power line, to recharge the internal battery, or to recharge the car battery.

The output connection for front-end testing is seen on the turn-up apron at the right-hand side of the chassis in Fig. 2. This receptacle accommodates a 300-ohm output lead for connection to the antenna-input terminals of a receiver on the bench. The manner in which this novel test is made will be discussed shortly. A rear view of the instrument is shown in Fig. 3, which shows the access door to the internal storage battery and the various connectors. Two fuses are accessible from the rear of the case, for convenience in the event that replacement should be required. The test cables can be stored inside the instrument, when the access door is opened.

Test Signal from Instrument

The signal for bench tests of receiver front ends is obtained from the cathode circuit of the first i.f. stage in the field-strength meter, as seen in Fig. 4. This is a 47-ohm low-impedance source, which provides almost the same signal level as is present at the mixer-output terminal of the tuner in the instrument. Being a low-imped-

ance signal source, the video voltage from the instrument can be applied at any desired point in the receiver under test, without appreciable loading of the field-strength meter.

The tuner output provides the video signal at a picture-carrier frequency of 45.75 mc. Accordingly tuner tests of receivers must be made at this frequency, and the test signal is not usable for receivers with a 23-mc i.f. However, most present-day TV receivers utilize the 45.75-mc. i.f., including all color-TV sets on the market.

To make a test of tuner response in a TV receiver, the 300-ohm output cable is plugged into the receptacle on the rear of the field-strength meter. The alligator clips at the other end of the 300-ohm cable are connected to the grid of the first i.f. tube in the receiver, and to receiver ground, usually the chassis, the black clip going to ground. However, if desired, the alligator clips can be connected between cathode and ground of the first i.f. tube in the receiver, since the signal is provided at low impedance.

Either a u.h.f. or a v.h.f. antenna lead-in is connected to the field-strength meter via the front-panel terminals, and the instrument is adjusted for maximum indication on the desired

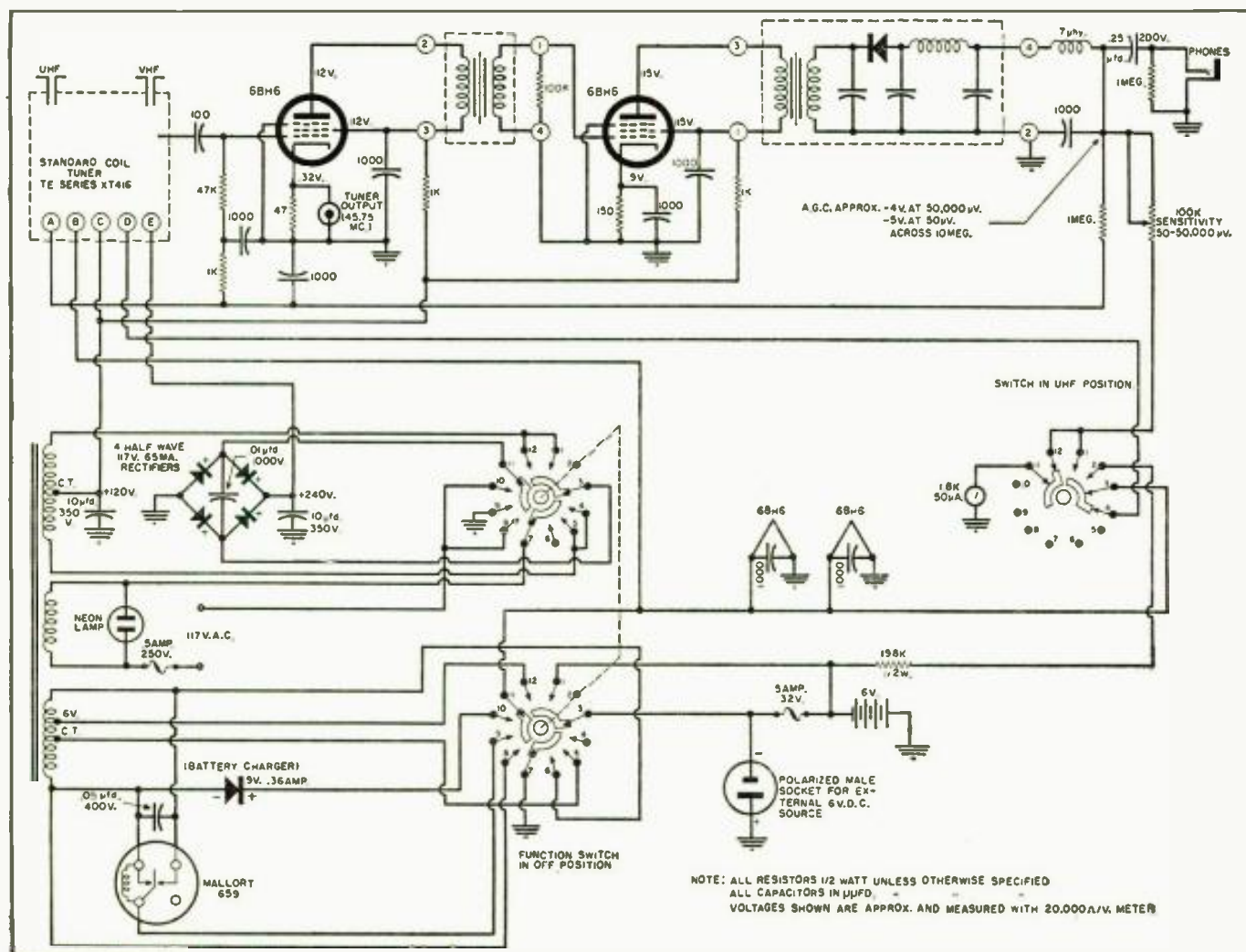
channel. The meter indicates the signal strength in microvolts, and the incoming picture is reproduced on the screen of the receiver picture tube. (Of course, the i.f. and video circuits of the receiver must be operative.)

The contrast of the picture is noted on the screen of the picture tube, and then the lead-in is transferred to the receiver input terminals, with the field-strength meter disconnected from the receiver. As much or slightly more contrast should now be observed on the picture-tube screen. *If a weak picture or no picture is obtained, the front end is undoubtedly defective.*

It will be apparent that the foregoing test serves to answer the question: "Is it the front end, or is the trouble originating in the i.f. or video amplifier?" In case of i.f. or video-amplifier (or picture-tube) trouble, the picture will be weak or absent when the receiver is driven from the field-strength meter.

Technicians in u.h.f. areas will recognize the great value of being able to check out u.h.f. tuners for operation and adequate sensitivity. Tuner repair stations will also find the novel test procedure useful for determining whether or not a repaired tuner has been restored to proper condition. —30—

Fig. 4. Schematic of the Simpson field-strength meter shows low-impedance take-off at cathode of the 1st i.f. Signal taken from this point can be fed to a TV receiver's i.f. strip as a test substitute for the set's own front-end signal.



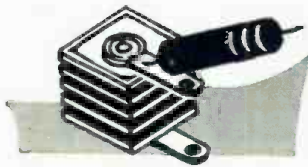


Fig. 1. Feeling selenium rectifiers for excessive heat after a few minutes of operation will often yield a quick clue as to the causes of inadequate "B-plus."

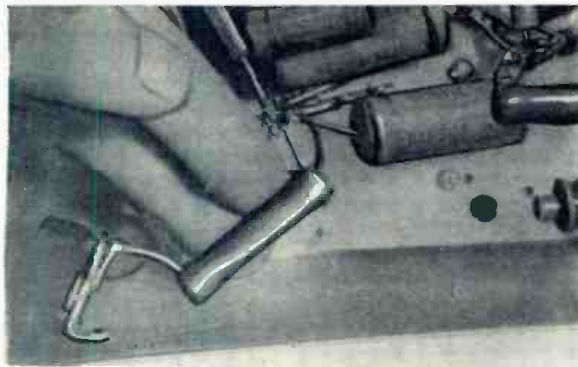


Fig. 2. A cold wirewound resistor may provide a shortcut to an open circuit.

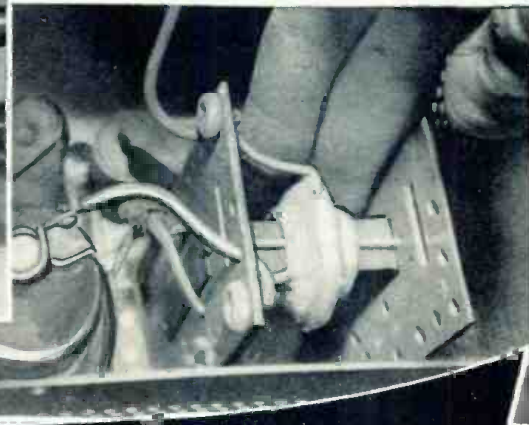
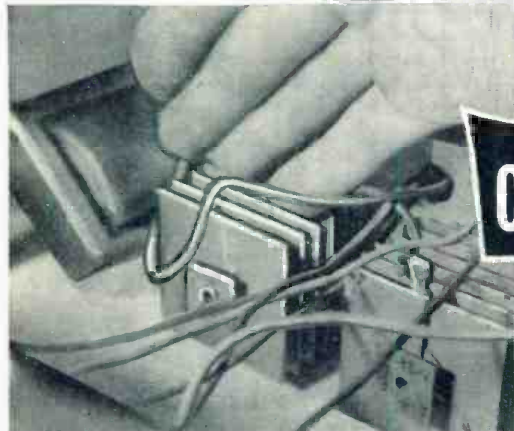


Fig. 3. With the h.v. rectifier out of its socket, the flyback transformer should run cold—unless it is defective.



Common-Sense Troubleshooting

By CHARLES GARRETT

Direct methods "not in the book" sometimes produce quicker results than purely theoretical techniques.

THERE are many talented and experienced service technicians, but some of them do not use their knowledge to the best possible advantage in their work. Among the latter are those who adhere rigidly to a systematic technique for service and parts replacement that is often very elaborate, and may involve all types of instruments before a diagnosis is made.

These first-rate men eventually accomplish what they set out to do—but they can be notoriously slow. To get the most out of his ability, the so-called theory man can benefit by adopting, when the situation warrants it, the direct-approach techniques of the "practical" man. This would tend to complement his systematic approach rather than exclude it.

The Sense of Touch

The presence or absence of heat in certain types of components will often give a clue to their condition more rapidly than the set-up for a test can. Selenium rectifiers, for instance, normally run warm—although not hot, unless the receiver has been in operation for two or three hours. Where operating symptoms (narrow raster, poor focus, etc.) indicate the possibility of an inefficient selenium rectifier, a quick, direct check can be performed as follows:

Allow the receiver to run for three or four minutes. Then turn it off and feel the rectifiers' plates, as shown in Fig. 1. If one or both rectifiers are hot, it or they are faulty; no further proof is needed once the technician familiarizes himself with normal and abnormal rectifier heat. If a short had

existed, the rectifiers would have given off an obvious, unpleasant odor and the set probably would not have been operating at all.

An open wirewound, high-wattage resistor is a common cause of receiver failure. So, before methodically voltage-checking a defective set, *feel* all wirewound resistors (Fig. 2) for the presence of heat after the set has been on for two or three minutes, then turned off. All these resistors get warm with operation. Therefore, if one stays stone cold, it is certainly open or the circuit it feeds is open. A simple ohmmeter check will show which is so.

If, on the other hand, a power resistor gets red hot after only two or three minutes operation, a short is likely to exist in the circuit it feeds. Again, ohmmeter checks will give the technician the final proof. Of course, for safety's sake, turn off the receiver when touching power resistors.

A defective horizontal-output transformer with shorted turns, ordinarily difficult to prove good or bad, often responds to a heat test. If the high voltage winding of the transformer (the rim or outside winding) has shorted turns, as is most often the case in defective horizontal outputs, it will get warm, even hot. Shorted turns act the same as would a shorted secondary winding in drawing excessive current and eventually heating.

With the 1B3 or 1X2 high-voltage rectifier removed, the high-voltage winding draws no current; therefore, it should run cool. That is, unless it is defective. So before going through a complicated process with the flyback tester, try this: Remove the high-

voltage rectifier and allow the set to run for five minutes or so. Then turn it off and feel the outside winding of the transformer, as shown in Fig. 3. If it has heated up, there can be little doubt that it is defective and needs to be replaced.

Often the insulating coating on this winding will soften and, in extreme cases, the winding itself may become soft and pliable when enough shorted turns exist. This simple test alone can often save hours of testing and frustration for a technician.

Elimination and Isolation

How many times has a defect in an intermittent receiver or one that has been unresponsive to all testing procedure finally turned out to be only a tube or combination of two tubes that had been previously checked and found to be good? Even if this happens once, it is too often. This discouraging, time-consuming complication can be prevented by facing the problem head-on in this manner:

When routine testing procedure fails to pinpoint the defect, *temporarily replace every tube in the set*. If the set comes to life or its defective operation ceases, re-install the original tubes, one by one, until the defective one or ones show up. Temporary mass tube replacement is especially recommended when servicing radios where only five or six tubes are involved. Many puzzling cases involving hum, distortion, and fade-outs can be cured quickly this way.

A lighted yet inoperative radio, or the sound section of a TV set showing similar symptoms, can be slow to diagnose if the technician is not certain

in which amplifier, i.f. or a.f., the trouble lies. To be able either to eliminate or to accuse definitely the audio-amplifier section as being at fault is a worthwhile step.

Here is a simple yet accurate check for audio-amplifier activity. Turn the set on and the volume control up to full. Then touch a finger to the center terminal on the volume control. A loud hum will issue from the speaker if the audio stages are normal. This hum may vary from faint to strong, depending on the polarity of the line plug, especially on a.c.-d.c. receivers. Portable radios will not hum on battery, so operate these on a.c. while testing. Practice this procedure on normally operating audio sections until the average hum level is recognized.

The i.f. section of a TV set can be eliminated as containing a defect, or a defective i.f. stage pinpointed, in this manner. Set a modulated AM signal generator to the middle of the i.f. passband, usually 24 or 42 mc., and at maximum output. Then inject this signal into the detector stage at point 1 in Fig. 4. Turn the contrast control to full. Faint horizontal bars should appear on the screen at this point, if the generator output is a tenth of a volt or more and the detector and video amplifier stages are functioning properly.

Then move the generator from plate to grid, plate to grid, through successively numbered points, working back towards the converter. The bars should increase in intensity from plate to grid all the way back to the converter plate, if the i.f. strip is normal. However, if the bars decrease or disappear at any one plate or grid, the defect has been localized to the stage associated with that plate or grid. The change in intensity of the bars as the generator lead is moved progressively back from detector to front end is shown in Fig. 5.

A similar technique can be used on the 455-kc. i.f. system of the conventional radio. Set the generator on maximum modulated output at the radio's i.f. and again work back from the detector diode plates to the converter

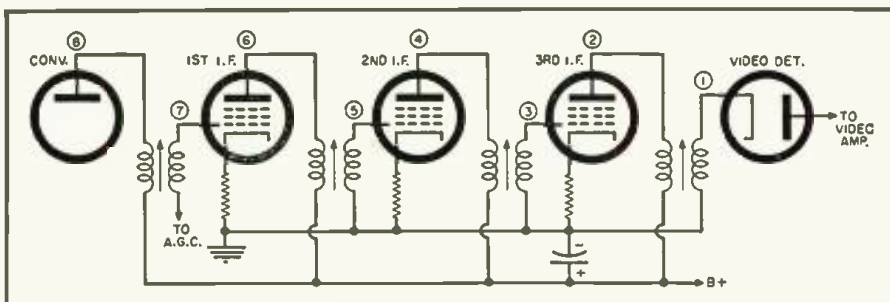


Fig. 4. This 3-stage i.f. plus video detector circuit shows how signal injection can be used, with the picture tube of the TV receiver acting as an indicator, to localize a video-circuit defect to one stage in the video chain. An amplitude-modulated output from a signal generator, adjusted to the i.f. of the receiver under test, is fed first to the input side of the video detector, shown as point 1 above. If vertical-bar output is not noted on the raster, the defect probably lies in the output side of the detector or in the video amplifier stage. If the bars appear on the picture tube, the injected signal is successively moved back, point by point, in the sequence numbered. Intensity of the bars should increase as the signal is moved back another stage, as the photographs of Fig. 5 show. If this increase in amplitude fails to take place, a defective stage is probably responsible. If this stage-by-stage increase in gain is apparent up to the converter plate, trouble is probably in the tuner or antenna circuit. A similar technique may be employed in tracing the circuits of AM radios, except that an audible tone is evident instead of bars.

grid. The signal may be barely audible at the detector but should increase to strong at the i.f. tube grid, if the i.f. is tuned and functioning properly.

Push-pull audio output stages can be given a quick, rough check for distortion or unequal output simply by removing one tube, replacing it, then removing the other tube, while noting the volume level and clarity of each single remaining tube. Volume and tone should be about equal with either tube in the circuit, although less than with both tubes functioning. But in abnormal operation, distortion may clear up when one tube is removed. Or on the other hand, the set may drop drastically in volume if one half of the push-pull circuit is out of order.

If distortion clears up with one tube removed, the distortion originated in or was fed to the speaker through the removed tube. If it drops in volume though, and some distortion results, the remaining tube or circuitry or its signal source is defective. (This check is of no value if one push-pull tube receives its signal from the output of

the other as is done in some older radios.)

Another direct elimination-and-isolation method is useful for the measurement of socket voltages. A voltage discrepancy that is not readily obvious with a tube in its socket may be exposed by removal of the tube. For instance, leaky coupling capacitors may not measurably affect grid voltages due to the counteracting cathode bias and developed negative grid bias. But, with the tube removed, these counteracting voltages disappear, thus allowing a leaky coupler to expose itself by placing thirty or forty, or more, volts positive in the grid circuit.

A circuit in which a leaking coupling capacitor might be concealed by operating action is the multivibrator shown in Fig. 6. The cathode and grid voltages developed during oscillation—the eventual result of action in both triode sections—can easily conspire to mask the fact that capacitor C_1 is leaking. With the tube removed, circuit action ceases. If the static voltage measured at pin 7 is now at all

(Continued on page 146)

Fig. 5A. Signal injected at test point 1 in Fig. 4 will look like this, low in level, with little contrast between light and dark areas.

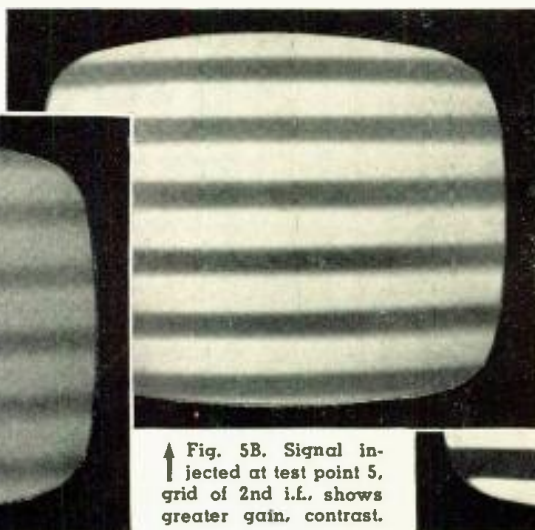
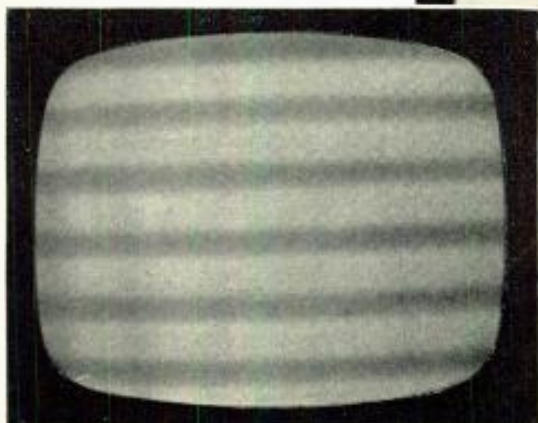


Fig. 5B. Signal injected at test point 5, grid of 2nd i.f., shows greater gain, contrast.

Fig. 5C. Injected at the converter plate, test point 8, the AM i.f. signal shows deepest contrast, evidence of greatest gain in normal operation.





Service

Diversification

By
**WILLIAM
LEONARD**

Handling a wider variety of products helps some service businesses survive; mergers help others.

THE AVERAGE TV service dealer, alternately buoyed by the fall business booms that start with the football season and dejected by the ever-recurrent slumps that are wafted in with the breezes of spring, hopes longingly for some kind of a system that would stabilize his business. Uninformed about and unusually uninterested in the workings of the economic forces that govern his entire life, he is inclined to favor licensing or some other type of activity control as a cure for all of the ills of his business.

The spectacular public acceptance of TV as an indispensable part of our way of life and the multi-million dollar service market it spawned, have led to many uneconomical practices in the entire TV field. Our economic system will tolerate inefficiencies as long as consumption exceeds production, but when production starts to run far ahead of sales, the pressure for economies and improved efficiency grips all levels of an industry in a steadily tightening vise.

During the past year, many TV receiver manufacturers either sold out or abandoned production. Along with that there has been a steady attrition in the number of TV set distributors. More recently the vise started to clamp hard on the service shops that specialize in TV service.

An interesting sidelight on the relative stability of TV service as a business as compared with other widely used electronic products, is reflected in the history of the auto-radio service shops that either stayed away from TV service or got into it and then dropped it.

The shops that stuck with auto-radio service and promoted the new auto electronic accessory products as they were developed have prospered, while their brothers in TV continued to ride the roller coaster of boom and bust.

The advantage of auto-radio service as a business is that it does permit diversification of effort within its own field. As an example, alert auto-radio service dealers found the 110-volt auto battery inverters of interest both to business executives and to many TV set owners. For the former, they provide an opportunity to dictate memos, notes and observations on a tape recorder during the formerly "lost" time used up in driving. Many TV set owners have had the inverters installed in their cars to enable them to use their portable TV's on picnics and for the facility they provide to use regular motorized tools at any place the car is driven.

Many TV service dealers have now reached the conclusion that their businesses are anchored to a foundation of quicksand that is getting more

treacherous every month. While they do not intend to abandon TV service completely, they plan to expand their field of activity either through mergers with other shops or by the addition of other allied services and departments.

An excellent example of service diversification is the establishment in Port Chester, N. Y., operated by William J. Bova and George Catalona. Functioning under the name of *Like-New Appliance & TV Service, Inc.*, the Bova-Catalona team has built a business that handles anything in the home that runs by electricity with the exception of sealed-unit refrigerating devices.

The partners feel that one of the most valuable advantages they have gained from their plan of activity diversification has been its stabilizing effect on the firm's labor needs. Although some types of service fluctuate seasonally, there is never an over-all slack period. While the summer would normally be a slow season for shops that do not handle domestic refrigerators, their organization is kept busy by servicing commercial air conditioning and installing and servicing room air conditioners.

"The biggest advantage of being diversified," said Mr. Bova, "is its value in promoting business. Home owners like to deal with one firm that can service anything in the house. Diversification helps us run our business more efficiently, too, by stabilizing our labor needs and by permitting us to do a large volume of business in a limited area.

"To begin with," continued Mr. Bova, "a customer who phones us for service or who brings in an appliance has probably heard of us from her friends because of the volume of service work we do. We may have repaired different types of appliances for her friends, but every recommendation is effective because we can handle any type of service she may need. That helps to put us in touch with many new customers.

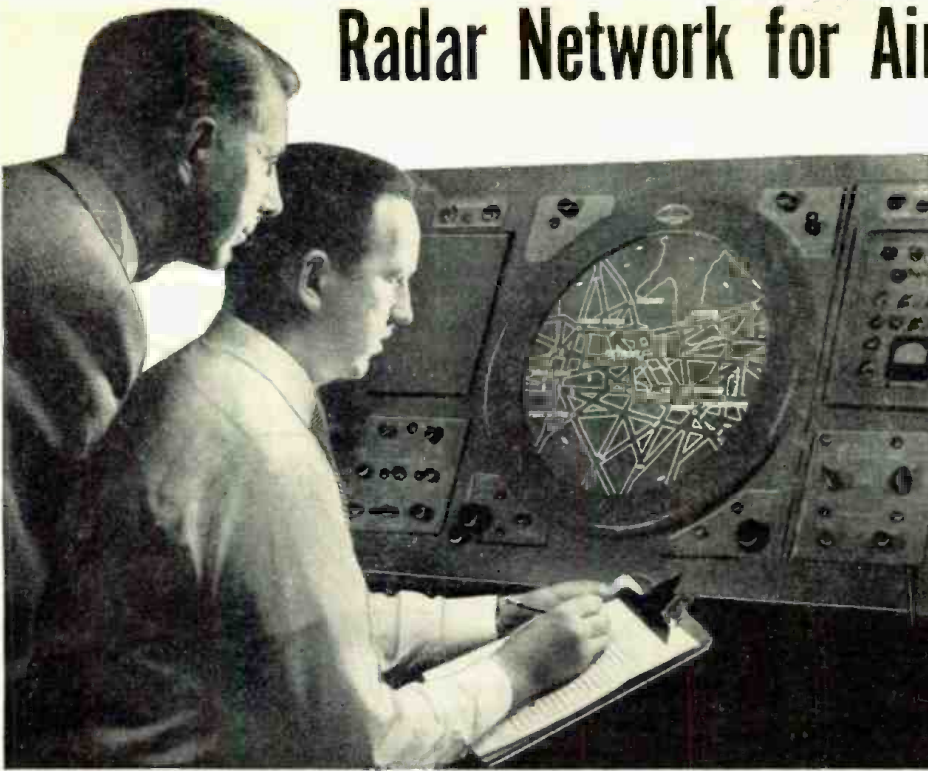
"The fact that we fix everything builds confidence in itself. The customer knows that we will do a careful, fairly priced job on her washer, for instance, because we want to be called later to repair her ironer or electric range."

The firm has been able to get an adequate volume of business from an area within ten miles of the shop. This results in a considerable reduction in travel time and car operating costs for the technicians.

Business Mergers

A recent development in the southwest may prove to serve as the survival pattern for many television service shops. Motivated by the conviction that independent electronic service shops must provide more complete and dependable service to survive, five San Antonio, Texas, service dealers recently merged their businesses to form a \$100,000 service company operation. (Continued on page 196)

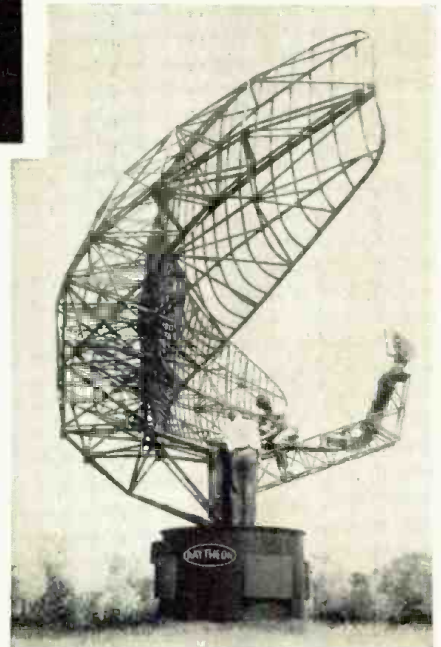
Radar Network for Air Traffic Control



CAA orders 23 long-range radars in biggest single electronics gear purchase.

Radar operators scan skies on long-range radar. Shown on the scope are air lanes connecting cities. Planes appear as light spots. Electronically projected map overlay enables the operator to pinpoint plane's position.

Giant 40-foot search antenna to be used with the new radars. This antenna will be equally effective for jet operation at 35,000 feet and higher or for low-altitude slower aircraft.



A MAJOR step in a sweeping plan for improvement of the nation's air traffic control system was taken recently, with announcement by the Civil Aeronautics Administration of an order for 23 long-range radars, biggest single purchase of electronic equipment in the agency's history.

The radars are the heart of a CAA plan announced last April by Secretary of Commerce Sinclair Weeks. The plan is designed to handle a fourfold increase in U. S. air traffic with minimum delay and maximum safety. The new radars will help CAA controllers accomplish this by scanning the skies for all aircraft up to 200 miles away, depending on size and altitude.

Raytheon Manufacturing Co. of Waltham, Mass., will design and build the equipment, which will cost approximately \$9,000,000. Deliveries will begin this summer.

The 23 radars will be part of an expanding coast-to-coast traffic control network of more than 70 civil and military radar installations. The network will give controllers a picture of aircraft from 15,000 to 70,000 feet in virtually all the U. S. airspace, and of aircraft at lower altitudes on densely traveled routes. Thus, radar will serve to track the civil and military jets which move at 600 miles an hour or more in the higher altitudes, and the conventional aircraft traffic using the lower altitudes.

Each radar uses a large 40-foot antenna, and effectively covers more than 125,000 square miles of area. A single set will be able to feed up to 15 different monitor screens simultaneously, so that each controller on duty in a CAA center can have a picture of traffic movement. At present, with the exception of the radar-equipped New York and Washington

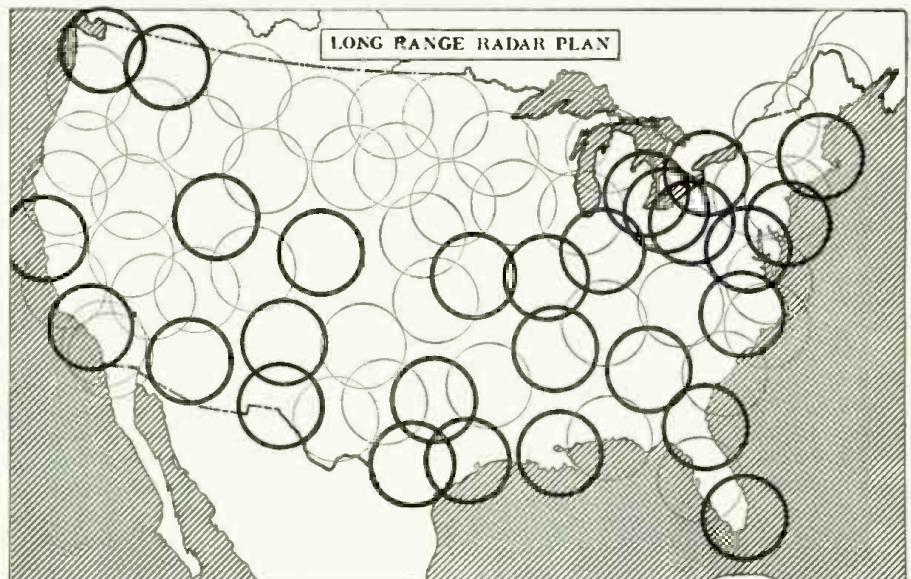
centers, CAA controllers depend on position reports radioed in by pilots en route. CAA also has radar for surveillance around 34 airports, which will continue to serve traffic within a range up to 30 miles.

The new equipment employs either linear or circular polarization of the radar signal so as to minimize the effect of rain or other bad weather interference. Another feature is an improved moving target indication arrangement that removes radar echoes from fixed objects, thereby allowing signals from moving aircraft to show up clearly.

Chances of breakdown are reduced because of the use of dual controls and functioning parts, allowing uninterrupted operations.

-30-

New radars are to be installed at 23 of the 28 heavily circled areas shown below. Remaining 5 areas will use military gear. Light circles show future coverage.



A Compact 6 Watt Power Amplifier

By E. TAYLOR HORTON

This simple miniature audio amplifier is small enough to be tucked out of sight. Two 2" by 4" by 5" chassis used.

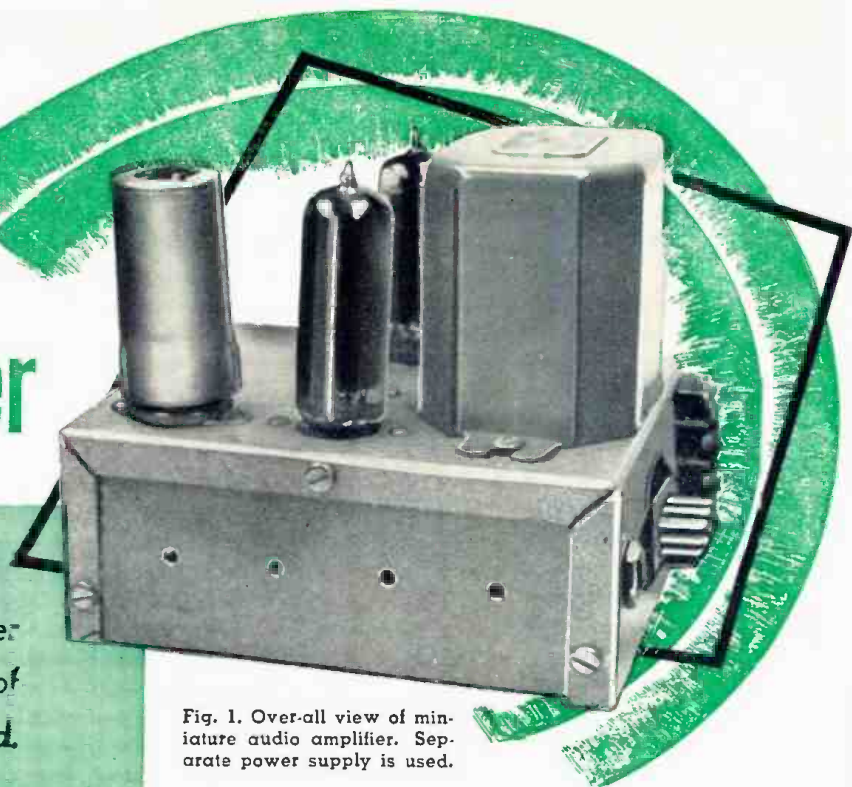


Fig. 1. Over-all view of miniature audio amplifier. Separate power supply is used.

WHEN space and cost limitations of an audio system dictate the use of a small speaker and enclosure, these same limitations also dictate the use of a small, low-cost amplifier. As long as the amplifier distortion can be kept to a negligible amount at normal listening level, the maximum power capabilities of the amplifier are unimportant for non-critical use. This unit was designed to produce a practical compromise among the often conflicting factors of size, cost, frequency response, distortion, and simplicity.

The amplifier is small enough to be tucked away out of sight in a bookcase or TV cabinet, and yet has enough power output to adequately drive a small, good-quality speaker. It is well suited for use with an external speaker to improve the audio quality of a radio or TV set or as a tape recorder playback amplifier.

The amplifier is built on a 2" x 4" x 5" chassis and is only 4½" high over-all. The power supply is mounted on a separate chassis to make it easier to install in cramped quarters. Its chassis also measures 2" x 4" x 5" and stands 5" high. Both chassis were made from a 3" x 4" x 5" aluminum case, with one inch cut off the 3" side. A series of ventilating holes were drilled in the bottom section of both chassis and ½" rubber feet mounted on each corner. As the bottom sections are not needed for shielding, but are used only to improve the appearance of the equipment, they may be eliminated if desired.

The schematic diagram of the two units is shown in Fig. 3. The amplifier uses only three tubes and a minimum of other parts. The first tube, a 6AN8, is a combination pentode and triode. The pentode section is used as a con-

ventional voltage amplifier direct-coupled to the triode section which is connected as a split-load phase inverter. The power output stage uses two 6CM6's in push-pull with screen feedback being provided from taps on the output transformer. The 10,000-ohm terminals of the transformer are connected to the plates and the 4000-ohm taps connect to the screens. This type of operation permits the tubes to be biased so as to draw a total cathode current of only 44 ma. while delivering six watts output at 1.6% distortion. The gain of the stage is greater than with triode operation and the distortion is less than if the tubes were used as pentodes. This low current drain allows the use of a small power transformer with the resulting saving in size and cost. Additional voltage feedback is provided from the voice coil winding of the output transformer to the cathode of the first stage. The power supply uses a 5Y3 in the usual full-wave rectifier circuit followed by a two-section RC filter.

The amplifier is very easy to assemble and makes a good "first project" for the novice builder. By using the parts specified, hole drilling on the chassis is kept to a minimum. The parts layout of the amplifier can be seen in Figs. 1 and 2. The underside of the chassis is not particularly crowded and a smaller chassis could be used if necessary. When wiring the amplifier it is advisable to keep the input and output sections well separated, and to run the a.c. heater leads as far from the input jack and pin 8 of the 6AN8 as possible.

All grounds can be made directly to the chassis at any convenient point. Near the 6AN8 socket, a 2-point tie

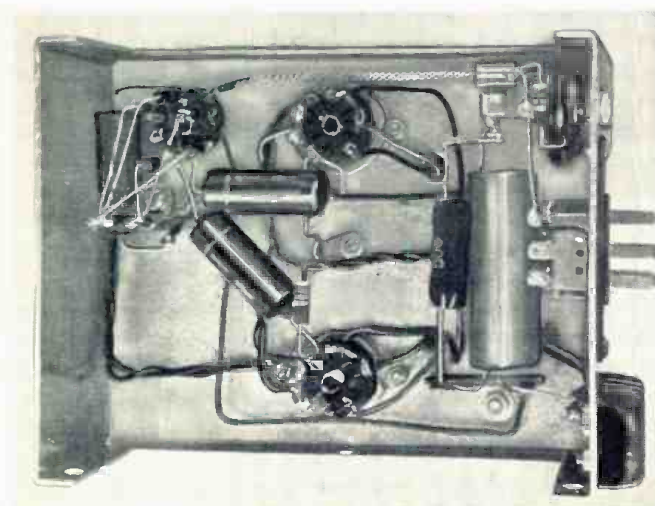


Fig. 2. Underside of power amplifier showing extreme simplicity of wiring and construction. Input jack, 6-contact power plug, and terminal strip for loudspeaker connection are at right.

strip is mounted above the chassis by a 1/2" brass spacer. One tie point is connected to ground and the other to terminal 2 of the Cinch-Jones male power plug. Resistors R_2 , R_3 , R_4 , R_5 , and R_6 are connected between their respective socket pins and to the two tie points, as indicated. In order to maintain a good balance in the phase inverter, R_5 and R_6 should be closely matched in value. These resistors can either be purchased as a matched pair or several resistors can be checked with an ohmmeter and two, whose value is as close as possible to the required 47,000 ohms, selected.

If R_1 is used, it is mounted directly on the input jack which is wired to pin 8 of the 6AN8 by a short length of shielded wire. C_1 is placed against the back drop of the chassis and connected between pin 7 and a soldering lug placed under the 1/2" brass spacer. The interstage coupling capacitors, C_2 and C_3 , are connected between the socket pins of the 6AN8 and the 6CM6's. R_7 and R_8 connect between the grid pins of the 6CM6's and a soldering lug fastened to the chassis between the two tube sockets. Another 2-point tie strip is mounted near the output terminal block. One tie point is connected to pin 9 of the 6AN8, and R_{10} , the feedback resistor, is connected between this point and the 8-ohm terminal of the output block. The other tie point is connected to pin 7 of both 6CM6's. and R_9 and C_4 are wired between this point and another soldering lug mounted on the chassis near the input jack.

The output transformer is mounted directly on the chassis, as shown, and three 1/4" holes are drilled through the chassis to pass the leads from the transformer terminals to the tubes and to the output terminal block.

When wiring the amplifier it is very important that the connections to the

(Continued on page 161)

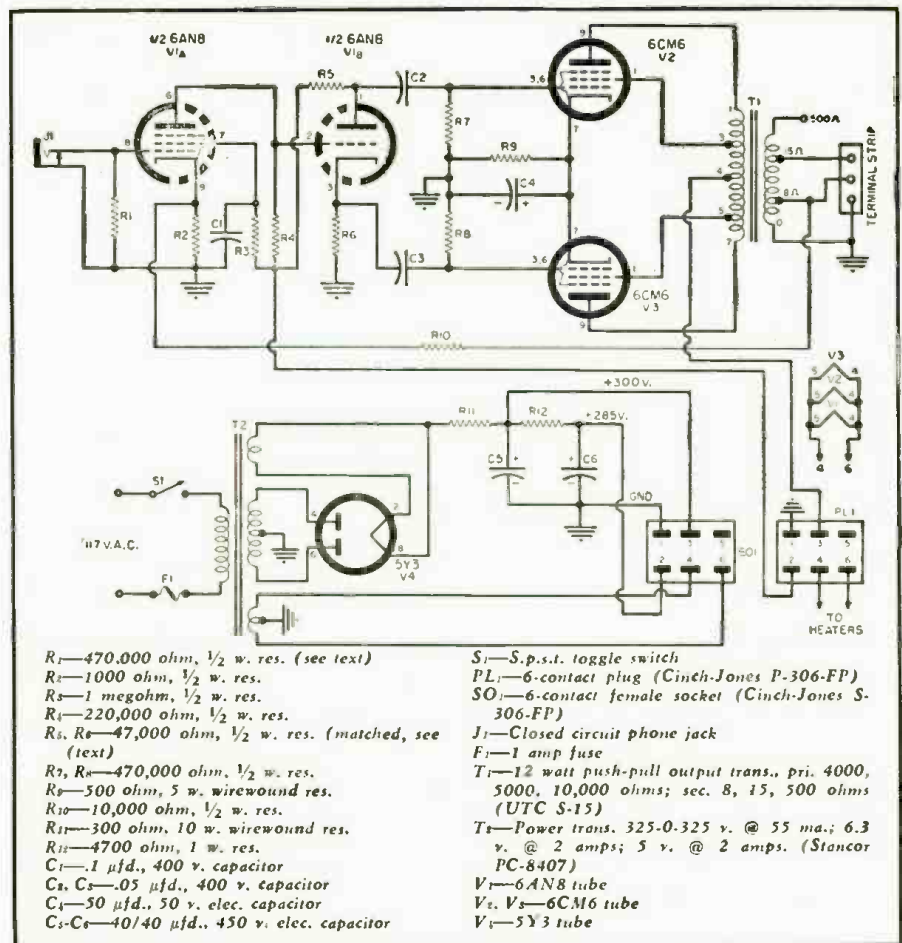


Fig. 3. Complete schematic diagram of audio amplifier and separate power supply.

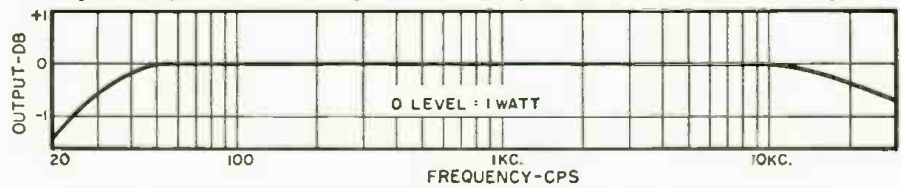
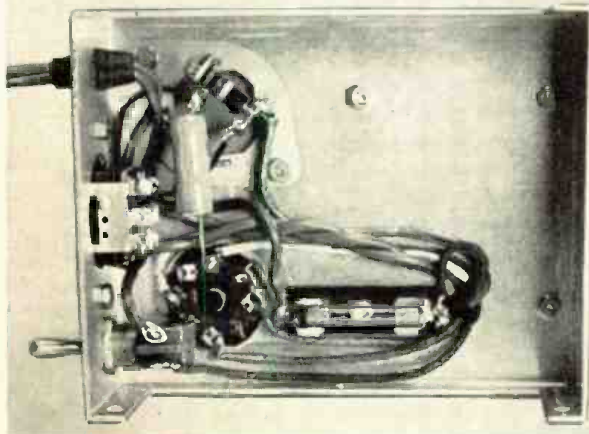


Fig. 4. Over-all frequency response of power amplifier. Zero level is at 1 watt.

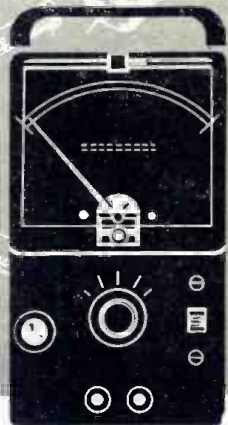
Fig. 6. View of power supply required for miniature, high quality audio power amplifier. Power transformer, rectifier tube, electrolytic capacitor, output socket, and switch can be seen.



Fig. 5. Underside of separate power supply is shown below. Two filter resistors and protective fuse are clearly visible.



Component Checking



A discussion of various ways that circuit components in radio and audio equipment can be checked without trouble.

SOMETIMES the simpler things one encounters in radio and audio work are apt to get overlooked. For example, it would seem to be quite an easy matter to check the inductance of a smoothing choke or the capacitance of an electrolytic capacitor, with the correct polarizing current or voltage. However, when one looks around to find a test instrument to make the measurement, it just isn't readily available, so we are virtually forced into the routine of taking things for granted.

If we wish to check as to whether a certain component is functioning correctly or not, the only available method seems to be by substitution, using another component of the same type. Often this proves to be somewhat unsatisfactory, because the results can be inconclusive. We really need to know how to check the various fundamental components used in radio: resistance, inductance, and capacitance, to varying degrees of accuracy, according to their purpose.

Resistance Values

The simplest method of resistance checking is by means of a simple ohmmeter, either an instrument built specifically for this purpose or an ohmmeter range on a volt-ohm-milliammeter. Accuracy of this method of measuring resistance rarely exceeds 10% and may not even be as good as this.

Assuming that the accuracy of the moving coil meter used for the instrument is $\pm 2\%$ and that the resistors used in the instrument are accurate to $\pm 1\%$, the accuracy of the instrument as a perfect comparator between the internal and external resistances cannot be better than $\pm 1\%$. And the accuracy of comparison is only to within $\pm 2\%$ of the full-scale current reading on the scale. If the scale reading, on a voltage or current scale, is compared with the reading on the ohms scale, it will be found that an error representing 2% of full scale in voltage or current reading may amount to an 8% error in resistance value. This is at the point of maximum accuracy of comparison, between the external resistance being measured and the internal resistance of the instrument.

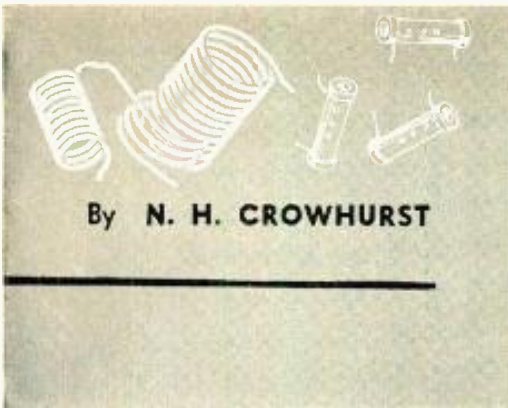
Thus it is seen that the best accuracy obtainable using an instrument with a $\pm 2\%$ movement and $\pm 1\%$ internal resistance gives a guaranteed accuracy at center scale reading of 9%. At readings between one-third and 3 times the resistance value, which is the range one might expect to use before switching to the next scale, the accuracy can reasonably be expected to stay within 10%. With an instrument using lower accuracy components than those used for illustration, the accuracy of the final reading in ohms will be considerably poorer than 10%.

From this it will be evident that an ohmmeter can only be used to make a rough check as to whether a resistance is within the preferred value range for which it is color coded—if it is of a $\pm 10\%$ or higher tolerance rating. To check that the resistance is within $\pm 10\%$ of its rated value, the result is a little doubtful and it is certainly impossible to rely on an ohmmeter reading to check to a tolerance of $\pm 5\%$ or closer.

Although the ohmmeter readings cannot be trusted for checking to close tolerances, it is possible to use an ohmmeter to check for reasonably good matching between pairs of resistors, if this happens to be the requirement rather than close precision in actual value.

As an example, in many push-pull amplifiers the resistors responsible for controlling the gain in the two halves of the push-pull arrangement must be closely matched to ensure balance. Production values may be specified to 5% or even closer tolerances, to avoid the necessity of having to select matched pairs, but the essential feature is that the value of the two corresponding resistors shall be within a close tolerance of one another. It will not necessarily matter if both of them are, say, 10% or 15% from their nominal rating, as long as they are within 5% of each other. This the ohmmeter is reasonably capable of checking, because it is quite possible to read an ohmmeter scale to within 5%. Since the question as to whether the reading is within 5% of its actual value is unimportant in this particular application, the significance of the reading does not matter as much as whether the two resistors which should be matched give readings within 5% of one another.

For some applications, however, such as calibrated attenuators or instruments for use in radio it is necessary to check resistor values to closer limits such as 5%, 2%, or even 1%, as the case may require. In these circumstances it is important that the value shall really be within the specified percentage of its rated value. The only method of making a measurement that is satisfactory for this purpose is to use a Wheatstone type bridge, using calibrated elements whose accuracy is



better than the required component accuracy.

For most radio purposes the *Leeds & Northrup* bridge used for telephone line work is quite accurate enough. In using a bridge there are two things that control the accuracy of the reading obtained: (1) the accuracy of the resistance elements of the bridge itself, and careful attention to see that contact resistance does not contribute an appreciable fraction under any circumstances; and (2) the sensitivity of the null detector.

This second cause of inaccurate results can be checked by unbalancing the bridge by a known percentage to see that an adequate off-balance reading is obtained. Suppose, for example, the value required is 120,000 ohms, $\pm 5\%$. Having balanced the bridge and obtained a null at, say, 120,000 ohms, the resistance in the calibrated arm should be altered by 5%, which represents a change of 6000 ohms.

If clicking in 6000 ohms additional in the calibrated arm shows appreciable deflection, then the reading may be regarded as accurate; but if the addition of 6000 ohms does not produce noticeable deflection from balance on the null detector, the result is not reliable. To improve its reliability one can either use a larger battery voltage or source of supply to the bridge, or else get a more sensitive null indicator.

Before leaving this discussion of resistance values it should perhaps be emphasized that it is not wise to put absolute trust in the color coding on a resistor. Occasionally even the best resistor will be found incorrectly color coded. If the error happens to be in the third color of the code, then the discrepancy in resistance value will be a matter of shifting the decimal point which can be quite serious. Also with some sets of coding colors the difference between some of the colors is somewhat difficult to determine, especially after the component has aged. For example, orange and brown can get to look quite alike.

Usually the first and second colors in the code can be identified by the combination used, from the recognized preferred value range. If the first color is blue, representing 6, the second color will most likely be either red, representing 2, or gray, representing

8, because 62 and 68 are the preferred values in the 60 to 70 range. But there is no such ready clue as to the likely color of the third band: it could just as easily be brown or orange. Thus a resistor in which this color looks at all doubtful could be either 620 ohms or 62,000 ohms, which is a considerable difference!

This is where an ohmmeter check can easily determine which of the two values is correct.

Inductance

Turning now to various kinds of inductance: the measurement of components not intended for the passage of d.c. and without iron cores is a fairly simple matter, with the aid of a conventional inductance bridge. Using such a bridge, employing either the Hay or Maxwell configuration (see Fig. 1), the inductance can be measured at a frequency suitable for the purpose, with a method quite similar to the operation of a bridge for measuring resistance.

The principal difference is that two kinds of adjustment are usually necessary to achieve null, because of the necessity for balancing the bridge in both amplitude and phase. This enables the bridge to give a reading of both inductance value and "Q" or loss factor. Bridges of this type are clearly marked to indicate the correct setting of the controls for making each kind of measurement.

There is usually no difficulty in achieving a null with the air-core type of coil, but if the inductance employs any kind of core, the null may not be quite as definitive, because of the distortion of the injected test signal caused by the core. Also, if the generator signal itself has any appreciable harmonic content, a Hay bridge will never give a balance at both fundamental and harmonics at the same setting. On the other hand, with an inductance where the only loss is due to its resistance, such as occurs in an air-core coil, the Maxwell bridge will give a fairly satisfactory balance for both fundamental and the lower harmonic frequencies at the same setting.

When measuring an inductor that employs any kind of core to increase the permeability, the magnetizing current is liable to distort so the inductor itself will generate some harmonics not present in the input from the generator. When the bridge is balanced to the fundamental generator input, there will be a residual harmonic present at the null point, generated by the inductor itself.

This is a good reason for using earphones if the generator frequency is in the audio range. Otherwise an oscilloscope with amplifier may be used as a null detector. It is then possible, listening to the tone or looking at the trace, to determine when the fundamental is balanced and the residue consists of harmonics.

But the conventional type of bridge is only suitable for measuring inductances where there is no polarizing

current. The usual variety of smoothing filter choke has to provide a specified inductance when polarizing current is flowing and the inductance in the absence of such polarizing current will be considerably higher than the rated inductance of the choke with polarizing current. Unfortunately there is no simple fixed relationship between these two values.

If the choke has been designed to provide its maximum inductance at the polarizing current for which it is designed, the air gap will be adjusted so that, at this value of polarizing current, either reduction or increase of the air gap would result in a reduction of inductance value. However, in the absence of polarizing current, increasing the air gap will *always* reduce inductance value, while reducing the air gap will *always* increase inductance value.

From this simple fact it is evident that measuring an inductance with no polarizing current flowing is no criterion of its performance with polarizing current. It can, of course, provide a check that the inductance is not

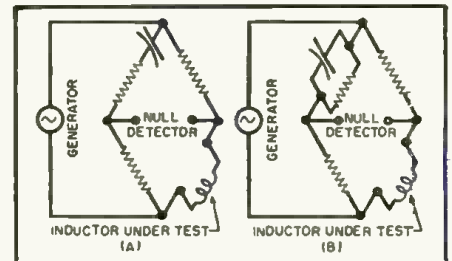


Fig. 1. Bridge configurations for measuring inductance. (A) the "Hay" bridge. (B) the "Maxwell" bridge. Relative advantages of each type are discussed in the article.

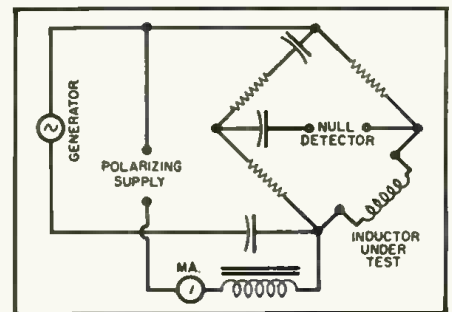
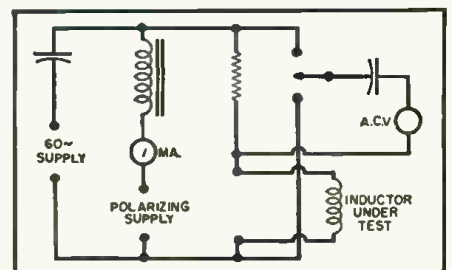


Fig. 2. Modification of the "Hay" bridge to enable it to measure inductance with polarizing current flowing. Care is necessary not to exceed the dissipation rating of the various bridge elements. See text.

Fig. 3. A simple inductance checker circuit for determining inductance with the polarizing current flowing in the component.



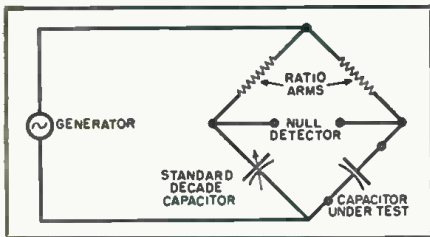


Fig. 4. The "Drysedale" bridge which is used for measuring capacitance. Refer to text.

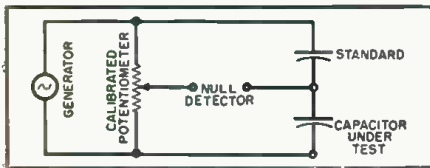


Fig. 5. A simple bridge for capacitor checking that forms the basis of a number of commercial units on the market. The null detector is usually a "magic eye" tube.

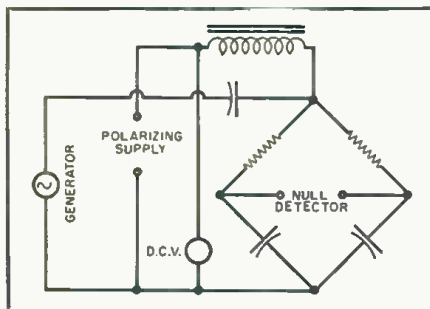


Fig. 6. Modification of a "Drysedale" bridge to permit the measurement of electrolytic capacitors with polarizing voltage applied.

completely missing, due to short-circuited turns, in which case the inductance might not even be adequate without polarizing current flowing. But the fact that the inductance may measure twice its required value with polarizing current is no evidence that the choke will give its rated value with polarizing current.

Fortunately, with filter chokes of this nature close tolerances are not too important. Usually a compliance with a minimum inductance value will suffice.

It is sometimes possible to use a modified Hay bridge, as shown at Fig. 2, to inject a polarizing current so as to measure the inductance with the polarizing current flowing. But this can be a dangerous procedure, because the polarizing current may exceed the wattage rating of some of the internal components of the bridge and cause permanent injury to it. It is, therefore, better to devise a simple checking arrangement, as shown schematically in Fig. 3.

This does not employ a bridge method, but checks the inductance by injecting a known frequency and comparing the a.c. voltage developed across the inductor with that across the resistor in series with it. The relation between the a.c. components of voltage developed will enable the approximate inductance value to be calculated. This does not take into account the effect of the inductor dis-

torting the waveform of the a.c. signal component, which invariably occurs in this type of inductor and is, in fact, another reason why any attempt to produce a precise figure of inductance will be somewhat meaningless. A rough check of this nature is quite adequate for the purpose.

If 60 cycles is the supply frequency for the a.c. component, dividing the calculated impedance of the inductor by 377 will give the inductance value. For example, suppose the series resistor used is 100 ohms (carefully checked in value), and the a.c. voltages measured across the resistor and inductor are 2 and 30 volts, respectively: then the impedance of the inductor at 60 cycles is 1500 ohms, representing approximately 4 henrys.

Capacitance

For measuring all except electrolytic capacitors there are two methods, which correspond in relative accuracy with the ohmmeter and bridge methods used for measuring resistance.

The Drysedale bridge (see Fig. 4) is a modified Wheatstone bridge, in which resistance arms are used in the ratio positions, while a calibrated decade capacitor is substituted for the variable standard arm. This type of instrument can give capacitance results comparable to those obtained with the Wheatstone or *Leeds & Northrup* bridge for resistance, but its use involves careful adjustment of a number of controls until a null is achieved.

The alternative method of capacitance measurement also uses a bridge, but one in which the null is much more quickly achieved. In this bridge (see Fig. 5) a standard capacitor is used in one arm, the unknown capacitor in another arm, and a single potentiometer-type resistance for the other two arms. This resistance is calibrated on the basis of the ratio between the unknown and standard capacitors necessary to achieve null.

With this type of bridge the unknown capacitor is connected across the terminals of the bridge and the one dial turned until null is indicated. The capacitance value is then read off the dial. The accuracy of this type of instrument is usually comparable to that of an ohmmeter, depending upon the accuracy with which the potentiometer type resistance has been calibrated.

Neither of these methods is really satisfactory for the measurement of

electrolytics. This can better be understood by discussing a little further the behavior of electrolytic capacitors under different conditions.

In the first place, electrolytic capacitors freshly formed ready for use, have a dielectric film on the active plate of the correct thickness for the working voltage. Under this condition the capacitor should have its rated capacitance.

But if the capacitor is operated consistently at a lower polarizing voltage, the thickness of the formed film will gradually deteriorate with the result that the effective capacitance will increase somewhat. This is not necessarily detrimental to the performance of the capacitor, provided it is not subsequently required for service at its nominal working voltage.

In much the same way electrolytic capacitors kept in storage also show a deterioration in the dielectric film resulting in an increase in effective capacitance. This means if a six-month-old capacitor is taken from the shelf and measured on a regular capacitance bridge, without applying the necessary polarizing, it will probably show a value considerably in excess of its nominal value. However, it will not be satisfactory for operation until the electrolytic film has been formed up to the requisite thickness for its working voltage.

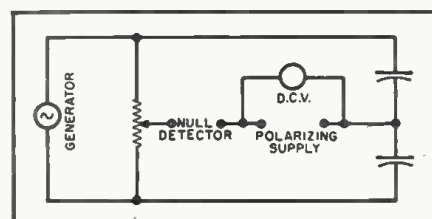
This will have to be done with the aid of a limiting resistor connected in series with the capacitor to limit the polarizing current while the film is forming. Only when the film has formed up so the voltage appearing across the capacitor is at its working value without excessive leakage current can its capacitance be measured to give a reliable indication of its operating condition.

Also, if the capacitor is to be installed in a piece of equipment for operation at its nominal working voltage, it is vital that this reforming of the capacitor be performed before installation, so the capacitor does not take an abnormally high leakage current when the power is switched on and possibly destroy itself before it has had a chance to become correctly reformed.

The correct measurement of electrolytic capacitors with polarizing voltage applied can be undertaken with either type of bridge, modified to a certain extent, as shown in the schematics of Figs. 6 and 7. If the actual capacitance value of an electrolytic capacitor is not vital, which often is the case, then all that is necessary in installing a new one is to ensure that it is correctly formed to its working voltage before connecting it in. This may be done with the aid of the circuit shown in Fig. 8, which consists of a high resistance feeding the capacitor with a voltmeter across it to indicate when working voltage has been reached. The resistor limits the leakage current through the capacitor to well within the maximum leakage

(Continued on page 185)

Fig. 7. Modification of the simple bridge of Fig. 5 to enable polarizing voltage to be applied to the electrolytic capacitors.

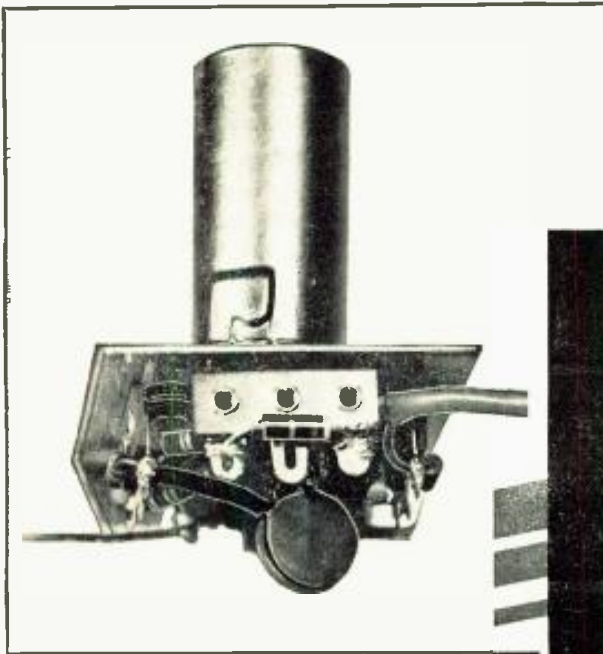


A Simplified Automatic Tone Compensator

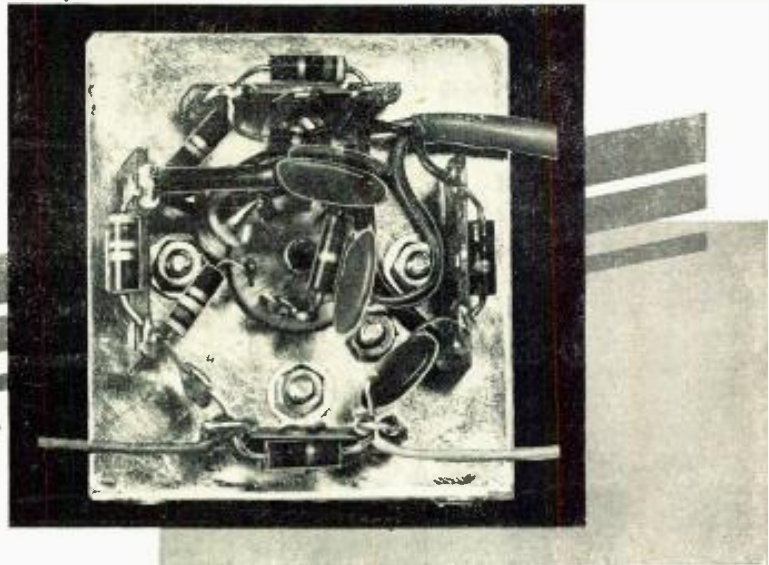
By

ED. C. MILLER

Tech. Dir., Inland Broadcast Co.



Two views of the automatic tone compensator. It is built on a small sub-chassis which can be put into amplifier chassis.



Details on a one-tube device which automatically boosts bass response at low audio levels. It is easy to build.

SINCE the appearance of the author's previous article on "The Auto-Tone" (RADIO & TELEVISION NEWS, April, 1954, page 54), many letters have been received asking for information on a less critical and more easily built device to provide automatic bass boost at low volume levels. This article covers such a circuit, reduced to its simplest practical form.

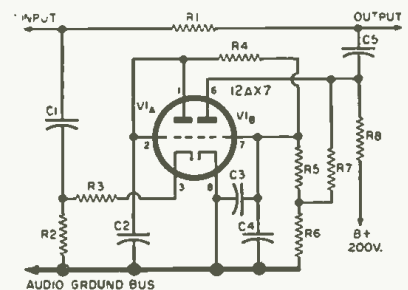
The unit shown in the photographs and schematically in Fig. 1 differs from the previous automatic tone control in many ways besides being of much simpler construction. Most significant, probably, is that because the control tube uses bias increasing in a negative direction with the application of signal, the control capacitor is in series with the plate impedance of the control tube, rather than in parallel. Fig. 2 is the equivalent circuit, with R_b inserted in place of the plate resistance of the control tube. If capacitor C in Fig. 2 is selected so that its reactance is large in relation to R_b at some frequency under consideration, changing the value of R_b will have little or no effect on the output. But if the reactance of C is small in relation to R_b , and R_b is at all times less than R_a , then changing the value of R_b will have a marked effect on the

output at that frequency. As the reactance of a capacitor increases with a decrease in frequency, maximum control will take place at the higher frequencies.

In effect, what we have is a volume expander that for a given range of input levels provides more expansion at the higher frequencies than at the bass frequencies. By proper selection of component values, a satisfactory expansion rate can be had that will be the same rate at all frequencies above about 500 cycles, with as much as a 2 or 3 to 1 reduction in rate at 50 cycles.

At first it may seem improper to use volume expansion as a type of control. Actually, it is one of two choices: 1. linear reproduction of the middle and high range of audio, with compression of the bass frequencies at higher volume levels; or 2. linear reproduction of a particular bass frequency with expansion of the middle and high frequencies. The use of the latter method adds about 15 db to the dynamic range of recording, if it is used with commercial pressings, and a similar amount of dynamic range increase in radio reception also (to a somewhat lesser extent, due to the sharp knee

(Continued on page 160)



- R_1 —2.2 megohm, $\frac{1}{2}$ w. res.
- R_2, R_3 —470,000 ohm, $\frac{1}{2}$ w. res.
- R_4, R_8 —1 megohm, $\frac{1}{2}$ w. res.
- R_5, R_7 —4.7 megohm, $\frac{1}{2}$ w. res.
- R_6 —15,000 ohm, $\frac{1}{2}$ w. res.
- C_1 —500 μ fd., 400 v. capacitor
- C_2, C_3 —.02 μ fd., 400 v. capacitor
- C_4 —.005 μ fd., 400 v. capacitor
- V_1 —12AX7 tube

Fig. 1. Complete schematic of the automatic tone compensator. Parts are standard.

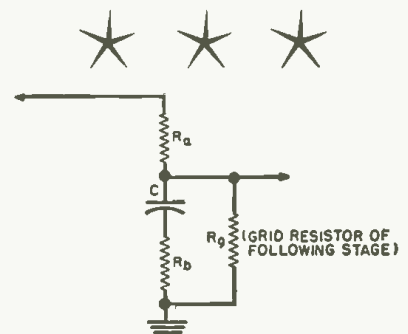
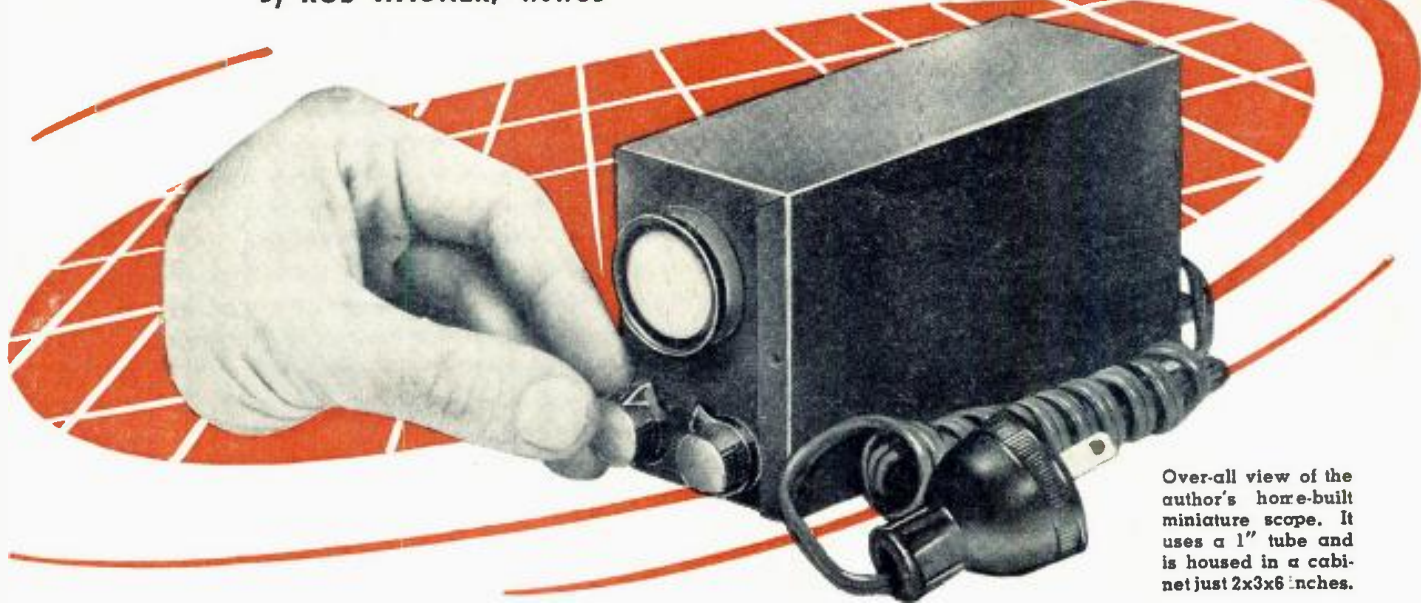


Fig. 2. Equivalent circuit to that of Fig. 1.

Miniature Scope for the Hamshack

By **ROB WAGNER, W6WGD**



Over-all view of the author's home-built miniature scope. It uses a 1" tube and is housed in a cabinet just 2x3x6 inches.

Construction details on compact unit for checking AM phone transmitters. The power supply is included on same chassis.

IF YOU'RE a ham operator on one of the phone bands, there are probably many times when the other fellow tells you the modulation is too low, too high, or perhaps plain lousy! Unless you have an instrument such as the miniature scope to be described on hand, there's no way to argue with the fellow. To be assured of a good audio report, adjust your transmitter with the help of this simple oscilloscope, which uses a minimum of parts and the one-inch 913 tube, or any of the other small scope tubes presently available. Then

it will be constantly apparent that the rig is correctly adjusted, not only for satisfactory amplitude, but with respect to proper operation of the transmitter itself.

Electronic Description

Fig. 1 is the schematic diagram of the instrument. Simple, isn't it? By limiting the scope's function to trapezoidal (triangular) presentation, a minimum of parts is required.

The one-inch 913 makes miniaturized construction possible, although the

two-inch 902 or 2AP1A tubes are electrically interchangeable with the 913.

The 913 plugs into a standard octal socket. The 6.3 volts a.c. come from T_1 , a small 0.6 ampere transformer, obtained from your junk box or supply house. Because oscilloscopes require extremely small current at relatively high voltage, there's no necessity for a power transformer in this circuit. The circuit utilizes a voltage tripler power supply operating directly from the 117-volt a.c. line. It delivers about 325 volts d.c., allowing an adequately bright screen presentation.

SR_1 , SR_2 , and SR_3 are small selenium rectifiers visible in Figs. 2 and 3. In the author's model, IRC #U15HM miniature rectifiers are employed; their ratings are 360 volts peak at 1.5 milliamperes. These units are more difficult to obtain than their slightly larger counterparts specified in the parts list.

Capacitors C_1 , C_2 , and C_3 , in conjunction with the rectifiers, form the high-voltage, low-current internal supply.

Note that the positive voltage output grounds to the chassis, because the scope cathode operates at negative potential with respect to the other elements. These, the control anode and focusing anode, are controlled with less negative amounts of potential derived from the voltage divider, R_1 , R_2 , and R_3 .

R_1 , a 150,000-ohm, ½-watt resistor, forms the divider's fixed element. The 50,000-ohm potentiometer, R_2 , serves as the focus control, and spot intensity is varied by the second 50,000-ohm pot, R_3 . Very little current flows through the voltage divider allowing R_2 and R_3

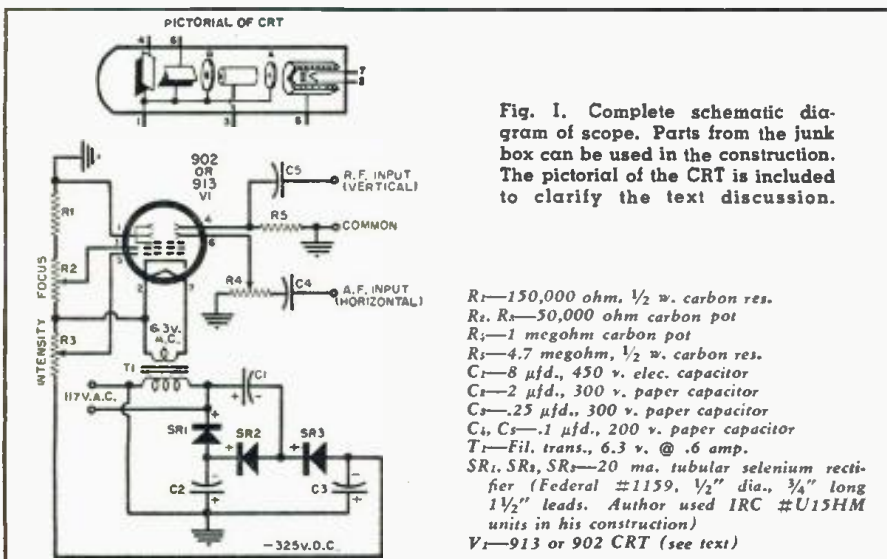


Fig. 1. Complete schematic diagram of scope. Parts from the junk box can be used in the construction. The pictorial of the CRT is included to clarify the text discussion.

- R_1 —150,000 ohm, ½ w. carbon res.
- R_2 , R_3 —50,000 ohm carbon pot
- R_4 —1 megohm carbon pot
- R_5 —4.7 megohm, ½ w. carbon res.
- C_1 —8 μ d., 450 v. elec. capacitor
- C_2 —2 μ d., 300 v. paper capacitor
- C_3 —25 μ d., 300 v. paper capacitor
- C_4 , C_5 —1 μ d., 200 v. paper capacitor
- T_1 —Fil. trans., 6.3 v. @ .6 amp.
- SR_1 , SR_2 , SR_3 —20 ma. tubular selenium rectifier (Federal #1159, ½" dia., ¼" long 1½" leads. Author used IRC #U15HM units in his construction)
- V_1 —913 or 902 CRT (see text)

to be midget carbon pots, the surplus items visible in Fig. 3.

R_1 is a 1-megohm carbon pot used to vary the amount of external audio voltage applied to the horizontal deflection plate. The blocking capacitor, C_1 , isolates the modulator's high voltage d.c., and C_2 prevents the r.f. pick-up link from being a d.c. closed circuit. R_2 maintains the vertical deflecting plate at the same d.c. potential as its grounded partner. R_3 serves the same purpose for the horizontal plate, in addition to its function as a "Horizontal Gain" control.

Theory of Operation

If you're not familiar with the oscilloscope's function, the following paragraphs may help toward an understanding of how the tube operates in this basic circuit.

Refer to Fig. 1, where the tube schematic is shown in pictorial form. In the smaller CR tubes, the cathode is internally connected to one side of the heater (2). When heated by the filament, the cathode emits electrons, which pass through a small hole at the center of control electrode (5). By varying R_2 , the bias on (5) can be made more negative than the cathode, thus controlling the number of electrons which pass through and, consequently, the intensity of the electron beam.

Shown as (A), the #1 accelerator anode operates at high positive voltage with respect to the negatively charged cathode electrode. (A) pulls the beam forward and through, giving it a push toward the tube's front.

The electron stream then passes through the focusing anode (3), which functions by a process of electron optics too complicated to discuss here. For all practical purposes, the procedure may be considered analogous to optical light focusing.

Accelerator anode #2 (B) operates similarly to (A), giving the pinpointed electron beam another shove toward the screen. The beam now passes between the deflecting anodes and strikes a fluorescent coating on the rear of the glass screen. The coating glows visibly when electrons strike it.

The electron beam may be either attracted or repelled by an electric field. When a.c. is applied to the horizontal deflecting plate (6), the first half-cycle being positive pulls the spot to the right, and the second negative half-cycle pushes it back to the left. Alternating voltage on the vertical deflecting plate (4) moves the spot up and down in the same manner.

The r.f. voltage applied to (4) oscillates between plus and minus at millions of cycles per second, thus the spot's motion is invisible, and a straight line (Fig. 5J) appears. The same is true of an audio frequency fed to (6), except as follows:

When r.f. and audio voltages are applied simultaneously from a plate-modulated transmitter as shown in Fig. 4, the spot moves very rapidly in complex directions, and a solid fluores-

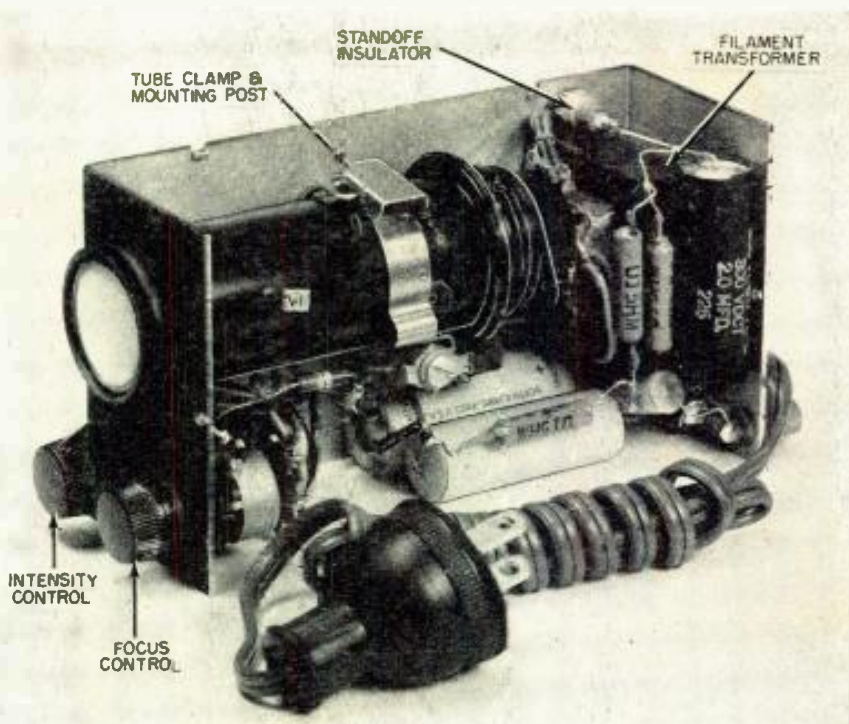


Fig. 2. Internal view of scope. Three units at right-hand edge and bottom center are tubular selenium rectifiers. Small stacked units may also be employed here.

cent pattern appears on the screen. These patterns and their causes are discussed in the Applications section following Construction Details.

Construction Details

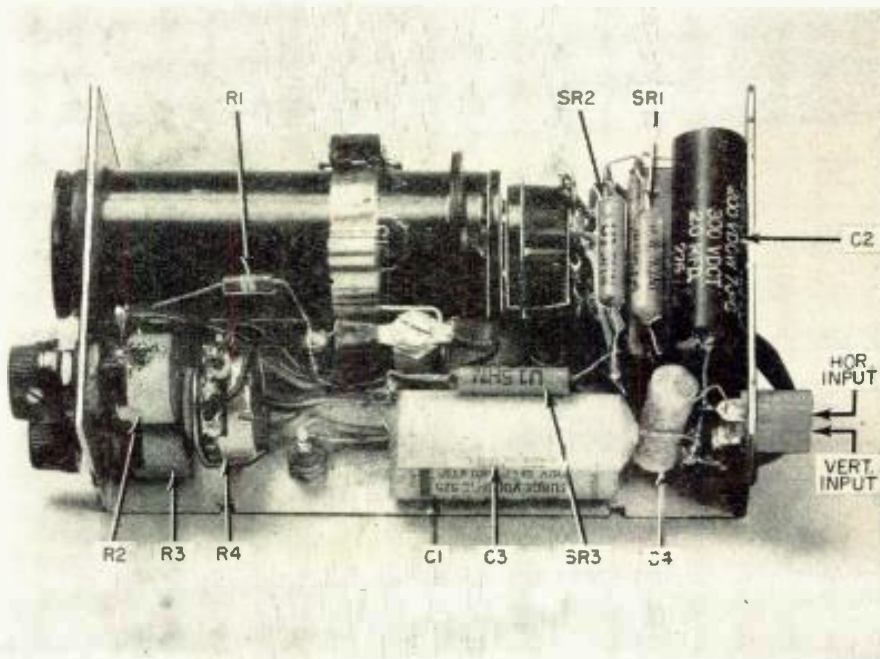
The scope, complete with power supply, is built within a two-section box chassis measuring 2 x 3 x 6 inches. Fig. 2, the box with cover removed, shows details of assembly. A hole large enough to allow insertion of the 913 tube through the front panel supports the tube at its front end. A standard octal socket plugs onto the tube's prongs,

and is not mounted at the rear, because the tube must be rotated until its horizontal and vertical axes occur at the proper angles. The socket wiring hangs loosely to allow this positioning.

A tube base clamp snaps around the tube's metal body, and mounts on a stud secured to the box's base. When the snap is loosened, the tube may be rotated to the correct viewing angle, then locked into position by the clamp.

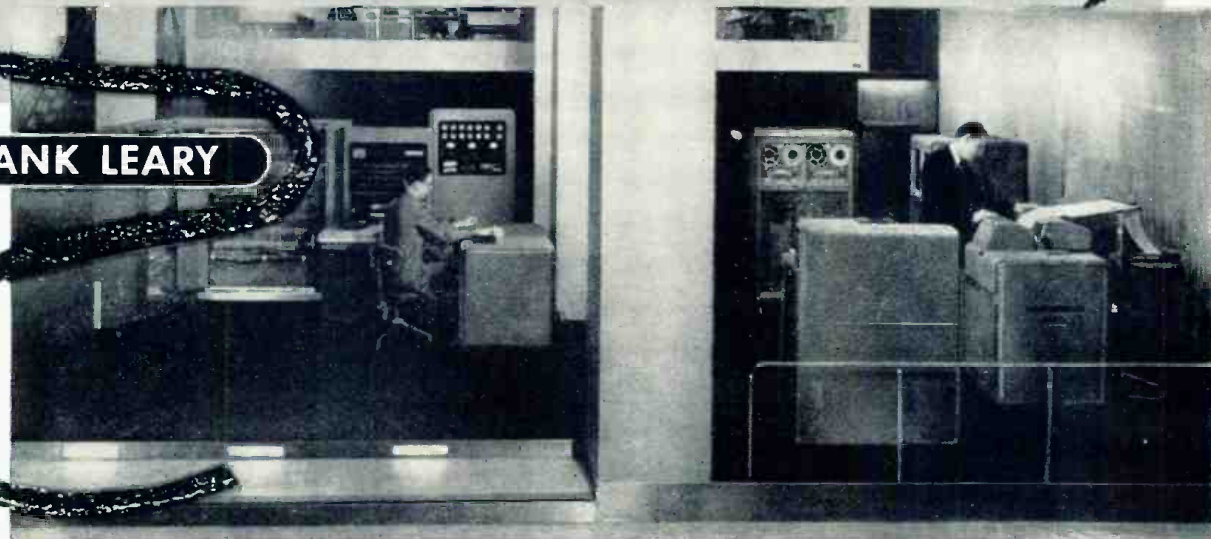
The filament transformer mounts directly behind the tube socket on the chassis' rear wall, as seen in Fig. 2. (Continued on page 186)

Fig. 3. Bottom view of instrument. The horizontal amplitude control, potentiometer R_1 , is screwdriver-adjusted through a hole between focus and intensity controls.



Behind the Giant Brains

By FRANK LEARY



Typical of the 700 series of scientific and commercial computing systems now being produced by International Business Machines is the IBM 701, which was also the first of the series. Primarily a scientific computer (the commercial members of the family are the 702 and 705), the 701 is extremely fast in computing speed, but limited in flexibility, since it depends primarily on punched cards for input.

Part 2. Advantages and characteristics of electronic computers, along with a general survey of the field and some predictions of the future effects on us all.

LAST month we discussed the development of the computer and its basic functions. Now we proceed with the advantages and a survey of the field.

The reason computers are valuable, and increasingly more valuable, in our time, has nothing to do with their innate ability, which is extremely limited. It has to do with their speed, which is fantastic, and their relative reliability.

A man figuring out his own pay, for example, might spend five minutes or more multiplying rates by times, computing and subtracting deductions, and finally arriving at his salary figure. A desk calculator permits him to reduce this to about two minutes. A punched-card calculator could make the same computations in a few seconds. An electronic computer like "Univac" could do the same work in less than a tenth of a second.

The man may tire of doing this work in an hour; certainly by the end of a day most men would be bored beyond distraction. Industry has discovered that most people cannot perform such repetitive work for more than three or four hours at a stretch without a sharp rise in the incidence of error. Machines, whether mechanical or electronic, never tire, never need to break for coffee or lunch, and never get bored; but after a few thousand opera-

tions, mechanical parts begin to wear. Electronic tubes can be slammed from cut-off to saturation millions of times a second (as they are in many electronic computers), and still operate for months without fatigue; new developments in electronics indicate even higher orders of efficiency. Solid-state circuitry, such as the transistor and Sperry Rand's still-newer "Ferractor," seem capable of almost limitless operation without fatigue. So, just as a mechanical device is better than a human being for repetitive tasks, an electronic device is usually better than a mechanical one; it lasts relatively longer at a high operating efficiency.

Programming a Computer

The first requirement for any job that is to be done by a computer is that it be capable of precise description. Or, as Dr. John Mauchly, co-inventor of ENIAC and "Univac," once remarked, "any activity that can be precisely described can be done by a machine. You're already well on your way to designing the machine in formulating the description." If anyone could analyze and define the complex operation we know as thinking, for example, the engineers could develop a machine to do it for us. Until that time, the name "thinking machine," or the concept of machines that think, merely wastes time.

Putting a job on a computer first requires a complete analysis of the job, and an exact definition of its scope. Then every step that a human being performs in doing the job, every decision he makes, every value he weighs, must be translated into terms that the computer can recognize, steps it can perform, or values it can weigh. A complete listing of the step-by-step instructions, recognizable to the computer's blind and dumb hardware, must be drawn up. Then the computer can do the job.

This operation, consisting of the analysis of the problem and the synthesis of the instruction routine, is known as programming. As is perfectly clear, the computer's decisions are really the programmer's decisions; its criteria for evaluation are given to it by the programmer.

Drawing up such a program can be a costly and time-consuming job. That is why advanced programmers concentrate some of their efforts on a technique called automatic coding, which gives the computer a library of simple, frequently used, chunks of programs, and makes it collaborate in the formulation of its own program of instructions.

It is also the reason why "repeatability" is one of the major criteria for determining which jobs will be done by a computer. The cost of making the program can be amortized if the job is to be repeated over and over again. A company payroll, for example, which must be computed every week or two, is a far more likely candidate for mechanized or electronic treatment than is the design of the earth satel-

life; but many of the myriad computations incident to the satellite design are being done by computers simply because of time a computer can save.

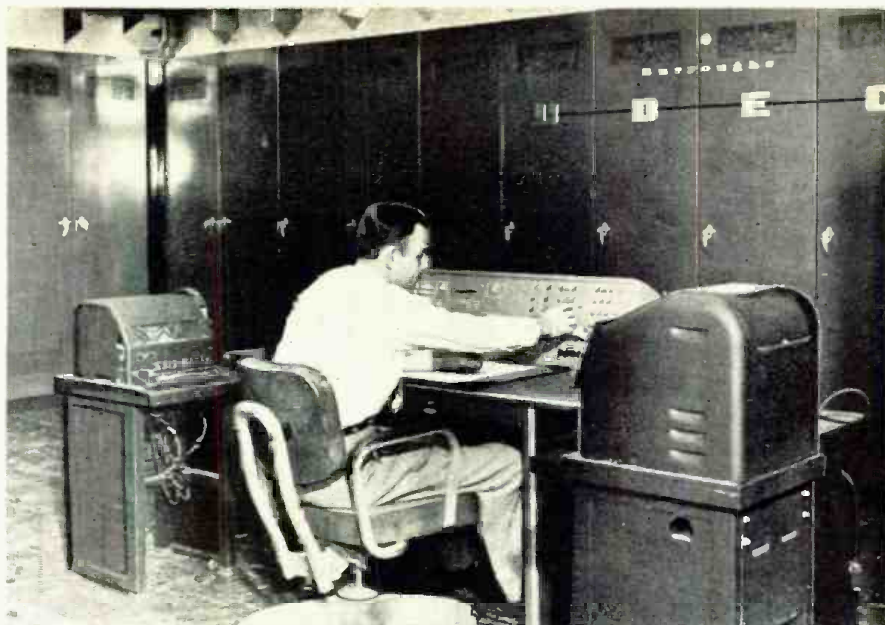
The Field Today

There are still some companies—but their numbers are decreasing—who are reluctant to submit their paperwork problems to electronic treatment, some because they do not trust the machines, others because they are not convinced of the economies of electronics. That computers are economical when the job is big enough is now an established fact. Evidence of the economies of electronic data-processing has been available ever since the first "Univac" was bought by the Census Bureau more than five years ago. The evidence is growing daily. And the acceptability of electronic record-keeping has even been tested—and accepted—in the courts.

The manufacture of electronic computers and computing systems has become a major industry, and a hotly competitive one, too. Led by *Remington Rand's* "Univac," which started in 1949, was the first production-designed business computer on the market; and by *International Business Machines*, which has concentrated millions of dollars in the design and production of its 700 series of computing systems, the industry has grown in very few years to become a giant. Some fifty companies are now manufacturing complete electronic computer systems or major systems components such as high-speed magnetic-tape units, magnetic-drum storage systems, instrumentation and data-presentation systems, and so forth. Business machine manufacturers, such as *Underwood*, *Burroughs*, *National Cash Register*, and *Royal-McBee*, and electronics manufacturers, such as *RCA*, *Philco*, *Raytheon*, and *General Electric*, have all contributed to the progress. And no one can overlook the contributions made by the *Bell Telephone Laboratories* in basic research and logical design of information-handling systems.

Business and industry are gradually accepting the machines. Not considering the countless analogue computers in use all over the world, and in Army, Navy, and Air Force fire-control and missiles-control equipment, the big digital computers alone—million-dollar systems all—form an impressive roster: *Remington Rand's* fifty-odd "Univacs"; *International Business Machines Corporation's* seventy-odd 701's, 702's, 704's, and 705's; *Burroughs Corporation's* two UDEC's and a scattered shot of university, research center, and one-time industrial designs. And within not too long we can expect to see *RCA's* "Bizmac"; the "Datamatic 1000," being built by the joint efforts of *Minneapolis-Honeywell* and *Raytheon*; and *Remington Rand's* much-heralded LARC, which was "commissioned" by the Livermore (Calif.) Atomic Research facility.

This besides the increasing flow of small systems, such as *Burroughs' E101*, *National Cash's* CRC series, *Un-*



The Burroughs-built UDEC (Unitized Digital Electronic Computer), shown in the Wayne University's Computation Laboratory in Detroit. This computer, also basically a scientific computer, is much used by the automotive industry for engineering problems.

derwood's "Elecom" 50, *Remington Rand's* "Univac" 60 and 120, *IBM's* CPC, 607, and 604; and the medium-sized systems, such as the "Univac" File-Computer, the "Elecom" 125, *IBM's* 650, *Burroughs' "Datatron,"* and many more. These compact and efficient machines are bringing the advantages of electronic data-processing to the small and medium-sized business. The market is ripe for the computers, and more companies enter the field daily.

And Tomorrow

Communications is also becoming an increasingly important consideration,

and *Western Union* and *AT&T*, on the one hand, and the computer makers on the other have cooperated on a number of plans to facilitate the transmission of data from place to place. These plans range from the conversion of data to telecommunications code and regular transmission over ordinary telegraph wire, to the direct transmission of the very-high-speed computer codes over special coaxial lines.

Naturally, all the activity has strained the creative facilities of the small nucleus of scientists and engineers who first launched the computer
(Continued on page 114)

New markets for computing systems are being tapped by the medium-sized general-purpose computer, typified by *Underwood's* Elecom File Processor. The Elecom system reduces the contents of 1600 conventional file drawers to less than three cubic feet of space; savings in space such as this, added to time saving, plus the different kinds and configurations of management information which computers provide, have given impetus to the furor of interest in electronic computing.



Subminiature Construction Techniques for the Home Builder

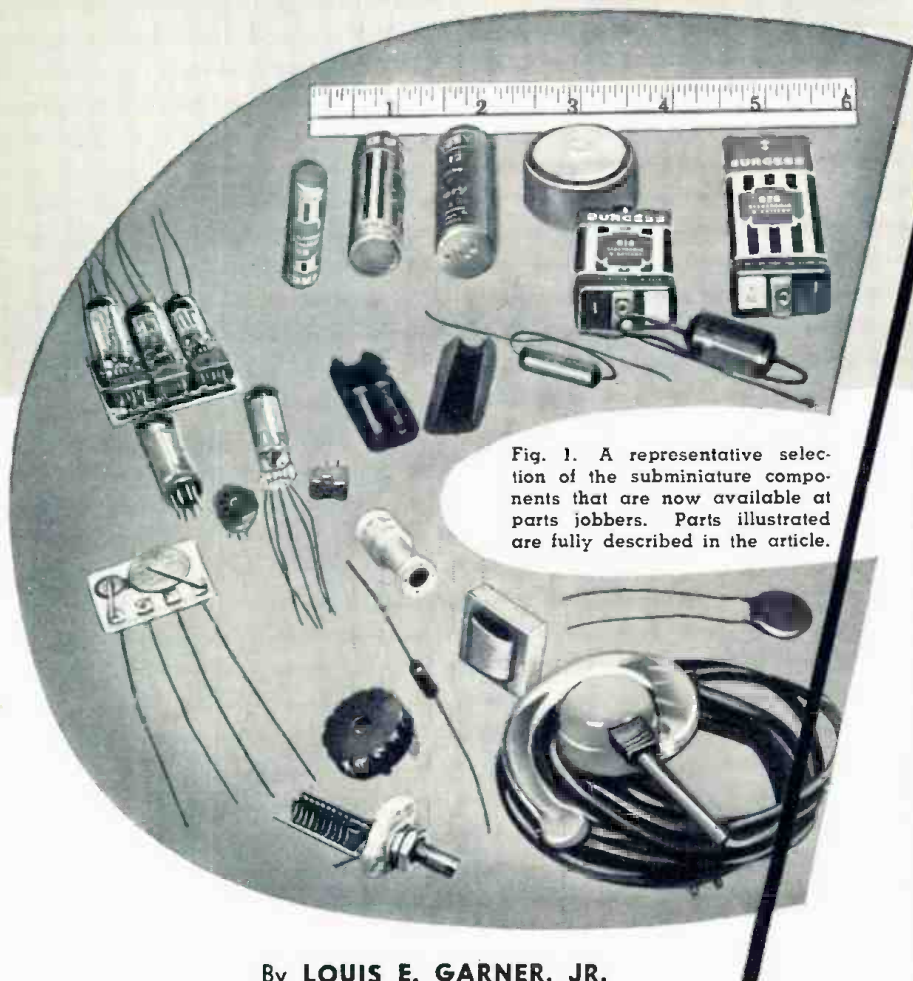


Fig. 1. A representative selection of the subminiature components that are now available at parts jobbers. Parts illustrated are fully described in the article.

By LOUIS E. GARNER, JR.

The availability of these tiny parts makes it possible for hobbyists with limited space to build electronic equipment.

FOR some time, the average home builder or electronics experimenter has followed a rather general path as he acquired greater skill and ability in his hobby. Starting with simple one- and two-tube receivers or amplifiers, the builder would work into more and more complex (and larger) equipment, eventually building such items as ten- to fifteen-tube communication receivers, complex test equipment, hi-fi audio amplifiers, and television receivers. Almost every hobbyist has, at one time or another, reached the point where "what to build next?" becomes an important problem.

Today, however, with the increasing availability of miniature and subminiature components, an entirely new construction field has opened for the experimenter— assembling subminiature equipment. Nor is this field restricted only to the experimenter; hams will find that the construction of subminiature receivers and transmitters offers a real challenge to their skill, hi-fi "bugs" can apply subminiature

construction techniques to the assembly of compact preamplifiers, and technicians will find that subminiature test equipment reduces the weight and space requirements of equipment that must be "toted" to a customer's home.

In addition to the advantages just outlined, assembling subminiature equipment is the ideal solution to the problem of the experimenter who lives in an apartment and has limited space at his disposal. The equivalent of a "shop full" of tools may be carried in a large briefcase. Enough components to assemble several receivers and amplifiers may be easily stored in a cigar box and a coffee or end table offers ample working area for most projects.

Subminiature Components

Recently subminiature components have become widely available at local radio-electronic wholesale supply houses. Previously, such parts were so difficult to obtain that the would-be builder soon gave up in disgust. Today most of these components may be pur-

chased across the counter as stock items. A few still have to be obtained on special order, but delivery time is now reckoned in days rather than in weeks and months.

A sample selection of components that were purchased at a local radio wholesaler is shown in Fig. 1. The 6" rule in the photo illustrates the sizes of the components shown.

Across the back is shown (from left to right) Burgess No. 7 and type Z penlite cells and Mallory RM-12 (RM-1200) and RM-4000 mercury cells. These cells are generally used as "A" batteries in subminiature equipment. Also shown is a Burgess U10, 15-volt hearing aid battery and a Burgess U20, 30-volt hearing aid battery. Batteries of this type are used as "B" supplies.

On the left side is shown (from top to bottom), a Centralab PC-201 3-stage printed circuit audio amplifier, two types of "subminiature" tubes with their corresponding sockets (a Sylvania type 1E8 and a Raytheon type CK512), a printed circuit "Cou-plate," a standard 1/2-watt carbon resistor, and a miniature volume control (Centralab type B16-224). The miniature volume controls are available in a number of resistance values and both with and without switches.

On the right side of the photograph is shown a small iron-core audio transformer, a miniature ceramic coil form, a miniature tuning capacitor, a miniature "metallized" paper capacitor (size shown is .25 μ fd., 200 volts), a miniature tubular paper unit, and a disc ceramic capacitor. The small iron-core audio transformers are available from a number of manufacturers, although the UTC SO (Sub-Uncor) and SSO (Sub-Sub-Uncor) series are the ones most often carried in stock by local suppliers.

Millen manufactures the miniature ceramic coil form shown and can supply these forms with either adjustable iron cores or brass slugs as stock items. The tuning capacitor shown is also a stock item and is manufactured by the E. F. Johnson Co. A type 20M11 is shown (2.6-19.7 μ fd.).

Large-capacity, small-size metallized paper capacitors are made by a number of manufacturers and stocked by most suppliers. A *Pyramid* type MT capacitor is shown in the photograph as representative.

In addition to the above the photo shows a miniature two-conductor jack (*Walsco* type 791) and a midget ear-set (*Telex* No. A4680). Again, both of these are stock items.

In addition to the items shown, there are a number of other miniature and subminiature components available that might appeal to the specialized builder. Such items include miniature sensitive relays hardly bigger than a standard miniature tube (such relays are manufactured by *Potter & Brumfield*). However, the items shown in the photograph are those most likely to be encountered as "stock" items at local distributors.

Tools

The builder of subminiature equipment will find it worthwhile to obtain tools that fit in best with his hobby. A typical assortment of tools is shown in Fig. 2.

The collection shown includes a *Casco* power tool with an assortment of accessories, including drills, brushes, slitting saws, etc. A set of *Moody* jeweler's screwdrivers is shown in the background. On the right is a set of jeweler's type pliers manufactured by *Kraeuter* and purchased by the author at a local radio wholesalers. Included are "dikes," "long-noses," and other useful pliers.

In the foreground are shown an *Ungar* pencil iron with small tip, a magnifying glass, a small triangular file, a small rat-tail file, a pair of tweezers, and a penlite.

Another useful tool, not shown in the photograph, is a small bench or hand vise. If a vise is not available, a small C-clamp may sometimes be used instead.

Materials

Some of the materials used in the assembly of subminiature equipment are illustrated in Fig. 3. Included are service cement, Bakelite cement, *Scotch* tape, *Scotch* electrical tape, rubber cement, a small aluminum box (*Bud* "Minibox"), a small plastic box, sheets of Bakelite and plastic, plastic tubing and rods, aluminum foil (used for shielding), small wire and spaghetti tubing, and small size machine screws and nuts (the "large" screws are size 4-40, the smaller ones size 2-56).

Not all the material shown may be available at local radio supply houses, and it may be necessary to go to a plastics "hobby" shop to obtain a supply of plastic sheets, rods, and tubing. Aluminum foil may be obtained at many drug stores and at most supermarkets. Rubber cement can be obtained at dime stores or stationery stores. Small machine screws and nuts may generally be purchased at hardware stores. The prospective builder



Fig. 2. Some of the tools that the builder of subminiature gear will find useful. Shown are power tool, jeweler's screwdrivers and pliers, soldering pencil, etc.

will find it convenient to purchase corresponding taps and dies at the same time.

In addition to the material shown, the builder will find it worthwhile to check through the small parts assortments offered in packages by most radio parts wholesalers. Assortments of small brackets, springs, and similar components often prove handy when assembling equipment.

Small diameter wire is likely to prove a little difficult to obtain in some cases, for many radio wholesalers do not stock wire smaller than #20 or #22 gauge, and these sizes are considered as "bus bars" in some types of subminiature construction work. However, it is often possible to "manufacture" small sized wire by removing individual strands from large size stranded wire and using small diameter plastic spaghetti tubing as insulation.

Although the basic methods used when designing subminiature electronic equipment are the same as those used when designing conventional sized equipment, there are certain special considerations that must be kept in mind.

First, since most subminiature equipment is self-powered, using small

batteries, it is necessary that the current drains be kept to a minimum to insure long battery life. Tubes or transistors should be selected so that optimum performance at minimum battery drain is obtained. As few parts as are necessary to accomplish the builder's minimum requirements should be used.

An example is in the design of audio amplifiers. While most conventional audio amplifiers are designed to have considerably more than the average gain needed, so that gain controls are left near "zero" in most work, it is not unusual to find a subminiature audio amplifier with the gain control usually adjusted almost to "full gain" as a normal operating condition.

This requirement makes it imperative to avoid the use of power amplifiers unless absolutely necessary, and here only to drive an earphone. While it is possible to build a subminiature amplifier with sufficient output power to operate a loudspeaker, this may result in the production of signal distortion.

The compact construction necessary in subminiature equipment requires small coils with, usually, high distributed capacities to ground. These factors lead to low "Q" circuits. Because

Fig. 3. "Accessory" items used in assembling small equipment. Service cement, Bakelite cement, *Scotch* tapes, aluminum and plastic boxes, foil, tubing, etc. are shown.



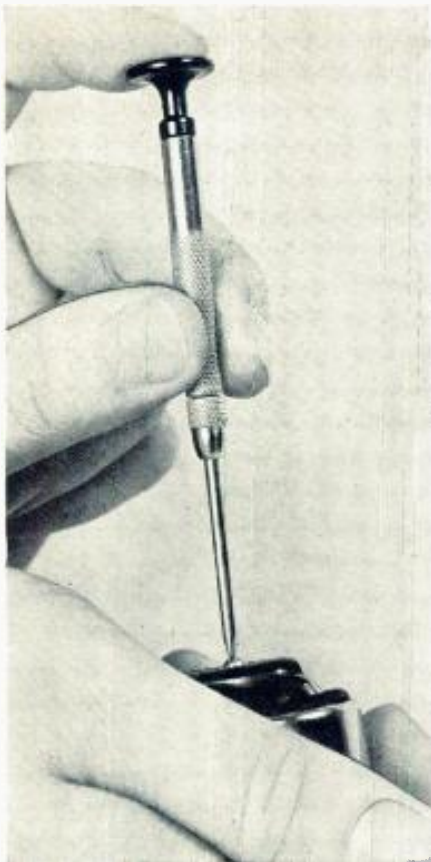


Fig. 4. One technique for working with subminiature parts. A jeweler's screwdriver should be used on small machine screws.

of this, r.f. circuits selected for subminiature assembly must be capable of operating satisfactorily with low "Q" coils. With subminiature-type tubes, "B" voltages as low as 15 volts may often be used, while a "high B" voltage is 45 volts. This makes it necessary to select circuits which can operate with very low "B" voltages, and sometimes makes an additional stage necessary to obtain sufficient over-all gain.

The builder of subminiature equipment will also find that "high fidelity" is actually difficult to achieve except in resistance-coupled stages due to the small amount of iron used in the miniature audio transformers.

Better results with subminiature

r.f. circuits will be obtained if the builder chooses parts designed specifically for the type of work contemplated. Check through the characteristics carefully before picking a particular component.

Wiring Techniques

A small "pencil" type soldering iron with a $\frac{1}{8}$ " tip will be found satisfactory for most subminiature wiring. The iron should be kept well tinned.

Most connections are made by pretinning the components to be wired and using simple "lap" joints, applying the iron only as long as is necessary to flow the solder. Care should be taken not to overheat subminiature components.

Some builders prefer to clamp the soldering iron in a small vise and to hold the subminiature assembly or components to the iron tip, as illustrated in Fig. 5. Note that this technique is just the opposite to that employed in wiring conventional sized equipment. If this method is used, be careful when clamping the iron in the vise. Use enough pressure to hold the iron securely, but remember that too much pressure may damage the iron.

Point-to-point wiring is generally used in subminiature construction in order to reduce over-all space requirements.

Tubes are sometimes wired directly into the circuit while, at other times, the special subminiature sockets are employed. The choice of which to use is a matter of individual preference.

Construction Practices

The builder contemplating subminiature construction should spend a little time becoming familiar with the tools used (Fig. 2). Somewhat greater skill and patience is required when working with subminiature components than is necessary when working with "full-sized" equipment.

Special care is required when working with small machine screws and the use of a "jeweler's" screwdriver is almost mandatory. One technique for using such a screwdriver is illustrated in Fig. 4 (the author is left-handed). Note that this technique makes it virtually impossible to apply very much twisting force to the screw-

driver handle, thus avoiding any tendency to bend the screwdriver blade or to "strip" the threads of the small screws used.

It is customary to mount many parts (even including small iron core transformers and complete printed circuit amplifiers) simply by cementing them in place, using either *Duco* cement or regular radio service cement.

When it is desired to keep a plastic surface free from scratches during construction work and layout, plain white paper may be cemented to the surface using rubber cement. All layout may be made directly on the paper, using a lead pencil. Once the construction is completed, the paper may be "peeled" off, with excess rubber cement removed simply by rubbing it with a finger.

Subminiature equipment is more often assembled in plastic cases than in metal because of the greater ease of mounting parts (using cement) and of avoiding wiring shorts. Where shielding is necessary, two techniques may be employed; one is to mount the plastic cased assembly inside a larger metal case, the other is to cement aluminum foil to the plastic case as a close fitting shield. "Heavy" grade aluminum foil should be used.

When working with plastics, an ordinary scratch awl makes an admirable "center punch" for small holes. Hand pressure is generally all that is needed to make a good sharp impression in most plastic materials to guide the drill.

It is generally not practical to "punch" large holes in plastic. Rather, a large drill or a series of small holes around the circumference of the large hole may be used instead, with the final "sizing" obtained with a file or pocket knife. Still another technique (generally used by the author) is to lay out the desired hole and then to use one of the "carving" bits of the electric power tool set to cut out the plastic.

Conclusion

Subminiature construction offers interesting possibilities to the electronics experimenter, ham, or home builder. Very little space and no "heavy" equipment is required.

As far as cost is concerned, the builder will find that individual items are generally somewhat more expensive than their counterparts in conventional sized equipment; however, the total cost of components for a finished piece of equipment is likely to be no higher than its full-sized "equivalent." This is due primarily to the use of batteries in place of expensive a.c.-operated power supplies and filter circuits.

Construction projects are numerous, being limited primarily by the ingenuity and interest of the builder. Typical projects are hearing aids, small preamplifiers, "vest-pocket" broadcast receivers, miniature transceivers, and transmitters (for licensed hams), vibration pickups and amplifiers etc.

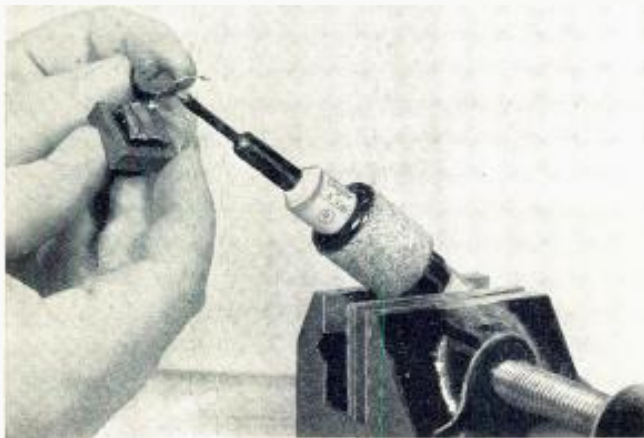


Fig. 5. Pencil type soldering iron is ideal for subminiature electronic construction work. To avoid damage to components, iron can be clamped in a vise—with part brought to the tip instead of usual technique.

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By JOHN T. FRYE

SAFETY LECTURE

WHISTLING "Blue Suede Shoes" softly to himself, Barney was working away at a rather battered three-way portable receiver while Mac, his employer, watched him. At some time or other the loop on the hinged back lid of the set had been discarded and replaced with a ferrite-core type antenna fastened inside the lid. The short length of solid enameled wire serving to give increased pickup to the loop came out through the crack between the lid and the case and stuck straight up, waving around as the set was moved. Barney, intent on getting a knob loose, bent over the set and then jerked his head back and rubbed his forehead where it had been pricked by the sharp end of the wire. As he started to return to his effort to loosen the stuck knob, Mac's hand fell heavily on his shoulder and pulled him back from the set.

"Does danger have to club you over the head before you recognize it?" Mac asked gruffly. "Next time that wire may pierce an eye."

Mac fashioned the end of the wire into a small loop and then taped it flat against the inside of the lid. "There now," he said, "that wire will not destroy the sight of a technician or anyone else handling the receiver. I hate to keep harping on the subject, but I want you to be more alert to danger in your work. Now that my eyes are beginning to slip a little, I can really appreciate how precious good eyesight is, and I don't ever want to see you taking any chances of injuring your eyes again."

"I'm usually pretty careful," Barney defended himself.

"'Pretty careful' is not good enough," Mac declared flatly. "I've seen you doing something again lately that I've warned you about time and again: holding a hot iron on a solder joint while you pull the wires soldered to that joint toward you. When the wires come loose, they often flip hot solder right into your face. I've seen you rubbing a spot where a little blob of molten solder hit your face more

than once. Can't you imagine what will happen if a bit of that hot solder strikes an eye?"

"Okay, I'll remember," Barney promised. "From now on I'll push instead of pull on those wires. Have you noticed my doing anything else wrong, I'm foolish enough to ask?"

"Plenty! But I've already taken care of one threat. I saw you using the scratch-awl the other day to pry loose wires you were unsoldering. Ignoring the dubious wisdom of misusing the scratch-awl in this fashion, I noticed that you had the right-angle point down inside the set while the needle-sharp straight point was directed right at your face. I stuck corks on both points, and I had better never catch you employing that tool without a cork on the point you are not actually using."

"Okay," Barney said with an impish grin, "I'll be sure you don't catch me when I'm doing it."

"Another thing not to let me catch you doing is being careless with that contact cleaner," Mac went on. "I'm not sure, but I have a strong suspicion that the stuff contains some carbon tetrachloride. If so, that makes it dangerous to the eyes. Don't go slopping and flipping it around carelessly. Remember your eyes."

"Aye, aye, Sir!" Barney punned.

"And don't forget," Mac continued relentlessly, "that you can hurt your irreplaceable eyes without punching them out or flipping harmful chemicals into them. It may take longer, but the end result will be the same. I've equipped our bench with the best lighting I know of, but you can still misuse it. For example, that flexible bench light is intended to throw the light exactly where you want it so that you can see into dark spots in the chassis not illuminated by the overhead lights. But every now and then I notice you allowing the flexible lamp to shine directly into your eyes simply because you are too lazy to reach up and turn it away."

"You *could* have said I was too intent on my work instead of saying I

was too lazy," Barney remarked bitterly. "Do I do things that endanger other parts of my anatomy besides my eyes?"

"Only about every square inch of it," Mac said promptly. "A prize example was when I saw you holding your hand behind a panel you were drilling the other day. I gathered you were trusting your reaction time being quick enough to stop the drill the instant it went through the panel. Well, it wasn't; and that gash across the side of your index finger proves it."

"Another thing I have seen you do quite often is to try and use a large bit with a cut-down shank in our quarter-inch hand drill for making a large hole in a panel or chassis. All at once the bit catches and twists the drill right out of your hand or starts the thing you are trying to drill going around like a fan blade. It is mighty easy to get a nasty cut, break a finger, or even break a wrist that way. That is a job for the drill press and not for the hand drill; and when you are using the press, make sure the material being drilled is clamped securely so it cannot budge when the rotating tool takes a heavy cut."

"I always think I'll be able to hold the darned drill," Barney muttered.

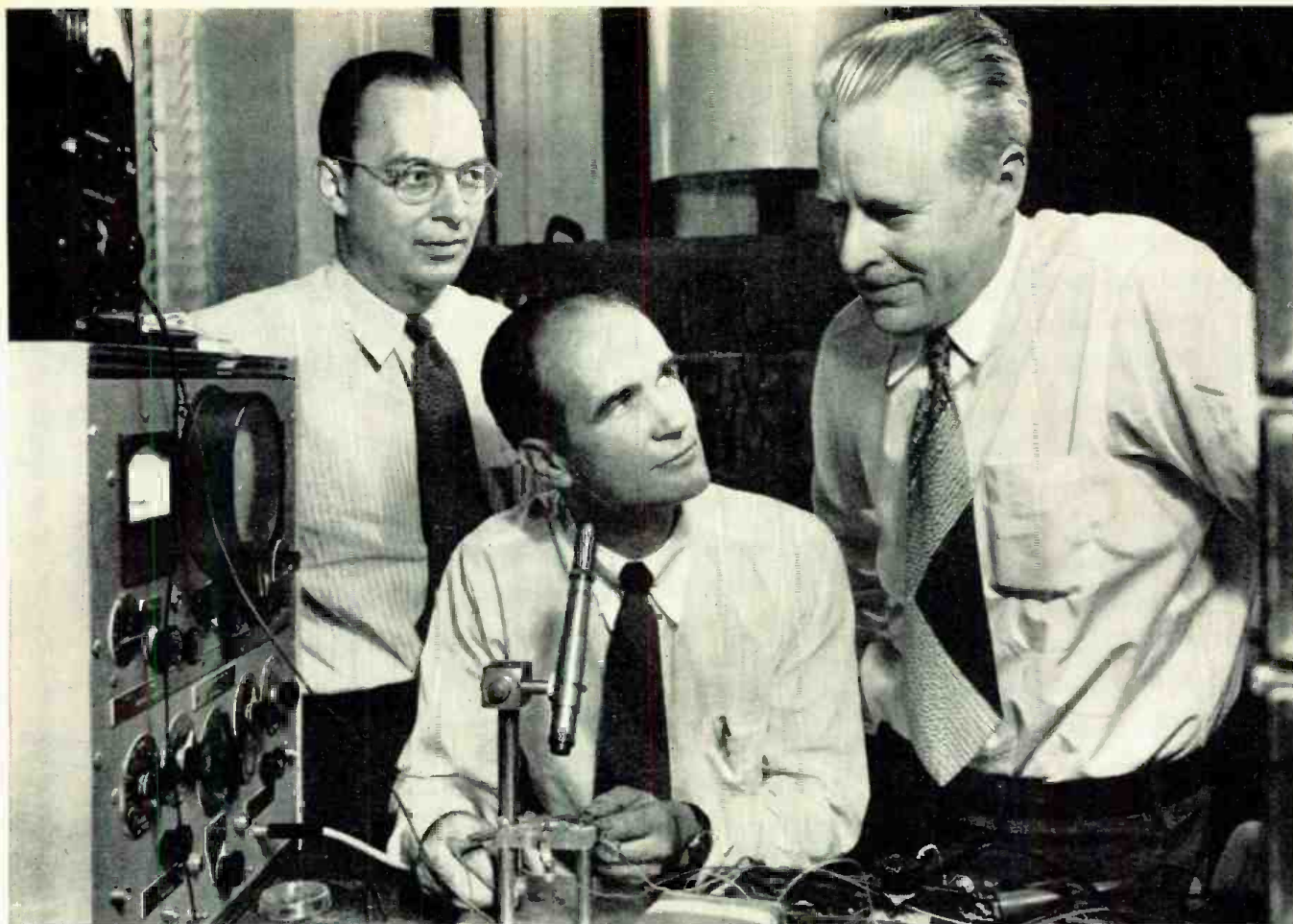
"Another thing I don't like are the number of soldering iron burns you have on your hands most of the time," Mac said as he reach over and spread Barney's hands out in front of him. Sure enough, the youth had three red welts on the fingers of his left hand. "There's no call for that," Mac said firmly. "You should be able to keep your fingers out of the way of the solder gun tip. Hold what you are soldering with pliers or tweezers; then if the tip slips off, you will not be branded with one of those 'carelessness' brands."

"Just remember a burn is always a good place for infection to enter the body, not to mention the painful annoyance it represents. Another dandy way to get burn marks on your arms is to reach back into a chassis for a tube and let your arm rest lovingly on a red-hot rectifier or output tube. It only takes a second to roll down your sleeve or to lay a newspaper over the hot tubes, but the burn you may get if you fail to take these precautions will be hurting you for several days."

"You keep on," Barney warned, "and you're going to have me scared to touch a radio or TV set."

"A little fear, plus a good imagination as to what *could* happen, is the best insurance against being hurt. A fine example is when you see a technician wearing a heavy glove or using a tube puller to wrestle hard-to-get-out tubes from their sockets. Every time I see a fellow pulling and tugging at one of these with his bare hands, I cringe inside. I keep remembering very vividly the time I saw a loctal tube break in the hand of a friend of mine and very nearly sever his thumb."

(Continued on page 197)



(Left to right) Dr. John Bardeen*, Dr. William Shockley* and Dr. Walter H. Brattain, shown at Bell Telephone Laboratories in 1948 with apparatus used in the early investigations which led to the invention of the transistor.

Bell Telephone Laboratories Salutes Three New Nobel Prize Winners

Drs. John Bardeen, Walter H. Brattain and William Shockley are honored for accomplishments at the Laboratories

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**Dr. Bardeen is now with the University of Illinois, and Dr. Shockley is with the Shockley Semiconductor Laboratory of Beckman Instruments, Inc., Calif.*



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Sylvania Color TV (Continued from page 55)

right of Fig. 1, just beside the plastic h.v. connector.

Fig. 6 shows the underside of the main chassis, housing the power and deflection circuits, with the h.v. and horizontal sweep circuits occupying the left portion.

Installation

The chassis and picture tube are ordinarily shipped inside the cabinet and, once uncrated, the set is ready to play. Connection to a good antenna is made through the conventional 300-ohm terminals at the rear of the set. After the power cord is plugged into the 117-volt power line, the "off-on" lever at the upper left of the screen is actuated. Volume, tone, brightness, and contrast controls operate just as in any ordinary monochrome set. To change channels, push the upper right lever to the right. For fine tuning, use the rim-type control next to the channel lever. The actual channel number is then visible in the upper center window.

Adjustment for color reception is done in two steps. The first step involves adjustment for good monochrome reception. Accordingly, the "Color" control is turned to the extreme left until it clicks off and adjustments are made for proper brightness, contrast, and fine tuning. Then the color control is turned on and adjusted for proper saturation while the "Hue" control is manipulated to make sure that colors, especially flesh tones, are correct.

If this procedure does not result in a good color picture, or if any of the controls do not seem to function, more skill is required. If it appears that a control knob turns without stop, the mechanical linkage to the actual control is probably missing. Sometimes re-alignment of the chassis in the cabinet can cure this type of defect. Should poor purity, convergence, color sync loss, or any of the other possible misadjustments or defects be observed,

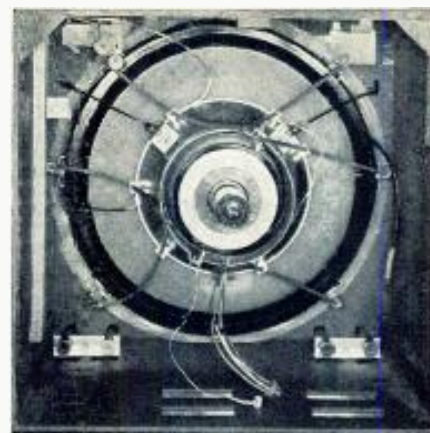


Fig. 4. Control shafts from the chassis mate with the knobs at the CRT corners.

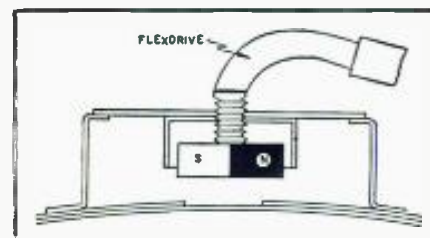


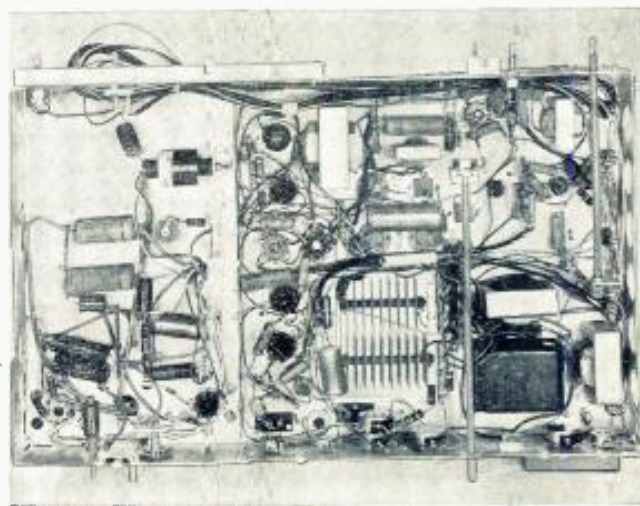
Fig. 5. Field neutralizing magnets are adjustable by flexible extension shafts. These shafts are also visible in Fig. 4.

the full set-up and alignment procedure may be needed. A detailed step-by-step convergence and purity adjustment of the Sylvania color sets is included in the service data.

In troubleshooting these receivers, good use can be made of the many special test points provided on the chassis and clearly shown in the circuit diagram together with the voltages and waveshapes which should be expected. The various connectors and plugs used in the Sylvania sets also speed up servicing because they facilitate isolating certain sections, and many voltages and signals can be checked at those connectors.

The technician who has some experience with other color receivers and who possesses the basic understanding of color circuitry will not find it difficult to service Sylvania models. —30—

Fig. 6. Underside of the main chassis. Horizontal sweep and h.v. circuits are to the left. Other deflection circuits are also on this chassis, as well as the power supply. Remaining circuits appear on vertical section of the L-shaped chassis.





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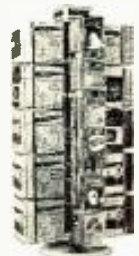
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New



MODEL O-11

Shpg. Wt.
21 Lbs.

\$69⁵⁰

- * An improved model of what was already an outstanding instrument.
- * Performance is unmatched in this price range.
- * Incorporates the extra features required for color TV servicing.

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH
TIME-PAYMENT PLAN.

**5
BIG
REASONS
WHY**



**HEATH
COMPANY**

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 15, MICH.

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5" Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 2.2 DB at 3.58 MC. The 11-tube circuit features a 5U1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serveshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

1 FEWER DOLLARS BRING MORE REAL QUALITY.

- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.

- You deal directly with the manufacturer.
- We are interested in you before and after sale.

Heathkits®

ARE YOUR BEST BUY...

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

4 EVERY KIT BACKED BY WORLD-WIDE REPUTATION.

- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

RADIO & TELEVISION NEWS

New HEATHKIT ETCHED CIRCUIT

5" Oscilloscope Kit

- * Brand new model with improved performance specifications.
- * Full 5" scope for service work at a remarkably low price.
- * Attractively styled front panel in charcoal gray with sharp white lettering.
- * Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.

GREATEST SELECTION . . .
 Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.



MODEL OM-2
\$42.50

Shpg. Wt.
 21 lbs.

HEATHKIT LOW CAPACITY PROBE KIT

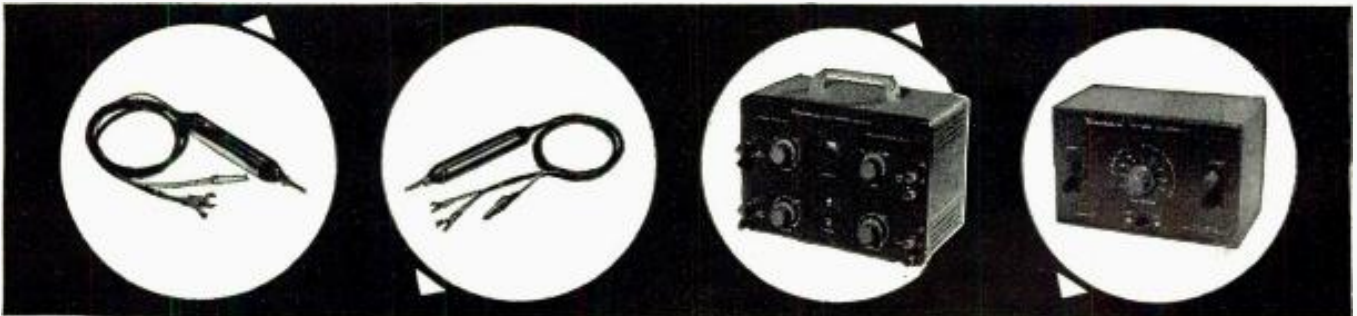
Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342
\$3.50
 Shpg. Wt. 1 lb.

HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3
\$21.95
 Shpg. Wt. 8 lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C
\$3.50
 Shpg. Wt. 1 lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are: .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3
\$12.50
 Shpg. Wt. 4 lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE



MODEL
V-7A

\$24⁵⁰

Shpg. Wt.
7 Lbs.

- * Easy to build — a pleasure to use.
- * 1% precision resistors employed for high accuracy.
- * Etched circuit board cuts assembly time in half.

Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM. Shpg. Wt. 1 Lb.

No. 309-C
\$3⁵⁰

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from -10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1
\$29⁵⁰

Shpg. Wt. 6 Lbs.

ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM. Shpg. Wt. 2 Lbs.

No. 338-C
\$5⁵⁰



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336
\$4⁵⁰

Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimenter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1
\$14⁵⁰

Shpg. Wt. 3 Lbs.



HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- * Brand new circuit for extended frequency response and added stability.
- * Ten accurate ranges from 0-.01 to 0-300 volts.
- * Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.

CONTROLLED QUALITY . . .
 Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover -52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.



MODEL AV-3

\$29⁹⁵

Shpg. Wt.
5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from -10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

\$29⁵⁰

Shpg. Wt. 6 Lbs.

HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

\$49⁹⁵

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1

\$49⁵⁰

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

\$24⁵⁰

Shpg. Wt. 10 Lbs.

HEATHKIT



MODEL
AG-8

\$34⁵⁰

Shpg. Wt.
8 Lbs.

- * Less than 0.1% distortion — ideal for hi fi work.
- * Large 4½" meter indicates output.
- * Step-type tuning for maximum convenience.

Audio Generator Kit

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within $\pm 5\%$. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

\$5⁵⁰

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

\$5⁵⁰

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ± 1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

\$29⁵⁰

Shpg. Wt. 11 Lbs.

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

\$16⁵⁰

Shpg. Wt. 3 Lbs.



HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

\$19⁵⁰

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

\$35⁵⁰

Shpg. Wt. 17 Lbs.



HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- * No calibration required with pre-aligned coils.
- * Modulated or unmodulated RF output.
- * 110 mc to 220 mc frequency coverage.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.



MODEL SG-8

\$19⁵⁰

Shpg. Wt. 8 Lbs.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50°C. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1
\$48⁹⁵

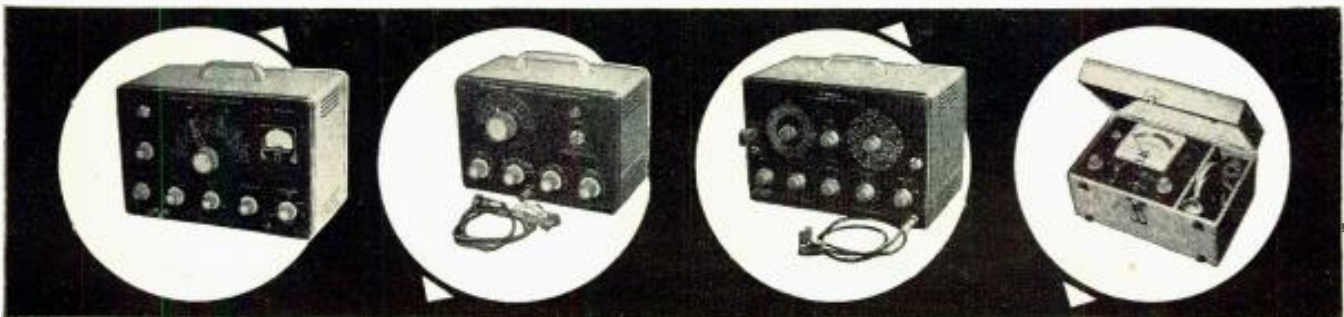
Shpg. Wt. 16 Lbs.

HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A
\$49⁵⁰

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2
\$22⁵⁰

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1
\$22⁵⁰

Shpg. Wt. 10 Lbs.

HEATHKIT



MODEL
TC-2

\$29⁵⁰

Shpg. Wt.
12 Lbs.

- * *Attractive counter-style cabinet.*
- * *Wiring-harness simplifies assembly.*
- * *Large 4½" meter with two-color "good-bad" scale.*
- * *Separate tube element switches prevent obsolescence.*

Tube Checker Kit

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

HEATHKIT TV PICTURE TUBE TEST ADAPTER



MODEL 355

\$4⁵⁰

Shpg. Wt.
1 Lb.

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.



MODEL
TC-2P

\$34⁵⁰ Shpg. Wt.
15 Lbs.

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locator circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

\$23⁵⁰

Shpg. Wt. 9 Lbs.

HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

\$29⁵⁰

Shpg. Wt.
7 Lbs.



HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

\$19⁵⁰

Shpg. Wt. 7 Lbs.



HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

PIONEER DESIGN . . .

New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 micro-ampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. 1/2 of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, $\pm 3\%$; capacitance $\pm 3\%$; inductance, $\pm 10\%$; dissipation factor, $\pm 20\%$; storage factor, $\pm 20\%$. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.

HEATHKIT

Impedance Bridge Kit

- * 1/2% precision resistors and silver-mica capacitors.
- * Battery-type tubes, no warm-up required.
- * Built-in phase shift generator and amplifier.



MODEL
IB-2

\$59⁵⁰ Shpg. Wt.
12 lbs.

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ± 3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4 1/2" panel-mounted meter is feature. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

\$44⁵⁰

Shpg. Wt. 14 lbs.

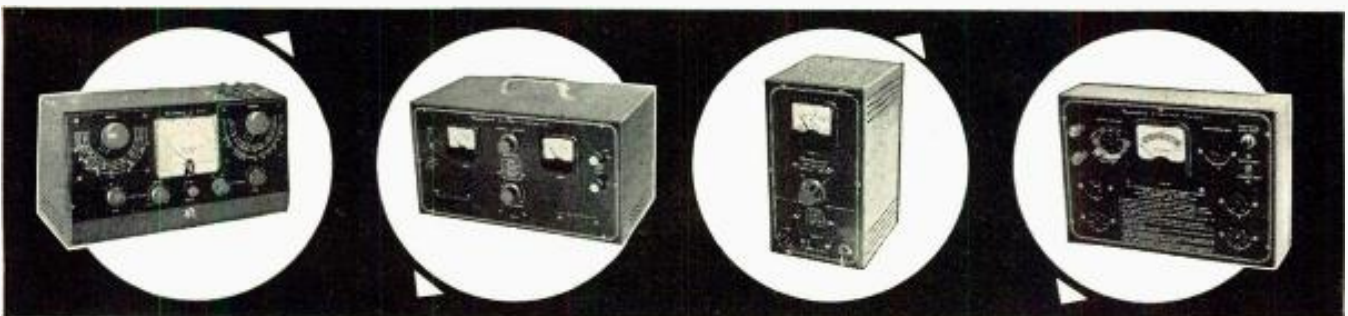
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continuously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

\$16⁵⁰

Shpg. Wt. 9 lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

\$31⁵⁰

Shpg. Wt. 17 lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

\$14⁵⁰

Shpg. Wt. 6 lbs.

HEATHKIT DX-100 PHONE AND CW



**MODEL
DX-100**
Shpg. Wt.
107 Lbs.

\$189⁵⁰

Shipped motor freight unless otherwise specified.
\$50.00 deposit required on c.o.d. orders.

- * Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.
- * Built-in VFO, modulator, and power supplies.
- * High quality components used throughout for reliable performance.
- * Features 5-point TVI suppression.

Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that it offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. \$4.95

MODEL AR-3
\$29⁹⁵

INCLUDING NEW
EXCISE TAX
(Less Cabinet)
Shpg. Wt. 12 Lbs.

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than \$20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1

\$19⁵⁰

Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20

\$35⁹⁵

Shpg. Wt. 18 Lbs.



HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

HEATHKIT PHONE AND CW

Transmitter Kit

- * 6146 final amplifier for full 65-watt plate power input.
- * Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.
- * Switch selection of three crystals — provision for external VFO excitation.



MODEL DX-35

\$56.⁹⁵ Shpg. Wt. 24 lbs.

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

\$14.⁵⁰

Shpg. Wt. 2 lbs.

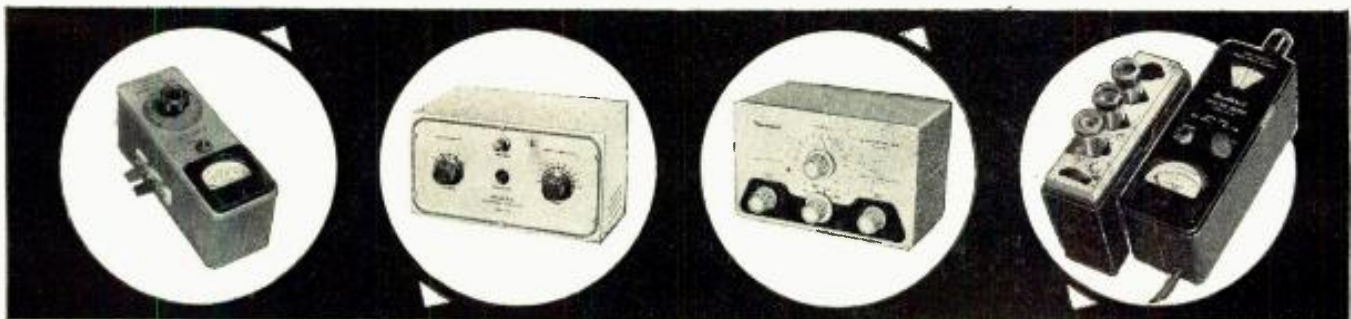
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

\$9.⁹⁵

Shpg. Wt. 3 lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

\$14.⁵⁰

Shpg. Wt. 4 lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorption-type wavemeter.

MODEL GD-1B

\$19.⁹⁵

Shpg. Wt. 4 lbs.

HEATHKIT BROADCAST BAND



MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

\$18⁹⁵

INCLUDING NEW
EXCISE TAX*

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- * Miniature tubes and high-gain IF transformer.
- * Rod-type built-in antenna. Good sensitivity and selectivity.
- * 5½-inch PM speaker.
- * Provision for phono jack.
- * Transformer-operated power supply.

Receiver Kit

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....\$4.95*

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0-.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
\$79⁹⁵

Shpg. Wt. 8 Lbs.



* Amazing new circuit for high efficiency.

- * Compact, portable and rugged.
- * Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a scaled germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
\$7⁹⁵

INCLUDING NEW
EXCISE TAX*
Shpg. Wt. 3 Lbs.



HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
\$11⁵⁰

Shpg. Wt. 3 Lbs.



HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

COMPREHENSIVE INSTRUCTIONS . . .
 The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

- * 5 switch-selected inputs, each with its own level control.
- * Equalization for LP, RIAA, AES, and Early 78's.
- * Separate bass and treble tone controls, and special hum control.
- * Clean, modern lines and satin-gold enamel finish.

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3¾" H. x 4¾" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.



MODEL WA-P2 (With Cabinet) Shpg. Wt. 7 Lbs.

\$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- * Illuminated slide-rule dial covers 88 to 108 MC.
- * Modern circuit emphasizes sensitivity and stability.
- * Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded

IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A
\$25.95
 INCLUDING NEW EXCISE TAX
 (With Cabinet)
 Shpg. Wt. 7 Lbs.



HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1
\$25.95
 INCLUDING NEW EXCISE TAX
 (With Cabinet)
 Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes inter-modulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1
\$18.95
 Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN



MODEL W-5M
Shpg. Wt. 3¹/₂ Lbs.
Express Only

\$59⁷⁵

MODEL W-5

Consists of Model W-5M plus Model WA-P2 pre-amplifier.

Shpg. Wt. 38 lbs.
Express only.... \$79.50

- * Full 25 watt output with KT-66 output tubes.
- * All connectors brought out to front chassis apron.
- * Protective cover over all above-chassis components.

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only..... \$49.75

MODEL W-3: Consists of Model W-3M plus Model WA-P2 pre-amplifier. Shpg. Wt. 37 Lbs. Express only..... \$69.50

HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of $\pm 1\frac{1}{2}$ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. Shpg. Wt. 10 lbs.

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for pre-amplification. Two inputs, RIAA compensation, and extra gain.

MODEL A-7D
\$17⁹⁵

INCLUDING NEW
EXCISE TAX

\$19.95⁺



HIGH FIDELITY

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8 1/2" D. x 8 1/4" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiophile who owns one!

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only..... \$39.75

MODEL W-4A: Consists of Model W-4AM plus Model WA-P2 pre-amplifier. Shpg. Wt. 35 Lbs. Express only..... \$59.50

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency response of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-98
\$35⁵⁰

Shpg. Wt. 23 Lbs.



HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

Range Extending SPEAKER SYSTEM KIT

- * High quality speakers of special design — 15" woofer and compression-type super-tweeter.
- * Easy-to-assemble cabinet of furniture-grade plywood.
- * Attractively styled to fit into any living room. Matches Model SS-1.



MODEL
SS-1B

\$99⁹⁵

Shpg. Wt. 80 Lbs.

All prices marked with a † include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY SPEAKER SYSTEM KIT



MODEL
SS-1

\$39⁹⁵

Shpg. Wt. 30 Lbs.

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

- * Special design ducted-port, bass-reflex enclosure.
- * Two separate speakers for high and low frequencies.
- * Kit includes all parts and complete instructions for assembly.

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Combines visual observation along with remote control over single coaxial cable.

A SINGLE-CABLE industrial TV control system, which combines both visual observation and remote control throughout a plant over a closed-circuit TV system, has been introduced by the *Jerrold Electronics Corp.* of Philadelphia. A unique feature of this system is its ability to carry all functions—two-way pictures, two-way communications, and remote control—over a single coax cable. Previously, a separate cable had been required to carry each of these functions.

This new system permits the use of virtually any closed-circuit TV camera. Cameras of different manufacture can be mixed in the same system and plugged in at any point. While featuring multiple inputs, it also offers an unlimited number of outputs to commercially available television receivers. The system can integrate any of the presently available supervisory control equipment, which can select cameras remotely and adjust them to show the desired picture.

Since the system will provide an outlet in every key area of a factory, various departments can make use of the same camera at different times during the day. No matter where the television camera is plugged into the system, it can be controlled by the user from the point that is most convenient for him.

Control center for mobile closed circuit TV system where visual observation and remote control features are available.



CENTURY TV TEST EQUIPMENT

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NOW you can pull the chassis and leave the speaker in the cabinet. No more mounting and dismounting... Special speaker connector plugs for RCA, Dumont, Admiral... Also a Signal Tracer and Voltage Checker... \$22.50 net



Model SS-1

Here are test instruments developed and produced by CENTURY to meet your every day service call needs... Brilliantly designed to save your valuable time and make extra dollars for you... Down to earth prices and rugged, durable quality are your assurance of the greatest value in test equipment.

CRT TESTER-REJUVENATOR

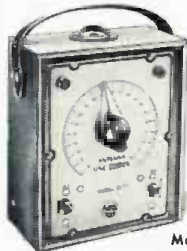
Built in power supply enables you to test and repair all picture tubes in or out of set... Check cathode emission... short and open elements. Estimate remaining life of tube... clear inter-element shorts and leakage... restore emission. \$19.95 net



Model CRT-1

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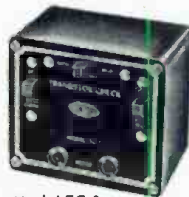


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This new amazingly low priced instrument combines with your VOM to make an accurate and dependable transistor tester. The TC-1 tests all transistors in or out of the set for current gain... leakage... open... short. Checks all crystal diodes for forward to backward gain... Equipped with test leads that enable the serviceman to leave transistor in circuit while checking. \$6.95 net



Model TC-1

REJUVA CHECK



Model RJC-1

The lowest price picture tube test and repair instrument available. Fits snugly in your tube caddy, ready to test, repair and rejuvenate any CRT right in the set. The ingenious RJC-1 powered by TV chassis checks cathode emission—shorts and open elements... Clears inter-element shorts and leakage. Restores emission... No other equipment needed to do the job... \$7.95 net

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something wonderful happened

"I don't suppose anyone could have convinced me, beforehand, that the new Fluxvalve would mean so much in the performance of my high fidelity system," says R. W. Sampson, of Princeton, New Jersey.

"Even now, I'm still amazed by the startling clarity of the strings, the richer and fuller range of the basses, the many subtleties that I'd been missing.

"And what makes it all the more satisfying is that *this* time I made the selection myself—without any advice from the 'experts.' I know they have run tests that explain why the Fluxvalve out-performs other pick-ups, but I didn't need this technical data. I *know* how good the Fluxvalve is—because I can *hear* the difference . . . right in my own living room."

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CHANGED
TO THE
NEW...**

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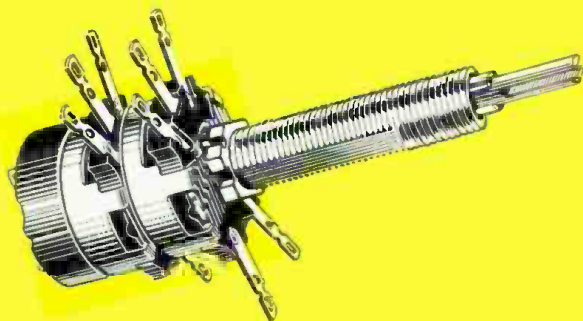
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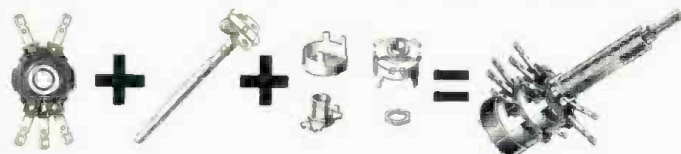
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Spot Radio News

(Continued from page 16)

1500-mile radius, dropping radiosondes at preset points. Although most of the drops are made over oceans and polar regions, sondes are often dropped into the eyes of whirling hurricanes to determine weather there.

A NEW VERSION OF A FLAT TV picture tube for color was described recently in London by Dr. Denis Gabor of the Imperial College of Science and Technology, at a meeting of the Television Society.

The new tube was noted as having the shape of a rectangular glass box, having a total depth of only 4½ inches for a 21-inch screen. The tube is divided into two halves by a metal tray which carries the complete electron optical system, and which also acts as a magnetic screen for the beam. By an ingenious system of electron lenses, the beam is curved to run parallel with the glass faces of the tube, and is finally deflected towards the screen by a series of conductors which run parallel to the screen itself.

Commenting on the construction of the tube, Dr. Gabor said that the flat tube can be made safer than the conventional picture tube, because the glass can be specially toughened, as the glass used in cars. Thus, it was noted, the tubes might dispense with the safety screen in front.

Silicones are used as insulation in the electrode system. This is believed to be the first time they have been applied in a sealed-off vacuum device. In the color models, the separate phosphors are deposited on the glass face through a shadow mask by a method which was described as being more economical than the present technique of depositing a color screen by printing a phosphor in register.

Although the new tube was still in the development stage, it was said that the main problem of making a satisfactory flat tube had been resolved and commercial production should not be too remote.

WITH MORE THAN a million fixed, portable, and mobile transmitters in operation, policing the radio spectrum has become a vast and time-consuming task for the FCC.

In a recent report on the odd problems the Commission is called on to solve through their Field Engineering and Monitoring Bureau, it was disclosed that solutions must be found for situations that might crop up on the sea, in the air, and in such far-off places as Hawaii.

Commenting on the trouble call in Hawaii, the Commission said that a plane en route from these sun-drenched islands radioed a distress call that a fire aboard had disrupted its navigational aid system. FCC monitoring stations obtained bearings which enabled the Coast Guard to guide the plane to safety.

Monitoring fixes from the FCC's field crew also helped to bring in a military transport plane which had developed engine trouble while nearing this country from the Azores.

In another entry, the FCC reported that early one morning operators in New York City police radio headquarters were startled to hear a woman's voice calling: "... running out of fuel . . . crash landing . . . plane 3417." While Coast Guard helicopters scanned the area, a series of phone calls made it possible to trace the hoaxer; a mother of four children. She was committed to a hospital for mental observation.

In California, interference to radio communications was traced by an FCC mobile monitoring unit to an electronic heater. In Florida, an arc welder in a shipyard was found responsible for disruption of marine radiotelephone service.

Nearly 150 illegal radio stations were discovered and closed by the FCC during the year. One was being used to transmit signals to operate a swing bridge over a Texas waterway. Another was employed by a retired tugboat captain to keep up his contacts with coastal radiotelephone stations.

Elsewhere, the FCC found that even a toy broadcast station can cause trouble. Its very young operator burst into tears when told that his programs were going on the air. The FCC engineer, noting the lad's genuine interest in radio, suggested that he take up amateur radio as a hobby. So this youthful tragedy was compensated by the

boy's new interest in trying to qualify for real two-way contact through ham radio service.

Another listing in the interference book concerned a Pacific coast radiotelegraph carrier who had been complaining that an unidentified strong signal was blotting out its communication with ships. Aided by a monitoring station general fix, an FCC mobile unit got a more definite bearing from a mountain top. This led back to the telegraph company's own station, where a transmitter revealed a faulty exciter unit. The only thing needed here was readjustment.

AS THIS COLUMN was being written during the final weeks of '56, TV's growth along station row was still bottled up by investigations, probes, and petitions. The slow station-grant pace set in the early days of the year continued and as a result authorizations were only trickling out. As the listings on page 12 show, the output continues to be quite meager.

UNUSUAL ELECTRONIC TOOLS involving TV and radio are now in use by oil companies.

In the southwest, a marine sonoprobe has been developed for exploring of the ocean floor and sediments 80 feet or beneath it; useful for offshore oil exploration, submarine pipeline construction, and underwater salvage operations.

The sonoprobe is similar in construction and operation to conventional recording echo sounders used for measuring the depth of water, but it has been specially designed to get echoes from beneath the ocean floor.

The instrument used a special sound source which produces sound pulses of much lower frequency and much greater power than in conventional echo sounders. These pulses have been found to penetrate bottom sediments and are reflected back from layers beneath the bottom.

The sea floor and layers beneath it are displayed on a small TV picture tube and are also recorded as a continuous profile on electrosensitive paper.

The electronic sea probe, intended for use in water-covered areas of the world, where conditions are favorable, can be mounted on shallow-draft boats for use in shallow water or on larger vessels for use in deeper water.

The instrument was originally designed, built, and tested for underwater geological research; it has also been used for mapping the routes of underwater pipelines and in surveying sites for offshore drilling platforms, for which pilings must be driven into the sea bottom.

In addition, the new tool has been used to find buried beds of oyster shells, which are then dredged from beneath the ocean floor for use in road construction and in making cement, chemicals, and fertilizer.

Experience with the new device indicates that it will provide reliable maps of shallow salt domes, shallow faults, buried ancient channels and valleys, and shallow geological structures. It may also give useful information to determine the extent of silting in reservoirs.

ON THE NORTHEAST of Borneo, electronics has also come to the rescue of oil operations. There a remote-control radio installation has been developed to meet difficulties involved in loading oil into tanks 3½ miles off the shore of Sarawak.

Because of the shallowness of the water off Sarawak, tankers are forced to load miles off shore using underwater pipelines, creating many engineering problems. The radio system has solved the problem.

Now, as a tanker approaches the moorings for a loading, a portable transmitter-receiver is taken on board, which in addition to providing a connection with the shore terminal, can transmit on a special pump control channel. Should it be necessary to stop the pumps in an emergency, the depressing of a control button on the panel of the portable set overrides the telephone channel and brings the pump control channel into operation.

Seven portable radio units are employed. They incorporate loud-hailing facilities and a remote-control unit which enables the equipment to be operated up to a distance of three hundred feet from the base. . . . L. W.

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SEE PAGES 117-123

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New Tube Tester Data

New radio and TV tubes are always being introduced. Bring your Eico and Philco tube checkers up to date with the data listed here for the new tube types.

EICO MODEL 625

No.	Shunt	Fil.	Sel.	Up	Down	No.	Shunt	Fil.	Sel.	Up	Down
2BN4	25	2.0	2	2,5,7	1,3,6	6CG8	26	6.3	2	1,2	3,4,8
3B2	100	3.3	4	10	1,3,5,7	(NO shorts test on levers 3 and 8)					
(Good = 500)						6CH8	24	6.3	2	2,3,7	4,6
4BS8	19	3.3	3	1,2	3,4	6CH8	26	6.3	2	8,9	1,4
4BS8	19	3.3	3	6,7	4,8	6CR6	27	6.3	2	5,6,7	1,3
4BX8	16	3.3	1	6,7	4,8	6CR6	30	6.3	1	2	1,3
4BX8	16	3.3	1	1,2	3,4	6DC6	22	6.3	2	1,5,6	2,3,7
5CG8	24	5.0	2	6,7,9	3,4,8	6DQ6	18	6.3	3	4,5,10	2,8
5CG8	26	5.0	2	1,2	3,4,8	12AC6	17	12.6	1	1,5,6	2,3,7
(NO shorts test on levers 3 and 8)						12AD6	16	12.6	1	1,5,6,7	2,3
6BK4	100	6.3	4	10	1,2,3,4,6,8	12AD6	16	12.6	1	1,6	2,3
(Good = 50)						12AE6	18	12.6	1	1,7	2,3
6BN4	25	6.3	2	2,5,7	1,3,6	12AE6	50	12.6	1	6	2,3
6BR8	24	6.3	2	6,7,9	4,8	12AF6	16	12.6	1	1,5,6	2,3,7
6BR8	24	6.3	2	1,2	3,4	12CR6	29	12.6	2	5,6,7	1,3
6BS8	19	6.3	3	1,2	3,4	12CR6	29	12.6	1	2	1,3
6BS8	19	6.3	3	6,7	4,8	12CU5	20	12.6	3	2,5,6,7	1,3
6BX8	16	6.3	1	6,7	4,8	12DQ6	18	12.6	3	4,5,10	2,8
6BX8	16	6.3	1	1,2	3,4	12F8	16	12.6	1	2,3,8	4,7,9
6CB5	20	6.3	3	1,4,5	2,3,6,8,10	12F8	37	12.6	1	6	4,7
6CG8	24	6.3	2	6,7,9	3,4,8	12F8	37	12.6	1	1	4,7
						12K5	16	12.6	1	2,5,6,7	1,3

PHILCO MODELS 7050 and 7051

Tube Type	Fil. Cont.	Tog. Short	Sw. Cont.	Load Qual.	Tog. Sw. Test	Tube Sec.	Tube Type	Fil. Cont.	Tog. Short	Sw. Cont.	Load Qual.	Tog. Sw. Test	Tube Sec.
2B3	2	kmop	8	KMOPT			6CL8	6	ABCDEF	3	BCEF		T
3AF4	4	bnrsAFE	4	BNERS		T						Cannot be tested	P
3BU8	4	ABCDEF	3	ABE		P1	6X8*	6	ABCDEF	2	BDE		P
				AF		P2					ABCF		T
3C2	1	klmneph	4	KLMNEPHT			8AU8	7	ABCDEF	3	A		T
3CE5	4	bnrEFS	14	ABNG							B		P
4BC5	5	bnrAGEF	2	ABGNT			8BA8	7	ABCDEF	4	ABCF		T
4BN6	5	nbAEFG	2	BNRT							ABDE		P
4BU8	5	ABCDEF	3	ABE		P1	8BH8	7	ABCDEF	4	A		T
				AF		P2					B		P
4BX8	5	CDEF	3	ADEF		T1	8BN8	7	ADBECF	4			T
				BCEF		T2					CEF		D1
4CB6	5	bnrAGEF	4	ABGNT							CDF		D2
4CE5	4	bnrEFS	14	ABNG			8CG7	7	ABCDEF	7	F		T1
4DT6	5	bnAEFGS	14	ABN							E		T2
5AU4*	5	mABDEF	4	MD		D1	8CM7	7	ABCEEF	4	AEF		T1
				BM		D2							T2
5BQ7	6	ABCDEF	2	ADEF		T1	8CN7	5	hABCDEF	5	AEH		D1
				BCEF		T2					DEH		D2
5BR8	5	ABCDEF	3	BCEF		T					BH		T
				ADEF		P	8SN7	7	csABDEF	2	ABCF		T1
5BZ7	6	CDEF	3	ADEF		T1					ABCDES		T2
				BCEF		T2	9AU7	5	hABCDEF	7	EH		T1
5X8*	5	ABCDEF	2	BDE		P					FH		T2
				ABCF		T	9U8	7	ABDEFCE	Cannot be tested			T
6BU8	6	ABCDEF	3	ABE		P1					ACF		P
				AF		P2	12AD7	6	hABCDEF	7	EH		T1
6BV8	6	ACCFBDE	3	ABCF		T					FH		T2
				Cannot be tested		D1	12AE6	8	bnAEFG	4	ABNEFRT		T
				ACDEF		D2					ABNE		D1
6BX8	6	CDEF	3	ADEF		T1					ABNF		D2
				BCEF		T2	12AF6	8	bnrAEF	5	BGNS		
6CG8	6	ABCDEF	4	BCEF		T	12AG6	6	bnAEFGS	11	ABN		
				Cannot be tested		P	12D4	8	cAB	4	AC		
6CH8	6	ABCDEF	Cannot be tested			T	12F8	8	ABCDEF	11	BCDEF		D1
				ABF		P					ACDEF		D2
											ABC		P

*Revised data

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Full Photographic Coverage: Photos of all chassis views are provided for each model; all parts are numbered and keyed to the schematic and parts lists for quicker parts identification and location.

Alignment Instructions: Complete, detailed alignment data is standard and uniformly presented in all Folders. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

Tube Placement Charts: Top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

Tube Failure Check Charts: Shows common trouble symptoms and tubes generally responsible for such troubles. Series filament strings are schematically presented for quick reference.

Complete Parts Lists: Detailed parts list is given for each model. Proper replacement parts are listed (with installation notes where required). All parts are keyed to chassis photos and schematics for quick reference.

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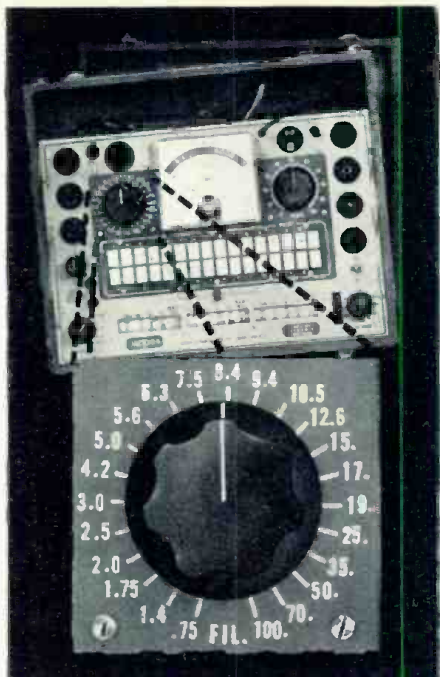
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In Canada: The Canadian Marconi Company



Bombardier (left) and navigator (right) operate this 2-man station at master control panel of a later version of fabulous "K-System" bombing-navigation controls.

B-52 Bomb Navigation System ...

First photos of system that pinpoints any spot on globe in any weather.

FAR cry from the relatively simple "bombsight" of early World War II is this later version of the "K-System" bombing-navigation controls in new USAF B-52 Stratofortress bombers. These are first operational views of a master control panel, just released 10 years after the system was initially developed and produced by *Sperry Gyroscope* for the still-formidable B-47 and B-36 squadrons of Strategic Air Command. First view here reveals, by a selector switch above navigator's helmet (top right), the trans-polar range capability of the bombers.

The K-System automatically measures distance and time to target, computes ballistics of bomb's curve for existing altitude, temperature and crosswinds, permits final hairline adjustment via radar or optical sight, triggers bomb away at proper instant, then helps the navigator to guide the shortest way home.

Originally designed, developed, and produced by *Sperry Gyroscope*, manufacture of this critical gear was rapidly dispersed through other plants of *General Motors*, *National Cash Register*, and *IBM*. *Eastman Kodak*, *Western Electric*, *General Mills*, *Motorola*, and *Farrand* were multiple prime or sub-system sources. *Western Electric* developed the radar. In all, about one

million factory workers and technicians in 36 states, at 3050 companies large and small, have been directly engaged in this Air Force program to supply needed K-Systems.

More than 70,000 individual parts make up the various computers and other elements of a single K-System for an individual aircraft—about as many parts as a modern automobile with power steering and automatic transmission. Each system contains complex circuitry for hundreds of pre-tested vacuum tubes, over 50 motors, and about 100 relays, with many sealed amplifiers for quick unit replacement while in the air.

The original prototype cost of nearly a half-million dollars was reduced to less than half by manufacturing improvements in volume production. Nearly 900 major improvements for system efficiency through all production channels have been made in the last six years.

Sperry is now "phasing out" its K-System activity, and turning to more advanced gear. Meantime, the Air Force has announced the later-model B-52's will replace the K-System with an improved "Brane" bombing system to be produced by *IBM*. —30—

Bombardier has complete control of aircraft for the final moments of target run.



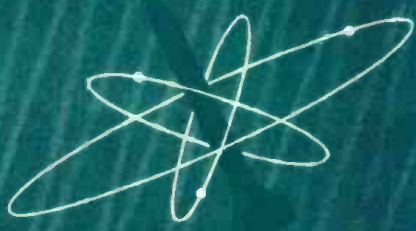
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"I chose CREI training upon recommendation of two top engineers. Before I completed the course, I became transmitter chief of a 5 kw station. I am now employed as a technician at a 100 kw TV station and in spare time have a good TV sales and service business."—Arlie D. Patton, 203 Burke Ave., San Antonio, Tex.

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many leading companies that a man is worth hiring. Moreover, employers contact us regularly for graduates to fill good jobs. Our placement bureau cannot keep up with the demands.

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"In view of the fact that we have recently merged with the General Dynamics Corporation, we are entering a period of greatly expanded activity. Our need for the technical institute graduate is, therefore, greater than it has been, and we are interested in bringing our opportunities to the attention of your students."—Stromberg-Carlson Company, Rochester 3, New York.

"Just about four months have passed since I made my first recruiting trip to CREI. As a result of that visit Messrs. Kohs, Plante and Wenger are now members of the Laboratories and Mr. Kreege soon will be . . . we have some openings now and will have others . . ."—Bell Telephone Laboratories, Murray Hill, N. J.

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IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED? _____

RADIO TV TUBES
WHAT A BUT
DYNAMIC
HIGH FIDELITY FOR LESS

Sales Aids

SELF-SERVICE TAPE DISPLAYS

Minnesota Mining and Manufacturing Co., 900 Fauquier Street, St. Paul 6, Minn. has introduced three new self-service tape merchandisers which are now appearing in stores throughout the country.

Due to the growth of the tape recording industry, magnetic tapes are now easier for the recorder owner to select and buy. Stores now handling tape and recorders include photo stores, music and record shops, high-fidelity equipment dealers, appliance stores, and department stores.

In the past, however, the tape recorder owner has had to ask his dealer whether he sold magnetic tape. With



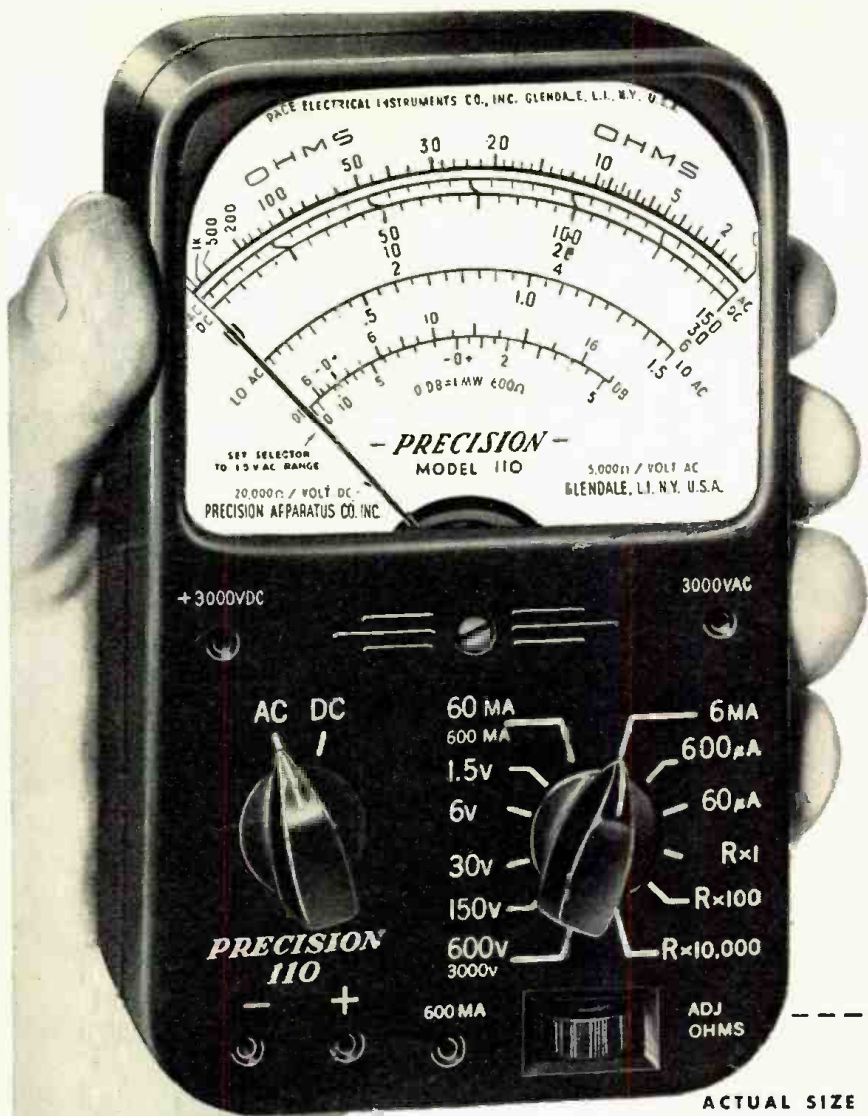
these new merchandisers the purchaser will be offered a full line of magnetic tape and will find it conveniently displayed for self-service.

PROFITABLE BUSINESS MANUAL

Stromberg-Carlson has prepared a new manual outlining the most important steps in conducting a profitable business.

The 36-page booklet contains a quick and easy method for estimating the market potential and probable sales for an individual dealer in a given area, and suggests a suitable promotional budget based on a percentage of this volume. The dealer is also shown how to make allowances for such factors as competition, cooperation from his supplier, and general buying trends.

Further guidance also is given on the dealer's approach to various media and services commonly used, such as newspaper, radio and television advertising, direct mail, displays, shows, etc., with suggested percentages for each. How to schedule promotions, build mailing lists, answer inquiries, write sales-pulling letters, how to select music for and handle demonstrations, organize shows and "open houses," how to make best use of mats, and suggested copy for newspaper ads, are all



ACTUAL SIZE

PRECISION 110

'THIN-LINE' POCKET-SIZE Model
20,000 ohms-per-volt V.O.M.

Model 110:
Complete with vinyl case, ohmmeter batteries, heavy-duty banana-plug test leads and manual. Dimensions 1 1/4" x 3 1/2" x 5 3/8". Shipping weight 3 lbs. Net Price \$34.50

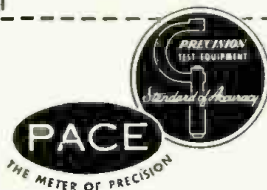
— Also Available —
Model 100: Similar to Model 110 above, except 1000 ohms per volt AC and DC
Net Price \$29.95

- Full-Range Instrument Performance small-sized instrument convenience
- Fits Your Pocket... Fits Your Tube-Caddy... the ideal extra V.O.M. for field and service
- Extra-High Sensitivity 20,000 ohms per volt DC... 5000 ohms per volt AC
- Extra-Low... Extra-High Voltage Ranges 1.5 volts full-scale extra-low AC and DC 3000 volts full-scale extra-high AC and DC
- Extra-Wide Resistance Ranges self-contained up to 20 megohms
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Available at leading electronic parts distributors.

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Get the new Stancor Replacement Guide from your Stancor distributor or by writing to Chicago Standard... NOW!

discussed in simple language that is well organized for quick reference.

Copies of the manual have been mailed to the company's "Custom Four Hundred" high-fidelity dealers, by the firm's Special Products Division, Rochester, N. Y.

RAM COIL DISPLAY

RAM Electronics Sales Company has created a new counter and wall display designed specifically to help distribu-



tors boost the sale of width and linearity replacement coils.

It stocks, displays, and enables refilling and inventory check in just a few minutes.

For further data, write to the company at: Irvington-on-Hudson, New York.

VACO "TOOL CENTER"

Vaco Products Company has introduced its "Tool Center" display in the form of a "Vari-Board" back panel and roomy storage cabinet with sliding doors underneath.

The "Vari-Board" perforated back panel is 3½ feet high and 4 feet wide, offering 14 square feet of display space. Over the top is an illuminated canopy which gives the tools a dramatic setting.

The storage cabinet is 48" wide, 15"



deep, and 18" high. The entire unit rests on four wrought iron black lacquered legs, pitched at a modernistic angle.

The display is furnished with a basic assortment of tools containing general purpose screwdrivers, nut drivers, pliers, wood chisels, and screwdriver and nut driver kits. All items are self priced. This unit may also be pur-

RADIO & TELEVISION NEWS

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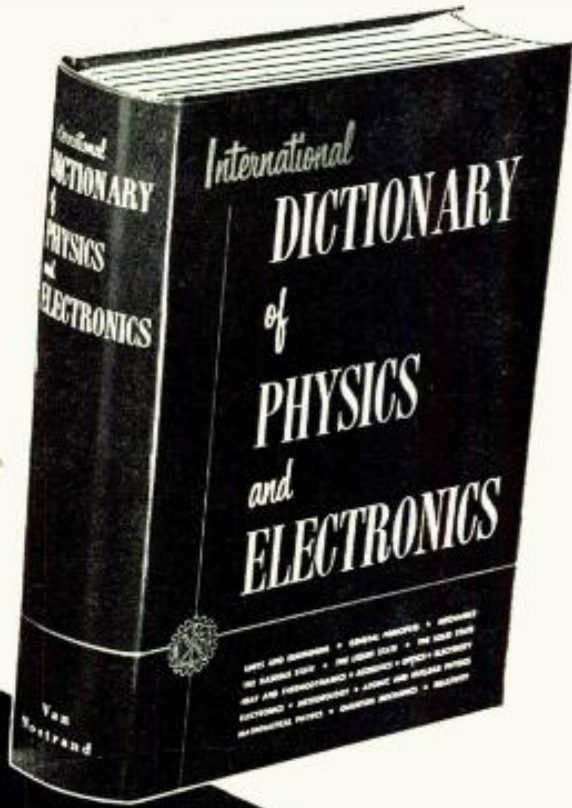
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tions, wherever possible, which have been established or recommended by recognized groups are included. Many terms that have been defined from the subject areas bordering on physics will be especially helpful. And, for those without an extensive mathematical background, both explicit and discursive statements and entries are given, as well as the definitions of the more common mathematical terms encountered.

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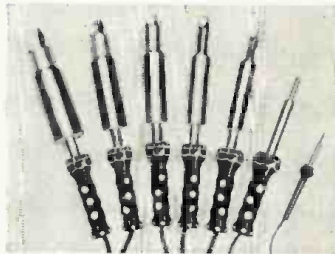
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OVER 20,000,000 SOLDERING PRODUCTS SINCE 1864

chased without the tool merchandise.

A four-page bulletin containing complete information may be obtained from the company. They are located at: 317 E. Ontario St., Chicago 11, Ill.

NEW DISPLAY CARTON

A new display carton has been introduced to dealers everywhere by the *Electronic Chemical Corp.* of Jersey City, N. J.

This corrugated carton now enables



dealers to show 12 cans each of "No-Noise Volume Control and Contact Restorer" and "No-Noise Tuner Tonic" in one compact arrangement. The display is done in red and black and is self-mounting. Features of the company's two products are prominently shown, together with price.

TRANSISTOR RADIO DISPLAY

Emerson Radio & Phonograph Corp. has introduced a new promotion device especially designed to solve the problem of pilferage of transistor pocket radios from retail counters.

There has been a strong dealer demand for a display fixture that would be durable, attractive, and theft-resistant. The small pocket radios tempt shoplifters and, consequently, dealers have been reluctant to display them.

The new fixture has four radio cabinet fronts (containing no chassis) permanently attached to a display under glass. An additional advantage to the dealer lies in his stock not being tied up for display purposes.

NEW RCA FILM

RCA Institutes, Inc. has made available for high school showings a new 16-mm color motion picture entitled, "Your Career in Electronics."

The purpose of the film is to familiarize the high school student with the role of the technician in the electronics industry. It shows how the student receives instruction in radio-television and electronics at the technical institute, and then puts his knowledge into practice at research and development laboratories, and industrial firms. The movie also illustrates some of the opportunities for electronic technicians, which include broadcasting, communi-

"I cut testing time in half"
 ... "doubled our tube sales" *



"Adds to my income and saves me unprofitable call-backs."

"We have two... one for the shop and one for house calls."

"Paid for itself several times. Really indispensable"

"Best tube tester I've ever owned. Simple to operate. Saves time."

"Makes lots of money for us. Wonderful instrument."

"Serves my purpose best for speed and dependability."



B&K MODEL 500
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DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

FASTEST SELLING TUBE TESTER
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Tests over 95% OF ALL POPULAR TV TUBES — IN SECONDS

- Accurately makes each tube test in seconds. Checks average TV set in minimum minutes
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- One switch tests everything. No multiple switching. No roll charts.
- Shows tube condition on "Good-Bad" scale and in micromhos. Large 4½-inch plastic meter has two highly accurate scales calibrated 0-6000 and 0-18,000 micromhos.
- Automatic line compensation is maintained by a special bridge that continuously monitors line voltage.
- Built-in 7-pin and 9-pin straighteners are mounted on the panel.

* NAMES ON REQUEST



Makers of Dyna-Quik, CRT, Dyna-Scan and Calibrator

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One extra tube sale on each of 5 calls a day pays for the Model 500 in 30 days

Enthusiastic comments like those above* come from servicemen all over the country. *Actual experience shows an average of close to 2 additional tube sales per call.*

Instead of the "trial and error" method of substitution testing, the Dyna-Quik 500 quickly detects weak or inoperative tubes. Cuts servicing time, saves costly call-backs, shows each customer the true condition and life expectancy of the tubes in the set, and makes more on-the-spot tube sales. Helps keep customer good-will, give a better service guarantee, and make more profit.

The B&K Dyna-Quik 500 measures *true dynamic mutual conductance*. Completely checks tubes with laboratory accuracy under actual operating conditions right in the home... *in a matter of seconds*. Saves time and work in the shop, too. Simple to operate. Easily portable in luggage-type case. Weighs only 12 lbs. **NET, \$109⁹⁵**

See Your B&K Distributor or Write for Bulletin No. 500-N



Model 1000 DYNA-SCAN
 Picture and Pattern Video Generator Complete Flying Spot Scanner. Net, \$199.95



Model 400 CRT
 Cathode Rejuvenator Tester. Tests and repairs TV picture tubes. Net, \$54.95



Model 750 CALIBRATOR
 Designed to check and adjust test instruments with laboratory accuracy. Net, \$54.95



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- Economical
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ILLUSTRATED Single and 6.12 Volt 6 Amp. Unit

ILLUSTRATED Single and 6.12 Volt 6 Amp. Unit

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cations, servicing, aviation, guided missiles, and civil defense.

This film is available for free showing at high schools, educational groups, Boy Scouts, and social service organizations. Running time of the film is 24 minutes.

For information on bookings, contact: Registrar, in care of the school at 350 West Fourth St., New York 17, N. Y.

CAPACITOR SERVICE KITS

Cornell-Dubilier Electric Corp. has introduced two service kits for capacitor replacements.

The kits are flat, clear plastic, hinged cover (11" x 6 1/2" x 1 7/8") cases that fit into a regular field service bag. The "Cub" kit is made up of 76 molded tubular capacitors of assorted ratings



and types most frequently needed on service calls and bench service. The "Blue Beaver" kit comprises 22 of the most widely used electrolytic types. Each kit also contains a location chart, ratings, and prices of each capacitor, and a guide which lists the complete lines.

These cases are supplied free of charge with the purchase of a pre-selected assortment of capacitors. The service technician pays only for the capacitors in the kit. The company's distributors can furnish additional detailed information, or write direct to the firm at South Plainfield, New Jersey.

NEW MULLARD TUBE PACKING

Mullard, British electronic tube manufacturer, recently introduced a blue-plastic pin protector which guards miniature tubes against the possibility of damage in transit.

These protectors fit snugly over the tube pins, effectively padding them against any damage which might be caused during shipment. When the tubes have been put into use, the protectors can be fastened to the workbench or perhaps a piece of board as a storage rack, thus preventing the breakage that often occurs when tubes roll or are knocked off the table. This is a convenience which is readily appreciated by the experienced and efficient service technician.

For further information, write to the firm's representative, International Electronics Corp., 81 Spring Street, New York 12, N. Y.

BUILD 16 RADIO

Reg. U. S. Pat. Off.

CIRCUITS AT HOME WITH THE NEW DELUXE PROGRESSIVE RADIO "EDU-KIT"



A Practical Home Radio Course ONLY \$22.95

FREE: Set of Tools, Soldering Iron, Tester, Membership in Radio-TV Club; Consultation Service, TV, Radio, Hi-Fi, Quiz Books, FCC Amateur License Training, Printed Circuit Boards, Pliers-Cutters, Alignment Tool.

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. You will learn radio theory, construction and servicing. You will learn to build radios, solder and wire in a professional manner, trouble-shoot radios. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for TV. In brief, you will receive a basic education in Electronics and Radio, worth many times the small price you pay.

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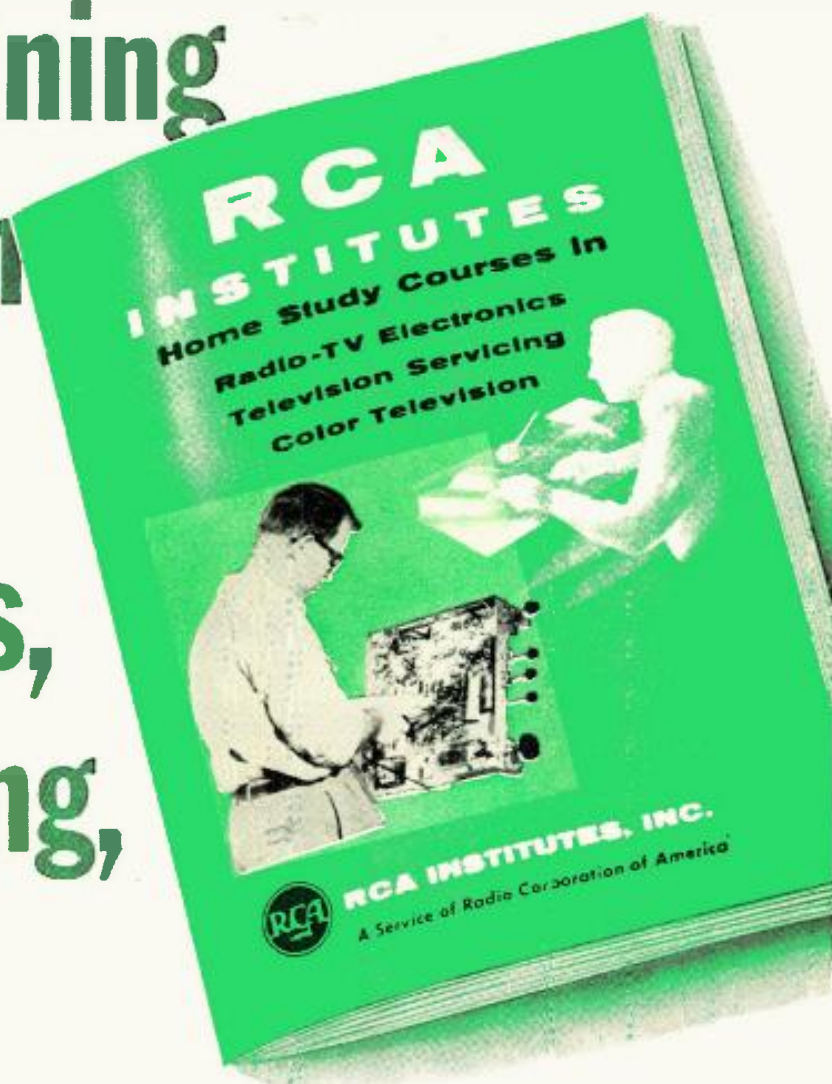
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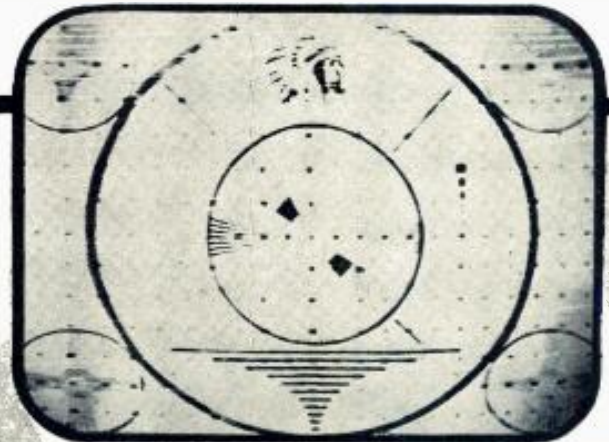
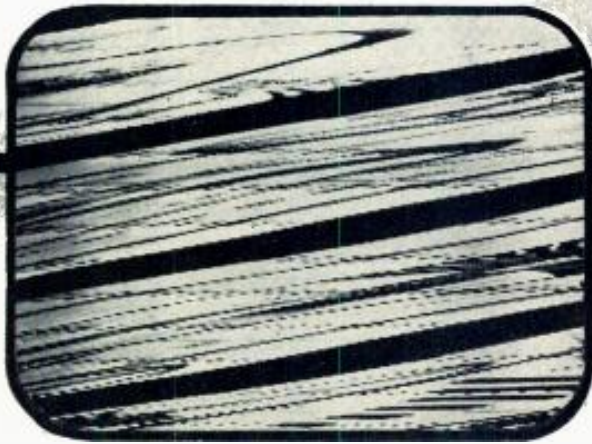
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Curing TV I.F. Troubles

By DONALD QUARANTA
CBS TV Technical Operations Dept.

A misadjusted i.f. strip can lead to the troubles shown in these two pictures. One indicates loss of horizontal sync with the resulting tearing, the other shows picture which is washed out—loss of detail.



Weak pictures, loss of detail, smearing, and poor a.g.c. action are often due to poor i.f. curve. Here is possible cure.

CHANGES in the i.f. response curve of a TV set due to misalignment of the i.f. strip may not only degrade the picture quality of the receiver but can be the source of other troubles. Weak sync, poor a.g.c., and poor blanking many times result from misalignment of the i.f. This article will explain the effect an improper response curve can have on the picture and a way of interpreting and correcting any improper alignment in the i.f.

Possible i.f. misalignment is a problem because of the critical design of this section of the television receiver. Some television manufacturers use specially chosen tubes for the i.f. strip to obtain optimum picture results. Actually, the alignment of the i.f. circuits of a television receiver determines, to a great extent, the kind of performance which the receiver will give.

When a television receiver becomes inoperative due to a defective i.f. tube, the new replacement tube may cause the picture quality of the receiver to change. This does not mean that every time an i.f. tube is replaced, the receiver needs alignment. However, over a period of years, the picture quality of the receiver may change due to the replacement of a few i.f. tubes and the heating of the i.f. circuit components. The deterioration of the response curve in the i.f. section due to these changes can be seen in the workshop on the sweep scope display.

Variations in the i.f. circuit may oc-

cur to such an extent that it is hard to say beforehand what form or shape the i.f. curve will take with the changing of i.f. tubes or circuit components. These changes can cause among others: high picture carrier, low picture carrier, increase of bandwidth, decrease of bandwidth, and/or tilting of the response curve. These variations in the i.f. curve can eventually result in poor sync or blanking, loss of high and low frequency detail, or poor a.g.c. operation.

To help in the interpretation of these troubles it is important to have a knowledge of the i.f. response curve and its effect on the picture. Fig. 1 shows a normal i.f. response curve with the response down 50% at the picture carrier frequency—the actual bandwidth is determined by the manufacturer's design. If a test pattern were being displayed by the picture tube of a receiver with this response, it would be interesting to note that it would show good reproduction of the fine picture details, good low frequency performance, and a good contrast range.

Fine picture detail can be checked on the test pattern by observing the lower vertical wedge. A normally aligned receiver would show distinct vertical lines far up towards the center of the test pattern before they begin to blend together. Low frequency performance of the receiver can be checked by observing any thick horizontal lines on the test pattern. These thick lines should be clean cut. Good

contrast affords many shades of brightness ranging from white, through grey, to black. By proper adjustment of the brightness and contrast controls the test pattern should show these distinct and different shades.

If the picture carrier were located at 10% of the response curve height, the low frequency response would be reduced and this effect would show up in the receiver as poor blanking, weak sync, and poor a.g.c. operation. It is important to know that major picture components and the blanking and sync pulses represent relatively low frequencies. On a test pattern this condition would show up readily as weak horizontal wedges and smears on any dark lettering or large picture areas.

If the picture carrier were up at 90% of the response curve, the low frequency picture signals would be strong but the high frequencies would be lost and the result would probably be poor picture definition. On a test pattern this would be clearly indicated by the blending together of the vertical wedges at a relatively low frequency and the loss of definition in small picture areas.

I.F. Tests

The frequencies to which the i.f. transformers and traps are tuned in different TV receivers are not the same, therefore it is necessary that the service technician obtain complete service data before attempting i.f. alignment or tests. Also, the procedures to use for different sets vary in

some respects, such as the amount of grid bias to apply or the method of peaking the i.f. coils, etc. For this reason, the information to be given in this article concerns a basic procedure rather than a specific method. However, as an example, one definite procedure is included for checking a stagger-tuned i.f. strip.

TV manufacturers often recommend use of a particular pad or network when aligning their sets. Valuable time can be lost in making up these special "heads" or detector pads, particularly if the service technician only wants to check the i.f. strip. The quick and accurate method of checking i.f. strips described here is the result of actual experience in servicing receivers.

The basic test equipment needed to check the i.f. strips of most TV receivers includes:

1. A sweep generator covering TV intermediate frequencies. The exact frequency setting should be determined by the use of external or built-in markers. The flatness of the sweep generator output should be checked before making any adjustments of the i.f. response curve. A simple detector which can be used for checking the flatness of the generator output is shown in Fig. 2. The output of the sweep generator should be flat for at least 10 mc.

2. An oscilloscope with good low frequency response. The vertical input should be calibrated to 3 volts peak-to-peak.

3. An accurately calibrated signal generator to cover the intermediate frequency range.

4. A low impedance bias box for different bias levels (0-6 volt) to be applied to the a.g.c. bus. If the receiver has keyed a.g.c., it is best to remove the keyer tube before aligning the i.f. strip. The low impedance supply is necessary to prevent any of the receiver bias from developing. A circuit for a low impedance bias supply for this purpose is shown in Fig. 3.

5. A "spray shield," as shown in Fig. 4, for feeding the sweep signal into the mixer stage of any receiver. This signal injection device is capacitive and looks into the complete i.f. strip, from the mixer output to the detector load. This special piece of test equipment is not only simple in structure and easy to make, but it has proven satisfactory in servicing most receivers. Using it is better than coupling the signal into the regular mixer tube shield. The latter method gives erroneous responses because the sweep signal is not evenly distributed onto the tube elements of the mixer and the final response shows either a tilt or an incorrect carrier position.

This "spray shield" should match the output impedance of the sweep generator. If the sweep generator has a 75-ohm output impedance, the shield should be terminated in this value. This is accomplished by connecting four resistors in parallel across the two parts of the shield to give a combined resistance of 75 ohms. In this

case, four 300-ohm resistors are used. The "hot" generator lead is connected to the upper part of the shield; the bottom portion accepts the ground lead of the generator. For even distribution of the sweep signal, it is best to use as round a shield as possible and to position each resistor at equal distances around the shield.

Now, let's examine a typical stagger-tuned i.f. strip. On the schematic diagram of such a circuit, Fig. 5, the mixer tube is not shown but it is a 6AT8. The second detector load resistor is R_1 .

Connect the sweep generator output to the "spray shield" and slip the latter over the mixer tube. Next, connect the scope lead through a 27,000 ohm isolation resistor to the top of the detector load resistor. For this particular circuit, insert a -3 volt bias at the top of C_1 and to the tuner a.g.c. terminal.

Turn on the receiver under test, tune it to an unused channel, and adjust the sweep generator to produce a 3 volt peak-to-peak signal on the scope. After the i.f. response curve is observed on the scope, inject the signal generator signal by placing its output lead near the i.f. circuitry. If the response curve shows that the picture carrier (45.75 mc.) is too low and the original trouble with the receiver was that it had weak sync, the trouble could be this low carrier. As a quick corrective step touch up coil T_2 (45.7 mc.) to raise the carrier side of the response and then straighten it out with T_3 which affects the tilt.

If the response curve shows that the carrier is up too high, it would be necessary to adjust T_2 (45.7 mc.) to lower the carrier response at the carrier frequency.

It is not necessary to completely align the i.f. section if only the carrier side of the response curve is wrong. Complete realignment is needed only when the picture quality is exceptionally poor.

Even in cases when the picture quality on a receiver is very poor and the technician may feel that complete realignment is necessary, it is advisable to try the method outlined here first. A simple touchup of the response curve can save lots of valuable time and the results may be very effective. However, if a complete realignment is nec-

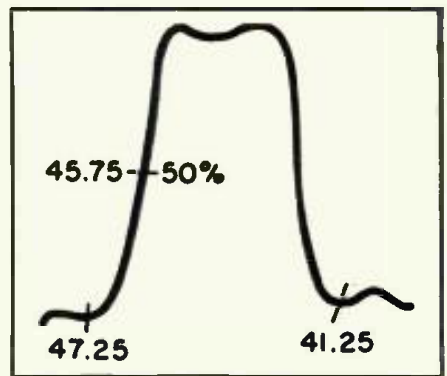


Fig. 1. Normal picture i.f. response curve showing the picture carrier at 50% of the peak amplitude. If this carrier is higher or lower on the curve, the picture suffers.

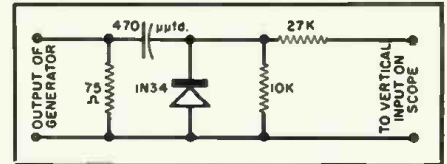


Fig. 2. The circuit shown here is a detector which may be used to check the flatness of the output of a sweep frequency generator.

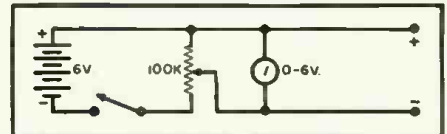


Fig. 3. This low impedance bias supply is useful for supplying the proper a.g.c. bias voltage to the i.f. and tuner circuits during alignment with the a.g.c. disconnected.

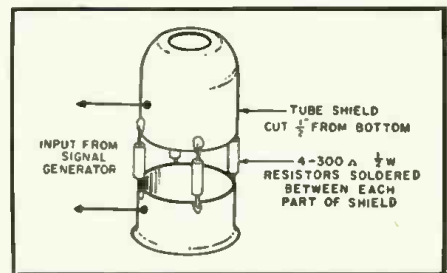
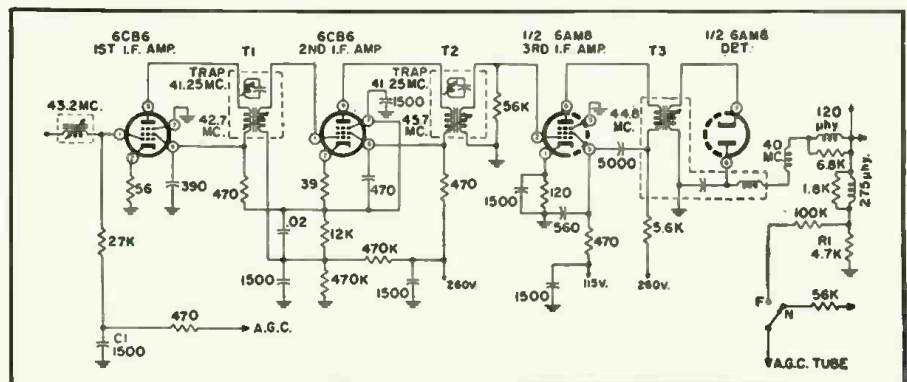


Fig. 4. This modified tube shield fits over the tuner mixer tube and is used as feed-in point for the sweep signal.

essary, be certain to refer to the service data for the receiver under repair to obtain the correct bias and frequencies.

Fig. 5. Schematic diagram of the picture i.f. circuits of a CBS-Columbia TV set.



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ber of the board of directors of *Kay Lab.* . . . **EVERETT S. LEE**, well-known engineer and past president of the American Institute of Electrical Engineers, recently retired after more than 40 years with the *General Electric Company* . . . *The Ramo-Woodbridge Corp.* has announced the election of **ROBERT J. HIGHT** as treasurer . . . **ALAN EASTON** has been appointed vice-president and sales manager of *General Transistor Corp.* . . . **HENRY F. ARGENTO** has been appointed vice-president, commercial sales, for *Raytheon Manufacturing Company*. He was vice-president and general manager of the firm's former television and radio operations in Chicago . . . *The National Company* has named **PHILIP R. HEATH**, recently retired Lt. Commander in the U. S. Navy, to the new post of field service supervisor. He will make his headquarters in Nagoya, Japan . . . **HARRY G. MCKENZIE** has been named general sales manager of the *Gray Research and Development Company, Inc.* He was formerly with the *Rudolph Wurlitzer Co.* . . . **DR. JOHN T. HENDERSON** has been elected president of the Institute of Radio Engineers for 1957. He is principal research officer of the National Research Council, Ottawa, Canada. **YASUJIRO NIWA**, president of Tokyo Electrical Engineering College, Tokyo, Japan, is the new IRE vice-president. Elected as directors for the 1957-58 terms are: **D. E. NOBEL**, vice-president in charge of the Communications and Electronics Div. of *Motorola, Inc.*, Chicago, Ill., and **SAMUEL SEELY**, professor and head of the Department of Electrical Engineering at Case Institute of Technology, Cleveland, Ohio.

J. P. ARNDT, JR. has been appointed assistant to the vice-president and general sales manager of *Brush Electronics Co.*, division of *Clevite Corp.*, Cleveland, Ohio.

He joined the company in 1935 as a patent engineer. Successively he became manager of the Patent Department, manager of the Crystal Measurements Department, and Crystal Sales manager.



In his new post, he will concentrate his activities on product planning and development.

DONALD B. HARRIS, manager of electron tube research at *General Electric's Microwave Lab.* in Palo Alto, Calif., has been elected chairman of the 1957 Western Electronic Show and Convention.

Vice-chairman in charge of exhibit operations for the show is Norman H. Moore, vice-president of *Litton Industries* and managing director of that

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company's electron tube division in San Carlos, Calif.

B. M. Oliver, director of research and development at *Hewlett-Packard Co.* in Palo Alto, has been named vice-chairman in charge of convention activities, and H. Myrl Stearns, vice-president and general manager of *Varian Assoc.* in Palo Alto, was elected secretary-treasurer.

The four additional convention directors are Bruce S. Angwin of the *General Electric Tube Div.*, E. P. Gertsch of *Gertsch Products, Inc.*, C. Frederick Wolcott of *Gilfillan Brothers, Inc.*, and Gramer Yarbrough of the *Elgin Electronics Division*.

* * *

DOUGLAS F. HUDSON has been appointed to the position of president of *Permo, Incorporated*, Chicago, Ill., manufacturer of the "Fidelitone" line of phonograph needles and accessories.



During his ten years of association with the organization, he has served as division manager, manager of industrial sales, and most recently as vice-president and director.

Mr. Hudson attended college at U.C.L.A. and prior to his employment with the company served in the U. S. Navy as Lieutenant, Senior Grade.

* * *

SYLVANIA ELECTRIC PRODUCTS INC. announced plans for a multi-million-dollar research and development center in Amherst, N. Y., for the company's Electronic Systemic Division . . . **CBS-HYTRON**, tube manufacturing division of the **COLUMBIA BROADCASTING SYSTEM, INC.**, has opened a new sales office and warehouse in Seattle, Washington. The new facility is located at 102 West Roy Street . . . **NEWARK ELECTRIC CO.** announced plans to construct a new 35,000 square-foot building in Inglewood, Calif., to house its West Coast headquarters. It will be located at Rosewood and Century Blvds., and occupancy is planned for early fall . . . A branch communications laboratory of **FEDERAL TELECOMMUNICATION LABORATORIES** has been established at 809 San Antonio Road, Palo Alto, Calif. . . . A \$250,000 expansion program has been announced by **KAY LAB.** Completion of this addition to the present plant is scheduled for late spring . . . Construction has begun on an addition to the assembly plant of **SERVO CORPORATION OF AMERICA**, New Hyde Park, L. I., N. Y. . . . **SYLVANIA ELECTRIC PRODUCTS INC.** will construct a 50,000-square-foot addition to the Electronics Division headquarters plant in Woburn, Mass. Completion is scheduled for July, 1957 . . . **MICROTRAN COMPANY, INC.** has moved to its new plant at 145 E. Mineola Ave., Valley Stream, N. Y. . . . A new electronic research and development building, containing 40,000 square feet, will

be constructed by **HOFFMAN LABORATORIES, INC.** in the 3700 block on South Grand Ave., Los Angeles, Calif. Ground is also being broken for a new administrative building immediately adjacent to the present facilities . . . **TRIPLETT ELECTRICAL INSTRUMENT COMPANY** of Bluffton, Ohio, is planning to construct a 10,000-square-foot plant in Oceanside, Calif. . . . **KOESSLER SALES COMPANY**, and its division, **KOESSLER INDUSTRIONICS**, recently announced the purchase of a building at 818 North Fairfax Avenue, Los Angeles, Calif. The new housing includes larger offices and demonstration room, more warehouse facilities, and 3000-square-feet of parking. The move into the new quarters was effective October 15, 1956.

* * *

RETMA will consolidate and move its Washington headquarters' operations about February 1, 1957.

The trade group will occupy what will be known as the "RETMA Building" at 1721 De Sales Street in Northwest Washington, D. C. Original plans, approved by the Board of Directors, calls for the transfer of the RETMA Engineering Dept., now in New York City, to the new consolidated offices. However, this move is deferred for the time being.

The building is a four-story structure and is being remodeled and modernized to the organization's specifications. A large conference room will be available for committee meetings, and it is felt that a single duplicating and mailing unit will result in substantial economies and greater efficiency.

* * *

ETA KAPPA NU ASSOCIATION, national electrical engineering honor society, has named Dr. Jordan J. Baruch as the Most Outstanding Young Electrical Engineer of 1956.

Dr. Baruch is a 1948 graduate of Massachusetts Institute of Technology and is now vice-president and director of New Products Development of *Bolt, Beranek and Newman, Inc.*, Cambridge, Mass.

Robert B. Seidel, president of *Automatic Temperature Control Co.* of Philadelphia, Pa., and a 1948 graduate of Cornell University, was chosen to receive the honorable mention this year.

* * *

JOHN J. BURKE, formerly head of the guidance and electronics divisions of the U. S. Government's Jet Propulsion Laboratory, has been elected vice-president in charge of engineering of *Hallamore Electronics Company*, Anaheim, Cal.



He has been with the Jet Propulsion Laboratory since 1948 and had a major role in that unit's development of the U. S. Army's "Corporal" missile, the country's first guided ballistic-missile to be placed in production.

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Behind the Giant Brains

(Continued from page 71)

business such a short time ago. Every computer research center in the country is straining at the seams, and every engineering staff is heavily overburdened. Computer engineers and experienced computer programmers have, within the last two years, discovered that they can practically write their own tickets.

Computer research has borrowed heavily from every known science and technology, and has managed to solve many of the most pressing problems. Frequently, however, each solved problem turns, hydra-like, into a hundred more questions. The name *mushrooming technology* is apt: computer research has frequently tried to grow in all directions simultaneously.

Industry and business now have heavy investments in the development of newer and more capable electronic tools, and our economy is gradually acustoming itself to depending on them more and more. Properly used, they can make life simpler and easier for all of us—and more rewarding, too, as the time-consuming and deadly dull repetitive tasks which are part of so much of our commercial and industrial effort are given over to the machines. Their growth was inevitable, because there were too many jobs to be done, and too few manhours to do them in; without manpower, we must inevitably fall back on the machine. And whether for better or for worse, automatic controls and electronic computers are with us to stay.

-30-

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RADIO amateurs throughout New York State combined forces election night in a unique demonstration of the hams' ability to gather detailed information from a large area and forward it swiftly and accurately to its destination.

Participating in the demonstration were members of the N. Y. State Civil Defense Command Nets, N.Y.C. RACES group, Amateur Radio Teletype Society, other cooperating hams. Election returns were gathered by counties and then transmitted via 80 meter c.w. and 75 meter phone to Civil Defense Headquarters. From this point, the reports were put on a high-speed 2-meter radio teletype printer circuit which terminated in Studio C of Stations WNYC and WNYC-FM.

Participating in the demonstration were Robert Link, W2VKF, RACES supervisor; Leonard Nachemov, W2DUP, asst. supervisor, RACES; Clay Cool, W2BZ, ARTS who set up and maintained the equipment; Tony Landry, W2IRT, who supplied the teletype and converter at WNYC; David Penner, K2JVB; and Dick Daynard, K2IAD—all at the station. Vincent T. Kenny, W2BGO, state radio officer, and William Knott, W2QGH, Westchester radio officer who supplied the radio teletype at the state control, held down the state headquarters post. Forty-two other hams throughout the state also contributed their time and gear to this project.

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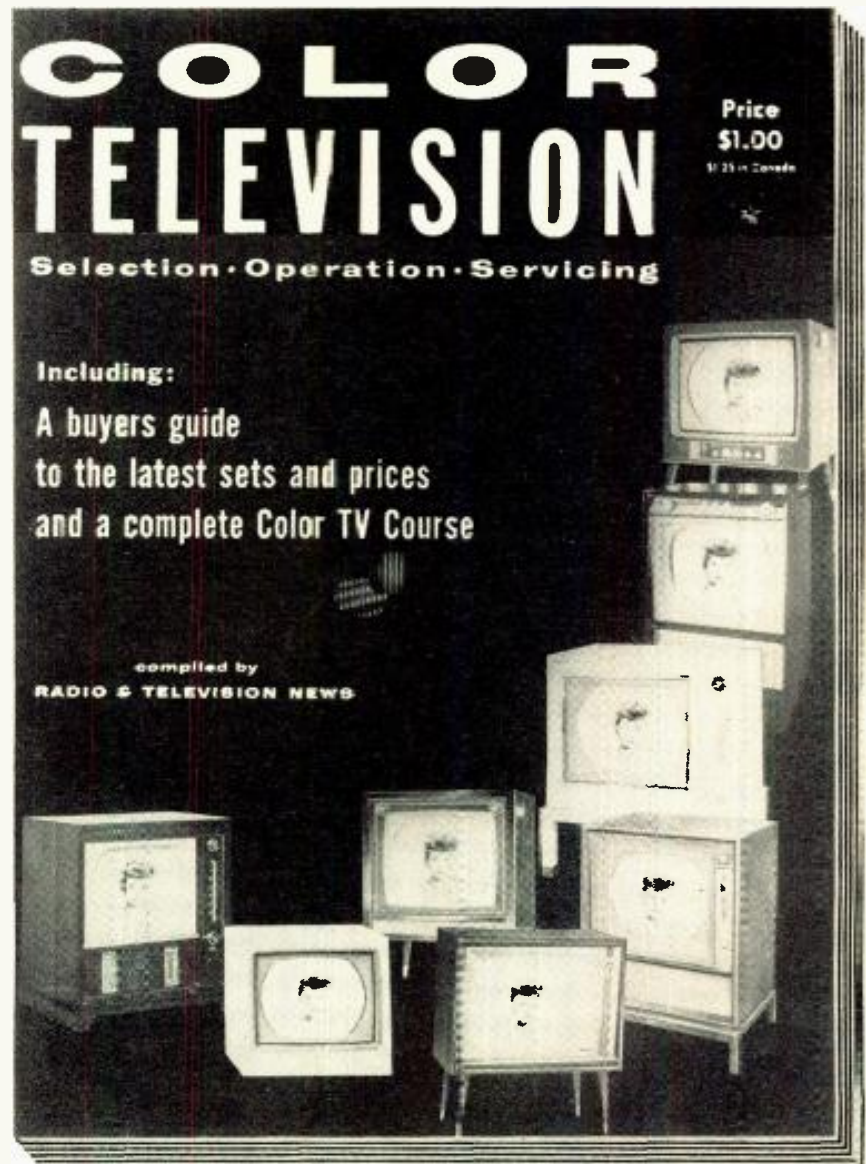
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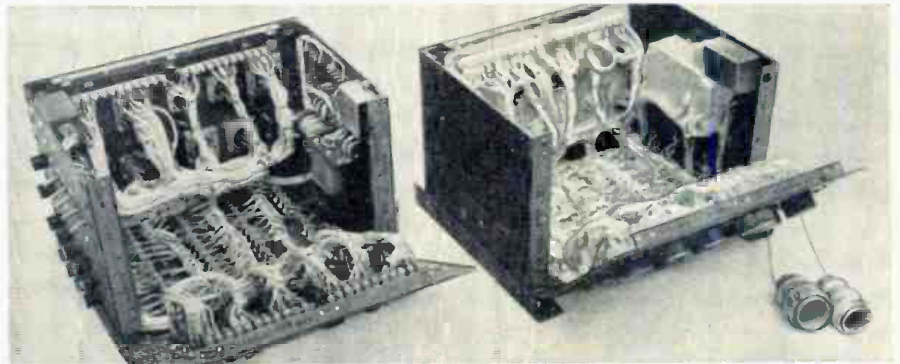


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cuits in the Snark guided missile, the
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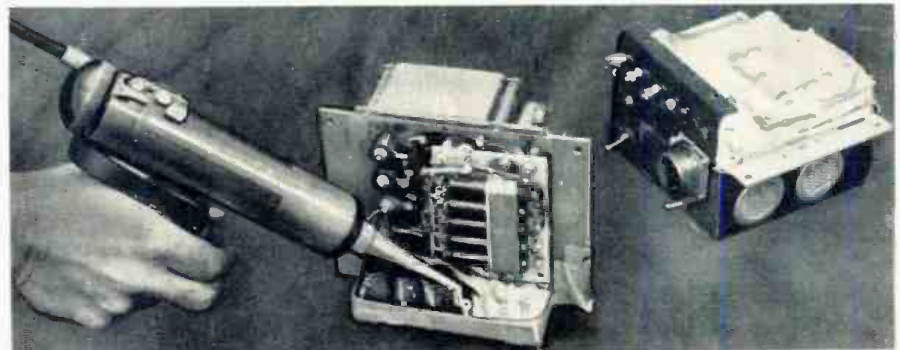
After electronic panels in the cir-
cuits are packed with resistors, ca-
pacitors, transistors, and other gear
designed to record or transmit infor-
mation during flight, the panels are

coated with Silastic RTV, the room
temperature curing silicone rubber
developed by Dow Corning Corp. Ac-
cording to Northrop designers a single
coating of the silicone rubber cushions
vibration, provides moisture resist-
ance, improves surface resistivity of
the panels, and protects the assemblies
from rough handling. Individual com-
ponents may be inspected after assem-
bly by simply slitting open the silicone
rubber to expose the unit. Slit is then
patched with the same rubber. —30—



Among the electronic components which Northrop Aircraft protects with the new silicone rubber are these junction boxes, shown here before and after the potting.

The silicone rubber material is applied with an air-pressure gun to many electrical components of the Snark missile. Here is a filter assembly during and after potting.





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Feature for Feature the World's Best Oscilloscope Value

Model F-146
\$49⁵⁰

This new oscilloscope delivers performance equal to wired units costing several times more and defies comparison with any other 'scope kit at anywhere near its price. It's the ideal choice for radio and TV servicing, audio work and hundreds of other applications—meets 90% of all 'scope requirements. Here are some of the features that make this kit a standout in its class: *Phantastron*

Sweep Circuit—versions of this circuit are used in \$1,000 'scopes; provides high linearity of sweep from 15 to 150,000 cps. *Regulated Calibration Voltage*—fully regulated square wave calibrating voltage is injected into signal circuit by spring return switch. *25 Millivolts Per Inch Sensitivity*—three times the sensitivity of other 'scope kits in its price class. *Retrace Blanking*—found only in high-priced 'scopes. *Vertical Amplifier*—frequency response $\pm 3\text{db}$ from 3 cps to 1.5 mc ($\pm 6\text{db}$ to 2.5 mc). Input controls are frequency-compensated. Rise time, 25 micro-seconds. Impedance, 3.3 meg. and 45 mmfd. Includes positive and negative internal sync. Outstanding construction features: CRT protected by heavy rubber ring; sturdy steel case with disappearing handle. For easy assembly: pre-cut color-coded wire; resistors carded and keyed to match instructions; printed circuit; laced wiring harness; "Step-and-Chek" construction manual with wall-size picture diagrams. Supplied with all tubes including CRT, all parts, graph screen, wire, solder. Size, $9\frac{1}{4} \times 13\frac{3}{4} \times 17\frac{3}{4}$ ". Shpg. wt., 26 lbs.

Model F-146. Complete 5" Oscilloscope Kit. Net only **\$49.50**
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Model F-123
\$44⁷⁵

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Guaranteed Linearity • Fool-proof Calibration • Wide-Range • Electronic Blanking

All-new; precision-designed for lab use, TV and FM servicing, production line testing. Covers 300 kc to 250 mc continuous on 4 bands (all fundamentals). Center frequencies of VHF TV channels appear on scales. Exclusive KNIGHT-KIT sweep circuit assures perfect linearity—RF sweep output in excess of 0.15 volts, flat within 1 db, is available on all bands. Sweep width continuously variable, 0-13 mc. Dual crystal marker oscillator and input for variable marker (RF Signal Generator on next page is ideal). Phase control provides blanking shift, 0 to 180°. Step-type and continuous output controls; separate marker amplitude control. Filter connected to 0-50 mc output jack provides 20 db attenuation of frequencies above 50 mc to assure pure, fundamental output. Sweep voltage for 'scopes on front panel. Professional-looking blue-finish steel case with gray panel. Has "disappearing" handle. $8\frac{1}{2} \times 12 \times 7\frac{1}{2}$ ". With all parts, tubes, test cable, solder and multi-color pre-cut wire. Less crystal. Shpg. wt., 13 $\frac{1}{2}$ lbs.

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P-145. 10.7 mc Crystal (.02%). Net 33.95

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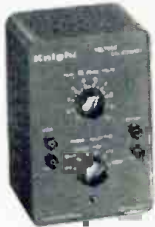
Model F-144

\$69⁰⁰

Wide-band, 5" Oscilloscope; equals or betters the performance of commercially-wired scopes costing several times the price. Two printed circuit boards and laced wiring harness assure wiring accuracy and reduce assembly time. Ideal for lab use, color TV servicing and high frequency applications. Provides unusually wide sweep range—from 15 to 600,000 cps. Locks in at frequencies as high as 9 mc. Vertical response, 5 cycles to 5 mc. Response, down only 1 db at 3.58 mc color burst frequency; down only 3 db at 5 mc. High vertical sensitivity of 25 mv/inch. Input capacity 20 mmf and 3.5 megs. Outstanding features: cathode-follower vertical and horizontal inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull vertical and horizontal amplifiers; positive and negative locking; faithful square wave response; frequency-compensated attenuator; Z-axis input for intensity modulation; one volt P-P calibrating voltage; astigmatism control; blanking circuit to eliminate retrace lines; DC positioning control. Complete with CRT, all tubes and parts. Handsome, professional, blue-finished steel case with "disappearing" handles. 14½ x 9½ x 16". Shpg. wt., 40 lbs.

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NEW knight-kit VOLTAGE CALIBRATOR KIT



Model **\$12⁷⁵**
 F-136

Permits the use of any scope as a precision peak-to-peak AC voltmeter. Provides a true square-wave voltage on scope screen. Range switch and calibrated potentiometer permit selecting any voltage between .01 and 100 volts, in 4 ranges. Fifth position of switch feeds external signal to scope for comparison. Constant output on line volt. variation from 80-135 v. ±6% on all ranges. Shunt capacitance only 15 mmf. Use any 20,000 ohms/volt VOM or a VTVM for initial calibration. Direct coupling of output provides ground reference for DC scopes. Portable case, 7¾ x 5¼ x 4¼". Ready to build. Shpg. wt., 5 lbs.

Model F-136. Voltage Calibrator Kit. Net... **\$12.75**

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Model F-145 **\$19⁷⁵**

Build this wide-range extremely stable RF signal generator and save two-thirds the cost of a comparable wired instrument. Ideal for alignment of RF and IF stages in radio and TV sets, and for troubleshooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonics to 220 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit with precision-wound coils—no calibration necessary. Has input for external modulator. Maximum audio output, 10 volts. RF output, over 100,000 micro-volts. Step and continuous-type output attenuators. With all parts, tubes, wire and solder. Portable case, 7 x 10 x 5". Shpg. wt., 10 lbs.

Model F-145. RF Signal Generator Kit. Net only... **\$19.75**

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Model F-137 **\$37⁵⁰**

An ideal audio frequency source for checking audio circuits and speaker response. Covers: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts into 600 ohms impedance. Offers the flat response of a lab standard—±1 db to 1 meg. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Cont. var. step-attenuated output. 17 lbs.

Model F-137. Audio Generator Kit. Net only... **\$37.50**



Model F-135 **\$26⁵⁰**

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A remarkable value in an instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits—has highest gain in its price class. Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of 91,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; single probe with plug-in head gives instant choice of RF or audio tracing. Provides noise test; built-in watt meter calibrated from 25 to 1000 watts; provision for external scope or VTVM. Blue-finish steel case. Shpg. wt., 13 lbs.

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Model F-129 **\$37⁹⁵**

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A valuable new unit for servicing auto radios, mobile gear, etc. Delivers continuously variable filtered DC output from 0 to 15 volts. Provides DC output at 0-8 volts or 0-15 volts. Continuous current rating: 12.5 amps at 6 volts, 10 amps at 12 volts. Can also be used as battery charger. Oversize rectifiers and transformer for better regulation and long life. Two meters provide simultaneous current and voltage readings; ranges: 0-15 volts DC; 0-20 amps DC. Doubly protected: fused primary and automatic-reset overload relay for secondary. Heavy-duty binding posts. Blue-finish steel case with "disappearing" handle. With all parts, solder and pre-cut wire. 9 x 12¼ x 7¾". Shpg. wt., 20 lbs.

Model F-129. Power Supply Kit. Net only... **\$37.95**

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Model F-139 **\$5⁹⁵**

Simplifies determination of resistor values needed in a circuit. 36 standard 1 watt resistance values between 15 ohms and 10 megohms with an accuracy of 10%. 18-position switch; also slide switch for multiplying values by 1000. Extra switch wafer serves as tie points, eliminating buss bar. 5 x 3 x 2". Complete with test leads and clips. 2 lbs.

Model F-139. Resis. Sub. Box Kit. Net. **\$5.95**

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Makes it easy to find capacitor values needed in a circuit. Provides 18 standard capacitor values from .0001 mfd. to .22 mfd., ±20%. Values are 600 volts, except .15 and .22 which are 400 volt. 18-position switch selects all values quickly and easily. In bakelite case, 5 x 3 x 2". Complete with all parts, test leads and clips. 2 lbs.

Model F-138. Cap. Sub. Box Kit. Net. **\$5.95**

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Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4 1/2" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, -20 to +69 in 6 ranges. Uses 1% precision resistors. 3-position function switch and 12-position range switch. Complete kit with bakelite case, (6 3/4 x 5 1/4 x 3 3/4"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2 1/2 lbs.

Model F-128. 1,000 ohms/volt VOM Kit. Net only \$16.95



Model F-140 \$29.50

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20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4 1/2" meter; accuracy ±2% of full scale; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust" Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-1-10-100; DC amps, 0-1-10; Decibels, -30 to +63 in 6 ranges. Uses precision 1% multipliers. Moisture-resistant film-type resistors. Complete kit with bakelite case (6 3/4 x 5 1/4 x 3 3/4"), batteries, pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

Model F-140. 20,000 ohms/volt VOM Kit. Net only \$29.50



knight-kit RESISTOR-CAPACITOR TESTER KIT

Model F-124 Measures capacitance and resistance by accurate bridge method; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and

resistance at a glance; balanced-bridge circuit with "magic eye" null indicator measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to 1000 mfd in 5 ranges. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ±10%. Automatic discharge feature prevents after-test shock. Blue-finished steel case, 5 x 3 x 2". With tubes and all parts. Shpg. wt., 8 lbs.

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NEW knight-kit TRANSISTOR & DIODE CHECKER KIT

Model F-149

\$8.50

Checks leakage-to-gain ratio and noise level of all junction, point contact and barrier transistors. Also checks diodes, forward and reverse current conduction of selenium rectifiers; useful for continuity and short checks. Easy-to-read meter. Features: spring-return leakage gain switch; calibration control; separate sockets for PNP and NPN transistors. Headphones or signal tracer may be used with checker for noise measurements. Case, 5 x 3 x 2". With 22 1/2 volt battery. 2 1/2 lbs.

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Model F-125 \$24.95

An extremely stable, and highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Maximum convenience in arrangement of scales; 3X AC and DC scale design permits utilization of best portion of each scale for most accurate readings. Also measures peak-to-peak for FM and TV work. Ranges: AC P-P volts, 0-4-14-40-140-400-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, -10 to +5. AC response, 30 cycles to 3 mc. Low-leakage switches and 1% precision resistors. Balanced-bridge circuit. 4 1/2" meter, 200 microamp movement. Polarity reversing switch. Input res., 11 megs. Shpg. wt., 6 lbs.

Model F-125 Printed Circuit VTVM Kit. Net only \$24.95
F-126. Hi-Voltage Probe; extends DC to 50,000 Volts \$4.75
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Model F-143

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PORTABLE MODEL

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"IN-CIRCUIT" CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and bother; an essential instrument for the service technician. Just press a button and the "magic eye" instantly shows opens and shorts (not leakage). Tests opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts may be made on any capacitor even when it is shunted by as low as 20 ohms. Blue-finish steel case, 7 3/4 x 5 1/4 x 5". With tubes, all parts, wire and solder. Easy to assemble. Shpg. wt., 5 lbs.



Model F-119

\$12.50

Model F-119. Cap. Checker Kit... \$12.50

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BAND SWITCHING
RECEIVER KIT

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Thrilling Short Wave and Broadcast

Famous 2-band AC-DC receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc) and standard broadcast. It's fun listening to amateur, aircraft, police and marine radio. Features highly sensitive regenerative circuit. Bandswitch selects broadcast or short wave. Has 4" PM speaker and beam-power output tube for plenty of volume; headphone connectors for weak signal listening; slide switch cuts out speaker. Uses 12AT7 regenerative detector and audio amplifier, 50C5 power output, 35W4 rectifier. Six controls: Bandsread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Includes tubes and all parts. 7 x 10 1/4 x 6". Shpg. wt. 4 1/2 lbs.

Model S-243. "Space Spanner" Receiver Kit. Net only **\$15.95**
S-247. Matching Cabinet for above. 2 lbs. Net **\$2.90**



Model S-295 **\$14⁷⁵**

NEW knight-kit TWO-WAY INTERCOM KIT

New low-cost, easy to build intercom system kit. Ideal for use in home or office. Consists of Master unit and Remote unit, each with press-to-talk switch. Remote unit may be left "open" for answering calls from a distance, for "baby-sitting", etc. Remote may also be connected for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier; each unit has 4" PM dynamic speaker. Complete with Antique White cabinets (4 1/4 x 6 1/2 x 4 3/8"), all parts, tubes and 50 feet of cable (up to 200 feet of cable can be added). For AC or DC. Shpg. wt., 7 lbs.

Model S-295. Two-Way Intercom Kit. Net only . . . **\$14.75**



Model S-740 **\$11⁷⁵**

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"OCEAN HOPPER" RECEIVER KIT

Tops for exciting broadcast, long wave and short wave reception. Highly sensitive regenerative-type circuit. Excellent headphone reception; can be used with 3-4 ohm PM speaker on strong broadcast band stations. Supplied with plug-in coil for standard broadcast; covers long wave and popular short wave bands with coils below. Pulls in thrilling foreign broadcasts, police, amateurs and aircraft. Controls: Main Tuning, Bandsread, Antenna Tuning, Off-On-Regeneration. With all parts and tubes (less extra coils and headset). AC or DC. Shpg. wt., 5 lbs.

Model S-740. "Ocean Hopper" Kit. . . . **\$11.75**

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"RANGER II" SUPERHET RADIO KIT

Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tunes 540 to 1680 kc; covers entire broadcast band and exciting police calls. Features automatic volume control, built-in preformed loop antenna, ball-bearing tuning condenser. Develops excellent tone quality from Alnico V PM dynamic speaker. Supplied with following tubes: 12SA7GT converter; 12SK7GT 1F amp.; 12SQ7GT det.-AVC-audio; 50L6GT audio output; 35Z5GT rect. Complete with handsome brown plastic cabinet (6 x 9 x 5) tubes, speaker, all parts, and instruction manual. AC or DC operation. Shpg. wt., 8 lbs.

Model S-735. "Ranger II" Superhet Radio Kit. Net only **\$17.25**



Model S-730 **\$19⁹⁵**

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3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1650 kc. Delivers excellent reception on AC or DC current or from self-contained batteries. Sensitive Superhet circuit features automatic volume control, economical operation. Includes powerful 5" Alnico PM dynamic speaker, efficient ferrite loop-stick antenna. Supplied with following tubes: 1R5 converter; 1U4 1F amplifier; 1U5 detector-AVC-audio; 3V4 audio output. Complete with attractive portable case (7 1/2 x 10 x 5 1/4"), tubes, speaker, all parts and instruction manual. Shpg. wt., 6 lbs.

Model S-730. 3-Way Portable Radio Kit (less batteries). Net. **\$19.95**
J-651. Battery Kit for above **\$2.50**



knight-kit LOW COST PHONO AMPLIFIER KIT

Model S-790 **\$8⁹⁵**

It's easy to build this fine-performing, low-cost compact phono amplifier. Ideal for use in a portable phonograph—simply add any

record player and a 3 to 4-ohm speaker. Amplifier works with crystal or ceramic cartridges. Inverse feedback circuit for rich, clean tone quality. Delivers full 1 1/2-watt output with less than .25 volt input. Includes efficient tone control; has AC outlet, controlled from amplifier switch. Complete with tubes and all parts. Size only 4 1/2 x 7 x 4"—fits into almost any portable phono case. Shpg. wt., 3 lbs.

Model S-790. Phono Amplifier Kit. Net only **\$8.95**

FAMOUS knight-kit CRYSTAL SET KIT

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Thousands of beginners have started in radio and electronics by building the KNIGHT-KIT crystal set. This feature-packed set delivers loud, clear reception of local broadcast stations. A germanium crystal diode detector assures high sensitivity and simple operation—no crystal adjustment required. "Hi-Q" coil boosts sensitivity. Ball-bearing variable capacitor for easy tuning. With all parts and simple-to-follow instructions. Shpg. wt., 1 lb.

Model S-261. Crystal Set Kit. Net only **\$2.15**
S-267. Accessory Kit. 2000-ohm headphones and all parts for outdoor antenna **\$2.95**



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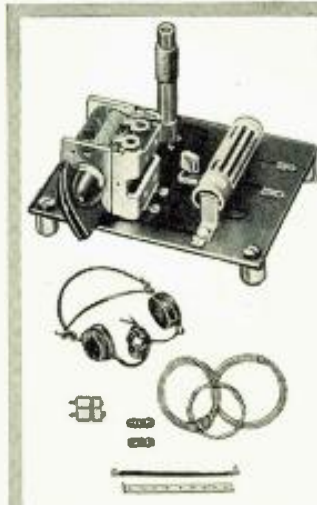


NEW knight-kit ELECTRONIC PHOTOFLASH KIT

Model S-244
\$28.50

New feature-packed photoflash kit—designed for top quality dependability—available at a money-saving low price. Ideal for black and white or color photography. Xenon-filled reflector-bulb assembly gives over 10,000 flashes at less than 1/2¢ each! 1/700-second flash freezes the fastest action. Has 50 watt-second output. Provides light approximating daylight in spectral quality; permits the use of outdoor-type film indoors. Film guide number for color (ASA10) is 45. Designed for "X" or "O" shutters only. Requires sync cable (available from any photo supply dealer) and either battery or AC supply listed below. Complete outfit with battery weighs only 3 1/2 lbs. Kit includes all parts, carrying case and easy-to-follow instructions. Shpg. wt., 3 lbs.

Model S-244. Electronic Photoflash Kit. Net.... **\$28.50**
S-246. AC Power Supply Kit. Easy to assemble.... **\$3.75**
J-626. Battery for above (Burgess U-200)..... **\$8.47**



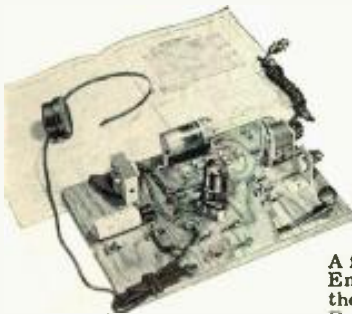
knight-kit TRANSISTOR RADIO KIT

Printed Wiring • Works from Penlight Cell

Model S-765 **\$4.35** Smooth Variable Capacitor Tuning

Experiment with the marvel of transistors! Printed circuit requires no wiring—just assemble with a few solder connections and enjoy excellent reception over the full AM broadcast band. No tubes to burn out—no crystal. Compact—fits in the palm of your hand—operates for months from a single penlight cell. Transistor provides plenty of power for strong headphone reception. Complete with all parts, transistor and penlight cell. Shpg. wt., 8 oz.

Model S-765. Transistor Radio Kit **\$4.35**
S-266. Accessory Kit. 4000-ohm headphones and all parts for outdoor antenna..... **\$3.15**



FAMOUS knight-kit LAB KITS

6-IN-1 RADIO LAB KIT

Model S-770 **\$7.95** Build Any of 6 Electronic Projects

A fascinating and instructive kit. Enables you to build any one of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Sine Wave Generator. Perfect for beginners. Once basic wiring is completed, circuits may be changed without soldering. Safe to build and operate; only tools needed are screwdriver, pliers and soldering iron. The ideal kit for students and beginners in electronics. Kit includes mounting board, tube, all parts and easy-to-follow instruction manual. Less headphone (also serves as mike). Shpg. wt., 6 lbs.

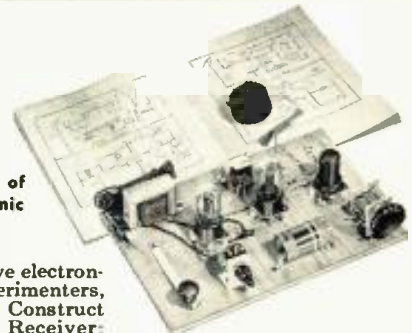
Model S-770. "6-in-1" Lab Kit. Net only..... **\$7.95**
J-112. Single 100C-ohm headphone for above..... **\$1.05**
C-100. Antenna kit for above..... **\$1.05**

10-IN-1 LAB KIT

Model S-265 **\$12.65** Build Any of 10 Electronic Projects

A wonderfully instructive electronics kit. Ideal for experimenters, beginners—fun to build. Construct a sensitive Broadcast Receiver; Amplifier (for phono or mike); Wireless Phono Oscillator; Home "Broadcast Station"; Code Practice Oscillator; Capacity-Operated Relay, or any one of four other fascinating projects. Low voltages; safe to build and operate. Only tools needed are soldering iron, screwdriver and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tubes, all parts, hardware, microphone, and 12-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only..... **\$12.65**
J-112. Single 1000-ohm headphone for above..... **\$1.05**
C-100. Antenna Kit for above..... **\$1.05**



knight-kit WIRELESS BROADCASTER KIT

Model S-705 **\$9.50** This fascinating unit makes it possible to "broadcast" with phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4 1/2 x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

Model S-705. Wireless Broadcaster Kit. Net only..... **\$9.50**
S-556. Microphone for above with 5-ft. cable..... **\$3.95**

knight-kit PHONO OSCILLATOR KIT

Model S-760 **\$5.85** This low-cost phono oscillator may be used with any crystal phonograph for "broadcasting" recorded music through any standard radio receiver up to 50 feet away. Requires no direct connection to radio set. Operates on any frequency between 600 and 800 kc. Has controls for adjustment of modulation level and selection of clear frequency on radio receiver. Uses 50L6GT tube and 35Z5GT rectifier. Complete with all parts, tubes and instructions. 4 1/4 x 4 1/4 x 4 1/2". Shpg. wt., 1 lb.

Model S-760. Phono Oscillator Kit. Net only..... **\$5.85**



knight-kit CODE PRACTICE OSCILLATOR KIT

Model S-239 **\$3.95** Transistor Circuit—Powered by Penlight Cell

An ideal code practice oscillator. Uses transistor circuit. Extremely low current consumption—powered by single penlight battery. Provides crisp, clear tone (400 to 600 cps). Has input jack for earphone; screw-type terminal strip for key. In compact bakelite case (2 3/4 x 3 3/4 x 1 1/2") with anodized aluminum panel. Complete with all parts, transistor, battery and easy-to-follow instructions. Shpg. wt., 1 lb.

Model S-239. Code Practice Kit.... **\$3.95**

See Next Page for Amateur Kits

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ALLIED'S own knight-kits give you the most for your money

BUILD YOUR OWN QUALITY HI-FI AMPLIFIER!

knight-kit
BASIC 25-WATT
LINEAR-DELUXE
HI-FI AMPLIFIER KIT

Model S-755
\$44⁵⁰

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis



This super-quality hi-fi basic amplifier is designed to satisfy the most critical listener. Intended for use with tuners incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has potted matched transformers. Delivers maximum output of 45 watts. Frequency response is: ± 0.5 db, 10 cps to 120 kc, measured at 20 watts. Harmonic distortion is only .15% right up to 30 watts. Intermodulation distortion is only .27% at 10 watts and only .4% at 20 watts, using 60 cps and 7 kc, 1:4 ratio. Hum level is -85 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AU7's, two 5881's, and a 5V4. Etched circuit is utilized in voltage amplifier and phase inverter stages to speed assembly. Has output tube balancing control, variable damping control, and on-off switch. Handsome chrome-plated chassis, 14 x 9 x 2". Overall height, 7". A deluxe true hi-fi amplifier equal in performance to amplifiers selling at over twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs.

Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only **\$44.50**
 S-759. Metal enclosure for above; black finish. 3 lbs. Net. **\$4.25**

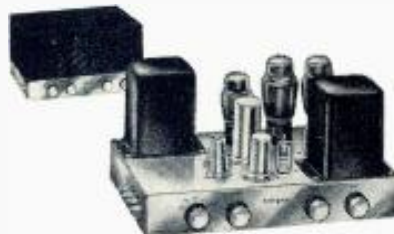


knight-kit
10-WATT HI-FI AMPLIFIER KIT

Model S-753
\$23⁵⁰

Chrome-Plated Chassis
 Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ± 1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net. **\$23.50**
 Model S-235. Preamp Kit for above ... **\$3.10**
 S-757. Metal Enclosure. 3 lbs. **\$3.95**



knight-kit
20-WATT HI-FI AMPLIFIER KIT

Model S-750
\$35⁷⁵

Chrome-Plated Chassis
 True hi-fi for less! Frequency response, ± 1 db, 20-20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono 72 db below 20 watts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records. Built-in Preamp. Outputs: 4, 8, 16 and 500 ohms. 23 lbs.

Model S-750. 20-Watt Kit. Net. **\$35.75**
 S-758. Metal Enclosure. 3 lbs. **\$4.15**
 S-752. Chrome-plated escutcheon for cabinet installation of amplifier. Net. **\$1.40**

LOW-COST TOP QUALITY KITS FOR THE HAM



knight-kit

Model S-255 **50-WATT CW TRANSMITTER KIT**
Built-in Pi-Type Antenna Coupler

\$38⁹⁵

Check the features packed into this new transmitter kit and you'll see why it's one of the greatest Amateur values ever offered. Compact and versatile, it is the perfect low-power rig for the beginning Novice or seasoned veteran. Features: 50 watts input to 807 final; high-efficiency 6AG7 modified-Pierce oscillator takes crystal or VFO without circuit changes; bandswitching coverage of 80, 40, 20, 15, 11-10 meters; pi-section antenna output matches line impedances from 50 to 1200 ohms —permits use with any type of antenna; no separate antenna tuner required. Crisp, clean, cathode keying of oscillator and final. Power take-off plug supplies filament and B-plus voltages for other equipment. Copper-finished chassis and cabinet interior, filtering, shielding, bypassing, and coaxial SO-239 antenna connector provide excellent TVI suppression. Meter reads either plate or grid current of final. Jacks for VFO, crystal and key. Supplied with all parts and tubes. Less crystal and key. 8 $\frac{1}{4}$ x 11 $\frac{1}{4}$ x 8 $\frac{3}{4}$ ". Shpg. wt., 18 lbs.

Model S-255. 50-Watt Transmitter Kit. Net. ... **\$38.95**



knight-kit
SELF-POWERED
VFO KIT

Model S-725
\$28⁵⁰

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. With all parts and tubes. 8 lbs.

Model S-725. Self-Powered VFO Kit. Net. ... **\$28.50**



NEW knight-kit
AMATEUR RF
"Z" BRIDGE KIT

Model S-253
\$5⁸⁵

Measures standing wave ratio (SWR) and impedance of antenna systems; also for adjusting antenna networks for optimum results. Any VOM may be used for null indicator. High accuracy with 20,000 ohm/v VOM. Correction factor info supplied for other VOM's. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart. 1 $\frac{1}{2}$ lbs.

Model S-253. "Z" Bridge Kit. Net only ... **\$5.85**

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Quantity	Description	Model No.	Price

\$ _____ enclosed. For parcel post include postage (express is shipped collect).

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City _____ Zone _____ State _____

← *order Today*

LATEST ALLIED knight-kits



NEW for the
Serviceman

knight-kit FLYBACK CHECKER KIT

Model Y-118 **\$19.50**

Race through TV deflection circuit repairs for extra servicing profits with this new Flyback and Yoke Tester! Instantly checks all types of standard horizontal output transformers as well as linearity and width coils. Positively indicates shorted turns for any coil with a "Q" greater than 1, and inductance between .003 and 2 henries. Determines continuity of any circuit with resistance from zero to .5 meg. Checks wider range of inductances than any other similar unit. Has highly legible 4 1/2" meter. Uses 6S4-A pulsed oscillator circuit. Supplied with all parts and test leads. 7 1/4" x 5 1/4" x 5". Shpg. wt. 5 1/2 lbs.

Model Y-118. Flyback Checker Kit. **\$19.50**
Net



NEW for the Ham

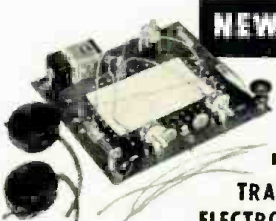
knight-kit 100 KC CRYSTAL CALIBRATOR KIT

Model Y-256 **\$10.50**

New universal frequency calibrator to fit any communications receiver—priced so low every Ham

can afford it. Uses hermetically-sealed 100 KC crystal. Generates 100 KC markers all the way up to 35 mc. Compact case is only 3 x 1 1/2 x 1 1/2"; has universal mounting flanges for mounting in any of several positions. Requires only 6.3 v. at .15 amps and 150-350 v. at 3-6 ma. Includes crystal zeroing trimmer and on-off switch which mounts on case. Connects to receiver input. Uses 6AK6 as electron-coupled oscillator. Complete with formed and punched case, 100 KC crystal, tube, all parts and instructions. Shpg. wt., 1 lb.

Model Y-256. Crystal Calibrator Kit. **\$10.50**
Net



NEW for the
Experimenter

knight-kit TRANSISTORIZED ELECTRONIC LAB KIT

Model Y-299 **\$15.45**

It's sensational—learn how transistors operate—see all the projects you can make with this all-

new electronic marvel! You just assemble the basic parts once. Then you complete project after project (10 in all), just by inserting the "plug-in" leads into the proper jacks on the printed-circuit board—without additional soldering! You can complete and enjoy any of these: a fine AM radio; a wireless home "broadcaster"; phono amplifier; code practice oscillator; electronic timer, switch or flasher; voice-operated, capacity-operated and photoelectric relays. It's the most fascinating experimenters' kit ever developed! Includes all parts, two transistors, battery, headphones and special cards showing you how to plug in each project. Shpg. wt., 3 lbs.

Model Y-299. Transistorized Lab Kit. **\$15.45**
Net

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
						12
						19
						26

CALENDAR of EVENTS

FEBRUARY 1, 2, 3

High Fidelity Music Show. Sponsored by Rigo Enterprises, Inc. Statler Hotel, Detroit, Michigan. Contact the sponsor at Suite 1002, 500 N. Dearborn, Chicago 10, Ill.

FEBRUARY 7-8

Conference on Nucleonics in Industry. Sponsored by American Management Association. Hotel Statler, New York, N. Y. Contact the association at 1515 Broadway, New York 36, N. Y., for full program data.

FEBRUARY 14

Symposium on Recording of Heart Sounds. Sponsored by PGME. University of Buffalo Medical School, Buffalo, N. Y. Godfrey F. Buranich, Bell Aircraft Corp., Buffalo 5, N. Y., program chairman.

FEBRUARY 14-15

Conference on Transistor Circuits. Sponsored by PGCT, Philadelphia Section of IRE, and AIEE, Philadelphia, Pa. Dr. Geo. H. Royer, Westinghouse Electric Corp., 356 Collins Ave., Pittsburgh 6, Pa., program chairman.

FEBRUARY 15-16

Spring Meeting. National Society of Professional Engineers. Hotel Francis Marion, Charleston, S. C. Contact society at 2029 K St., N.W., Washington 6, D. C.

Cleveland Electronics Conference. Masonic Auditorium, Euclid Avenue & East 36th, Cleveland 14, Ohio. D. C. Griffith, conference chairman, 18511 Euclid Ave., Cleveland 12.

FEBRUARY 22, 23, 24

High Fidelity Music Show. Sponsored by Rigo Enterprises, Inc. Hollenden Hotel, Cleveland, Ohio. Contact the sponsor at Suite 1002, 500 N. Dearborn, Chicago 10, Ill.

FEBRUARY 25-27

Special Conference on Electronics in Action. Sponsored by the American Management Association's Finance Div. Statler Hotel, New York, N. Y. Contact AMA at 1515 Broadway, New York 36, N. Y.

FEBRUARY 26-28

1957 Western Joint Computer Conference. Sponsored by the IRE, AIEE, and Association for Computing Machinery. Hotel Statler, Los Angeles, Cal. Information on program from IRE, 1 E. 79th St., New York 21, N. Y.

SENSATIONAL NEW knight-kit HI-FI FM TUNER KIT



knight-kit HI-FI BASIC FM TUNER KIT

Model Y-751

\$37.75

- Featuring deluxe custom high-fidelity styling
- With latest AFC and Flywheel Tuning Control
- Latest printed circuit—no critical wiring required



Advanced Tuner Circuit—noise-free and highly sensitive. Automatic Frequency Control "locks in" on station; AFC disabling feature helps tune in weak stations.



Flywheel Tuning—Weighted flywheel tuning mechanism permits velvet-smooth, accurate station selection over entire band.



Printed Circuit—all critical wiring is already completed—greatly simplifies assembly and reduces wiring time. Circuit board clearly shows placement of basic components.

INCOMPARABLE HI-FI KIT VALUE

Here is not only the best-looking tuner kit your money can buy, but the only FM tuner kit offering all these features: *Printed circuit* for easy assembly; *automatic frequency control* for "lock-in" tuning of stations, with disabling feature for tuning in weak stations; *pre-adjusted RF coils on rigid forms*—no further adjustment required; *pre-aligned I.F.'s*; *front ventilation*—an integral part of panel design (no unsightly perforations on cabinet.)

SPECIFICATIONS: *Tuning Range:* 88-108 mc. *Output:* 2 volts at 1000 microvolt input. *IF Bandwidth:* 200 kc. *Audio Response:* 20-20,000 cps with only .06% distortion. *2 Output Jacks:* one for feeding amplifier, the other for tape recorder. *Sensitivity:* 10 microvolts for 20 db quieting across entire band. Cascode broadband RF amplifier. Drift-compensated oscillator. Ideal for use with the Model S-750 KNIGHT-KIT 20-Watt Amplifier kit (see opposite page), or any amplifier equipped with phono-tuner switch. In beautiful gray cabinet with polished aluminum control panel; 4 x 13 x 8"; illuminated lucite pointer highlights station selection. Complete, ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-751. Basic FM Tuner Kit. **\$37.75**
Net

SPECIAL TUNER-AMPLIFIER OFFER

Exclusive hi-fi value—the new FM tuner kit, plus the 20-watt amplifier kit on opposite page (including metal enclosure) for only **\$73.65!** Buy this matched Hi-Fi combination and save **\$4.00!** Shpg. wt. 35 lbs. Y-761. Knight-Kit Tuner and 20-Watt Amplifier. Net. **\$73.65**
Only **\$7.37** down on our Easy Pay Plan

use order blank

on opposite page

use order blank

on opposite page

QUARTZ CRYSTALS

Fast Service—Unconditional Guarantee!

We will grind and etch crystals to your specified frequency at the lowest cost in the industry—supplied in popular FT-243 holders, 1/2" pin spacing, .093" pin diameter—also in DC-34 holders, 3/4" pin spacing, pin diameter .156 or FT-171 holders, pin spacing 3/4" with banana plug pins (fits 5-prong tube socket).



In FT-243 holders from 1100KC to 9000KC. In DC-34 or FT-171 holders from 1100KC to 8000KC (specify holder wanted).

Tolerance:

.05%	\$1.35
.01%	1.50
.005%	2.50

With thousands of frequencies in stock for immediate delivery, we list a few of the more popular frequencies. Write for complete listing. Crystals listed are in FT-243 holders but can be supplied in FT-171 holders at 79 cents. (Add 5¢ per crystal for postage and handling.)

YOUR CHOICE
50¢
EA.
OR
11 FOR
\$5.00
POST-PAID

2910	6150	7206	8106
2945	6300	7225	8125
3000	6400	7240	8140
3190	6500	7250	8150
3195	6575	7273	8175
3245	6625	7275	8200
3525	6700	7300	8240
3885	6706	7306	8250
3955	6750	7325	8300
3995	6775	7340	8350
4110	6800	7350	8375
4190	6850	7373	8400
4845	6900	7375	8425
5030	6950	7400	8450
5300	7000	7406	8475
5305	7006	7500	8500
5700	7025	7606	8525
5800	7050	8000	8550
6000	7075	8006	8575
6025	7100	8025	8600
6040	7106	8040	8625
6050	7125	8050	8650
6075	7140	8073	
6100	7150	8075	
6125	7200	8100	

WRITE FOR FREE CRYSTAL CATALOG

Novice Crystals 80 meter band within 1KC of specified frequency from 3701KC to 3749KC in 40 meter band from 7152KC to 7198KC within 1KC of specified frequencies 79¢; in DC-34, FT-171 or FT-243 holders (specify holder wanted) 79¢. (Add 5¢ per crystal for postage and handling.)

Stock crystals in FT-243 holders from 5675KC to 8650KC in 25KC steps 50¢.

FT-241 lattice crystals in all frequencies from 370KC to 540KC 50¢.

100KC Frequency Standard Crystals	4.50
200KC Crystals	2.00
455KC Crystals	1.00
500KC Crystals	1.00
1000KC Frequency Standard Crystals	3.50

Jobbers and manufacturers, write far quantity prices and catalog.

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Texas Crystals

The Biggest Buy in the U.S.

8538 W. GRAND AVENUE · RIVER GROVE, ILL.
ALL PHONES — GLADSTONE 3-3555

Terms: All items subject to prior sale and change of price without notice. All crystal orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. NO C.O.D.s. Postpaid shipments made in U.S. and possessions only. Add 5¢ per crystal for postage and handling charge.

First Guidance System for Satellite Rocket

Honeywell describes operation of inertial guidance system.



First guidance reference system for rockets that will attempt to put man-made satellites in their earth-circling orbits gets the once-over from test pilot Jim Bailey, whose job is testing automatic flight control systems on supersonic jet aircraft.

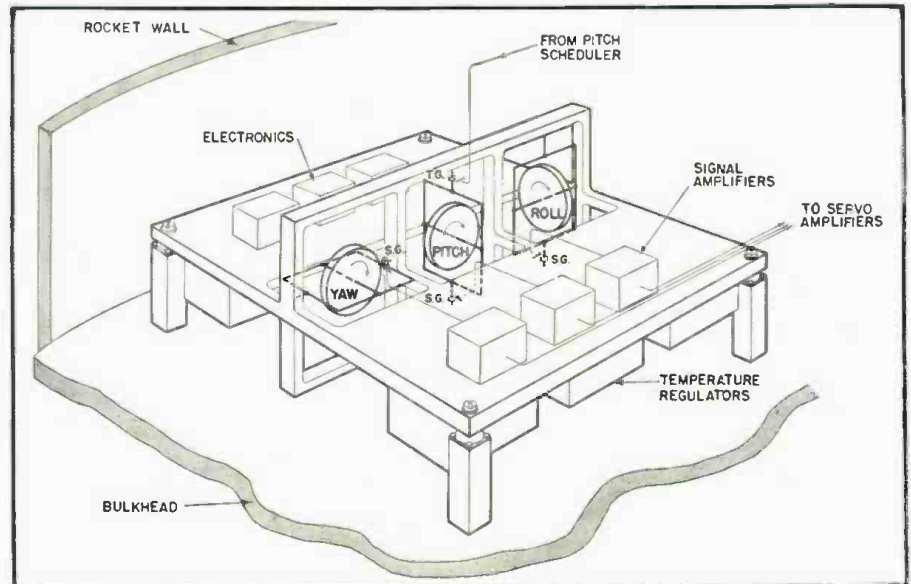
THE first guidance reference system for the dozen or more proposed earth-satellite-carrying rockets has come off a pilot production line at Minneapolis-Honeywell Regulator Co. more than a year before the Project Vanguard vehicle is scheduled to be launched. Unlike systems that require radio or radar tracking, the Vanguard guidance reference system is entirely rocket-borne. Its job will be to keep the finless rocket from swerving off course because of sloshing fuel, air currents, or other forces, and to gradually "tip" the rocket's trajectory so that it enters a globe-circling course some 300 miles above the earth. Heart of the control system are three highly accurate gyroscopes that will be calibrated to a "memorized" heading reference in the three axes or directions of flight—roll, pitch, and yaw.

Temperature controllers will be used to keep the gyros at operating temperature through built-in heaters. The controllers are all-transistor amplifiers built around a half-dozen H-6 power transistors, which are used for both power and switching functions. There are no relay contacts in the system,

thereby avoiding shock and vibration problems. Signal generator pick-offs and torque generator units are at the ends of the gyro cases.

If the rocket incorrectly rotates—because of sloshing fuel, engine irregularity, etc.—about any of the three axes "memorized" by the roll, pitch, and yaw gyros even an infinitesimal part of a degree, the gyro motor will respond by rotating the gimbal on its jeweled bearings. This movement is sensed by the gyro signal pick-off and sent out as an electrical signal from the gyro through the autopilot amplifier to the error-correcting servo system.

Functional diagram of three-axis guidance reference system for Project Vanguard rocket shows placement of three gyros on platform in second stage of the three-stage rocket. These and other components will be housed in container resembling two derby hats placed brim to brim. Each gyro will have its own temperature regulator, amplifiers, and other electronic equipment. A scheduling device will operate through the pitch gyro only to control the arching path of the rocket.



4 Pages of
Mail-Order
Bargains

RADIO

CROSLLEY TRANSISTOR RADIO SALE!



**LEATHER BOUND
TRANSISTOR BOOK RADIO**

Sold
for
\$49.95

\$29⁹⁵

One of the most sensational money-savers we've ever run across. Fabulous CROSLLEY TRANSISTOR BOOK RADIO made to actually net for \$49.95! You save a clear \$20.00 at RADIO SHACK. What's more you get one of the most luxurious, hottest transistors ever built. Lift the cover and radio plays, close cover and radio automatically shuts off. Richly bound in durable top grain leathers with handsome gold embossing. Latest combination transistor and subminiature circuit provides outstanding performance and an amazingly long battery life. Has all of the most desirable electronic developments including printed circuits chassis, alnico V PM speaker, automatic volume control, built-in ferrite antenna, sensitive superhet circuit and push-pull transistor output for greater usable audio level than receivers using a tube in this stage. Ship. wt. 2 1/2 lbs. Order Item A-1E
Order Item A-2E Batteries for Above.....\$3.95

TRANSISTOR RADIO KIT

Complete with:
\$1.10 MERCURY BATTERY
\$1.39 CRYSTAL EARPHONE



Reg. \$22.44 **\$12⁹⁵**

New powerful midget, 2 transistor portable to take with you everywhere! Step-by-step assembly; includes chassis, parts! Ship. 1 1/2 lbs. Order Item A-3E Complete \$12.95

VERDUN EARPHONES!

For Transistor and
Subminiature Use



\$1.39

Just 3 oz. in weight; wide range, sensitive Crystal earphone can be used as tiny mike. Less plug and jack. Ship. 1/4 lb.
Order Item A-4E.....Sale \$1.39
"Dynamic"—3000 ohms @ 1000 cps.
Order Item A-5E.....Sale \$1.89

1 1/2" PM SPEAKER

WORLD'S
SMALLEST



8-ohm voice coil imp. Shallow cone with shielded pot construction, magnet totally enclosed 15/16" depth, 6/32 mtg holes Ship. 1/2 lb.
Order Item A-6E.....Sale \$1.95
With Marching Output Transformer!
Order Item A-7E.....Sale \$2.90

PORTABLE RADIO AND

**3-SPEED
PHONO**



Reg. \$39.95
\$24.95

Compact, jewel-like molded case holds a fine 3-speed record player with an all-groove cartridge and an AM superhet radio. Ship. 7 lbs.
Order Item A-8E.....Sale \$24.95

DIAMOND-SAPPHIRE for GE RPX-050, RPX-050A



List \$30.00

\$10⁴⁰

NEW-type stylus assembly with slip-on diamond .001" LP tip and sapphire .003" 78 tip. Guaranteed 1st quality whole stone. Ship. 1/4 lb.
Order Item A-9E.....Sale \$10.40

**Do You Have
Radio Shack's Complete
212 Page
Catalog?
It's FREE!!!**

PRECISION MICRONTA MULTITESTERS



- ★ ALL WITH SILVER SWITCH CONTACTS!
- ★ ALL WITH RUBBER LEADS, 3" METERS!
- ★ ALL WITH MICRONTA-RETMA GUARANTEES!
- ★ ALL ASTONISHINGLY LOWER PRICED!



NOW WITH 1% WIRE-WOUND RESISTORS

RADIO SHACK's answer to high quality at a sensible price. 5-AC ranges to 1000 volts. 6-DC ranges to 5000 volts. 4-DC current ranges from 50 ua. to 500 ma. 4-resistance ranges to 10 megohms. 2-db ranges -20 to +36. Not a kit!
Order Item A-12E Ship wt. 4 1/4 lbs.....Only \$19.90

\$19⁹⁰

Exclusive MICRONTA multirester would cost at least twice our price if made in this country. Same ranges as above except DC current 4-ranges from 250 ua. to 500 ma. 150 ua. jeweled meter. Bakelite case. Completely wired and tested.
Order Item A-11E Ship wt. 4 lbs.....Only \$14.50

\$14⁵⁰

Lowest priced high sensitivity (4000 /v DC) multirester in America! 16 ranges: 5-AC ranges to 1000 volts; 4-DC ranges to 1000 volts. 3-DC current ranges from 250 ua. to 250 ma. 2-resistance ranges to 1 megohm. 2-db ranges -30 to +36 db. Wired, with test leads and batteries.
Order Item A-10E Ship wt. 2 1/2 lbs.....Only \$9.95

\$9⁹⁵

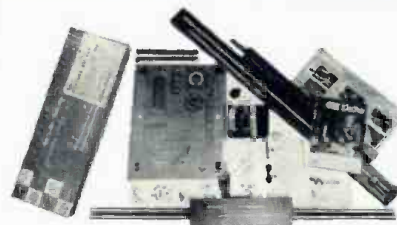


Reg. \$39.75
\$19⁸⁸

HALF-PRICE SALE! RCP FLYBACKER

Fast, accurate, reliable tester has 3 direct-reading calibrated GOOD-BAD scales for high and low impedance. 4 1/2" illuminated meter. Operates dynamically. Ship. 8 lbs.
Order Item A-13E.....Sale \$19.88

FABULOUS TAYLOR WEATHER KIT!!



Exclusive Sale!

Made by Taylor
Instrument Co.
to sell for \$24.95

\$9⁹⁵

With \$11.00 Mercury Column Prepared under guidance of Encyclopedia Britannica and Chicago Museum of Science and Industry!

- ★ Over \$30 Parts Value!
- ★ Builds 34 1/2" Barometer!
- ★ Builds Hygrometer!
- ★ Builds Max-Min Therm'r!
- ★ Builds Wind and Cloud Speed Dir. Indicators!
- ★ 48-Page Weather Book!

Save \$15.00 on this lavishly complete weather measurement and forecasting kit! Packed in a huge 37 x 12 1/2 x 2 1/2" carton — an immense variety of parts, instructions, charts, this kit is the ultimate in education, entertainment and useful practicality. Deluxe components of glass, metal and wood. Ship. 10 lbs., Railway Express only.
Order Item A-14E.....Complete \$9.95

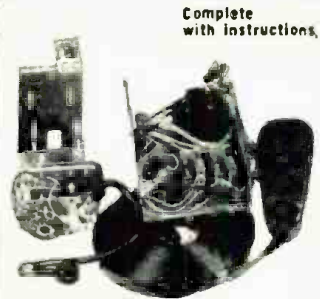
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ON LAST PAGE ➡

REALISTIC "AM" TUNER CLOSEOUT!!

SALE!! \$59.95 RCA TV REMOTE CONTROL



Complete with instructions.

RELAY ACTUATED MOTOR DRIVEN \$17.95

Turns set On-Off, selects channel, adjusts volume, adjusts picture, adjusts fine tuning... at distances up to 30 feet from set! Superbly engineered and built by RCA for installation in VHF TV receiver, using KCS96 and KCS97 series chassis. Also fits most receivers KCS66 thru KCS92 series chassis. (Complete listing of Sets and Chassis available upon request.) Complete assembly consists of: Relay Unit containing motor relay, on-off relay, local-remote relay and relay transformer; Channel Selector Drive Motor Unit; Remote Control Tuning Head with 30 feet of flat control cable. Official RCA installation booklet included. RCA factory boxed with all necessary parts. RCA Cat. No. 965099. Wt. 12 lbs. Order Item No. B-1E \$17.95

Exclusive "Archer" Brand MIKE SALE! 'LIPSTICK' CRYSTAL



LIST \$21.00
\$5.95

NEW 4 7/8" long 3-OUNCE mike has hi-fi 50-10,500 cps response! Includes 10 feet of cable, stand attachment for 180° tilt. 100% detachable for hand-mike use. TV-gray and chrome. Ship. 2 lbs. Order Item B-5E Sale \$5.95

'BULLET' CRYSTAL



List \$9.00
\$3.85

NEW imported mike has 85-7000 cps response and output 1000 c/s — 18 db, yet cost 50% less than if made here. TV-gray; 15 feet of cable, swivel neck. 3/8" .27 thread. Ship. 1 lb. Order Item B-6E Sale \$3.85

SI-D DYNAMIC



List \$40.00
\$10.95

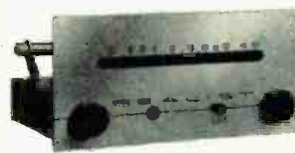
NEWLY restyled for 1957 with lustrous gray body, gold screen, gray cord. High imp. (30K), hi-h (50-11,000 cps) SLIM dynamic features built-in on/off switch, tuned cavity design. 12 ft. cable. Has slip-over cradle rest. Ship. 2 lbs. Order Item B-7E Sale \$10.95

SALE! HI-FI ORGAN DEMONSTRATION!

Reg. \$5.95
12" LP RECORD } **\$2.95**
List \$10.95
7 1/2 ips TAPE } **\$4.98**

A rare record at any price! All classical selections: Farnam, Karg-Elert, Dupre, Vierne, Mulet, Alain, Brahms, Widor. Organist: Adam Hamme, S.M.M. instrument: 3-manual Aeolian-Skinner pipe organ of Zion Lutheran Church, York, Pa. This fine record is exclusive at Radio Shack. All selections are complete and uninterrupted — no speaking. Ship. 3/4 lb. Order Item B-8E Sale \$2.95
PRE-RECORDED TAPE of above organ disc. 7 1/2 ips dual track. Order Item B-9E Sale \$4.98

1st TIME EVER AT THIS PRICE! ALL 1956 MODELS MUST BE SOLD



\$39.95 Value
\$21.95

1st Available Below \$70

Matching Mate to Realistic FM in size, appearance, controls, electrical specifications. Features: tuned RF stage, superhet circuit, built-in AC supply, 5 uv sensitivity, 8 kc bandwidth, response 20-5000 cps ± 3 db, 530-1650 kc AM range. Order Item B-10E Ship. 6 1/4 lbs. Closeout of \$21.95

Radio Shack's "FM" Buy of a Lifetime!

REALISTIC "FM" HI-FI TUNER \$39.95

Features Armstrong FM with Foster-Seecley discriminator, 5 uv sensitivity for 30 db quieting, double-tuner limiter, automatic frequency control (AFC), tuner RF stage, built-in AC power supply, 20-20,000 cps response ± 0.5 db, pilot light, slide rule dial, function switch. Solid 1-piece gold-tone metal front panel. Output 1V for 100% mod. For 117V 60 cycle AC. SUPER-SMALL SIZE: 4 1/4" H x 9 1/2" W x 6 3/8" D! Order Item B-11E Ship. 6 1/4 lbs. Exclusive of \$39.95

When you think of AMPS, think of the Realistic

\$29.95 10W AMPLIFIER



Realistic "AF" 10 watt hi-fi amplifier, matches Realistic tuners in appearance. Features: 10 watts (18 peak), ± 1 db 20-20,000 cps @ 1 watt level, built-in RIAA-equalized preamp, treble control 18 db attenuation @ 18 kc, bass control 15 db boost @ 50 cps, hum 80 db below 10 watts; output 4-8-16 ohms, jack for direct feed to tape recorder; inputs for tuner or crystal pickup, magnetic pickup or high-imp. mike. Order Item B-12E Ship. 10 lbs. Exclusive of \$29.95

NEW "REALISTIC" SUSPENSION CONE HI-FI SPEAKER



\$19.95 COMPLETE IN FURNITURE-FINISHED WOOD ENCLOSURE!

- VERIFIED 50-12,000 CPS!
- ULTRA-COMPLIANT CONE!
- CASE FINISHED ALL 4 SIDES!
- EXCLUSIVE AT RADIO SHACK!
- LIST PRICE IS \$41.50.

Here's compactness — 14 1/2" x 11 x 10 1/2" — for small-space hi-fi systems, for paired stereophonic systems, for school or P.A. use! Here's quality — verified by lab checks and thousands of sales — plus cabinetry that's right out of the audio handbooks, tuned, vented, duct-type Helmholtz resonator. Includes leg rails for use if desired. Solid wood case finished to harmonize either with walnut or mahogany; lumite-type grille cloth front. Sealed wood back with terminal strip connection. Heavy PM-magnet speaker has cone attached to super-soft leather suspension rim for enhanced low frequency reproduction. An exclusive Radio Shack import to save you money. Order Item B-13E Ship. wt. 12 lbs. Realistic System Complete \$19.95

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FAMOUS RECORDING TAPE BONANZA!



- 600 FT ACETATE ON 5 INCH REEL Regularly \$2.25 **99¢** B-2E
- 1800 FT ACETATE ON 7 INCH REEL WITH NEW 2 1/2" HUB Regularly \$5.50 **\$2.39** B-3E
- 2400 FT MYLAR ON 7 INCH REEL WITH NEW 2 1/2" HUB Regularly \$8.95 **\$3.99** B-4E

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RADIO

SALE! \$40 FAST 35mm f/3.5 CAMERA



Ultra-Compact-and-Light

Reg. \$40
\$18⁹⁵

- ★ Coated f3.5 Lens!
- ★ Semi-wide Angle, 40mm Focal Length!
- ★ Shutter; Bulb, 1/25, 1/50, 1/100, 1/200!
- ★ Flash Synchronized!
- ★ PC Flash Tip!
- ★ Save At Least 1/2!

Brand new, multi-feature 35mm MICRONTA-guaranteed camera is one of Radio Shack's favorites for color or black-and-white! Solidly built, all metal camera has all the requirements you'd expect in a \$40.00 camera. Takes as many as 36 pictures per roll! LENS: f3.5-f16, sharp from 3 feet to infinity. Has double-sprocket take-up accessory clip, removable back. A mere handful (4 1/2 x 2 3/4 x 2 3/8") — this imported satin-chrome-and-black beauty is NEWLY restyled for 1957. We believe there's no finer to give or receive at Radio Shack's dollar-stretching price. Ship. wt. 1 1/2 lbs. Order Item C-2E\$18.95
Order Item C-3E\$2.95

\$70 35mm CAMERA



Sale

\$37⁵⁰

**COUPLED RANGEFINDER
AUTOMATIC FILM ADVANCE**

- SELF TIMER
- FAST 3.5
- SYNCHRO-FLASH
- 3 ELEMENT LENS

Has every wanted feature of \$70 cameras including: coupled rangefinder; 9 SPEEDS: 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100, 1/300, bulb; 3-element coated lens; built-in self-timer; double-exposure prevention device **INCLUDES 2-PART LEATHER CASE!** Ship. wt. 2 lbs. Order Item C-4E\$37.50

Your Choice **\$19⁹⁵**

MICRONTA 6.5mm F/1.9 CINE WIDE-ANGLE LENS

REG. \$41.50

Gives your 8mm movie camera an extra eye for "area", for shooting in confined spaces or for extreme depth of field! Pictures are sharp to the very edge without distortion! Fully color-corrected. Standard fixed-focus mount. Coated. Order Item C-7E.....\$19.95

FAST F/1.4 MICRONTA TELEPHOTO 1 1/2" LENS

REG. \$69.50

SUPER-FAST f1.4 telephoto lens for all Revere, Bolex, DeJur, Keystone, Kodak and other 8mm movie cameras. Magnificently constructed. Five elements, coated, f1.4 lens yielding 3X magnification. click-stop iris f1.4-f16. focusing mount 3/2 ft. to infinity Ship. wt. 1 lb. Order Item C-6E\$19.95

PHOTO ELECTRIC EXPOSURE METER

Most Sensational Meter
In Our 34-Year History!



Reg. \$16.95
\$6⁹⁹

- Outstanding Features:
- "Flick" For Incident, Reflected Readings!
 - New LVS Synchro Compur Readings!
 - ONE HAND Operation; Light and Compact!
 - Apertures f1 to f45
 - 8 sec. to 1/1000
 - YEAR Guarantee!

Preferred by professionals (and praised by amateurs). Meter has 7 movie speeds, push-button control allowing automatic changing of scale for incident reading. Full ASA and shutter ranges for all film emulsions; for movie or still pictures, indoors, or out. Highly accurate even in dim light. Has both standard and new Compur shutter speeds. Order Item C-5E\$6.99

MIRACLE SCREEN SALE

Reg. \$21.95

\$11⁹⁵



'RADIANT' 40x40 SCREEN WITH VYNAFLECT FABRIC

World-famous RADIANT color-slide and movie screen with permanently white million-glass-beaded Vynaflect is washable and flame- and mildew-proof! The 40x40" size is just right for slides and for movies. Latest 1957-type chromed tripod assembly and end bells; full length suspension bar that seals out dust from sturdy metal Radiant screen case; latest-type pressure-adjust levers — no screws to tighten! Fabric covered by 10-YEAR guarantee! Ship. wt. 12 1/2 lbs. Order Item C-1E\$11.95

PRISM BINOCULARS BELOW OUR COST!



8 x 25
\$10⁹⁵ Plus 10% Tax

Never before so low — includes year guarantee! Hard-coated optics; fully color-corrected. Includes pigskin case. Individual focus. Ship. 2 lbs. Order Item C-9E.....Sale \$10.99

100X, 200X, 300X MICROSCOPE



ORIG. \$14.95
\$3⁹⁹

UNHEARD-OF for \$3.99! PLUS features are 1-year guarantee, all metal construction, ground and polished achromatic lenses, triple objectives. Ship. 3 1/4 lbs. Order Item C-10ESale \$3.99

STYLUS MICROSCOPE



50-TIME MAGNIFICATION
List \$3.00 **\$1.95** Ship. 4 oz. Order C-8E

"PRISMATIC"

Binocular Microscope
1st Available Below \$90

3-D TWIN 30X OBJECTIVE LENSES



\$19⁹⁵

EXTRA WIDE
FIELD FOR
COMPARATIVE
STUDIES!

Exclusive industrial and biology lab 3-D microscope has full color-corrected lenses and stereo-binocular vision. Also features adjustable eyepiece tubes, dual optical prisms, ground glass view stage. Complete with hardwood case, Micronta 6-mos. guarantee. Buy-of-a-lifetime. 4 lbs. Order Item C-11E. Complete \$19.95

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Has the Latest

Comprehensive Product
Listings Including
Industrial Electronics,
Transistor Components.

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FREE Copy Today

PORTABLE 35mm VIEWER-PROJECTOR

- ★ It's a TABLE VIEWER
- ★ It's a WALL PROJECTOR
- ★ It's PORTABLE
- ★ For COLOR SLIDES
- ★ F3.5 LENS

\$75 Value **\$27⁵⁰**



SEMI-AUTOMATIC CHANGER

Projects a direct view image onto its self-contained 5 3/8" sq. ground glass screen. Projects COLOR slides onto any light colored wall. Sharp focus 10 ft. sq. picture. The size of your wall is the only limit to the size of MICRONTA-VUE's picture! Semi-automatic 36 slide changer. Efficient convection cooling. Finest optical parts. F/3.5 lens. All-metal portable carry-case; 7x10x3 1/2" D. Weighs only 4 lbs. With 100 Watt bulb, line cord, instructions. For 115V AC-DC operation. Ship wt. 5 lbs. Order Item C-12E\$27.50

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SALE! RCA 45 rpm SLIDE-O-MATIC

FAMOUS MAKE 7" POWER SAW

1/4
hp



Reg.
\$44.95
List

\$29⁹⁵

Nationally-famous electric saw features FULL 8 AMPS, 5000 rpm saw arbor speed, helical drive gears, retractable saw guard, power cord at 45° angle. Operating controls are at rear of saw; air-stream blows dust away from saw line. A \$60-\$70 value in everyone's book. Ship. wt. 12 lbs. Order Item D-1E.....Sale \$29.95

5-PC. JEWELERS PLIER SET SALE!

Reg. \$12.95

\$5⁹⁹

- Drop Forged
- Chrome Plated



Magnificent set includes: End Nipper, Diagonal Cutter, Round Nose, Flat Nose, Half-round Flap Nose. Has our Skillman brand. Ship. 1 1/2 lbs. Order Item D-2E.....Sale \$5.99

PRECISION MICRONTA LOG-LOG SLIDE RULE!

\$25.00
Value

\$11⁹⁵



Standard-size! Features 18 different scales. Graduations engraved in ivory-finished veneer body. Includes leather case. Ship. 1 lb. Order Item D-3E.....Sale \$11.95

POWERFUL GE 6 RPM DISPLAY MOTOR KIT

Worth \$11.95

\$3⁹⁵



Designed to continuously operate a 30 lb. load on GE's famous revolving shelf refrigerator. Can be adapted to serve a hundred useful functions in display work, hobby and industrial applications. Consists of very heavy duty AC synchronous motor with reduction gear assembly to 6 rpm, 2-3/4" pulleys with spring belt drive, line cord and light socket AC adaptor. Brand new packed in original GE Box. Ship. wt. 6 lbs. Order Item D-4E.....\$3.49

WILSON "TINY ATOM" REVERSIBLE DC MOTOR

Has Clear
Plastic Case

Reg. \$149
\$2.50



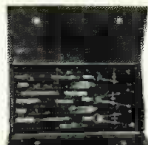
Operates from 1 or 2 flashlight batteries. Ideal for model builders, hobbyists. Precision construction. Alnico V field. Brass sleeve bearings. Speeds from 3500 to 9200 rpm. Instantly reversible. Ship 4 oz. Order Item D-5E.....Sale \$1.49

POWER DRIVE ACCESSORY KIT
Contains all the necessary parts for belt, direct connected spur gear, and worm drives at a wide range of speeds. Hundreds of hard-to-get power drive parts. Wt. 2 lbs. Order Item D-6E.....\$3.00

14-PART DRAFTING SET!

\$14.00
Value

\$7⁷⁵



Deluxe set of nickel-plated brass drafting instruments in velvet-lined case. Self-centering style construction. Ship. 1 1/2 lbs. Order Item D-7E.....Set \$7.75

REMOTE CONTROL MODEL BOAT!

Remote Control Functions:

- Forward
- Reverse
- Left Rudder
- Right Rudder
- Running Lights

\$7⁹⁹

Battery-Powered



WORTH \$35.00 — 2-seater motor boat has all functions controlled by hand-held R/C unit. Built to scale of lightweight woods. Hand made and lacquered. NOT A KIT, but a 15 1/2" long, 5" wide fully wired boat. Uses 3 standard flashlight batteries. Waterproof control cable. 4 lbs. Order Item D-8E.....Complete \$7.99



RCA "Victrola" Super-Sale

Reg. \$14.95

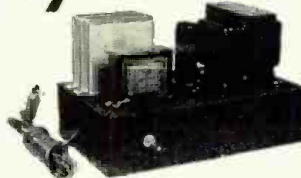
\$6⁹⁹

- Slide in 45rpm Disk
- Starts Automatically
- Stops Automatically
- For all the Family
- Safe for Children

Below DEALER cost at Radio Shack! Compact 4 1/4" x 7 1/4" x 10 1/4", fully hi-impact plastic encased, has Miss Francis' dual, Automatic single-play operation: slip in any 45 rpm disk, flip up Play Bar, concealed arm descends and disk starts automatically; stops automatically after playing! Plug into any amplifier, any radio or TV with phono input. Complete with AC plug, phono cord. RCA guarantee, in orig. Victor carton. Ideal for kids — they can't get at arm or motor, can't damage disk, can't get hurt — everything's enclosed. Sold everywhere for \$14.95, it's over 50% off at Radio Shack. Ship. wt. 7 lbs. Order Item D-9E.....\$6.99

POWER SUPPLY KIT 400 VDC @ 150 MA.

\$9⁹⁵ Worth \$25.00



A complete sell-out the last time we advertised this great power supply kit! Designed for continuous operation at 400 VDC-150 MA with less than 1/2 of 1% ripple! Excellent regulation. Makes an ideal power supply for Williamson-type amplifiers and other equipment. Kit includes metal encased power transformer, 400-0-400 @ 200 ma., 5 V., @ 4 A., 6.3 V @ 5.4 A. 2-8 mfd. @ 600 VDC oil filled capacitors, 7 henry @ 150 ma open cased choke. 5T4 rectifier, 100 W. bleeder, line cord, switch, socket and 7x12x3" chassis. Complete with schematic and chassis layout. Ship. wt. 18 lbs. Order Item D-10E.....\$9.95

COLUMBIA SALE!

22-RECORD 45-RPM
PACKAGE—WORTH \$20
With 2 45-EP Discs

\$3⁹⁵



Famous Artists:
Frankie Laine
Rosemary Clooney
Buck Clayton
And Others!

20 Different hit-tune, jazz and other hi-fi 45 rpm discs featuring top Columbia artists! Sale has BONUS of 2 (Reg. \$1.49 ea.) Columbia 45-EP discs! Ship. 3 lbs. Order Item D-11E.....Sale \$3.95

BACH'S MASS IN B MINOR

Reg. \$11.90

\$4⁹⁹

COMPLETE on 2 fabulous high VANGUARD 12" LP records in an album featuring the complete text in English and Latin. Ship. 2 1/4 lbs. Order Item D-12E

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Please Rush the following items:

Quan.	Item	Net	Quan.	Item	Net	Quan.	Item	Net
_____	A-1E	_____	_____	B-4E	_____	_____	C-8E	_____
_____	A-2E	_____	_____	B-5E	_____	_____	C-9E	_____
_____	A-3E	_____	_____	B-6E	_____	_____	C-10E	_____
_____	A-4E	_____	_____	B-7E	_____	_____	C-11E	_____
_____	A-5E	_____	_____	B-8E	_____	_____	C-12E	_____
_____	A-6E	_____	_____	B-9E	_____	_____	D-1E	_____
_____	A-7E	_____	_____	B-10E	_____	_____	D-2E	_____
_____	A-8E	_____	_____	B-11E	_____	_____	D-3E	_____
_____	A-9E	_____	_____	B-12E	_____	_____	D-4E	_____
_____	A-10E	_____	_____	B-13E	_____	_____	D-5E	_____
_____	A-11E	_____	_____	C-1E	_____	_____	D-6E	_____
_____	A-12E	_____	_____	C-2E	_____	_____	D-7E	_____
_____	A-13E	_____	_____	C-3E	_____	_____	D-8E	_____
_____	A-14E	_____	_____	C-4E	_____	_____	D-9E	_____
_____	B-1E	_____	_____	C-5E	_____	_____	D-10E	_____
_____	B-2E	_____	_____	C-6E	_____	_____	D-11E	_____
_____	B-3E	_____	_____	C-7E	_____	_____	D-12E	_____

C.O.D. CUSTOMERS: Radio Shack accepts C.O.D. orders of \$5.00 and over ONLY if accompanied by a deposit of at least 25%. It should be noted that such orders cost you more because of postoffice charges on the services involved. Add estimated postage.

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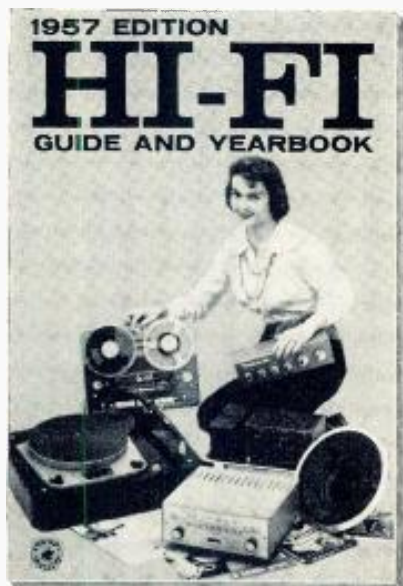
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1957 CATALOG

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167 Washington St., Boston, Mass.

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164
PAGES!



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- Tuners
- Tapes
- Record Players and Changers
- Tone Arms, Cartridges and Needles
- Preamplifiers and Amplifiers
- Loudspeakers
- Speaker Enclosures
- Saving Money in Hi-Fi

Also included in this new H-Fi volume is a giant YEARBOOK SECTION covering all the latest trends in high fidelity. This "book within a book" lists the nation's best-selling records and artists, pre-recorded tapes, all FM stations, and contains a new Hi-Fi glossary and much, much more!



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ON SALE FEB. 7 AT ALL NEWSSTANDS AND RADIO PARTS DEALERS!

Bench Puzzlers

By JAMES A. McROBERTS

An assortment of problem repairs, from one technician's experience, may rescue others from headaches.

IN THE spirit of mutual helpfulness, the author offers the following jottings from his service notebook in the hopes that it will save some fellow technician valuable time in tracking down these unusual service faults.

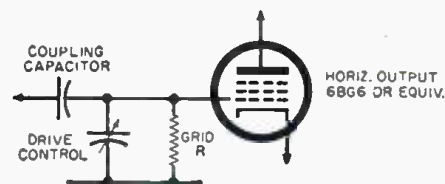
* * *

Horizontal Output Blocking

A symptom of a sudden cut-off of the raster, with a period of no raster, followed by an increase to normal raster brilliance, may be due to the blocking of the horizontal output tube.

The trouble originates in the grid of the output tube. This resistor may increase in value to an open circuit, or a nearly open circuit. The schematic diagram of this section of the receiver is shown below.

When the value of this grid resistor increases, the grid circuit of the hori-



zontal amplifier may block, as occurs, for example, in multivibrator and blocking-oscillator action. When the tube blocks, it obviously cuts off the high voltage (flyback type assumed) and there is no raster. With a gradual turn-on of the tube, the raster will increase in brilliance and also in sweep width.

* * *

Wow with Good Capstan

When the *Pentron* 9T-3C tape recorder exhibited wow and an inspection of the capstan assembly showed no flats or other troubles, the most likely source of the difficulty was the spring which holds the idler wheel in contact with the motor pulley (manufacturer's part #39) or excessive wear of the idler wheel, or both.

Check the condition of the spring even if the trouble is obviously a badly worn idler wheel.

* * *

Poor Height-Compression

The *Raytheon* chassis 21T8 displayed considerable compression at the bottom of the picture together with inability to secure quite enough raster height. A new vertical output tube (6S4, V_{10}) improved matters slightly for a few minutes but the trouble slowly returned.

When this problem is encountered, check and replace C_{127} , the .01 μf . capacitor connected in series with resistor R_{418} (180,000 ohms, 1 watt). C_{127} and R_{418} are connected from the plate

TELEPHONE & CONTROL EQUIPMENT



• CONTROL UNIT RM-53—(Pictured at left.) Used to operate radio equipment and provide remote control and intercom. of such equipment by use of the RM-52 Unit listed below. Up to 1/2 mile, uses 2 flashlight batt. Internal transformer has High-Low Impedance Sw. and Sidetone. Also Mic. & Phone Jack & PL-55 & PL-68 Plugs.
USED: \$3.95 NEW: \$5.95

REMOTE CONTROL RM-52—(Pictured at right) Can be used with RM-53 or used as a separate telephone system. Up to 1/2 mile. Uses 3 flashlight batt. Also can be used as a direct remote control for radio equipment. Provides bias for Mic. & Sidetone to headset. High or Low Imp. Also Mic. & Phone Jacks.



USED: \$2.95 NEW: \$4.95

TS-13 HANDSET for RM-53 or RM-52... Used: \$5.95

EE-8 FIELD TELEPHONE—Ideal for private telephone system for two or more phones, up to 17 miles. Hand ringer, generator with handset, carrying case. Uses 2 flashlight batt. Price—Used, Checked... \$14.95
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of the 6S4 to ground, the resistor be-
ing next to the tube.

* * *

Black Lines on Raster

The customer complained that his *Motorola* TS 292A chassis displayed black vertical lines on the left side of the raster.

Adding a 120-ohm, 1-watt resistor in the screen grid lead of the horizontal output tube V_{15} (6BQ6GT) suppressed the parasitic oscillation which caused this pseudo-Barkhausen effect.

* * *

Picture and Raster Stretch

The *Admiral* chassis 20A2 displayed vertical nonlinearity at the top of the raster by stretching or expanding the first twenty or so visible lines. Some variation in the amount of stretch could be obtained by an adjustment of the vertical linearity control, R_{111} , although too much stretching remained at the limits of motion of this control.

The difficulty was traced to C_{40A} , cathode-to-chassis electrolytic bypass capacitor for the vertical output tube, V_{102} . This capacitor had lost some capacity, but also had an abnormal power factor when tested with a capacitor checker. Replacement was made with a tubular unit after clipping the lead to the original one, which was part of a multiple unit. This case was a puzzling one inasmuch as the clue furnished by the linearity control indicated something wrong in the circuit associated with the vertical output tube, but shunting the cathode-to-chassis bypass did not cure the trouble and no evidence of excessive leakage showed on an ohmmeter check.

* * *

Washed Out Picture

In those cases where the grid of the cathode-ray tube is fed the video signal through a coupling capacitor, leakage in this capacitor will result in increased brilliance of the picture and a washing out of the video information on the picture tube. The case is especially true if the "B+" to the video amplifier is fed through a resistor of relatively high value so that the video

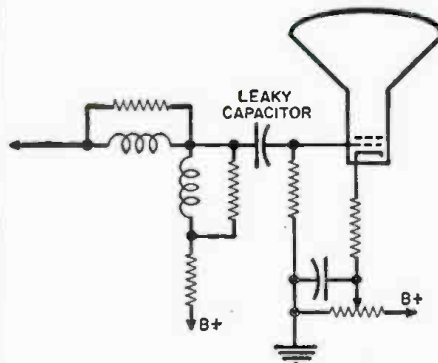


plate voltage drops only a little from normal, and the grid voltage of the CRT is only a trifle more positive than normal. The schematic diagram above shows such a typical case.

As a check prior to direct substitution of the suspected capacitor, have

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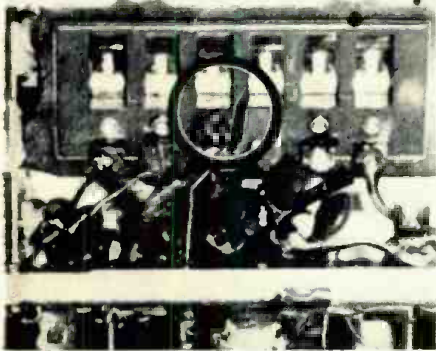
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RADIO & TELEVISION NEWS

the set running and tuned to an unused channel (no signal present). Clip off one lead of the capacitor while monitoring the grid voltage of the CRT or the plate voltage of the video amplifier tube with a voltmeter. If the capacitor is good, no change will be noted in the meter reading.

Snow Due to Flux Leakage

The photograph below shows a leakage path between the third and fourth



contacts of a turret tuner. The darker area is soldering flux with its accumulated dirt and grime.

The leakage path resulted in a reduction of the a.g.c. voltage applied to the tuner. Thus the tuner operated at nearly full gain irrespective of the developed a.g.c. As a consequence, more snow was developed since the noise pulses easily overloaded subsequent stages. These pulses were unduly prominent even when overloading did not occur.

Record Changer Trouble

After considerable service the RCA Victor RP 176 record changer may develop an intermittent case of no sound. The symptom will become progressively worse. The trouble spot is the muting switch on the pickup arm which serves to kill the input to the amplifier during the changer cycle. Due to the constant pushing, the switch blade, in time, will jam against the other switch blade to form a permanent, or near permanent, closed circuit.

The remedy is to manipulate the blades of the switch so that they make contact only during the change or reject cycle.

Poor Horizontal Sync

When the report of poor horizontal sync was made on the Philco r.f. chassis R-191, we replaced capacitor C_{600} in the sync feed filter from the video amplifier to the sync separator tube, V_{11} , a 6CS6.

Capacitor C_{600} has a value of 220 $\mu\text{fd.}$ and is located in series with another capacitor, C_{601} (4700 $\mu\text{fd.}$) which is connected to the sync separator (V_{11}) grid, pin 1. C_{600} is shunted by a 150,000-ohm resistor, R_{600} , to form a filter for the sync.

When C_{600} opens, as in this case, the high-frequency (i.e., horizontal) sync pulses are greatly reduced in ampli-

tude. The low-frequency pulses pass with relative ease through the shunting resistor R_{600} , so that the vertical pulse group's flat tops are not appreciably affected. The capacitor, C_{600} , even though disconnected, will leave some capacity in the circuit due to stray wiring so that some horizontal sync action can be effected.

No Sound from KCS-81

Some audio buzz was noted in the RCA KCS-81 when the volume control was touched. The 33,000-ohm resistor connected to pin 6 of the 2nd sound i.f. tube, V_{102} , soon heated up sufficiently to reveal the passage of heavy current through it. Capacitor C_{100A} , part of a dual unit, was the cause of the trouble.

As several complaints have been traced to either this section or its mate in this particular capacitor, replacement of this dual capacitor is a recommended procedure when servicing this chassis, even when the specific complaint doesn't involve this particular component.

Lines and Hiss

The complaint on the Crosley chassis No. 431 concerned a series of beady vertical lines on the left-hand side of the raster with the lines to the far left the most intense. The symptoms were present with or without a picture. A slight hiss could be heard on all stations or in the absence of a station.

The cause of the trouble was a parasitic oscillation at the screen grid of the horizontal output tube, V_{100} , a 25CU6. Installation of a 100-ohm, 1-watt anti-parasitic resistor between pin 4 (screen grid terminal) of the horizontal output tube and the dropping resistor, R_{11} (a 12,000-ohm, 3-watt unit) and the bypass capacitor, C_{11} (.05 $\mu\text{fd.}$) cured the complaint.

The resistor damps out the high-frequency oscillation at the second subharmonic of a frequency near the sound carrier in the i.f. passband. The oscillation is started with each horizontal line, hence its steadiness.

Blooming in Admiral 20D2

Blooming, exemplified by an abnormal expansion of the raster area with a change in setting of the brightness control, may be due to trouble in the horizontal output circuit. The resistance in the screen grid circuit increased abnormally in this particular case.

The output tube for this chassis is V_{105} , a 6BQ6GT. The screen grid dropping resistor is R_{120} with a rated value of 8200 ohms and a rated dissipation of 2 watts. The case history revealed that this resistance had changed its value to approximately 17,000 ohms. A 5-watt, 8200 ohm resistor was used as a replacement so as to allow additional dissipation with less likelihood of further trouble due to a resistance change in the circuit.

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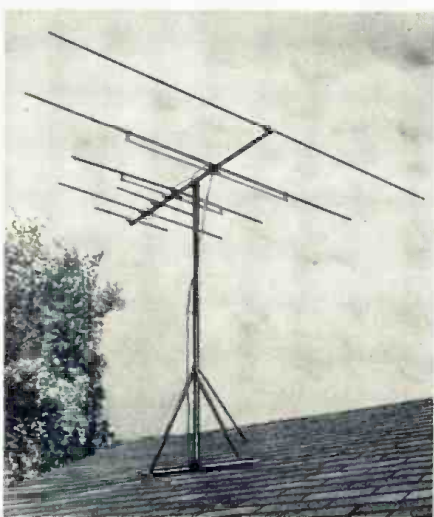
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HIGH-GAIN WIDE-BAND ANTENNA
Winegard Company, Burlington, Iowa, has announced another antenna, the "Color Beam Deluxe," incorporating the "Electro Lens" feature. The result, according to the manufacturer, is an all-channel antenna with performance comparable to separate cut-to-channel yagis, yet retaining the small physical size and good mechanical design of the yagi. It has been designed to meet the requirements of color reception. Factory-assembled, it



opens like an umbrella at the installation site, setting up the possibility of convenient, one-man installations. Completely anodized in gold, the unit is corrosion-resistant and weather-protected.

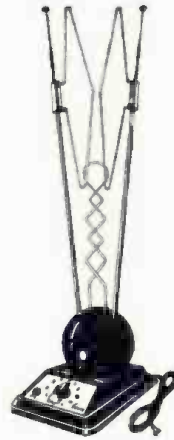
Included with the "Color Beam Deluxe" is the "Jigger Mount" device, a universal mount that permits quick attachment to any type or pitch of roof. Also included is lead-in wire with attached terminal clips and other material needed for the complete installation.

SALES REORGANIZATION
Snyder Manufacturing Company, Philadelphia, Pa., will reorganize its sales program in its Automobile Accessories Division during coming months. According to President Ben Snyder, sales representatives will be established in all areas. Establishment of a sales representative organization for this division closely follows a similar, successful reorganization of sales for the Antenna Division.

Newly appointed representatives for the Antenna & Electronics Division include J. W. Lehner Co., 367 Brynhill Rd., Columbus, O., to cover Ohio, western Pennsylvania, and W. Va.; also Herbert L. Dienes Co., 1505 Paper Mill Rd., Erdenheim, Pa., to cover

eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia, and Virginia.

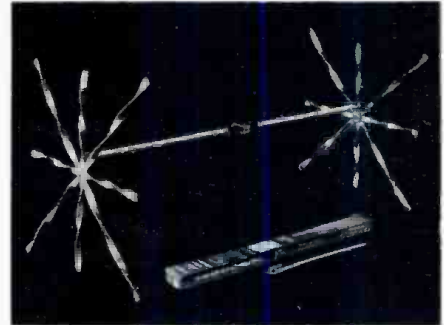
INDOOR ANTENNA
Radio Merchandise Sales, Inc., 1916 Bronxdale Avenue, New York 62, N. Y., claims for its new "Focus," model F-38K, that it has the gain of three separate switch-type indoor antennas stacked together. Features include the exclusive diamond phasing loops, a criss-cross phasing element, and a 12-position all-channel phasing switch. The mahogany-finished base has a felt pad to prevent damage to furniture surfaces.



Edward E. Wineblatt, general manager of the firm, has announced the appointment of Ed Martin as representative in the state of Virginia.

MAGNETIC AERIALS
Brach Electronic Division, General Bronze Corporation, 711 Stewart Ave., Garden City, N. Y., is seeking new applications for the magnetic antenna materials already introduced in a top-of-the-set indoor antenna that has no conventional elements protruding from its modest-sized, radio-like cabinet. It is presently conducting development in the direction of aircraft antennas, miniature in size and low in weight, that maintain the same operating efficiency of aircraft antennas currently in use.

LIGHTWEIGHT ANTENNA
Starbeam Company, Box 5087, Waco, Tex., uses a new principle in its "Starbeam" antenna, in which eight twisted aluminum elements are arranged in a star pattern on each end of a 34-in. two-piece aluminum

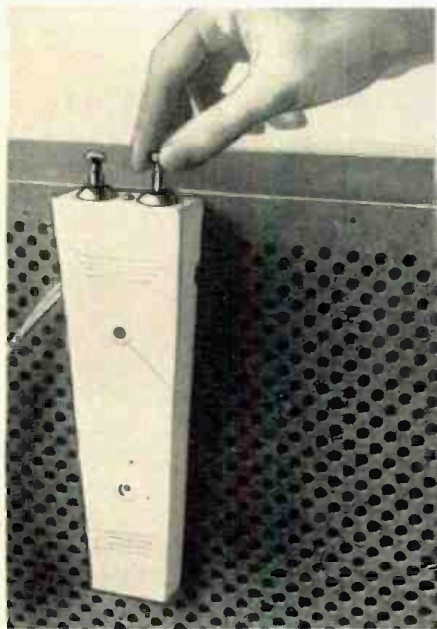


beam. Its designer is Dr. Corlett, a nuclear physicist who once studied under Albert Einstein and who believes that TV waves are composed of individual particles of energy. He states that the twisted antenna elements use more of the bouncing rays, which have heretofore been a source of annoyance in TV reception.

Since the unit is light (9½ oz.) and relatively small in size, it may easily be disassembled and reassembled for portability, and may be used indoors, as in an attic, or outdoors.

TUCK-AWAY INDOOR ANTENNA

JFD Manufacturing Company, Inc., 6101 16th Avenue, Brooklyn 4, N. Y., offers an indoor dipole antenna, the "Periscope," that mounts to the back

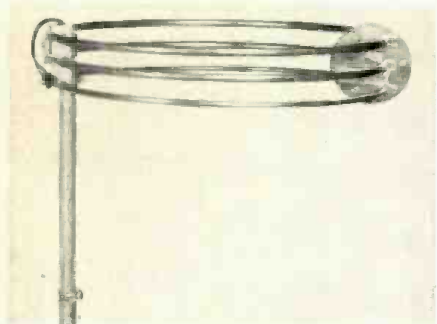


of the TV receiver. When not in use, it can be telescoped out of sight. The ball-socket nicked brass telescoping dipoles pivot in any direction in use, drop out of sight behind the set when not in action.

Encased in a high-impact styrene housing and available in a choice of four colors, models of the "Periscope" are available in either special or deluxe versions to fit portable, table, or console receivers of various sizes.

6-METER MOBILE ANTENNA

Hi-Par Products Company, Fitchburg, Mass., offers the "Saturn 6" for the many amateurs who have gone over to horizontal polarization in the 6-meter band. Design center is 50.5



mc. but a trimmer permits resonating between 50 and 53 mc. As compared to vertical whips, the antenna shows improved results, especially over hilly terrain, with less flutter and swish, and less ignition noise. A universal bumper mount is available. -30-

February, 1957

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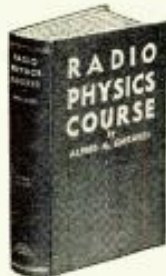
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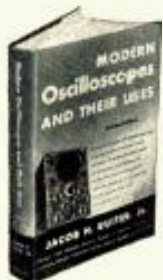
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Now you can build any of the basic Jensen speaker enclosures at tremendous savings. All kits are cut from 3/4" plywood panels and all baffles are pre-cut. All hardware, glue, sound absorbing material and complete simple instructions are included. You need only a screwdriver. Brochure available.

K-101. Imperial Cabinet Kit. \$89.00
K-103. Triplex Cabinet Kit. \$48.00
K-105. 15" Base Ultra-Flex Cab Kit. \$48.00
K-107. Concerto Cabinet Kit. \$39.00
K-109. 12" Base Ultra-Flex Cab Kit. \$39.00
K-111. 8" Base Ultra-Flex Cab Kit. \$23.00
K-113. Treasure Chest Cab Kit. \$18.00

Standard Coil Cascade TV Tuner

Replacement for any type TV set. 41 MC. IF. Shaft length 3 1/4". **\$9.95**
Knobs to match—69c. in lots of 3. \$8.95 ea.

Building Your Own Hi-Fi System? Write Us FOR PRICES ON OUR PACKAGE DEAL QUOTATION.

All merchandise is brand new, factory fresh & guaranteed. Mail & phone orders filled on receipt of certified check or MO of 20% of items as a deposit. Balance C.O.D. F.O.B. factory, N. Y. Prices & specifications subject to change without notice.

AIREX RADIO CORP.
64 Cortlandt St. N.Y. 7, N.Y. CO 7-2137

Electronic Agitator
(Continued from page 43)

appear on C_1 . When switch S_1 is closed, full line voltage is connected across the plate-cathode circuit, but the tube does not fire because of the negative charge present on C_1 . This charge blocks space current until it has dissipated through R_1 . Resistor R_1 functions as a coarse adjustment by shifting the operating point.

The tube fires at the expiration of the timed period and applies rectified a.c. to the relay, RL_1 . The tube continues to pass current and hold RL_1 closed until S_1 is opened. Plate current then ceases, RL_1 opens, and C_1 begins to charge. After a second or so the cycle may be repeated. R_2 protects the grid by limiting the current during the charge and firing periods. R_3 connects the cathode to L_2 . Fuse F_1 is used to prevent tube failure if C_2 or the relay become shorted.

In operation the film reel is clipped to a string which passes through the string guide and is attached to the motor drum. The drum on the motor shaft need not be grooved as shown in the illustration. A short piece of 1/2" diameter dowel with a hole drilled into the end to accept the motor shaft and a screw tapped into the side is sufficient. The string guide will keep the cord from running off the drum.

The string guide is made from a short length of coat hanger wire bent

sharply at one end and soldered closed at the other. The slot left should be sufficient to pass the string, but not the knotted string. After assembling the switch onto the chassis, the string guide is soldered to the switch lever.

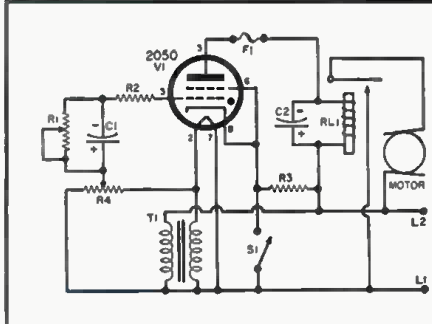
When the timing circuit fires and closes the relay, the motor begins to wind the string and raise the film reel out of the solution. This is the draining period. The lower knot in the string is unable to pass through the string guide, thus raising the guide and opening switch S_1 . The motor then stops, allowing the film reel to coast down into the solution. As the reel enters the solution, a second knot located above the string guide, about three inches from the motor drum, pulls the string guide down, closing S_1 and starting the timing cycle again. The period for which the film is draining may be changed by varying the distance between the lower knot and the string guide. The "in solution" period is adjusted by means of the two controls on the front panel.

The completed unit is supported by a board which hooks onto a shelf above the sink.

This agitator has given daily service for over two months. It has operated perfectly and assures us of consistent results in our color film processing. The advantages of automatic agitation will also prove valuable to the careful black-and-white processor.

Agitation is an important detail and, unlike a person, this mechanical unit is almost infallible. -30-

Complete schematic diagram of the electronic agitator. All parts are standard.



only LAFAYETTE can do it! OUR DIRECT IMPORTATIONS

YOU SAVE IMPORTERS PROFIT!

SAVE 33 1/3-50%

PROFESSIONAL TRANSCRIPTION TURNTABLE AND VISCOUS-DAMPED TONE ARM THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE



PK-100A TRANSCRIPTION TURNTABLE
New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within $\pm 7\%$ using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferal. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13 1/2" x 14" and requires 2 3/4" clearance above and 3 3/4" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-100-A Net 49.50

PK-90 VISCOUS-DAMPED TONE ARM
This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidentally dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-100 with matching finish. Shpg. wt., 2 1/2 lbs.
PK-90 Net 15.95

COMBINATION DEAL

72.50

PK-100-A

New!



HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

14.95

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohm impedance. Size: 4 1/4" long x 3" diameter, lens extends 2 1/2". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 Net 14.95

METAL-CASED CONE TYPE HI-FI TWEETER

FREQUENCY RESPONSE 2000-16,000 CPS • HANDLES 20 WATTS OF POWER

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3 1/8" x 2 1/8" x 3" Diam. Shpg. wt., 3 lbs.



5.95
Net

HK-3 Net 5.95

CROSSOVER NETWORK WITH CROSSOVER AT 2000 CPS



8.75

CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS • BUILT-IN LEVEL BRILLIANCE CONTROL

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2 1/2" ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2 3/8" H x 2 3/8" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 Net 8.75

NEW!



IMPORTED 12" HI-FI COAX. SPEAKER

- FREQUENCY RANGE 30-15000 CPS
- HANDLES 20 WATTS OF POWER
- COMPLETE WITH LEVEL CONTROL
- POWERFUL TSK-5 MAGNETS
- SPECIAL SHEEPSKIN-EDGED CONE

A Lafayette exclusive import and exceptional value. Consists of a 12" woofer, coaxially mounted 2 1/2" tweeter and a built-in crossover network. The specially processed fibre cone has a sheepskin edge to suppress unwanted nasal vibrations and insure beautiful tone quality. Highly efficient TSK-5 magnets. Level control provides variation to 6 db cut. Maximum input 20 watts, impedance 8 ohms. Rugged all-metal frame. If made in this country, would cost at least \$49.50. Shpg. wt., 11 lbs.

SK-58 Net 29.50

Reg. Price **44.50**
Net **29.50**

3 WAY CROSSOVER NETWORK

Carefully designed and engineered to Lafayette's own specifications. Insertion loss is well below the acceptable minimum. Crossover is at 350 and 5000 cycles. Permits full enjoyment of any 3 way system. Properly balances woofer-mid range speaker and tweeter inputs. Complete with 2 continuously variable "presence" and "brilliance" controls for tonal adjustment and full instructions. 8" L x 3 1/4" H x 2 3/8" W. Shpg. wt., 7 lbs.

LN-3 Net 14.95



3 WAY HI-FI SPEAKER SYSTEM



SK-74

55.50

SK-67

- 15" Woofer with 31.5 oz Magnet
- 8" Mid-range speaker
- Acoustical Lens Tweeter
- 3-Way Crossover Network

A complete 3-way system capable of performance heretofore found only in systems at many times this price. The components were specially selected by Lafayette sound engineers to offer the maximum in audio fidelity at the lowest price possible. Includes continuously variable presence and brilliance controls. Offers superb reproduction across the entire audio spectrum. Shpg. wt., 25 lbs.

SY93 Net 55.50

1 WAY SPEAKER SYSTEM 40-16,000 CYCLES



LN-2

FK-3

SK-68 12"

This 2-way speaker system is another excellent buy for the moderate purse. It is basically the same as the SY-85 system described at the top of the page, but incorporates the de luxe SK-68 speaker with 21.5 oz. Alnico V magnet. This results in more efficient reproduction and extension of the lower register. Complete system includes the SK-68 12" 25 watt woofer, HK-3 cone type tweeter and LN-2 crossover network with level-brilliance control. Range of system 35-16,000 cycles. Shpg. wt., 18 lbs.

SY-87—Complete System Net 27.50

SY-86—Complete System, same as above except the HW-7 Tweeter with acoustical lens is supplied instead of HK-3. Shpg. wt., 20 lbs. Net 36.50

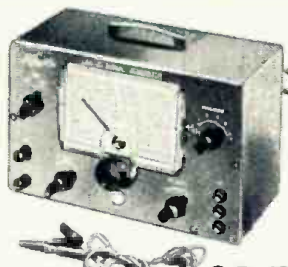
LAFAYETTE RADIO

DEPT RB-1

JAMAICA 33; N. Y. 165-08 Liberty Ave. Write for FREE Bargain Packed Catalog!

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PLAINFIELD, N. J., 139 West 2nd St.
NEWARK, N. J., 24 Central Ave.
BRONX, N. Y., 542 E. Fordham Rd.

LAFAYETTE SENSATIONAL VALUES! IN COMPLETELY WIRED TEST EQUIPMENT at LESS than the PRICE of KITS!



LAFAYETTE SIGNAL GENERATOR

NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY

A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC—320KC, 320KC—1000KC, 1MC—32MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately.

22.50

Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6 1/2" x 10" x 4 1/2". Comes complete with pair of leads, AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

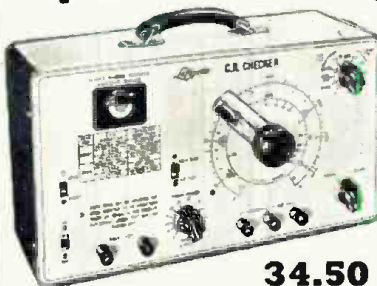
LAFAYETTE LSG-10 SIGNAL GENERATOR

22.50

NEW!

LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED



- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CAPACITORS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001-.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives

34.50

you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14 1/2" L x 8 1/4" H x 5" D. Shpg wt. 19 lbs.

MODEL LC-4

NET 34.50

NEW!

LAFAYETTE CAPACITOR-RESISTANCE TESTER COMPLETELY WIRED AND TESTED



- COMPLETELY WIRED AND TESTED
- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

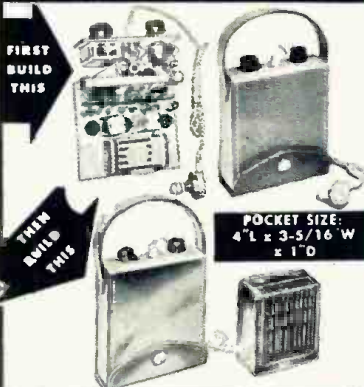
21.50

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to 5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9 1/2" H x 7 1/2" W x 5 1/4" D. Shpg. wt. 10 lbs.

MODEL LC-15

NET 21.50

4 AND 6 TRANSISTOR SUPERHET KITS POCKET AND HOME RADIOS FOR SPEAKER AND EARPHONE OPERATION



Completely self-contained, pocket size portable set which operates a miniature earpiece so only you can hear. The circuit uses 4 transistors (2 high frequency and 2 audio) plus a germanium diode, 2 IF stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective receiver covering the entire broadcast band. It requires no outside antenna or ground connection. The kit is supplied complete with transistors and all parts, including battery, and drilled and punched chassis. Pictorial and circuit diagrams are included with simple, easy-to-follow instructions. (Note: Earpiece and carrying case are not supplied.)

- KT-94—Complete Kit. Shpg. wt., 2 lbs. Net 19.95
- MS-311—Leather Carrying Case. Net 1.95
- MS-260—Super Power Dynamic Earpiece. Net 3.95

2-TRANSISTOR PUSH-PULL OUTPUT KIT WITH SPEAKER SELF-CONTAINED IN BEAUTIFUL PLASTIC CASE.

Converts 4-Transistor Kit KT-94 into a 6-transistor home radio with speaker. Transistorized push-pull audio stage plugs into 4-transistor kit, suitable for group listening. Performance equal or superior to commercially wired sets selling at much higher prices. Kit includes 2 transistors, 2 transformers, 2 1/2" PM speaker, pre-punched chassis, speaker case (holds all components), battery, hardware, instructions and diagrams.

- KT-96—Shpg. wt., 1 lb. Net 11.50

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both AC and DC

- 160 ua 3" METER
- 1% PRECISION RESISTORS
- SILVER CONTACT SELECTOR SWITCH



FULL SCALE RANGES

DC Volts: 0-10; 0-50; 0-100; 0-500; 0-1000 Volts—AC Volts: 0-10; 0-50; 0-500; 0-1000 Volts—DC Current: 500 ua and 500 ma—Resistances: 0-10K; 0-1 Meg—Decibels: -20 to +22; +20 to 36 db (0 db = 0.775 V)—Capacity: 250 mmfd to .2 mfd—.005 mfd to 1 mfd—Output Ranges: 0-10; 0-50; 0-500; 0-1000 volts

8.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4 1/4" x 3 1/2" x 1 1/2". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A

Complete 7.95

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER



LOOK AT THESE FULL SCALE RANGES!

DC Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts—AC Volts: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts—RESISTANCE: 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—DC CURRENT: 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps—DECIBEL: -20 to +17 db (0 db = 0.774V)—CAPACITY: .0001-.01; .005-.15 mfd—INDUCTANCE: 20-2000 millihenry—OUTPUT RANGES: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

19.95

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit) in addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch. 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 6V A.C. for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6 1/4" x 4 1/4" x 2 1/2". Complete with batteries and leads. Shipping weight 4 1/2 lbs.

RW-30A

Singly Each 19.95

In lots of 3, Each 19.25

3 TRANSISTOR SUPERHET POCKET RADIO KIT



- A TRUE POCKET SUPERHET RECEIVER—NO EXTERNAL ANTENNA!
- NO EXTERNAL GROUND!

A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case. The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors, battery, case, dial and easy to follow step-by-step instructions. 4 1/4" x 2 1/2" x 1 1/16". Shpg. wt., 1 lb.

The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors, battery, case, dial and easy to follow step-by-step instructions. 4 1/4" x 2 1/2" x 1 1/16". Shpg. wt., 1 lb.

- KT-116—Complete Kit, less earphone. Net 16.95
- MS-260—Super Power Dynamic Earphone. Net 3.95

LAFAYETTE RADIO

DEPT RB-2

JAMAICA 33; N. Y. 165-08 Liberty Ave. Write for FREE Bargain Packed Catalog!

100 SIXTH AVE., NEW YORK, N. Y. BOSTON, MASS., 110 Federal St. PLAINFIELD, N. J., 139 West 2nd St. NEWARK, N. J., 24 Central Ave. BRONX, N. Y., 542 E. Fordham Rd.

FREE!
LAFAYETTE
CATALOG



**ELECTRONIC CATALOG
PACKED WITH MONEY SAVERS**

Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — ALL AT GREAT SAVINGS — For the economy minded servicemen, dealer, engineer and technician. **CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.**

35 WATT HI-FI AMPLIFIER KIT WITH METERED OUTPUT AND 4 PUSH-PULL PARALLEL NEW EL84 TUBES

New Lafayette high power amplifier kit with a host of features not in any other single amplifier. Calibrated output meter permits use as either a recording or reproducing amplifier. EL84 power pentodes provide high peak power and low distortion required for better audio quality. Features exceptional control versatility and ample inputs for all associated custom hi-fi equipment. DC operated preamp filaments and balancing adjustment to minimize hum. Meter can be switched to indicate either recording voltage or output level of amplifier. Features rumble filter, loudness control, separate bass and treble controls, silencing switch, speaker selector switch, output balancing adjustment and monitoring jack.



SPECIFICATIONS

FREQUENCY RESPONSE: ± 1 db 20-20,000 cps. **HUM:** 85 db below rated output. **POWER OUTPUT:** 35 watts with 4% total distortion at full rated output. **INPUTS:** TV Sound, Radio, Magnetic Phono, Crystal Phono, Tape. **OUTPUT IMPEDANCE:** 4, 8 and 16 ohms; high impedance for tape recorder. **TUBE COMPLEMENT:** 3-12AX7, 1-12AU7, 4-EL84, 1-5U4. **FEEDBACK:** Negative feedback loops virtually eliminate distortion. **POWER:** 117V, 60 cps, 80/130 watts with auxiliary power receptacles. Removable esutechcon. Size 12 3/4" L x 9 3/4" D x 4 1/4" H. A combination of high power, high fidelity, gleaming beauty and advanced engineering features unmatched at even twice the price. Supplied in complete kit form with simplified easy-to-follow instruction sheets. Shpg. wt., 25 lbs.

KT-115—Complete kit.....Net 59.50
LA-66 completely wired.....Net 79.50

LAFAYETTE'S FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL



The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output. **FREQUENCY RESPONSE:** FM, ± 5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 µv for 30 db quieting; AM, Loop sensitivity 80 µv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down—375 KC FM discriminator peak to peak separation; AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5 1/2" high x 9 3/4" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 8 lbs.
KT-100 kit, less case.....Net 34.95
LT-10—Completely wired.....Less metal case.....Net 52.50
ML-140—Metal case for above, shpg. wt., 3 lbs.....Net 5.00



**LAFAYETTE MATCHED HIGH FIDELITY
PHONO SYSTEM**

**NOTHING
FINER AT
THIS PRICE!**

Reg. Value
~~158.55~~
SALE!
119.50

NEVER—in the annals of HIGH-FIDELITY has a phono system of this quality—at this price—been offered. A Lafayette "best buy" system designed around the new Lafayette LA-59 amplifier. The performance of this Phono system surpasses the most critical requirements of music lovers. Twenty-four combinations of record equalization provide an almost endless variety of tone compensation to match varying recording characteristics. This system includes the famous Garrard RC-121 "Renown" 3 speed automatic and manual record changer, LAFAYETTE LA-59 18 watt amplifier with features found only in the most expensive amplifiers—G.E. triple-play-turnover cartridges with genuine G.E. DIAMOND SAPPHIRE STYLI, AND LAFAYETTE SK-58 12" coaxial HI-FI speaker. All units are supplied with plugs, jacks and prepared color-coded interconnecting cables for quick easy installation. For 110-125 volt, 60 cycle AC. Shpg. wt. 50 lbs.
HF-154—Complete Phono System.....Net 119.50

**LAFAYETTE DELUXE
FM-AM TUNER
Completely Wired**



- 2 3/4" Tuning Meter
- Armstrong FM Circuit-Foster-Seeley Discriminator
- Cathode Follower Output
- Tuned RF Stage

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 Kc. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and low impedance external antenna. **FREQUENCY RESPONSE:** FM, ± 1 1/2 db 20-20,000 cps; AM, ± 3 db 20-5,000 cps. **SENSITIVITY:** FM, 3 microvolts for 30 db quieting; 15 on AM. **HUM LEVEL:** 60 db below 100% modulation. **SELECTIVITY:** FM, 200 Kc bandwidth, 6 db down, 375 Kc FM discriminator peak to peak separation; AM, 8 Kc bandwidth, 6 db down. **IMAGE REJECTION:** 50 db. **DISTORTION:** Less than 1% at rated output. **OUTPUT LEVEL:** 3 volts for 100% modulation, 1 volt for 30% modulation. **TUBE COMPLEMENT:** 2-6U8, 6BA6, 6BE6, 6AU6, 12AT7, 6AL5 and 6X4 rectifier. **POWER REQUIREMENTS:** 11C-120 V, 60 cycle AC; 35 watts. Size: 4 1/4" H x 12 1/4" W x 9 3/4" D. Shpg. wt., 9 lbs.

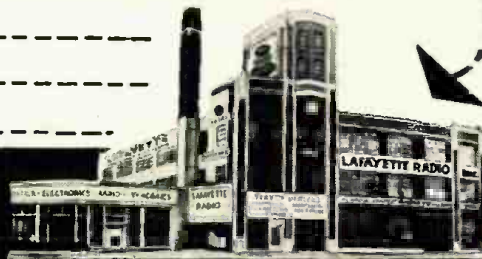
LT-20 FM-AM Tuner, Including Federal Excise Tax, less cage.....Net 62.50
ML-110 Metal Cage for above. Shpg. wt., 3 lbs.....Net 5.00

Lafayette Radio 165-08 Liberty Ave.
DEPT RB-3 JAMAICA 33, N. Y.

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Bendix Radio

DIVISION OF BENDIX AVIATION CORP.
BALTIMORE 4, MARYLAND

Portable 90-Degree CRT

(Continued from page 49)

picture tube's external coating. The 8XP4 has no external coating, so on receivers that require the capacitor, a 500- μ fd., 20-kv. capacitor may be connected from the high-voltage terminal on the receiver to chassis ground.

Housing the yoke and check tube in a small cabinet or box makes a handy test unit for mounting above the service bench or carrying along on service calls. Leads with battery or alligator clips connect the yoke to the yoke terminals in the receiver. The 8XP4 tube is self-focusing and without ion trap, so the service technician need not worry about focus or ion-trap adjustments. With this unit, all parts of the receiver chassis are readily available for servicing. There is no possibility of important parts on the chassis being covered by the picture tube, as is the case with vertical chassis. Because the picture tube need not be especially supported or braced, the chassis can be tilted to any position for repair.

On a few TV sets, it is actually easier to remove the picture tube from the chassis and leave the chassis in the cabinet. For a situation like this, the 8XP4 can be inserted in the chassis and still leave room for servicing. It's a good idea, therefore, to make a door on the box holding the 8XP4 tube and yoke so the tube can be removed for direct use.

While the 8XP4 will work satisfactorily for the deflection system in nearly any receiver, it is particularly useful in 90-degree systems, especially where such deflection-circuit problems as width and linearity are under examination. In such 90-degree systems, therefore, it has broader application than its useful companion and forerunner.

Like its predecessor, however, this CRT is subject to development of a small dark area—ion burn—at the center of the faceplate. This spot will not impair the usefulness of the 8XP4 in its intended application or shorten its life. The use of low brightness settings will retard this burn. —30—

PICTURE FLICKER

By JAMES A. McROBERTS

WHEN the volume control was advanced on the Sylvania Chassis 1-504, a flicker was noted in the picture with any loud passage of the sound. Some slight evidence of a hum bar was present on the picture and even more so on the plain raster.

The presence of the hum bar suggested improper filtering of the "B+" to the video or the video i.f. stages. This coupled with the symptom of flicker caused by loud sounds pointed to the common feature of trouble in the sound "B" supply.

Bridging capacitor C₁₁, a 40 μ fd. unit, eliminated the hum bar and sound interference. Replacing C₁₁ (the "B+" bypass of the audio amplifier output stage) proved to be the permanent remedy. —30—

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IT'S A CONDENSER BRIDGE

with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A RESISTANCE BRIDGE

with a range of 100 ohms to 5 megohms

IT'S A TV ANTENNA TESTER

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

SPECIFICATIONS

RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

SIGNAL TRACER SECTION

A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy.....Only

\$26⁹⁵
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As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

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- ✓ Audio Frequency Generator

- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only

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ADDED FEATURE:
Built in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

SPECIFICATIONS

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms

CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)

REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms

INDUCTANCE: .15 to 7 Henries 7 Henries to 7,000 Henries

DECIBELS: -6 to +18 +14 to +38 +34 to +58

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

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ALLMETER

SPECIFICATIONS

8 D.C. VOLTAGE RANGES (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

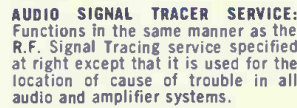
7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.

2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliampere, 0 to 15 Amperes.

3 DECIBEL RANGES: -6 db to +58 db.



AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified at right except that it is used for the location of cause of trouble in all audio and amplifier systems.

R.F. SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

FEATURES

Giant recessed 6 1/2 inch 40 Microampere meter with mirrored scale. Built-in Isolation Transformer. Use of the latest type printed circuit and 1% multipliers assure unchanging accurate readings

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY

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The Busy TV Service Organization, which needs extra Tube Testers for its field men.



CHECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS — Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. "FREE-POINT" ELEMENT SWITCHING SYSTEM — Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap." ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATION — The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

Model TD-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench — use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

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TUBE TESTER



- Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novals, Sub-Minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving in large easy-to-read type.

built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

- NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

- SEPARATE SCALE FOR LOW-CURRENT TUBES—Previously, on standard emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the standard scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

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'56 G-E TV: Many Symptoms-One Cause

By LLOYD B. HUST

A single bad connection causes several different defects in various sets.

CHASSIS in the G-E "ST" line tend to suffer from a fault that shows up in many different and puzzling ways. Knowing about it in advance may save considerable time spent in troubleshooting, as it is not otherwise likely to be suspected as the cause.

The symptoms noted here which may occur as a result of this single defect are by no means a complete list. On one set it appeared as though the picture tube were at fault, with low emission as the chief symptom. On another set, the fault manifested itself mainly as sync trouble. In yet another case, the high-voltage section of the receiver seemed involved, as there was severe raster blooming. In one, the video circuits appeared to be involved, with a very snowy picture resulting. In most cases, the set plays best when first turned on, with the trouble becoming worse after warm-up.

On all of these sets, the trouble was traced to one point—a poor ground connection at the point where the filament leads from the power transformer are grounded to the chassis. This defective grounding would affect some tubes more than others on the various sets, since not all tube filaments are returned to ground in exactly the same way.

The cure for this condition is obvious—make a good ground connection between the chassis and the transformer leads which should be grounded. On this set, these leads are soldered to a terminal which is riveted to the chassis. Heat seems to develop at this point, and the result is oxidation of the area around the rivet as well as on the surface of the rivet itself.

To make a good connection, first clean the chassis and the rivet, then flow a good grade of solder all around the junction with plenty of heat. Let the solder flow in and around the rivet. At the same time, it is a good idea, while the job is under way, to re-solder other transformer heater leads to their respective terminals.

So much time was spent in localizing this trouble in the different sets with different symptoms that now, on every set of this series that comes into the shop, the writer solders these connections as a matter of routine. On many, this procedure has saved time by immediately curing the complaint on which the set was brought in, thus eliminating the need for further testing. The practice has paid off. —30—

February, 1957

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The spiral antenna that is designed for maximum performance featuring the NEW TELESCOPING DIPOLES. This versatile antenna swivels on ball and socket in any direction. Gold spirals, plastic base blend with any room. LIST . . . \$14.95

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The UHF ANTENNA with the highest signal gain that is specially designed for ALL UHF areas. Luxurious gold upright and crossbar. LIST . . \$5.95



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PEAK PERFORMANCE which is unsurpassed is guaranteed with this antenna . . . for ANY and EVERY area. The gleaming gold upright, shiny spirals, bakelite base, aluminum bars, modern design . . . all make this YOUR BEST ANTENNA BUY. LIST . . . \$9.95

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Common-Sense Service (Continued from page 59)

positive, we can be sure that leakage is taking place through the capacitor.

Other clues can be obtained by removing a tube from its socket. Assuming that the tube is the only component in a given circuit through which current can be drawn, as is usually the case, there should be no current and therefore no voltage drop across plate and screen resistors with the tube out of its socket. This means that plate and screen voltages should rise to the full value of their "B+" source. If this action is not observed, further checking is indicated in the components of the tube's associated circuit.

Series-string filament chassis need not be excluded from this type of test. Even with a tube removed, thus opening the filament continuity, voltages hold up long enough (thirty seconds to two minutes) to permit a check.

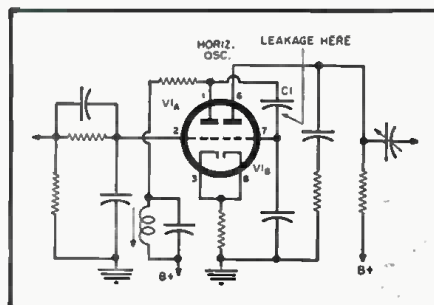
Parts Replacement

The replacement of a power transformer, a can-type filter, a concentric control, or an i.f. transformer is a time-consuming, often tedious project due to the usual maze of wires and attached small parts on terminals or tie points. However, much of the time can be saved and heat damage prevented by cutting out some steps.

For instance, when replacing power transformers, many technicians will patiently tag for identification each and every wire and tie point to which the replacement is to be connected. But if a technician knows his business, is this multiple tagging really necessary? Or is it only that that is the way he has always done it?

For, when he unsolders the wires coming from the defective power transformer, it should be obvious to the technician what function each has. For example, transformer wires going to pins 4 and 6 of the 5U4 rectifier are high-voltage plates; pins 2 and 8 are 5U4 5-volt filament connections; one wire of the 6.3 filament secondary goes to pins 2 or 7 of most octal tubes with the other going to ground or chassis, etc. It does not take much to see

Fig. 6. This cathode-coupled multivibrator is an example of a circuit where the leakage voltage through a defective capacitor might be disguised by stage operation. Killing the stage by withdrawing the tube permits useful readings.



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Cat. 406MC16X10RN. Ten for only **\$3.95**
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TRANSMITTER: 30 Watt TV transmitter. Uses 4-8025, 2 as 250-385 mc P-P osc. driving the other two as PA. The PA is grid modulated by a 3-tube video amp., and plate-mod by a 3-tube AVC unit. New with all tubes, schematic and instructions for easy conversion to 420. Only **\$35.75**
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(Please print clearly)

RADIO & TELEVISION NEWS

what the function of each wire is just by where it connects.

The practical and sensible way for an experienced technician to replace power transformers is this: Cut each wire coming from the old transformer, leaving about a two-inch stub of wire on each pin or tie point to which it connects. Raise these stubs upright so that they will be easy to locate later on.

Tag nothing! Slip out the old transformer and mount the new one. If it is an exact-brand replacement, its color coding will be the same so that no special effort is needed to match leads. If it is a commercial replacement, it will be supplied with a chart identifying the function and color coding of each wire.

Hook up the easiest and more obvious windings first, such as the four 5U4 connections, the two from the a.c. primary, and the two or three that go to ground (check with the schematic). The destination of the two or three remaining wires, if not immediately obvious, require but little tracing. Clip off each stub of wire remaining from the original transformer as each new wire is installed. This may at first appear to be a reckless system. After a technician tries it once he may wonder why he had ever bothered to tag eight or ten wires when all along he knew exactly where they should go.

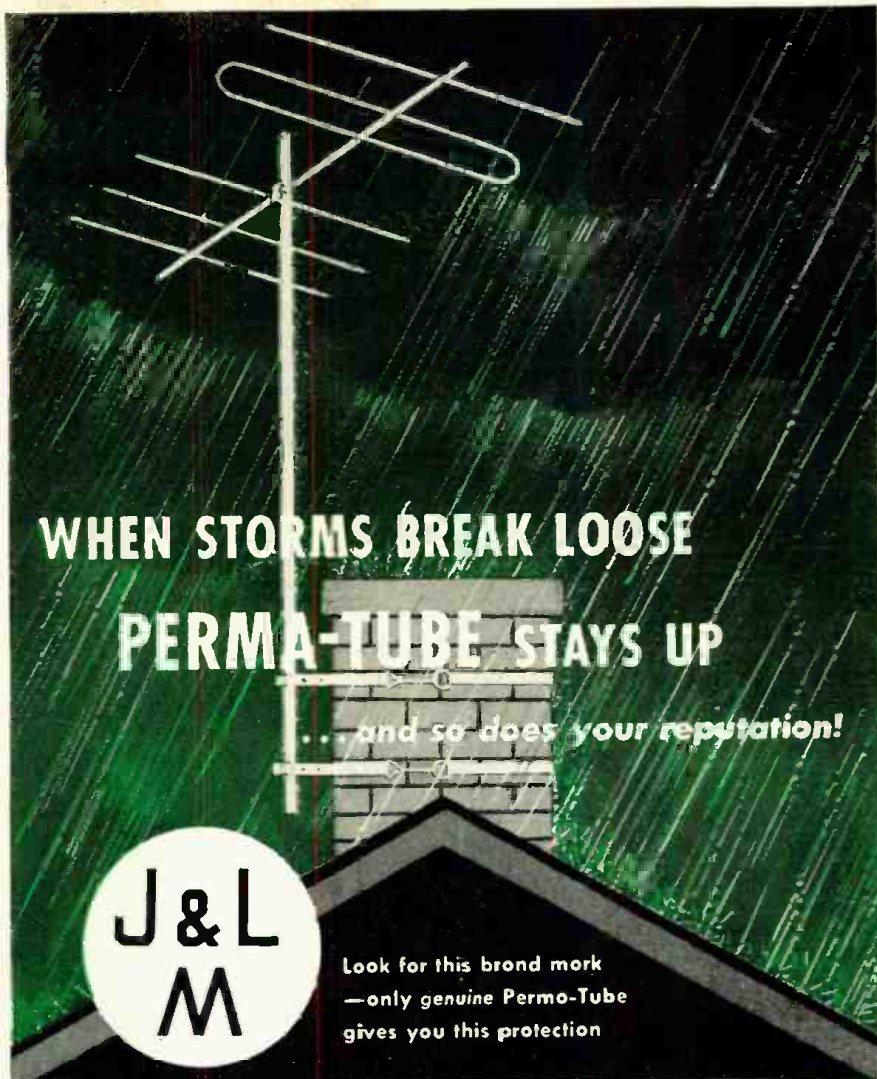
The tagging of wires or the sketching of an involved wire color code and layout diagram is a common sight, too, when many technicians replace concentric controls, can-type filters, and even some i.f. transformers. These components have multiple wires and small parts attached to their terminals, making it confusing to wire in new units. Some technicians will unsolder each wire and small part, usually melting the plastic wire insulation and occasionally breaking the lead off a resistor or capacitor in the process. And they may patiently tag each wire and small part or make a diagram for identification. But the practical and direct approach is not to remove all wires and parts from their terminals and ground lugs. Instead, *remove the terminals* with all their wiring intact and undamaged. Just clip them off the old units, which are being discarded anyhow. You can cut off these terminals with a pair of diagonal cutters and leave each one in its relative position. Install the new unit and simply sweat-solder each old terminal to the corresponding one on the replacement part.

Where it may require twenty to thirty minutes to replace a concentric control, with this method the job can be finished neatly, without wire insulation damage, in less than five minutes.

There is probably no end to the number of direct-approach servicing and replacement techniques that are in use today. Few technicians can afford to ignore all of the satisfactory and time-saving results achieved with them.

-30-

February, 1957



WHEN STORMS BREAK LOOSE

PERMA-TUBE STAYS UP

...and so does your reputation!

J & L
M

Look for this brand mark
—only genuine Perma-Tube
gives you this protection

Here's why . . . sturdy steel PERMA-TUBE is stronger than any other television mast

1. Its resistance to bending is *five times stronger* than structural aluminum.
2. Its resistance to deflection is *three times stronger* than structural aluminum.
3. Its resistance to destruction by wind-force is *twice as strong* as structural aluminum.

ADDITIONAL REASONS FOR USING PERMA-TUBE EVERY TIME

PERMA-TUBE IS CORROSION PROOF . . . it's treated with vmsynite—then coated *inside and outside* with a metallic vinyl resin base.

PERMA-TUBE IS EASILY INSTALLED . . . it's the *only mast* with *both ends* of the joint machine fitted.

ONLY GENUINE PERMA-TUBE GIVES THIS PROTECTION AND SERVICE . . . look for this brand mark . . . accept no claims from substitute materials.



For complete information and scientific data write to: Jones and Laughlin Steel Corporation, Department 455, 3 Gateway Center, Pittsburgh 30, Pa.

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STEEL CORPORATION · PITTSBURGH

AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20 WATT AMPLIFIER \$22.95

IMPERIAL 30 WATT AMPLIFIER \$29.95



\$24.95
Push-Pull 6L6 Output Tubes
Response 30-15,000 cps
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V. R. Phono

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20-watts power output. Use with any 8-ohm speaker. Chassis size 7 3/4" x 10 1/2" x 7 3/4" high. Complete with tubes: 2-6L6, 2-6CA, 12AX7 and 504C. This is a terrific value. A ready to use High Fidelity amplifier at less than the cost of a kit. Model HF-21, 20-watt Hi-Fi amplifier. Sale Price \$24.95.



NEW 1957 MODEL
Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

With CU-14Y, 12" Coax Speaker . \$39.95
With P15-CR, 15" Coax Speaker . \$49.95
With Imperial IV Speaker System \$46.95
With Imperial VI \$55.95 **With HF-33GE \$76.95**

New 1957 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A \$100.00 list value for only \$29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feedback; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal Phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls for mic gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs., net. Full size transformer components would cost you up to \$15.00 if purchased separately. Gold color chassis is 12 1/4" x 7 3/4" x 7 3/4" high. Complete with tubes: 6AT6, 12AU7, 6CA, 12AU7, 2-6L6G, plus 504C amplifier. Stock No. IMP-30 30 watt Imperial Hi-Fi amplifier complete with tubes and diagram. Ship. wt. 23 lbs.. Sale price only \$29.95.

NEW IMPORTED MONARCH HIGH FIDELITY AUTOMATIC CHANGER

With RONETTE #222 Hi-Fi turn-over crystal cartridge with separate sapphire needles.

SALE PRICE \$27.95

Monarch Model UA8 new imported high fidelity 4-speed automatic record changer, size 10 1/2" x 12 1/2" x 10 1/2" and 12" records automatically. Interlocks records of the same speed in any order. Features a 4-pole high fidelity motor eliminating rumble and wow. 9" turntable with high fidelity rubber molded cushion dynamically balanced. Counter balance tone arm with adjustable weight to any desired cartridge—adaptable for G.E. cartridge. Ship. wt. 15 lbs. Model UA8 Monarch automatic record changer with Ronette No. 222 crystal cartridge—Sale Price \$27.95. With Goldring No. 500 Var. Rel. cartridge—Sale Price \$29.95. 45 rpm spindle. \$1.88 extra.

12" COAXIAL PM SPEAKER RESPONSE 25-17,000 CPS

\$9.95

Model 12X3Y, new 1957 12" Coaxial PM Speaker, has high efficiency 12" woofer with Alnico V magnet and 3/4" Alnico V tweeter. Built-in crossover with variable brilliance control on an 18" lead for remote control of the tweeter volume. 10-watts response to 17,000 cps. Ship. wt. 5 lbs. Stock No. 12X3Y, 12" coaxial PM Speaker. Sale Price \$9.95.

SPECIAL MONEY SAVING COMBINATION PACKAGE DEAL

Model HF-21, 20-watt Hi-Fi Amplifier **PRICE \$59.95**
 Model UA8, MONARCH Hi-Fi Automatic Changer, and
 Model 12X3Y, 12" Coaxial PM Speaker as described above:

3 - 1957 MODEL Hi-Fi SPEAKERS • COMPLETE SYSTEMS WITH 4 SPEAKERS • ACOUSTICALLY LINED ENCLOSURES

The new 1957 Hollywood, 4 speaker high fidelity speaker systems are expressly designed to give realistic reproduction from your Hi-Fi amplifier or FM-AM radio. Juke box bass response with brilliant, middle and high range response. All 3 models have genuine LC crossover networks and variable brilliance controls. Only 2 wires to connect to the 4 or 8 ohm tap on your Hi-Fi amplifier. A fine speaker system to use with our Imperial 20, 30 and 34 high fidelity amplifiers, and all FM-AM chassis in our Radio & TV News offerings. Adjusting the twin tone controls on our Imperial amplifiers along with the brilliance control on the Hollywood speaker systems you can have fidelity of your own personal taste. All 3 Hollywood models are housed in the same fine cabinet. Choice of either blond or mahogany finishes. Baffles are fully enclosed and acoustically lined. Small enough to fit on the average room, yet large enough for proper baffling. 35" high, 19" front to back, 25" wide. Specify cabinet finish when ordering, otherwise we will ship mahogany finish. Take \$3.00 discount when you order with any of the Imperial amplifiers or Espey FM-AM chassis offered in this 3 page ad.

Model H-4M, Hollywood 4 speaker high fidelity speaker system. 20 watts, response 20 to 17,500 cps. Choice of blond or mahogany finish enclosure. Features a 12" General Electric 6.8 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance LC crossover network. Model H-4M. Ship. wt. 55 lbs. Price \$39.95.

Model Y-4Y, Hollywood 4 speaker, high fidelity speaker system. 25 watts, response from 20 to 17,500 cps. Choice of blond or mahogany finish enclosure. Features 12" General Electric 14 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance LC crossover network. Model Y-4Y. Ship. wt. 55 lbs. Price \$44.95.

Model Z-4Z, Hollywood 4 speaker, high fidelity speaker system. 25 watts, response from 18 to 17,500 cps. Choice of blond or mahogany finish enclosure. Features a 15", 2 1/2" oz. Alnico V Utah heavy duty woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance, LC crossover network. Model Z-4Z. Ship. wt. 57 lbs. Sale price, \$49.95.

NEW IMPERIAL SPEAKER SYSTEMS

Imperial IV with 8" G.E. High Fidelity Speaker \$19.95

3-Way Imperial VI with 12" G.E. Speaker \$29.95

New 1957 Model IMPERIAL IV, high fidelity speaker system with General Electric 8" speaker. Housed in high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 or 9770 Norelco 8" extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvilinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial \$49.95.

1957 Model Imperial VI, 3-way speaker system. Baffle is of heavy wood, leatherette covered. Similar in appearance to the Imperial IV pictured above, except 4" taller and 1" deeper. Equipped with 3 matched speakers. A 12" G.E. Model 1203 with 9 oz. Alnico V magnet, plus 5 1/2" PM for middle range and 3" tweeter. The low audio register from 600 cycles down to 20 cps. An Electro-Voice Model 847 horn type speaker is used for the middle range and high range of audio. These two speakers are connected to a 600 cycle inductive-capacity LC crossover network in the network is the field exciter for the 4" woofer. You can spend over \$100 for a speaker system and not beat this one. Stock No. EV-15847X. McGee's sale price, \$39.95.

THEATER QUALITY HIGH FIDELITY SPEAKER SYSTEM \$39.95

15" WOOFER PLUS—ELECTROVOICE MODEL 847 MID-HIGH RANGE SPEAKER—600 CYCLE LC CROSSOVER.

A theatre quality, powerful speaker system for homes and sound demonstration rooms. This speaker arrangement will connect to any high fidelity audio amplifier (8 ohms impedance) Features a 15" electro-dynamic heavy duty woofer which is equal to a PM speaker with up to 10 lbs. of Alnico V magnet. This woofer reproduces the low audio register from 600 cycles down to 20 cps. An Electro-Voice Model 847 horn type speaker is used for the middle range and high range of audio. These two speakers are connected to a 600 cycle inductive-capacity LC crossover network in the network is the field exciter for the 4" woofer. You can spend over \$100 for a speaker system and not beat this one. Stock No. EV-15847X. McGee's sale price, \$39.95.

NEW IMPERIAL 24 WATT AMPLIFIER \$39.95

PUSH-PULL EL-34 ENGLISH MADE MULLARD OUTPUT TUBES
WILLIAMSON TYPE CIRCUIT
RESPONSE 15-20,000 CPS

With CU-14Y, 12" Coax Speaker . \$49.95
With P15-CR, 15" Coax Speaker . \$59.95
With Imperial IV Speaker System \$56.95
With SP12/25CR . \$65.95. With HF-33GE . \$86.95. Model IMP-34X

New 1957 model Imperial 34X, 24 watt high fidelity amplifier for the audio enthusiast who wants high fidelity, tone and bass boost tone control. This amplifier features Push-Pull EL-34 English made Mullard output tubes in a Williamson circuit. Heavy duty 6 lb., specially wound Williamson type ultra-linear output transformer in potted case has a response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. Amplifier has input for crystal pickup and built-in pre-amplifier for the General Electric and Goldring variable reluctance cartridges; as well as input for crystal or high impedance dynamic microphones. 4 controls are microphone gain, phono gain and separate variable treble and bass boost tone control with off-on switch. Chassis size: 12 1/4" x 7 3/4" x 7 3/4" high. Complete with 7 tubes and diagram. Model IMP-34X, 24 watt high fidelity amplifier. Ideal for use with any of our high fidelity coaxial or multiple speaker systems. Ship. wt. 26 lbs. Sale price, \$39.95.

McGEE'S NEW 1957 MODEL 25 WATT 12" COAXIAL SPEAKER

★ 14 1/2 oz. G.E. 12" WOOFER—
★ 3/2" COAXIALLY SUSPENDED TWEETER—
★ BUILT-IN CROSSOVER—
★ ALUMINUM VOICE COIL WOOFER— \$18.95

McGee's new 1957 model, GE-120XT, 12" 25 watt high fidelity coaxial PM speaker. No frills or dummy pot cover, it's all speaker value. Features a General Electric 12", 14 1/2 oz. Alnico V woofer with aluminum voice coil and exponential, molded aluminum voice coil with off-on switch. Chassis size: 12 1/4" x 7 3/4" x 7 3/4" high. Complete with 7 tubes and diagram. Model IMP-34X, 24 watt high fidelity amplifier. Ideal for use with any of our high fidelity coaxial or multiple speaker systems. Ship. wt. 26 lbs. Sale price, \$39.95.

less cone. The tweeter is a specially designed, 3 1/2" speaker which extends the high frequency response to 17,500 cps. It is electrically connected to accept only the upper register of audio. Only two wires connect this complete high fidelity speaker to any 8 ohm amplifier. Ship. wt. 8 lbs. Stock No. GE-120XT. McGee Sale price, \$18.95. New 1957 model, 20 watt deluxe 12" coaxial PM speaker. Only 2 wires to connect to any 8 ohm Hi-Fi radio or amplifier. Features an aluminum voice coil General Electric 12" PM speaker with 10 oz. Alnico V magnet, plus a coaxially suspended tweeter. Crossover network built-in. Responds up to 17,500 cps. Stock No. GE-100XT, 12" coaxial PM speaker. Ship. wt. 8 lbs. Sale price, \$14.95.

TREMENDOUS McGEE VALUE NEW 1957 HI-FI SPEAKER SYSTEMS ON BAFFLE BOARDS

Model B-125, high fidelity 20-watt, 5-way speaker system, mounted on an 18" square baffle board. Has 12" G.E. woofer, 2-4x6" mid-range speakers, plus a 4" high-range and 3" tweeter; all with Alnico V magnets. Built-in LC crossover network with variable brilliance control. Ship. wt. 11 lbs. Stock No. B-125, 5-way, 20-watt Hi-Fi speaker system. **AUDIOPHILE VALUE \$30.00. SALE PRICE \$18.95.**

SALE PRICE \$27.95

Model B-236, high fidelity 24-watt, 4-way speaker system, mounted on a 24" square baffle board. Has 12" 9-oz. woofer, a new high fidelity extended range 6x9" speaker, plus 2-3" tweeters; all with Alnico V magnets. Built-in LC crossover network with variable brilliance and presence controls. Ship. wt. 16 lbs. Stock No. B-236, 4-way, 24-watt Hi-Fi Speaker system. **AUDIOPHILE VALUE \$49.95. SALE PRICE \$27.95.**

SALE PRICE \$39.95

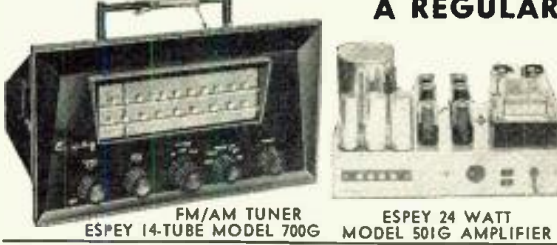
Model B-347, high fidelity 30-watt, 5-way speaker system, mounted on an 30" x 24" baffle board. Has 15" UTAH 2 1/2-oz. woofer, 2-new high fidelity extended range 6 x 9" speakers, plus 2-5" tweeters; all with Alnico V magnets. Built-in LC crossover network with variable brilliance and presence controls. Ship. wt. 22 lbs. Stock No. B-347, 5-way, 30-watt Hi-Fi speaker system. **AUDIOPHILE VALUE \$59.95. SALE PRICE \$39.95.**

Mount these Hi-Fi speaker systems in your own cabinet or use for custom installation. Ideal for use with any radio or amplifier. Ready to connect to any 8-ohm output.

McGEE RADIO COMPANY PRICES F.O.B. KANSAS CITY TELEPHONE VICTOR 2-5092
 SEND 25% OR FULL REMITTANCE WITH ORDER. 1903 McGEE ST., KANSAS CITY, MISSOURI
 BAL. SENT C.O.D.

22 TUBE ESPEY FM-AM HI-FI TUNER - AMPLIFIER SALE PRICE \$119.90

A REGULAR \$199.50 NET VALUE COMBINATION FOR \$119.90



MODEL 700G FM-AM TUNER ONLY—SALE PRICE \$79.95

MODEL 501G AMPLIFIER \$39.95 If Ordered with Tuner

\$49.95 SEPARATE

ESPEY DEAL—1A
Espey 700G-501G tuner with 24 watt amplifier plus VM-956 GE 3 speed VM on metal base—1 Mil Diamond—\$20.00 extra. Needle \$10.00 extra. Net \$149.95

ESPEY DEAL—2
Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net \$164.95

ESPEY DEAL—3
Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-98 equipped with a GE RPX-052A cartridge. Net \$194.95

SPE MENDED
Order any of the following speakers with your Espey tuner and amplifier:
12" coaxial PM, CU-14Y—\$10.00 extra
15" coaxial PM, P15-CR—\$20.00 extra
Imperial VI system—\$15.00
Imperial VI set—\$25.00
Norelco 9762-12" regularly \$59.50 at \$30.00 extra.
EV84-15W system—\$150.00 extra.

McGee offers you both the regular \$119.50, 14 tube Deluxe FM-AM tuner and the \$79.50 value 8 tube audio amplifier for the special sale price of only \$119.90. The Model 700G Espey tuner has its own built-in power supply. Performance features are: Sensitivity 3mv on AM, 5 mv on FM for 30 db quieting, AM selectivity 10kc at 6 db, FM 240kc at 6db. Audio response flat from 20 cps to 20,000 cps, with less than 1/4 percent distortion with one volt audio output. Chassis is 14" long, 8 1/2" high and 10" deep. Features a one-piece molded, gold color plastic front which makes a custom installation both extremely attractive and easy at the same time. Full tuned RF stages-AFC on FM with defocusing switch for easy FM tuning. Built-in preamplifier for GE or other popular variable reluctance cartridges. Three position equalizer switch for LP, AES or European records. Separate bass and treble tone controls with 23db boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Has built-in ferrite loop antenna for AM broadcast band and 300 ohm input for FM band. This fine quality 8 tube tuner is second to none. It has all of the features that you might expect of a tuner that would cost as much as \$200. All of the controls are on the front panel. This is a most desirable feature when the tuner is used in conjunction with a good audio amplifier, such as the 501G which was designed with no tone control or preamplifier circuits.

The Model 501G, 8 tube ultra linear high fidelity, 24 watt audio amplifier is made to match the 700G tuner. This amplifier is offered separately at the special sale price of \$49.95, but costs you only \$39.95 when purchased with the 700G Espey tuner. This amplifier features less than 1/2 percent distortion with high fidelity response from 10 cps to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size, 12"x8"x8". Output tubes; 4—6V6GT in push-pull Williamson circuit, 6SN7GT phase inverter and 2—5V4G rectifiers. Has an 8 pound potted case output transformer with specially made grain-oriented iron core. Output impedance taps of 4, 8 and 16 ohms. This output transformer alone is a \$20.00 value.

Buy just the 700G FM-AM tuner at the special sale price of \$79.95, or buy both the 700G tuner and the matching 501G amplifier for \$119.90. Model 501G amplifier sale price, \$49.95 when purchased separately. Tuner shipping weight 20 lbs. Amplifier shipping wt., 22 lbs. See the special deals of the 700G-501G tuner-amplifier combination with record changer and GE cartridges for extra money saving values. Also, special discount on speakers and speaker systems when ordered with your Espey tuner and amplifier.



BUY YOUR AUTOMATIC CHANGER AT MCGEE AND SAVE

COLLARO 456 - \$34.50
WEBCOR 1642-1
GARRARD RC-98

4-SPEED COLLARO Latest 1957 Model RC-456, Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. All of the desirable features of the Model RC-532, plus 4 speed operation. Model RC-456 Collaro 4 speed automatic record changer, less cartridge. Sale price, \$34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus. Sale price, \$46.95. Large spindle \$3.30 extra.

Webcor 1642-1, popular 3 speed changer on metal base with ceramic crystal cartridge. Sale price, \$27.95.
Webcor 1641-21, 3 speed changer, less base with RPX-050 G.E. VR cartridge, \$27.95. No. 1914, large 45 RPM spindle for 1641 and 1642 Webcor changers, \$2.44 extra.
Webcor CR-1631-27, Hi-Fi chrome changer with 2-separate plug-in cartridge shells, less cartridge, no base. Sale price, \$34.95.
Webcor CR-1631-27, same as above and with G.E. RPX-052A cartridge with 1 mil diamond stylus. Sale price, \$49.95.
Webcor CR-1633-21, Hi-Fi chrome changer same as above except has one piece tone arm with RPX-052A Golden Treasure cartridge, 1 mil diamond stylus. Sale price \$47.95. No. 1915, large 45RPM spindle for 1631 series Webcor changer, \$2.44 extra. Precut mounting board for 1641 or 1631 series Webcor changer, \$1.96 extra.

New 1957 Garrard Model RC98. "Crown 11," 3-speed super automatic changer, one of the world's finest. Provides the greatest combination of Hi-Fi features ever found in an automatic changer, Model RC98 changer, less cartridge—\$66.15. With VR cartridge, 1 mil diamond and 3 mil sapphire needles, RPX-052A—\$82.10. Large 45 rpm, center spindle \$3.43, extra.

Popular RC88, "Triumph" model with most of the features of the 98. RC88, less cartridge—\$53.41. With RPX-052A cartridge as above—\$69.36.

GOLDRING V. R. CARTRIDGE WITH 2 SAPPHIRE STYLII \$5.95 WITH 1 MIL DIAMOND, 3 MIL SAPP. \$13.95

McGee offers the internationally famous Goldring variable reluctance phono cartridge, made in England and sold throughout the world to those who want the finest and most accurate music reproduction from 33 1/3, 45 and 78 RPM high fidelity phono records. (Input gain and compensation similar to G.E. var. cartridge required.) Furnished as standard equipment with sapphire 1 and 3 mil stylus. A regular \$9.90 net item on sale at McGee for \$5.95. For \$13.95 with a diamond 1 mil stylus. These are the latest production, individually cartoned turnover cartridge with mounting bracket. Fits tone arms on most changers. Made for and bearing the famous Wilcox-Gay Recordia name. No. 548 Goldring V.R. (Wilcox-Gay) cartridge, Net \$5.95. No. D546-D5, Goldring V.R. (Wilcox-Gay) cartridge with diamond 1 mil stylus \$13.95. 1 mil diamond stylus for Goldring V.R. cartridge, purchased separately, \$9.95.

8" NORELCO P14 \$7.95

Specialty Priced at \$7.95 for this ad. Norelco imported from Holland 8" Hi-Fi PM Model 970M—fine audio reproduction from 75 cps to 19,000 cps.—Imp. 4 ohms. Flux density 11,000 Gauss. Powerful Alnico Magnet. A fine addition to your Hi-Fi speaker collection.

12" NORELCO 9760 HI-FI SPEAKER \$19.95

Model 9760, 12" Norelco 20 watt extended range high fidelity PM speaker. Has a 15-8 oz. Ticonal magnet. Response from 40 to 20,000 cps. Made by North American Phillips Co. of Holland. A single cone coaxial speaker with extra high frequency cone, 8 ohm voice coil. Response frequency 45 cps. Total flux density, 11,000 gauss. Ideal for use with any Hi-Fi amplifier or FM-AM chassis. Sale price only \$19.95.

Model 9762, 12" Norelco 20 watt extended range high fidelity PM speaker. Better quality than above, in that it has a 38 oz. Ticonal magnet, greater flux density of 11,000 gauss and a built-in high frequency mechanism but in the center of the large cone. Model 9762, 12" Norelco Hi-Fi PM speaker, Sale price only \$39.95.

WRITE FOR MCGEE'S 88-PAGE 1957 CATALOG

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL \$37.95

New model 5H-78555-X, 8-tube, 6-volt universal mounting auto radio with push buttons and 6x9 speaker. Made for Hudson cars, but their compact construction lends them to underdash installation. Has push-pull 6AQ5 high-powered audio. Stock no. 5H-78555-X with 6x9 speaker—\$37.95. With 2—5x7 speakers—\$39.95; with 1—5x7 speaker—\$27.95. Specify speaker size wanted. Three-section top cowli mounting antenna—\$2.29 extra.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

\$12.95 \$23.95

12-Inch Model CU-14Y
15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3-2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price \$12.95 each, two for \$25.00.

Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps, and up to 17,500 cps. Full 21 1/2 oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Model P15-CR. McGee's Sale Price, \$23.95.

McGee's new 15" Junior coaxial PM speaker, 15" woofer has 6.8 oz. Alnico V magnet. Specially suspended tweeter with crossover. Only two wires to connect to an 8 ohm radio or amplifier. Frequency response from 40 to 45,000 cps. Model No. P15-CR, 15" Junior coax PM speaker. Sale price, \$16.95.

FAMOUS STANDARD COIL CASCODE TUNERS

TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 2 7/8" or 4 1/4" shaft length. A tremendous purchase makes our low \$12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price 2 FOR \$25.00.

Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps, and up to 17,500 cps. Full 21 1/2 oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Model P15-CR. McGee's Sale Price, \$23.95.

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only \$9c a pair.

STANDARD COIL PENTODE TUNERS \$7.95

SC-948, Standard Coil, 21 mc Pentode tuner with 6BC5 or 6AG5 and 6J6 tubes. Popular 12 channel, 2 thru 13, used in millions of TV sets. Why spend time repairing an old tuner when it may be easier to just replace it. Shaft can be cut to desired length. Available with 2 7/8", 3", 4 1/4" or 4 3/4" shaft. Specify length of shaft. Sale price, \$7.95 each, 2 for \$15.00. Matching knob set \$9c extra.

TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES

No. TT-3A, 2 tube Sarkes-Tarzian 12 channel TV tuner for 21mc. Used in CBS, Arvin, Crosley, etc. Ideal for general replacement. 3 1/4" shaft. With tubes, \$7.95 each, 2 for \$15.00.

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RCA KRK-12 TV TUNER Brand New—with Tubes

SALE PRICE \$6.95

2 for \$13.00

RCA Model KRK-12, UHF-VHF TV tuner with tubes: 2—6BQ7A, 6AF4 and 654. A complete tuner with all 12 VHF strips, but with blank strips in the UHF positions. This tuner fits many RCA sets using 40 megacycle I.F.'s. 27D382 also KC5-66, etc. Original tuner list was about \$50.00. We offer them new at about the value of the tubes. Ship. wt. 10 lbs. McGee's sale price, \$6.95 each, 2 for \$13.00.

MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE

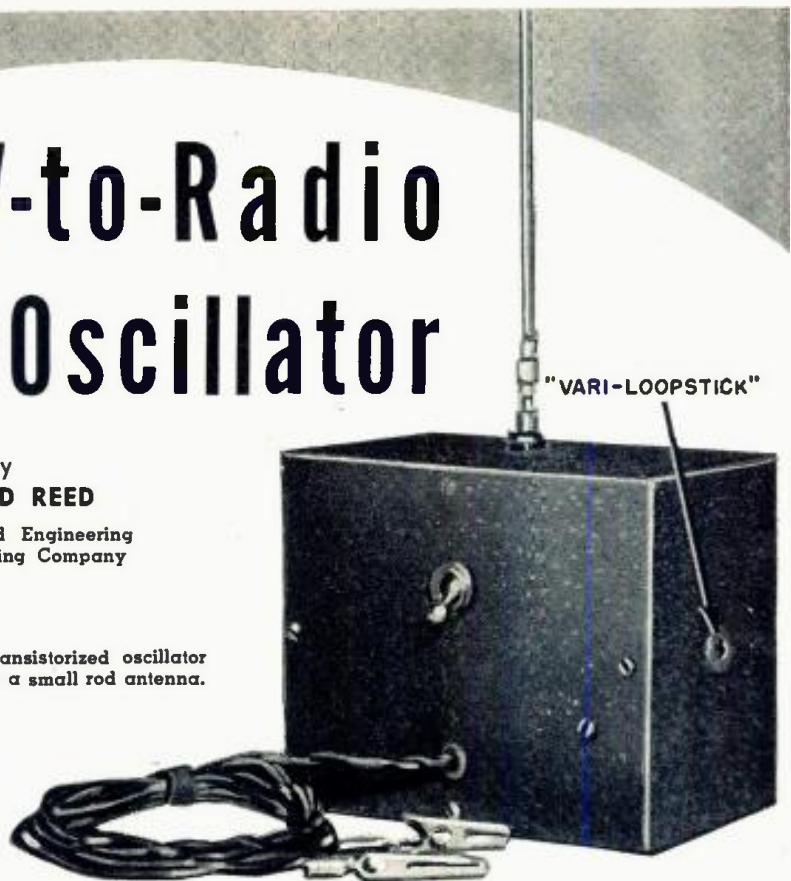
SALE PRICE \$9.95

VERSATIONAL new Model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted as not with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price \$9.95.

TV-to-Radio Wireless Oscillator

By
HAROLD REED
Research and Engineering
U. S. Recording Company

Over-all view of transistorized oscillator unit. Note the use of a small rod antenna.



You can still enjoy the non-visual portions of favorite TV programs by using a small portable and this oscillator.

PHONO oscillators and "wireless" microphone devices, whereby music or voice-modulated radio frequency carriers are transmitted over short distances to radio receivers, have been popular for many years. Providing their radiation range is limited and does not cause interference, as prescribed by FCC regulations, the experimenter and hobbyist may construct and operate such devices.

Transistors are especially suited to this application due to the miniaturization advantages possible by their minute size and small power requirements. A novel approach to this limited "wireless" transmission is presented in this article.

In the two applications just mentioned, the voice picked up by the microphone, or music from a record player, is transmitted to the radio receiver and heard on the receiver loudspeaker. The idea presented here is to transmit voice and music from a television set to the home broadcast radio receiver.

The author has observed that there are many television programs such as music, speeches, etc., which may be enjoyed or are informative without actually watching the television picture. This can prove to be quite a convenience. For instance, the listener may be in a room remote from the television set location and engaged in

work in which music may not only be unobjectionable, but beneficial. In other cases, he may be occupied with duties that can be accomplished while listening to television speech. A portable radio set is quite handy for this arrangement.

The transistor oscillator, as shown in Fig. 1, employs the Colpitts type circuit, using a CK722 junction transistor. The necessary feedback to sustain oscillation is provided by connecting the emitter to the junction of the two capacitors in the tuned circuit. The Hartley circuit may also be used with a single capacitor, connecting the emitter to a tap on the coil, usually near the center.

The coil L_1 is a "Loopstick" antenna with adjustable iron core. Capacitors C_2 and C_3 each have a value of 270 μfd . With these values in the tuned circuit, and with the "Loopstick" adjusting screw set to about mid-position, the oscillating frequency was slightly above 700 kc. This was a "quiet spot" on the radio set at the author's location. The constructor may vary the capacitor values and iron core adjustment to produce a carrier frequency to suit radio broadcast conditions at his particular location.

A rod antenna is connected to the tuned circuit at the collector end of the inductor. Different antenna lengths will change oscillator frequency slight-

ly. Longer lengths will provide greater r. f. radiation, but if too long, may prevent oscillation. An 18-inch rod seems about right to cover the average home.

Choke coil RFC_1 is included, of course, to prevent r. f. current from flowing through the power supply.

Audio frequency modulation of the r. f. carrier is introduced from the television receiver through the resistive network composed of R_4 , R_5 , and R_6 . The transistor base circuit is connected across the 1000-ohm resistor, R_4 , which is shunted by the two 10,000-ohm resistors, R_5 and R_6 , and the TV speaker voice coil in series. Thus, the 10,000-ohm resistors bridge the speaker voice coil, and as their value is very high in relation to the low impedance of the voice coil, no undesirable loading of the speaker circuit results and TV sound is not affected. The audio signal level to the oscillator may be adjusted by varying the values of R_5 and R_6 . The value of each resistor should remain identical and increasing the value of each will decrease the sound level to the oscillator, while decreasing the value of these resistors increases the audio level. These resistors should be selected so that oscillator modulation is satisfactory when the TV set controls are adjusted for normal listening conditions at the TV receiver. The magnitude of the audio modulating signal should not be so great as to produce over-modulation of the r. f. carrier which will result in distortion of the sound reproduced by the radio loudspeaker. The author found the 10,000-ohm resistors

shown just right for normal operation of his TV set, while providing undistorted sound reproduction in the radio receiver.

The component parts are assembled in a standard 3" x 4" x 5" metal box. Felt tabs are cemented to the bottom of the box to prevent scratching of the top of the TV set where the device is placed. A small insulated banana type jack is fitted to the top and a matching plug is soldered to the #10 copper wire rod antenna. A flexible lead is connected from the jack to the "Loopstick." All parts are mounted on the 2-3/4" x 4" plastic shelf attached to the front panel, except the antenna jack and "on-off" switch. The "Loopstick" is mounted in the center to be as far as possible from all metal surfaces of the cabinet. A rubber-grommet-equipped hole is provided at one end of the metal box to allow for adjustment of the "Loopstick" iron core. Another hole fitted with a grommet is provided to pass the wire leads for connection to the TV loudspeaker voice coil. These leads are equipped with alligator clips for connection across the TV speaker. Other than placement of the "Loopstick," the physical arrangement of parts is not critical. No attempt was made toward extreme miniaturization of the unit. For instance, some of the capacitors may be of the 6-volt type.

Battery power supply is indicated in the schematic diagram and photograph of the device. A 15-volt hearing-aid-type battery may be used as shown. Collector current runs about 0.8 ma. at this voltage. The oscillator operated satisfactorily with a supply voltage down to about 7 volts. Higher voltages will result, of course, in greater oscillator output.

An a.c.-operated power supply may also be employed. The diagrams of Figs. 2A and 2B give two circuit arrangements the author tried. The simple circuit of Fig. 2A resulted in some hum modulation of the carrier. Reversing the power supply line cord plug in the a.c. outlet produced less hum in one certain position. In the interest of safety, the plus, or ground, side in the transistor circuit should not be connected directly to the metal box when using this a.c. supply.

The circuit of Fig. 2B introduced less hum even without the line isolation transformer. This transformer could just as well be a filament transformer with an appropriate secondary voltage. It will be seen that additional filtering is provided in this circuit. Best results were obtained hum-wise with the addition of the isolation transformer and it also eliminates the shock hazard.

The resistors given in these power supplies are of such value as to provide, depending on their tolerance, about 12 volts to the oscillator, with an a.c. supply line voltage of 117 volts. Other potentials may be obtained by varying the values of R_1 and R_2 . However, in order not to exceed the rating of the 1N34 diode, the a.c. voltage

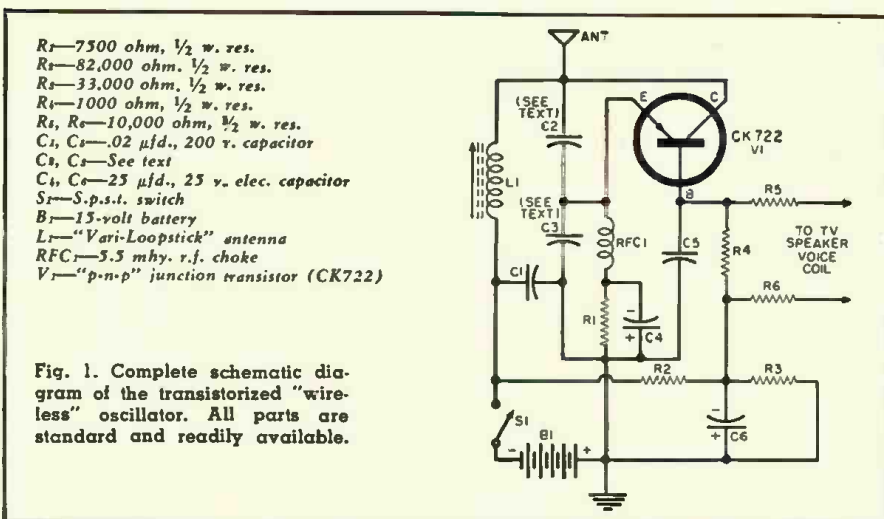


Fig. 1. Complete schematic diagram of the transistorized "wireless" oscillator. All parts are standard and readily available.

across R_2 should be held to not over about 20 volts.

The TV-to-radio oscillator performed very well. There appeared to be negligible frequency drift. With the TV set operating normally in the author's den, the sound was picked up clearly and undistorted on a kitchen radio receiver, a distance of 35 feet. The oscillator carrier, if of the same frequency as a radio station carrier, will beat with same, causing a heterodyne "whistle" in the radio. A "quiet spot" on the radio dial must be chosen.

When using a portable radio, the directional characteristics of the built-in antenna of the set may be used to advantage when necessary at extreme distances, by orienting the radio for maximum pickup.

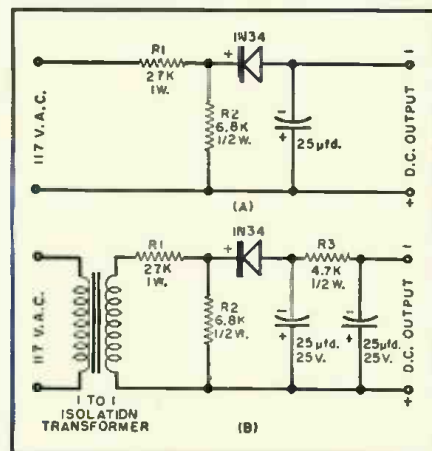
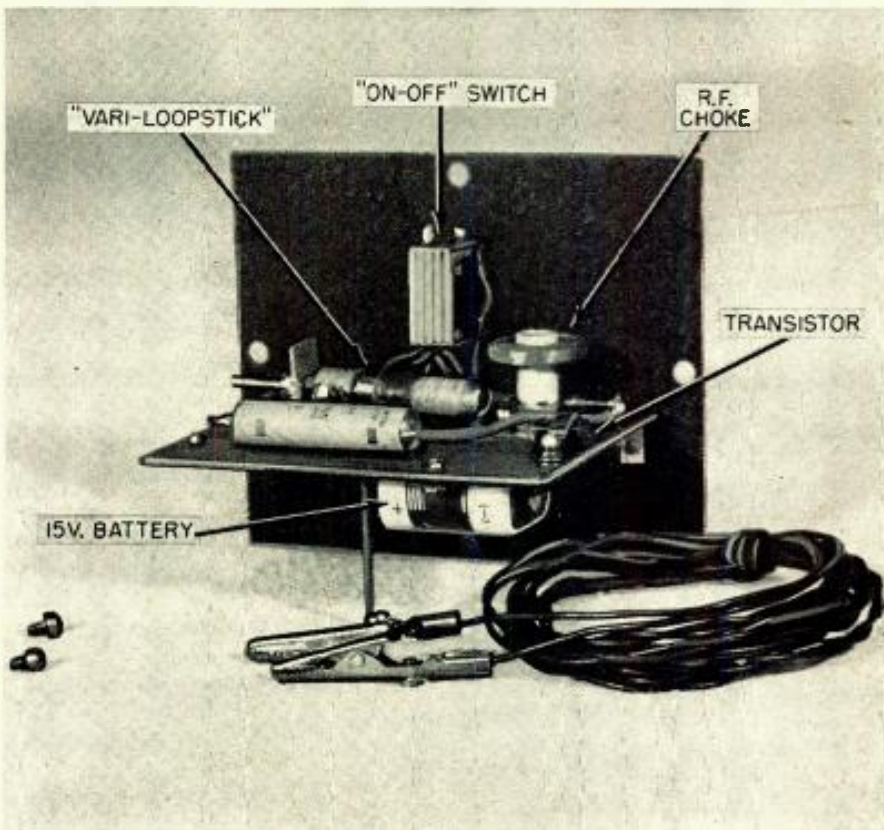


Fig. 2. Alternate supplies. refer to text.

Rear view of unit removed from case. Parts are mounted on shelf fastened to panel.



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Strategy of Color Service

(Continued from page 41)

Admittedly, a factory service branch has certain advantages over the independents. Its technicians become well-versed specialists on the relatively few models they handle while the independent struggles with a variety of makes and models. But their alleged advantage can help out the independent too.

The factory branch men run into the tough ones, too—often sooner than the independent. After they have worked out the solution, the independent can cash in on this experience and thus save a tremendous amount of time, money, and customer goodwill. The help is there for the asking—don't be embarrassed or ashamed to seek it.

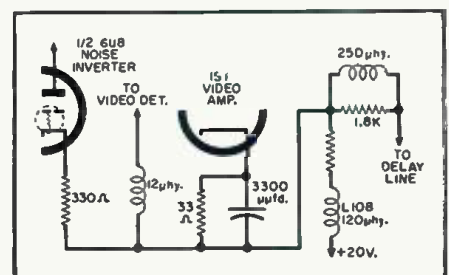
One of the troublesome cases encountered by a factory branch involved a 21" receiver which displayed a smeary picture. It seemed to be a classic illustration of frequency response distortion, as if a peaking coil or something in the video amplifier circuits had let go. The circuit was checked carefully and thoroughly but no defective component was found. The chassis was pulled and after a lot of group "conferences" it was decided that components would be changed one at a time until the trouble was located. The job was started with the tubes. When the 6U8 noise inverter was replaced, the picture cleared up!

The tube was checked carefully and it was found that there was a cathode-to-control-grid short in the triode section. A glance at the schematic, Fig. 6, showed that the noise inverter was hooked into the video detector, the cathode of the first video amplifier, and the grid of the second video amplifier through some peaking coils and the delay line. This was a real stumper.

The experience of the technicians at the factory branch paid off for the writer when he encountered an identical case which was cleared immediately when the 6U8 was replaced.

Save yourself hours in color work by taking advantage of every possible source of servicing information—from books to experienced technicians' friendly tips!

Fig. 6. Poor h.f. response (smeary) was caused, not by a defective peaking component, but by the load placed on the detector from another defective circuit.



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New Hi-Fi-Audio

Equipment

TAPE RECORDER-REPRODUCER

Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y., has announced the availability of a new magnetic tape recorder-reproducer



which has been designed for broadcast studio and other high-fidelity applications.

The Model 1000 is a portable dual track magnetic tape recorder and reproducer. The sound is recorded on and reproduced from a 2400 foot reel which operates at 7½ or 15 ips.

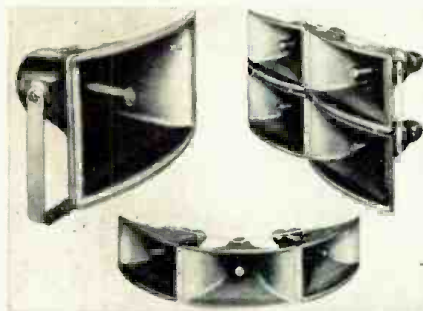
Frequency response is 30 to 10,000 cps ±2 db at 7½ ips and 30 to 15,000 cps ±2 db at 15 ips. Rewind time is 1 minute for 2400 feet of tape. The Model 1000 operates at 117 volts a.c., 60 cycles.

The unit is housed in two aluminum clad plywood cases, especially designed to withstand portable usage. It can also be supplied in gray Fabrikoid covered plywood cases, if desired.

RECTANGULAR HORNS

Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago 38, Ill., has added a rectangular horn, the RT-20, to its professional series line of speakers for commercial, industrial, institutional, and p.a. applications.

The RT-20 is an axial projector horn with rectangular mouth section molded from glass fiber re-inforced polyester resin. The speakers can be mounted on car tops, used singly or doubly in wall corners, or installed horizontally



or vertically, depending on the acoustical conditions. The speakers can be mounted with a minimum of rigging, clusters are readily joined with stacking hardware and require no special platforms.

For full information on these new horns, write the manufacturer direct.

PROFESSIONAL TURNTABLE

Intersearch, 7 Arcadia, Cincinnati, Ohio, is acting as the exclusive U. S. importer of a new Japanese-built turntable for hi-fi applications.

The I/S Model TP-50 features a magnetic eddy current speed adjustment which permits a 23% speed adjustment and a neon illuminated stroboscope which is viewed through an observation window in the motor plate. One speed adjustment corrects all three turntable speeds.

A separate "flip switch" permits instant selection of 33½, 45, or 78 r.p.m.



The 12-inch cast aluminum turntable is rim driven by a new two-phase capacity type motor. The motor can be operated for long periods of time with very little rise in temperature. Complete U. S. servicing facilities are available.

NEW "INTERADIOCOM"

Stratford Corporation, 745 Fifth Ave., New York, N. Y., has recently introduced a new intercommunications system for home use.

Known as the "Interadiocom," the new unit combines an intercom and radio. It can service five relay stations within the home, permitting simultaneous radio and inter-room communication at each or any of the outlets.

The master control panel includes a radio, intercom, clock, electric timer, a.c. socket, five-position switch, safety interlock, jewel pilot light indicator, and phono jack. The set includes four relay stations, each with a powerful 5-inch PM heavy-duty speaker, and an entry door relay station with a push-button bell.

CALIFONE "DIRECTOR"

Califone Corporation, 1041 N. Sycamore Ave., Hollywood 38, Cal., is currently in production on its new 1957

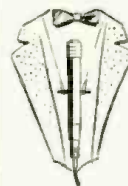
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Versatility: Can be used (1) on a floor stand; (2) on a desk stand; (3) quickly removed for use as a hand-held microphone; (4) furnished with lavalier cord for wearing around the neck; (5) impedance switch permits use as high or low impedance microphone. Accessory on-off switch requires no wiring.

Ruggedness: Built to withstand hard usage and extremes of temperature and humidity.

Beauty: Slender, convenient shape, finished in brushed satin chrome.

Reliability: High efficiency magnetic materials and circuits assure years of consistent high quality performance. Shure quality control techniques result in an exceptionally high degree of uniformity for microphone interchangeability and multiple use.

SLENDYNE Model "530"

This deluxe version of the Slendyne has a frequency range of 50-15,000 cps and is furnished with a Cannon XL-3-11 broadcast connector. Strikingly attractive non-reflecting black and gold anodized finish. LIST PRICE \$110.00

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G. L. Electronics, Inc.
1632 Venice Blvd.
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"Director" unit, an all-purpose variable speed phonograph and p.a. system.

The Model 12V-7 features a center-driven, continuously variable speed turntable (having a range of from 16



to 84 r.p.m.) which eliminates cones, idlers, and rollers and provides for exact setting of speed without drift from a cold start to continuous running; a "Strobeselector" which is a combination of single knob speed control and illuminated stroboscope; and a precision machined cast aluminum turntable with a cork cover and pop-up 45 r.p.m. centering device. An all-aluminum pickup arm features double wrist action. A counterbalanced weight adjustment controls needle pressure at the pickup head while the entire arm lifts for easy handling and needle replacement.

An 8-page catalogue describing this and other of the company's new units is available without charge from the manufacturer.

MICROPHONE CALIBRATOR

Brush Electronics Company, 3405 Perkins Ave., Cleveland 14, Ohio, is now offering a microphone calibration unit which is manufactured by *Bruel & Kjaer* and is catalogued as the Model BL-4119.

Designed for the accurate calibration of the firm's condenser microphone Model BL-4111 as well as the condenser microphone cartridge MK-0002, the apparatus enables both a calibration procedure which is a simplified form of the standardized reciprocity calibration technique and the determi-



nation of the complete frequency response curve of the microphone by means of an electrostatic actuator.

The first measurement yields the accurate absolute sensitivity of the microphone at any arbitrary frequency without the use of any precalibrated standard by using three condenser cartridges. The second measurement

gives the total frequency response of the microphone between 20 and 20,000 cps.

NEW RONETTE MIKE

Ronette Acoustical Corp., 135 Front St., New York, N. Y., is now offering a new, semi-directional microphone, the "Ronomike."

The microphone is housed in a slim, sturdy die-cast housing that is fully chrome plated. Its modern, convenient shape adds strength and attractiveness and its performance is especially suitable for use with tape recorders, p.a. systems, and ham transmitters.

A high impedance instrument, the new unit requires a high value of load resistance. It has a sensitivity of -55.4 db. The flat response from 30 to 10,000 cps is peak-free when matched to a



500,000 ohm to 1 megohm input of a triode stage. IM distortion is negligible.

The microphone cable, of special design, has a minimum of 90% shielding and is included along with a fully shielded telephone-type plug.

HI-FI GRILLE SCREEN

General Cement Mfg. Co., 400 South Wyman St., Rockford, Ill., has introduced a new heavy metal grille screen designed especially for hi-fi system applications.

Featuring a style suitable for any modern or period enclosure, this grille screen is designed for high-fidelity systems, juke boxes, TV consoles, p.a. speakers, and other similar applications.

The screen is of the rigid type that affords maximum protection for an enclosure and is finished in brushed brass, then lacquered for extra durability. The screen comes in five sizes ranging from 12" x 18" to 36" x 48". Write the company for full details.

EQUALIZER-PREAMP

McIntosh Laboratory, Inc., 320 Water St., Binghamton, N. Y., has released a new equalizer-preamplifier unit which is designed to serve as an accurate and versatile control center of a hi-fi home music system.

The C-4 provides separate bass and treble accentuate and attenuate controls, five input channel selectors for tape, tuner, microphone, and two

phono cartridges, and a master "on-off" switch with volume control.

This unit features low distortion, good stability, and wide frequency response. Full specifications on this equalizer-preamp are available without charge from the manufacturer on request.

REPLACEMENT CARTRIDGE

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill., has announced production of a replacement pickup cartridge for the Chrysler "Highway Hi-Fi" system.

The WC20, a direct replacement for the PC20A used in these Columbia-built record players, will track at extremely low pressures. This ceramic cartridge has a minimum needle force of 2½ grams and frequency response to 12,000 cps.

Additional information on this replacement unit is available from the manufacturer or any of its authorized distributors.

NEW KLIPSCH "SHORTHORN"

Klipsch and Associates of Hope, Ark. has introduced a new corner horn loudspeaker system which is known as the "Shorthorn" Model "T".

Designed to be used to provide full range sound reproduction for television as well as for record players, tape players, and radio, the dimensions of the new unit are such that it can be used as a stand for table model TV sets.

Extending from below 40 cps to above 20,000 cps, the new system provides good efficiency from 45 to over 16,000 cps. The Model "T" is available



with the company's "K-Ortho" 3-way drive system, consisting of three drivers with a choice of a 12- or 15-inch bass cone driver and crossover network. The bulk of the unit is the bass horn and, mounted inside it, are the mid-range and high-frequency horns.

The mahogany enclosure is of simple classic design which fits into any type of modern or traditional decorative scheme.

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February, 1957

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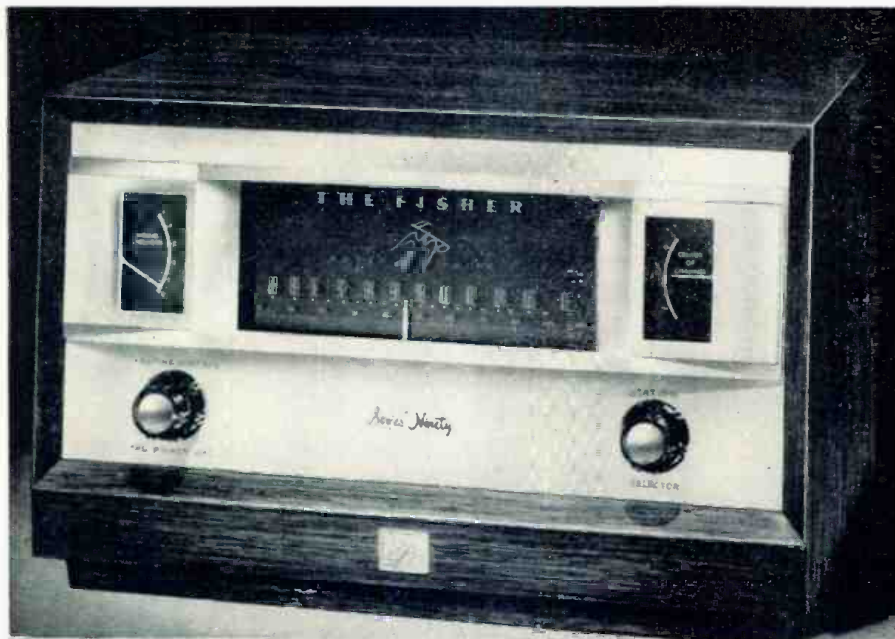
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*Vol. 2, No. 3 (December 1956). Authorized quotation No. 60. Please consult The Audio League Report, Vol. 1, No. 6-7 (March-April 1955) for the complete technical report and listening evaluation of the ESL. Subscription: 12 issues, \$4, from P. O. Box 262, Mt. Vernon, N. Y.



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HARD ON THE HEELS of the new Model FM-90, we are proud to present the Model FM-90X with its revolutionary GOLD CASCODE RF amplifier. Precision manufactured, this tube is the costliest of its type in the world! It carries a two-year warranty. The use of the gold cascode and special circuitry has brought the FM-90X to the theoretical limits of sensitivity — an achievement never before possible. *Only the FISHER has it!* The standard FM-90, with its silver-plated RF shield, already surpasses ALL other FM tuners — excepting the FISHER GOLD CASCODE 90X.

Basic Features of the Series FM-90

- TWO meters, for micro-accurate tuning. • Revolutionary, dual dynamic limiters, assure noise-free reception where all others fail. • Full wide-band detector for maximum capture ratio. • Exclusive, variable inter-station noise eliminator. • Full limiting on signals as low as 1 microvolt. • Dual triode, cascode-tuned RF stage, four 13 stages. • Uniform response, 20 to 20,000 cycles. • Three outputs (Main, Recorder and Multiplex). • Dual antenna inputs (72 ohms or 300 ohms balanced). • Four controls. • 10 tubes plus four matched germanium crystal diodes. • Special circuits for meter operation. • Chassis completely shielded and shock-mounted. • Beautiful, die-cast, brushed brass escutcheon and control panel. • Dipole antenna supplied. • SIZE: 13 7/16" w. x 6 1/4" high x 8 3/4" deep (plus 1" for knobs). • WGT: 15 lbs.

FM-90X • Gold Cascode FM Tuner • \$159.50

FM-90 • Professional FM Tuner • \$149.50

MAHOGANY OR BLONDE CABINET: \$17.95

Prices Slightly Higher in the Far West

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORP., 21-23 44th DRIVE • L. I. CITY 1 • N. Y.

Tokyo Tsushin Kogyo, Ltd., and imported from Japan.

The "Sony" Model C-27-A condenser microphone is a polydirectional unit. A switch selects unidirectional or omnidirectional operation. It features a



new type of titanium diaphragm designed to provide stable operation and smooth response from 30 to 20,000 cps. The output impedance is 200 ohms. The output level is -73 db non-directional and -70 db directional. Three frequency responses may be selected by a switch on the panel of the power supply.

The second unit, the Model 10, is a moving coil microphone designed especially for tape recording applications. Response is smooth from 50 to 12,000 cps. The output level is -62 db and the impedance is 10,000 ohms.

Write the distributor for additional details and prices.

ELECTROSTATIC TWEETER

Pampa Electronics Corp., 7354 Frankford Ave., Philadelphia 36, Pa.,

is now offering a single-ended, non-powered electrostatic tweeter in a finished wooden cabinet as its Model 5-20.



Frequency coverage is substantially flat from 5000 to 20,000 cps. The tweeter is designed to be used with amplifiers rated at up to 25 watts output. The distribution angle is 360 degrees in the horizontal plane. The impedance matches 4, 8, and 16 ohm sources. A divider network and matching transformer are built into the tweeter itself, eliminating the necessity for external networks.

The housing for this tweeter measures 4 1/2" wide, 4 1/2" deep and 12" high. The company will mail a specification sheet on request.

BRITISH-BUILT TAPE DECK

Truvox Limited, 15 Lyon Road, Harrow, Middlesex, England, is now offering the "Mark III" in its "U" series of tape decks for high-fidelity system applications.

The deck is powered by three shaded-pole a.c. motors, with electrically and mechanically interlocked push-button control. A separate push-button brake is of the patented elec-

RADIO & TELEVISION NEWS

tric type. There is drop-in tape loading and the machine will handle 60 minutes on each track of half-track 3 1/4 ips or 30 minutes each track at 7 1/2 ips. A visual playing-time indicator operates at either speed to show lapsed time and balance of time to run on the reel. The deck will take all standard tape reels up to 1200 foot sizes.

With a suitable amplifier, the equipment covers a frequency range from 50 to 10,000 cps at 7 1/2 ips. Write the company for a data sheet containing full specifications.

DUOTONE SPEAKER LINE

The Duotone Company, Locust St., Keyport, N. J., manufacturer of a complete line of needles for high-fidelity phonograph applications, has entered the loudspeaker field with seven units.

The line ranges from a 15-inch woofer (the "Supreme") to four coaxial units and two tweeters. The 12" "Royal," for example, has a frequency response of 35 to 18,000 cps. It will handle 25 watts of power and has a



magnet weight of 1.5 pounds. The efficiency is 14% at 400 cps and the resonating frequency is 45 cps.

Write Dept. PR-2 of the company for complete details on this entire line of moderately priced "DFP" speakers.

NEW "KONTAK" MIKE

Amperite Company, Inc., 561 Broadway, New York 12, N. Y., is now offering a new "Kontak" mike designed to be used for all fretted and stringed instruments, including the piano.

The Model KKH-3 can be used with any p.a. amplifier, tape or wire recorder, and all electric guitar amplifiers. A fingertip volume control is conveniently mounted on the microphone and supplied with a large knob for ease of operation. Frequency range is 40 to 10,000 cps ± 2 db. The output level is -55 db. The unit is not affected by temperature, pressure, or moisture.

FREQUENCY DIVIDER

Colbert Laboratory, Inc., 160-09 Hillside Ave., Jamaica 32, N. Y., is now offering a three-channel electronic frequency divider for high-fidelity reproducing systems.

February, 1957



ON ONE COMPACT CHASSIS! FISHER FM-AM TUNER, AUDIO CONTROL AND 30-WATT AMPLIFIER!

New!

EVERYTHING YOU NEED!
ON ONE SUPERB CHASSIS!

THE FISHER "500"

THOUSANDS have asked us for it—and here it is! An extreme-sensitivity FM-AM tuner, a powerful 30-watt amplifier, and a Master Audio Control—all built on one compact chassis. Simply add a record changer and loudspeaker to the FISHER "500" and, as easily as that, you have a complete high fidelity system. Its quality—in the finest FISHER tradition. Its appearance—the timeless beauty of classic simplicity. Here is the most economical form in which you can own FISHER equipment.

Chassis Only, **\$239.50**

Mahogany or Blonde Cabinet, **\$19.95**

Outstanding Features of THE FISHER "500"

- Extreme sensitivity on FM and AM. Meter for micro-accurate tuning.
- Full wide-band FM detector for maximum capture ratio.
- Powerful, 30-watt amplifier: handles 60-watt peaks.
- Uniform response, 16 to 32,000 cycles.
- 4 inputs, including separate tape playback preamp-equalizer.
- 4, 8 and 16-ohm outputs match all existing speakers.
- Recorder output ahead of volume and tone controls.
- 7 Controls, including 9-position Channel Selector (AM, FM, AES, RIAA, LP, NAB, TAPE, AUX 1 and AUX 2), Loudness Contour (4-position), Volume, Bass, Treble, AC-Power, Station Selector.
- Beautiful, die-cast, brushed brass escutcheon and control panel.
- Pin-point, channel indicator lights.
- Smooth, flywheel tuning.
- Largest, easy-to-read, slide-rule dial, with logging scale.
- High efficiency FM and AM antennas supplied.
- 14 tubes plus 2 matched germanium diodes.
- SIZE: 13 7/16" w. x 12 3/4" d. (excluding knobs) x 6 1/4" high.

Prices Slightly Higher In The Far West

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORP., 21-23 44th DRIVE • L. I. CITY 1 • N. Y.

Friction
Free
as a
feather
in air

REK-O-KUT TURNTABLE ARM

Pat. Pending

A-120 for records up to 12" \$26.95
A-160 for records up to 16" \$29.95
slightly higher west of Rockies

LATERAL FREEDOM FROM FRICTION
achieved by unitized sealed-in
twin-bearing pivot.

FRICTION-FREE VERTICAL SUSPENSION
between 1 mm chrome-steel
bearings... sealed in cross-shaft!

ENDS NEED FOR STYLUS PRESSURE
GAUGE! With cartridge mounted
and arm in state of balance...
turn micrometer-action counter-
weight to build up stylus pressure.



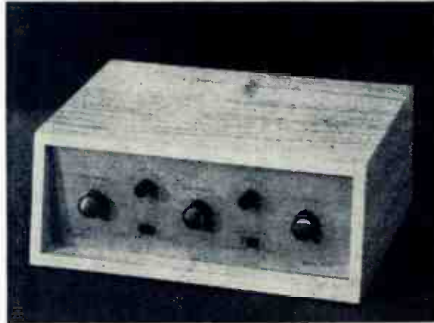
See your dealer or write:

**REK-O-KUT
COMPANY, INC.**

38-01 Queens Blvd., Long Island City 1, N. Y.
EXPORT: Morhas Exporting Corp., 458 8'way, N. Y. 33
CANADA: Atlas Radio Corp., 56 Wingold Ave., Toronto 10

The Model 3-CFD divides the frequencies before amplification to increase definition and clarity of the reproduced sound. The unit features variable crossover controls for low-, mid-, and high-ranges, permitting exactly right adjustment for every conceivable combination of components. Individual level controls are provided for each sound channel. Since separate amplifiers are used for each frequency range, the frequency response each amplifier is asked to deliver is limited.

Designed for use on two- or three-way systems, the Model 3-CFD in-



cludes a 10-watt "Ultra-Linear" amplifier using the latest-designed, low-noise audio tubes developed by *Mulard*.

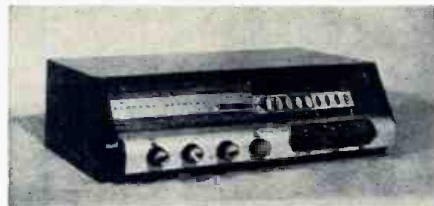
A data sheet on this new unit, including complete specifications, is available without charge from the manufacturer.

DELUXE CONTROL AMPLIFIER

Sargent-Rayment Co., 4956 E. 12th St., Oakland 1, Cal., has added another item in its new line of hi-fi components, the SR-200.

This deluxe control amplifier includes a preamp, tone control, and 20-watt "Ultra-Linear" amplifier in a single housing. Among the unique features of "The Claremont" are a variable rumble control, a variable scratch filter, and a nine-position amplifier control dial.

The instrument uses six tubes; has output impedances of 4, 8, and 16 ohms; and operates from 110-120 volt



a.c. 50 or 60 cycles. The housing measures, 4½" high, 15" wide, and 11½" deep.

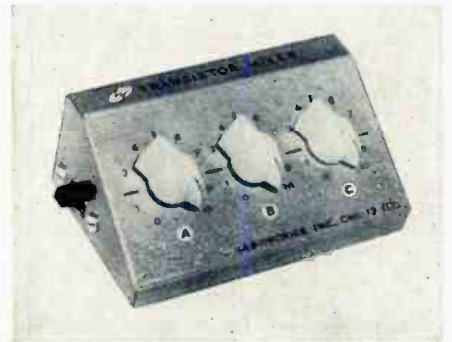
An illustrated brochure on this equipment is available without charge from the company.

TRANSISTOR-MIXER

Lab-Tronics, Inc., 3656 N. Lincoln Ave., Chicago 13, Ill., is now marketing a new transistor-mixer which is designed to meet the needs of the p.a. and recording industries.

Compact in size, the Model No. TR-36 has a built-in transistor preamp and can provide an over-all gain on each of its three channels of better

than 6 db. Three input phone jacks mix any three channels of microphones, phonographs, or tuners, mak-



ing possible great flexibility. The unit is humless and has an extremely low noise level.

Frequency response is from 20 to 20,000 cps, ±2 db. The inputs will mix any combination of three high-impedance microphones, crystal phonograph cartridges or tuner outputs, as well as magnetic cartridge preamp outputs.

The circuit uses a low-noise *n-p-n* 2N35 transistor and is powered by three mercury cells.

AMPLIFIER IN KIT FORM

Quality Electronics, Inc., 319 Church St., New York 13, N. Y., has introduced a 12-watt amplifier kit for the "do-it-yourself" contingent.

The circuit incorporates a built-in preamp; a 5-position switch with three



equalizer positions; output impedances of 4, 8, and 500 ohms; and four separate input jacks on the rear apron of the chassis.

The amplifier uses six tubes, including three multi-purpose tubes, which provide nine-tube performance.

Housed in a mahogany case with an ivory and gold front panel, the Model 2000 kit comes with a 25-page illustrated assembly instruction manual.

AUDIO CATALOGUES

"ULTRA-LINEAR" THEORY

Keroes Enterprises, 369 Shurs Lane, Philadelphia 28, Pa., has just issued a new 24-page booklet which presents a detailed study of the theory and operation of the "Ultra-Linear Circuit."

Included in the booklet are the mathematical analysis of the circuit's operation and a typical amplifier design using this circuitry.

The small booklet is priced at 25 cents a copy and can be ordered direct from the company.

West Coast Hi-Fi Shows

Institute to sponsor Los
Angeles and San Francisco
events early in February.

THE Institute of High Fidelity Manufacturers will be duplicating the successful format of its 1956 New York High Fidelity Show at Los Angeles and San Francisco early in February.

The Institute has scheduled the Los Angeles show February 6th through 9th at the Ambassador Hotel. The public will be admitted, at a nominal charge, between the hours of 2 and 10 p.m. on the first three days of the show and from 10 a.m. to 6 p.m. on Saturday, February 9th.

February 4th, from 10 a.m. to 7 p.m., will be given over to Audio Components Representatives Assn. Conference Day. This will consist of a meeting of sales reps, dealers, and manufacturers. No exhibits will be open during this session. At 7 p.m., the AES will hold its banquet at the Coconut Grove of the Ambassador Hotel.

February 5th has been left open to enable exhibitors to set up their displays. The dealer preview of the exhibits is set for February 6th from 9 a.m. to 1 p.m. before the general public is admitted.

Among the special features of the show will be Oliver Read's (publisher of *RADIO & TELEVISION NEWS*) "Replica of an 1890 Recording Studio"—an outstanding hit of the New York Show. In this exhibit, original equipment of the period is shown "in use" in a realistic setting.

A series of seminars, "The Ins and Outs of High Fidelity," will be conducted under the direction of C. G. McProud. The same editors who participated in the New York Show seminar will repeat in Los Angeles.

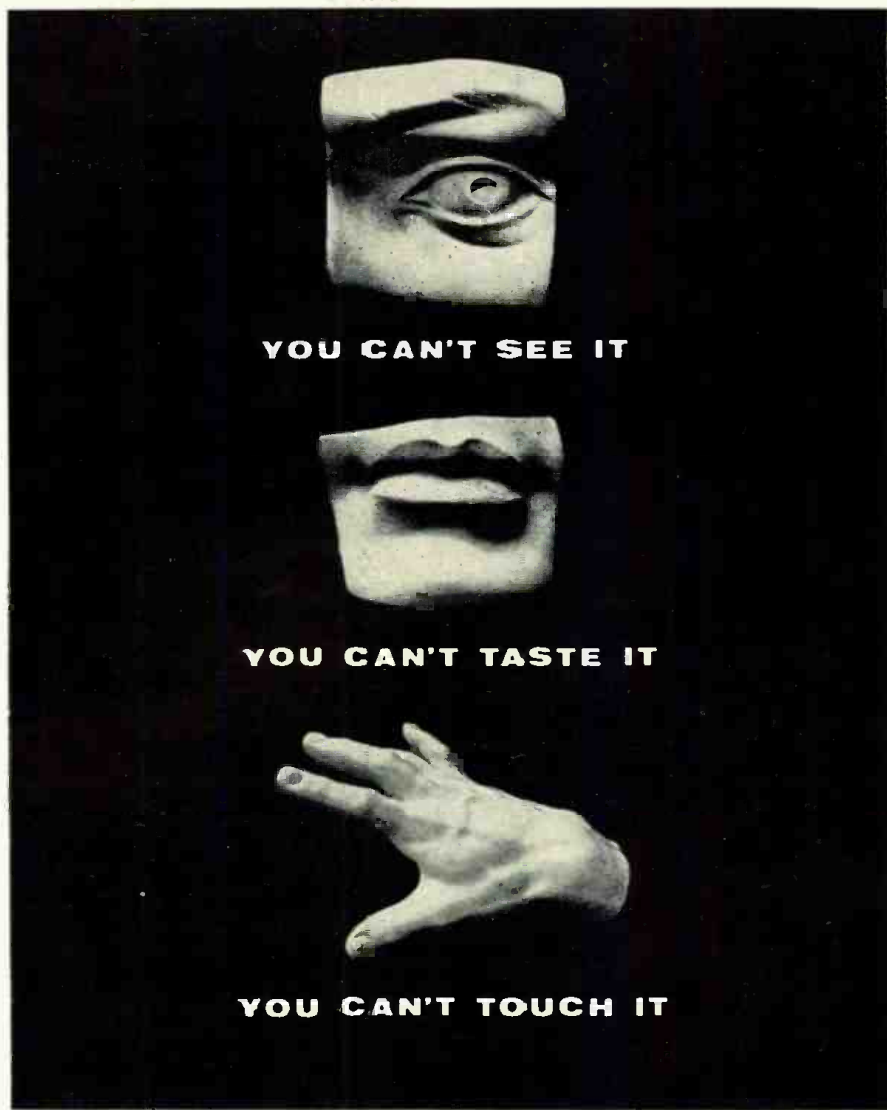
From Los Angeles the Show will move to San Francisco where it will be held from February 15th through 18th at the Hotel Whitcomb. Show hours will be from 2 to 10 p.m. each day. A special preview for the trade only will be held on February 15th from 10 a.m. to 1 p.m. Special features at this Show will include an "Information Room," staffed by experts, who will answer questions on hi-fi posed by visitors.

The scheduling of the two shows one week apart was done to permit manufacturers to call on the trade during the week between. Exhibits can be shipped direct from Los Angeles to San Francisco.

Additional information on either or both of the Shows is available from Sanford L. Cahn, executive secretary, Institute of High Fidelity Manufacturers, P.O. Box 284, Mineola, New York.

-30-

February, 1957



... But it's the most important asset a company can have

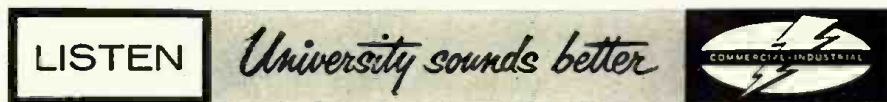
A modern plant, a well-stocked inventory, a good shipping department—these things are important. But, more important than all of these, is the *integrity* of a firm... that sense of moral responsibility that demands that you do your best and stand behind what you do.

Integrity starts at the top and filters down, enhancing everything it touches. It serves notice on its customers that every product bearing its label has a team of responsible people behind it.

And something happens to the *product* too! Integrity seems to be built right into it... in ways that you can see and in many more ways that you can't.

In addition to a close check on the quality of the various parts, we, at University, do not tolerate any "sweeping under the carpet." Even those parts which are completely enclosed and hidden from view are as carefully finished as the exposed parts, guaranteeing trouble-free performance.

That's why everyone is saying ...



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Build with the BEST

Enjoy the ease and economy of Systematic Growth, the Sustained Satisfaction, possible only with

BOZAK

Quality Loudspeakers

The one-line, one-quality Bozaks are never outgrown or outclassed—never discarded as you build your Speaker System into ever-greater power and realism. From the B-207A to the magnificent B-310 and B-400, in a wall or infinite-baffle enclosure, each for its size unrivalled in quality of sound—The Purest Voice for a Fine Music System!

Step 1 - B-207A

B-199A + B-200X
+ 4-mfd. Filter.
40 cps to 16 kc.
8 Ohms, 15 Watts.



Step 2 - B-302A

B-207A + B-209
+ N-10102.
40 cps to 16 kc.
8 Ohms, 20 Watts.



Step 3 - B-305

2 B-207A + B-209 + N-10102.
35 cps to 16 kc.
16 Ohms, 30 Watts.



Step 4 - B-400

4 B-199A + B-209 + B-200XA.
Below 28 cps to beyond 16 kc
N-10102 + N-25
8 Ohms, 50-60 Watts.



May be arranged vertically to form the B-310A.

All Bozak Products are Designed and Built by The R. T. Bozak Mfg. Co.

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EXPORTS: ELECTRONICS MANUFACTURERS' EXPORT COMPANY, PLAINVIEW, NEW YORK

Tone Compensator (Continued from page 67)

of the compression curve on broadcast transmitters).

In Fig. 1, C_s is the capacitor that determines the amount of effective "bass-boost" at low volume levels. R_s controls the amount of d.c. feedback from the plate to grid of the control tube and, hence, the rate of expansion or control. The values shown will give an operating range in excess of 20 db, with a 1 kc. to 50 cps ratio of about 2 to 1.

The principle of operation is as follows: V_{1A} functions as a diode rectifier, providing a negative, filtered d.c. voltage on the grid of V_{1B} proportional to the amount of applied audio signal. As this voltage increases, less current flows in V_{1B} , resulting in a higher plate impedance. As this impedance is in series with C_s , the increasing impedance reduces the effectiveness of C_s , and, hence, provides a more nearly flat response to all frequencies at the output. A portion of the voltage present at the plate of V_{1B} is applied through a voltage divider network to its grid return, giving a sort of d.c. negative feedback, to control the sensitivity of the circuit and, to a certain extent, its linearity.

In order that the level that determines the amount of control is primarily from the middle and higher frequencies, C_1 is made small so the amount of signal reaching the rectifier (V_{1A}) is reduced at the lower frequencies. R_s is a limiting resistor, whose purpose is to prevent undue loading of the input with sudden dynamic increases. C_2 , C_3 , and R_4 form an RC filter network. R_5 determines the recovery rate (in conjunction with C_2 , C_3 , C_1 , and R_4 ; R_6 and R_7 , the d.c. feedback, or expansion rate. Because R_7 must be kept large (because it is effectively in parallel with R_8 and the plate impedance of V_{1B}), R_8 is the determining component.

The unit pictured was built on a small subchassis to be mounted under the main chassis of an amplifier. With the layout shown, all but three of the necessary connections are made by the component leads themselves. This simplifies the wiring and also reduces the problems of hum and noise. There is no reason why this unit could be built only in this manner, though. Any method where good audio construction practices are employed, should be satisfactory.

It should be remembered that there is a minimum loss of 15 db, also, that the unit should be inserted in an amplifier at a point where there is about 5.0 volts r.m.s. of audio present during normal programming. This circuit must follow any equalizers and precede any tone controls. The volume control should be prior to this compensating device, so that manual adjustment of the volume level will have the same effect as will changes in the intensity of particular passages of sound from the record or radio.

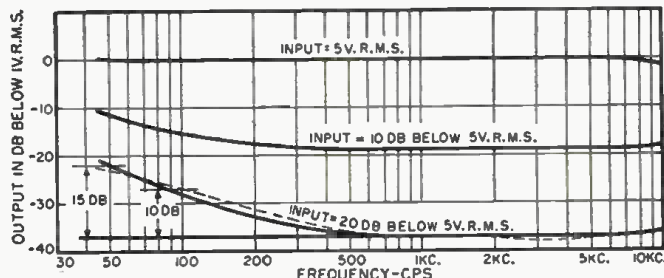
The curves of Fig. 3 show the measured performance of the unit over a 20 db range. It can be seen how closely it follows the change in the human ear response over the same range (obtained from information supplied by the Acoustical Society of America). In taking these measurements, C_1 is shorted out, so that the control frequency and the controlled frequency can be the same. In actual operation, the controlling frequencies are primarily above 500 cycles because of the RC circuit used in the input of the rectifier. Using different tube types and various changes in C_s and/or R_s , various amounts of control, over a wide range of frequencies, can be obtained.

A switch can be inserted in the cathode of V_{1B} , if desired, to disable the circuit's operation. In this manner, the effectiveness of automatic tone compensation can be more easily realized by comparison. If the cathode of V_{1B} is opened, the plate impedance will rise to its maximum, and the response of the circuit will be nearly flat over the audio range, with an insertion loss of 15 db. Closing the switch (grounding the cathode of V_{1B}) will leave the response and insertion loss unchanged at high volume levels, but will increase the insertion loss at the middle and high frequencies on low volume levels. This, in effect, provides an increase in the bass boost at lower volume levels, compensating for the non-linear intensity response of the human ear to low-frequency sounds.

This circuit should not be considered the solution to all audio problems, but rather as a building block, in the continuing search for the reproduction of sound in a small, acoustically imperfect room in our home, that will closely resemble the original sound as recorded in an acoustically treated room, at a much louder sound intensity. When considered in this light, it performs its function simply and inexpensively.

-30-

Fig. 3. Measured performance of compensator over a 20 decibel range. The dotted line is change in human ear response over a similar range of intensity. See text.



Compact Amplifier

(Continued from page 63)

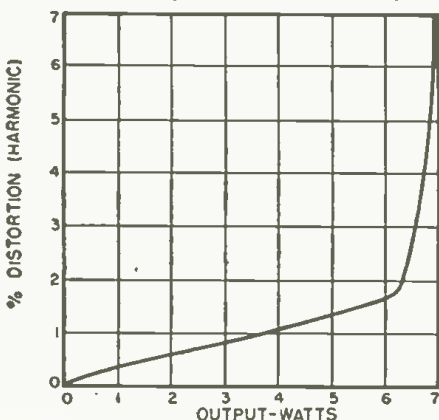
output transformer terminals be made exactly as shown or the feedback circuit will cause the amplifier to oscillate. For the same reason it is also important that the 6CM6 which is connected to terminals 1 and 3 of the transformer is the one whose grid is connected to pin 1 of the 6AN8 through C_2 . If a different transformer than the one specified in the parts list is used, it may be necessary to ground the 8-ohm tap of the secondary and connect R_{10} to the common terminal. This should be done if the amplifier oscillates.

The parts layout of the power supply is shown in Figs. 5 and 6. As in the amplifier, the parts layout is not critical and perhaps a smaller chassis could be used. R_{11} is mounted by connecting its leads to pin 2 of the 5Y3 and to the positive terminal of C_5 . R_{12} is connected between the positive terminals of C_5 and C_6 . The fuse holder is secured to the chassis with one of the screws holding the power transformer. Although the filter circuit is very simple, the noise voltage at the 8-ohm output tap is only one millivolt, or about 77 db below 6 watts.

If the amplifier is to be used with an external speaker to improve the audio quality of a radio tuner or as a playback amplifier for a record player or tape recorder that is equipped with an output jack, it is only necessary to connect a shielded lead between the output jack and the input to the amplifier. As an isolating capacitor is usually furnished in the set in such cases, the input resistor, R_1 , should be used. If the amplifier is to be used with a TV or radio set without an output jack, connect a shielded lead between the volume control of the set and the input jack of the amplifier. The lead should be connected to the arm of the volume control and the shield to the ground lug of the control. In this case, R_1 is not needed.

The gain of the amplifier is high enough so that only 0.7 volt of audio is required for the full six watts of output.

Fig. 7. Total harmonic distortion of audio amplifier is 1.6 per-cent at 6 watts output.



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ARKAY WINNER!!

SPECIFICATIONS:
POWER—30 watts @ 1% IM.
FREQ. RESPONSE $\pm 1/2$ db.—
10-50,000 cps.

HUM—120 db. below rated output (Actually zero)
CONTROLS—(6) Fine selector, loudness, bass, treble, level set, 5-position level compensation control.
• 2 EL-34/6CA7 Super-Lin Williamson
• Special output for simultaneous tape recording and monitoring.



ARKAY Model FL-30 Hi-Fi AMP-PRE-AMP

Featuring a transistorized front end for use with a reluctance pick-up, this engineering masterpiece assures the finest in Hi-Fi reproduction. Record equalization for more than 30 labels (LP, RIAA, and EUR). Complete with rose gold panel and black cabinet.

\$49.95



ARKAY Model FL-10 Hi-Fi Amplifier

A super lin. Williamson 12-watt Hi-Fi amplifier with built-in pre-amp. 18 watt peak with a frequency response of 20-40,000 cps. 4 controls including record equalization (LP, RIAA, EUR). Output impedances, 4, 8, & 16 ohms. Special output for simultaneous tape recording and monitoring.

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SPECIFICATIONS:

ELECTRICAL RATING—9-volt transistor energizer.

OPERATING FREQUENCIES: Tuning range—540 to 1620 KU. I.F. amplifier—45.5 KC.

POWER OUTPUT—275 + milliwatts.
SPEAKER—large alnico V permanent magnet.

TRANSISTOR COMPLEMENT: X1 oscillator-converter; X2 1st I.F. amplifier; X3 2nd I.F. amplifier; D1 diode detector-AGC take-off; X4 class B driver; X5 class B output; X6 class B output.
Federal Excise Tax Included **\$37.50**



TRANSISTORIZED PORTABLE SUPERNET RECEIVER
The Model TR-6 is a newly designed all transistor portable supernet receiver push-pull Class B output providing clear crisp output better than 275 milliwatts. Construction is extremely simple because of the advanced engineering techniques employed in its design.



ARKAY Model HFT-7 Hi-Fi AM-FM Tuner

4 UV sensitivity for 30 db quieting. Automatic frequency control with provisions for AFC erase. Allows pinpoint, high selectivity tuning. Foster-Sceley discriminator, high efficiency AM loop stick antenna and temperature compensated oscillator circuit.

New! Wired & Tested \$49.95
Kit Less Cover \$32.00
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ARKAY Model B-8 Hi-Fi Speaker System

Frequency Response: 10 to 20,000 cps. Crossover Frequency: 1600 cps. Power Rating: 25 watts. Impedance 16 ohms. Features a bass reflex, ducted port enclosure equipped with a low frequency speaker and a compression driven horn of special design. A variable balance control w/network provides smooth continuous adjustment of the H/F speaker.
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ARKAY Model 14T21 NEW! TV KIT

Very latest design used in sync. circuits results in excellent stability with extremely low noise characteristics. A.G.C. circuit results in maximum sync. hold characteristics. The only vertical chassis construction, series-string-heater type tubes, vertical trace blanking circuits, and many more features. **\$79.50**

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All impedances
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From \$15.00 to \$24.00 NET.



WEATHERPROOF LINE MATCHING TRANSFORMERS
For constant impedance
or constant voltage systems.
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HIGH-POWERED PUBLIC ADDRESS SPEAKERS
Four sizes from 2 1/2' to 6' air column.
From \$10.00 to \$39.00 NET.



U-L APPROVED EXPLOSION-PROOF SPEAKERS
For hazardous applications.
Several sizes, all classes.
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For all purposes,
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All sizes and types:
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Adjustable 12" goose
neck. Use as desk support,
for dispatcher office,
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Certified Record Revue

(Continued from page 50)

percussive but properly so for most of this work. All orchestral elements are nice and clean, frequency and dynamics are wide in range, acoustics live and spacious. Unhappily most of this fine sound is for naught as in the over-all picture the impression is that orchestral weight is insufficient. I can't be sure of this, but offhand I'd say the orchestral forces employed were on the thin side, definitely not at full complement. Still, if you want the best sounding version of this work, this will have to be your choice.

JANACEK SINFONIETTA TARAS BULBA (RHAPSODY FOR ORCHESTRA)

Pro-Musica Symphony of Vienna conducted by Jascha Horenstein. Vox PL9710. RIAA curve. Price \$4.98.

This recording is a few months old and somehow got mislaid. It is more than worthy of being brought to your attention, despite the time lapse. "Taras Bulba" is a somewhat programmatic work depicting some highly dramatic scenes in the life of a 15th century Cossack hero. The music is a rather odd admixture of romanticism with a liberal admixture of atonalities and dissonances strictly 20th century in origin. It is quite entertaining to listen to and easily assimilated and, incidentally, is a first rate vehicle for hi-fi treatment.

Quite another matter is the "Sinfonietta". A very powerful work with a highly astringent flavor, the first, third, and the allegro of the 4th part calls for incredibly massive orchestration. Most of the instrumentation is doubled and there are extras beyond that as well. As you might expect, this is productive of some mighty sound, and the sonority of the massed brass in the opening bars is, to put it mildly, impressive. Good clean sound and fine balance throughout the two works and it is recommended to you as an interesting "off-beat" musical experience.

TCHAIKOVSKY SYMPHONY #2 ("LITTLE RUSSIAN")

L'Orchestre de la Societe des Concerts du Conservatoire de Paris conducted by Georg Solti. London LL1507. RIAA curve. Price \$3.98.

Here is a gem of a recording. For Tchaikovsky buffs who have had a surfeit of the 4th, 5th, and 6th symphonies, this delightful work is like a refreshing sea breeze. This ingratiating score deserves much more exposure in the concert hall. It has all the elements so dear to the lover of Tchaikovsky's music. It is tuneful and melodic . . . it has infectious rhythms . . . it generates excitement in its surge and sweep. I find Solti's reading at least the equal of the Beecham/Columbia disc of several years ago. Beyond this Solti has the advantage of some of London's very top engineering. This is a sensational hi-fi work in almost every movement and especially in the ebullient scherzo. Here you will find percussion to gladden the hi-fi heart, including a really tremendous bass drum that on a big speaker system will give forth with a candle-snuffing, windy WHUMP! All elements are beautifully clean and articulate, frequency response and dynamics very wide, acoustics very live and spacious. Highly recommended.

TCHAIKOVSKY FRANCESCA DA RIMINI CAPPRICCIO ITALIEN

London Symphony Orchestra conducted

by Anthony Collins. London LL1441. RIAA curve. Price \$3.98.

More Tchaikovsky from London and a real hi-fi dazzler! If you like these two works coupled together, there is no question of superiority over the only other such coupling on the Allegro label. Taken separately, there is a divergence of opinion. Collins is rather slow-paced in "Francesca da Rimini" and also misses some of the essential passion of the work. His reading of the "Capriccio" is competent and workmanlike, but he is out-gunned in drive and excitement, notably by Beecham and Dorati. And the Dorati/Mercury even outguns it in hi-fi terms, although it must be admitted that I am really referring to kind or type of hi-fi sound rather than degree of "hi-fi-ness" in itself. "Francesca" has a much clearer field in the sound department being demonstrably superior to the fine Capitol version or London's own earlier efforts. Good clean string work here, with the annoying edginess that has plagued earlier recordings of "Francesca" happily absent. Exceptional cleanness and wide dynamics throughout both scores.

MASSENET MANON (COMPLETE OPERA)

Victoria de Los Angeles, Henri Legay, Michel Dens, and other soloists with the chorus and orchestra of the Theatre National de l'Opera-Comique conducted by Pierre Monteux. Victor LM6402. RIAA curve. Price \$15.92. Four discs.

The big news here is Papa Pierre Monteux at the conductorial helm. Under his skillful baton we are given a performance that is ravishingly beautiful and I predict that few opera lovers will be able to resist this recording. All the elements are most happily French. A frame of reference where they belong, except of course, Victoria de Los Angeles. And what an exception! This role is almost tailored for the sweet-voiced lady of Spain and she makes the most of it. Throughout the work she traverses all difficulties with consummate ease and at all times is clear-voiced and completely articulate. Legay is a solid and convincing Chevalier, Jean Borthayre as the Count Des Grieux, is a compelling and believable figure and Michel Dens essays the role of Lescaut, with a voice of considerable beauty although his weak top register was annoying at times. All other soloists were well suited to their roles.

The choral and orchestral scoring was a revelation in the hands of Monteux. His acute sense of balance, his deft handling of tonal masses and textures, his pacing and phrasing contribute mightily to the enjoyment of this opera. Soundwise this is an outstanding job. Vocal and orchestral balances were smooth and complementary. Frequency response and dynamic range was as wide as I've ever heard in an opera recording. Acoustics were intelligently employed, so that there was nice crisp definition to the voices and instruments, yet they had the "liveness" and roundness that makes for "presence" and easy listening. While the London and even the old Columbia recordings have their virtues, in the final and over-all evaluation the superiority of this album is clear and unchallenged. An absolute "must" for the opera lover.

STRAUSS, RICHARD DER ROSENKAVALIER SUITE TILL EULENSPIEGEL'S MERRY PRANKS

Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG 50099. RIAA curve. Price \$3.98.

This recording is quite fantastic. If your hi-fi system can reproduce all that is on this record, man . . . you've arrived! It will take a very fine system indeed to even begin to cope with the incredible dynamic range of this disc. Fair warning to all who play this

RADIO & TELEVISION NEWS

record . . . don't start this disc at what you would consider "normal room volume", otherwise later on you will find yourself being blown out into the street! This is especially true with "Der Rosenkavalier", and in fact there are several parts of this recording where if you encounter tracking difficulties, you had better suspect your system rather than the record. "Der Rosenkavalier" has long been a Dorati specialty and his reading of it on this disc is quite stunning. In it he combines the sharp pungency, and weighty power of the score with the beautiful lilting waltzes and the exquisite melodies in a manner that betokens complete mastery of his idiom. Oh, there are several other conductors one could name whose readings have more of the old "gemutlichkeit", but I feel this attitude should really be reserved for the opera itself and that the "Rosenkavalier" suite should be treated almost as a separate entity. And an entity which demands much more robust handling.

"Till Eulenspiegel" is somewhat less successful in performance. Dorati's fast pace and rhythmic drive are certainly not lacking in excitement, or exhilaration, but some of the final drama is missing that characterized the reading of the late great Clemens Krauss. But I quibble on minute points . . . this is such an orchestral *tour de force* that it leaves one breathless. Here you will find strings that sound clean and smooth but which also have a hard and incisive bite when called for, woodwinds mellow in their sonic contour or sharp and piercing as the score demands . . . and the brass resounds mightily throughout both works. The opening of "Der Rosenkavalier" heralded by the French horn and trombones is impressive and then a few bars later the incredible sound, so typically "Straussian", of the French horns in that unison triplet figure in an impossibly high register really floors you! Percussion throughout both scores is thunderous and in parts of "Rosenkavalier" it hits like a battering ram. Add the usual spacious acoustics favored by Mercury and the over-all result is an overwhelming musical experience. I can't recommend this too highly.

BACH, J. S.
DOUBLE CONCERTO IN D MINOR
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STRINGS
TRIPLE CONCERTO IN A MINOR
FOR FLUTE, VIOLIN, HARPSI-
CHORD, AND STRINGS
 Solisti di Zagreb conducted by Antonio Janigro. Vanguard BG-562. RIAA curve. Price \$4.98.

The Solisti di Zagreb is a chamber orchestra made up of thirteen strings played by performers of virtuoso caliber. They are still another of the musical groups from Europe that have been touring the United States and embellishing our local music scene. Vanguard has recorded this splendid ensemble and issued four discs containing generous samples of their art. This disc concerns itself with old master Bach and I can't urge you too strongly to listen to it. This is certainly one of the finest chamber recordings ever issued. The performances are superbly executed, with Janigro lovingly revealing the inner depths of the scores. He and the Solisti show us the flawless symmetry, the subtleties and nuances of dynamics and phrasing, the fullsome expression, the unalloyed beauty of these works.

The cleanness of tone and the precision and warmth of the playing of the Solisti is something at which to marvel. Vanguard has clothed them in a rich tapestry of sound and from every aspect of frequency range, dynamics, transient response, balance and acoustics the disc is well nigh perfection. If you are one of those people who instinctively



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Concert Orchestra conducted by Prof. Klaus Liepmann. Unicorn UNLP1032. RIAA curve. Price \$3.98.

BETHOVEN

PIANO SONATAS #30 AND #31
Ernst Levy, pianist. Unicorn UNLP1033. RIAA curve. Price \$3.98.

These three recordings are the most representative of a group of six issued under the generic title, "Music at M.I.T." by Unicorn Records. "M.I.T." is of course the abbreviation for the famous Massachusetts Institute of Technology. These recordings were made at the new Kresge auditorium and M.I.T. Chapel and are of more than passing interest. Both are super-modern structures which have been designed for specific acoustic balance by famed M.I.T. acoustic authority Leo Beranek and colleagues Bolt and Newman. Space is too limited to go into a detailed explanation of the design and construction which, however, is covered at some length on the back of the record jackets. Suffice to say that nearly ideal reverberation characteristics have been produced for recording purposes. Such is the design that the acoustic "climate" for a given piece of music can be fairly well controlled.

These discs, as recorded and mastered by expert Peter Bartok, are indeed impressive. I still feel that the acoustics, however idealized, would not be perfect for all types of music. Usually, in the new auditoriums which have been designed for maximum intelligibility in the speech frequencies, there is trouble in obtaining a good solid bass and in keeping higher frequencies from becoming hard and overbright. Perhaps this will not be true of the new M.I.T. structures . . . in subsequent issues with the possibility of larger repertoire we will be in a better position to judge.

The brass recording has works by four modern composers including the great Paul Hindemith. There is a great deal of atonality and dissonance here with the Berezowski "Brass Suite", the most listenable and easily assimilated. There are some truly remarkable brass textures and sonorities on this disc. The sound is very sharp and bright, transient response is superb, the over-all acoustic impression is that it affords extreme clarity and instrumental definition with spaciousness for a great deal of that elusive thing called "presence". There is also a little nigeling thought that good as these acoustics are, there is a sort of "dry" overtone, that some may like and others find too "sterile".

The Handel concerti performed with fine competence by Moe on the Holtkamp Baroque organ installed in the Chapel, are models of clean sound. In spite of Mr. Moe's somewhat excessive use of staccato, definition is sharp throughout and the orchestral parts are projected with equal clarity.

Levy, the pianist in the Beethoven sonatas, is somewhat heavy handed and many will take exception to this while others will admire his robustious thundering. The piano is magnificently delineated. Albeit the tone is a little hard, this is razor sharp, crystalline clear piano sound, with extraordinary transient response. The harmonic structure is quite easily discerned and, all in all, one looks forward to hearing piano concerti from this hall.

Summing up . . . these are musically acceptable performances recorded with exemplary sound quality, with the reservation that the type of sound may not appeal to all tastes.

THE TONE POEM

Victor LM6129. RIAA curve. Price \$11.94. Three discs.

This is a miscellaneous collection of what is generally described as "tone poems", some of which are new to records and others which have appeared in previous editions. The

February, 1957

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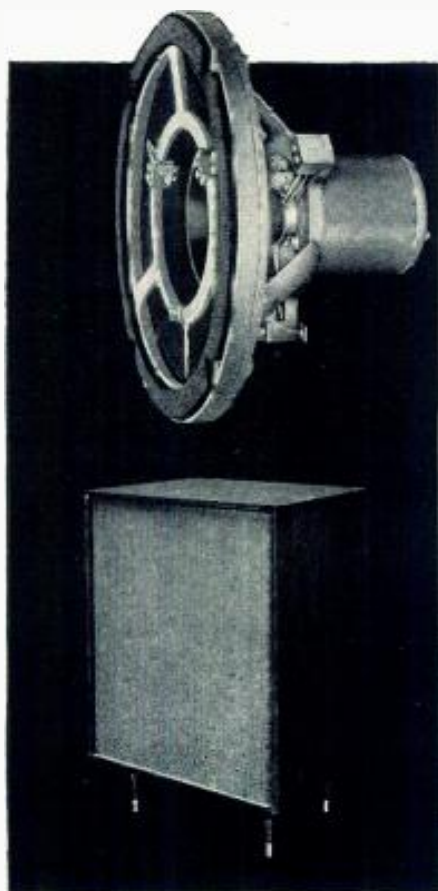


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standout works are superb performances of Liszt's "Mephisto Waltz" and Strauss' "Don Juan" under Fritz Reiner and the Chicago Symphony. Also of much merit is Copland's "El Salon Mexico" and Ravel's "La Valse", as well as Ibert's "Ports of Call" as done to a turn by Stokowski. Five other varied works fill out the six sides and throughout most of the scores the sound is good and clean with some outstanding realism in the works mentioned. An ideal album for those beginning to assemble a record library.

JOHNNY DUFFY
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CARNIVAL IN RIO
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CALENDER GIRL
 Julie London. Liberty SL9002. RIAA curve. Price \$3.98.

An enterprising new company in Hollywood by the name of *Liberty Records* has been turning out material that deserves mention for the musical content and especially for the outstanding sound quality. All the listed recordings are prime examples of the kind of work they do. The organ recording is superb in clarity and definition and the accompanying notes on the record jacket about the organ and the recording are very

well done. In their respective fields the recordings listed have some of the best sound I've heard. Notable particularly is the transient response and the wide frequency and dynamic range. Their brass is really sharp and pungent, percussion has impact and is always crisp and completely articulate. They have chosen acoustic perspectives which allow for a maximum of "liveness" and "presence" and good instrumental separation without the excessive and objectionable echo chamber overhang found in so many pop recordings. These records make ideal demonstration material of the pop variety. If you go for this sort of thing these are definitely worth looking into and there are other titles in the *Liberty* catalogue you might find rewarding.

GRIEG
LYRIC SUITE
TCHAIKOVSKY
MARCHE SLAV
SIBELIUS
FINLANDIA
LISZT

HUNGARIAN RHAPSODY #4
 Danish State Radio Symphony Orchestra conducted by Eric Tuxen. London LL1313. RIAA curve. Price \$3.98.

A potpourri of potboilers, but all expertly played by the superb Danish orchestra and recorded with sound of sumptuous quality. The "Marche Slav" sounds better here than in any competing version and the performance is all one could desire. An outstanding record of its type.

Stereophonic Tape

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ROMEO AND JULIET (EXCERPTS)

A SIMPLIFIED GATED-BEAM FM DETECTOR CIRCUIT

By CHARLES ERWIN COHN

THE gated-beam FM detector using the 6BN6 tube has gained some popularity in this country. It uses a tuned circuit in the quadrature grid of the tube on which a voltage, 90 degrees out-of-phase at center frequency with that on the limiter grid, is induced by electrostatic induction within the tube.

There is, however, a circuit used in England with the EQ80 "nonode" seven-grid tube, in which the 90 degree phase difference between grids is obtained much more readily. This circuit is easily adaptable to the American-made 6BN6 and will give excellent performance, especially since the 6BN6 limits more readily than the EQ80.

The circuit is shown in the diagram. It will be noted that the limiter grid of the 6BN6 is fed from the secondary of the last i.f. transformer, while the quadrature grid is fed from the primary. The voltage on the secondary of the transformer will be 90 degrees out-of-phase with the primary voltage at the center frequency due to the transformer action, with the phase difference departing from 90 degrees away from the center frequency.

As in the conventional circuit, this phase difference determines the width of the pulses of plate current occurring at the signal frequency, which are integrated in the plate circuit to yield an audio signal.

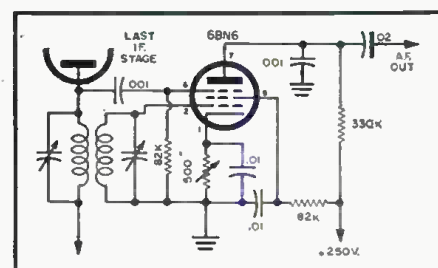
This circuit is somewhat less critical to build than the conventional circuit since the latter must have a quadrature coil with a very high "Q" and a very high L/C ratio in order that sufficient voltage be developed across it by electrostatic induction. In the circuit diagrammed here, any i.f. transformer

suitable for quality FM reception may be used, except that it must not be over-coupled. If an overcoupled transformer is the only one available, its coupling must be brought below the critical point by proper damping of the primary—a step which can be done most easily by adjusting the value of the quadrature grid resistor. Capacitive coupling between the primary and secondary must be avoided, both in the transformer and in the external wiring since such coupling would upset the phase relationships. In order to get proper performance, the i.f. amplifier must provide an ample signal at the 6BN6 to give good limiting.

This circuit is very easy to align. The transformers need only be peaked up on an AM signal or on noise. The secondary of the detector transformer might have to be touched up for best sound on an actual signal. As in the conventional circuit, the cathode pot should be set for the most advantageous AM rejection.

—30—

An adaptation of a British FM detector circuit using an American-made 6BN6 beam tube.



RADIO & TELEVISION NEWS

NBC Symphony Orchestra conducted by Leopold Stokowski. Victor DCS-18. 7" reel, NARTB curve. Price \$12.95.

Repeated listenings to this tape convince me that this is one of the very finest stereotapes yet to appear. This is an extraordinary musical and sonic experience. The music is quite wonderful, surely one of the best things Prokofieff has done. It combines the elements of exquisite melodies spiced with typical Prokofieff atonalities, with moments of drama of searing intensity. As a vehicle for the talents of Stokowski it is nigh perfect and he makes the most of it and elicits a stunning performance from the NBC men. As for the sound . . . it is tremendous. I wouldn't be at all surprised if the presence of Stokowski was partly responsible for this excellence. He has experimented more with sound than any other conductor and is generally acknowledged to have made some important contributions to the recording art. He has always had an intense interest in stereophonic reproduction, as witness the early efforts with "Fantasia" (which is not really true stereo, but is fairly effective nonetheless). Because of his interest in the subject I have had the pleasure of recording stereophonic tapes with Dr. Stokowski on a number of occasions. One that comes to mind was really something . . . a Monteverdi "Vesper Mass" with full orchestra, several hundred voices and organ. I hope some day he can do this work for commercial issue.

The general cleanness of this tape and the breathtaking instrumental clarity and definition are something to hear. The sense of directivity is excellent, and once again, the "hole-in-the-middle" effect was minimal. Some of the brass sonorities on this tape are astounding in their weight and brazenness, and in the first section some low, low bass drum thuds of exceptional power. Some of the strings here are bowed so intensely and in such a high register that I am sure that in any other medium except stereo, they would have an edginess that would be unbearable. Here they are not only bearable but add immeasurably to the drama of certain sections. Balance both orchestrally and acoustically was excellent and tape hiss, while still noticeable was down considerably from the last Victor tape I have played. Nuff said. If you are a stereo fan, this will surely become one of your most oft-played tapes. —30—

TUBE REJUVENATION

By CHARLES ERWIN COHN

IT HAS been common practice to reactivate weak picture tubes by subjecting them to an above-normal filament voltage for a short time.

This technique can be easily extended to ordinary receiving tubes, using an ordinary tube checker. If a tube tests weak, turn up the filament voltage control while holding down the test button. At each step, see if the needle rises into the "good" scale. When it does, hold the setting until the needle stops moving. Then turn back to normal filament voltage and see where the needle again comes to rest. If it remains in the "good" scale, the reactivation can be considered successful.

Go through the shorts check again to see if any shorts have been induced by the process and if the tube checks out on this, return it to service. Don't be afraid to pour on the filament voltage as most tubes, except battery types, can stand over twice their normal voltage without blowing. However, since a weak tube would be discarded anyway, it is a risk worth taking. Results with this process will be found extremely variable, some tubes responding well and some not at all. —30—

February, 1957

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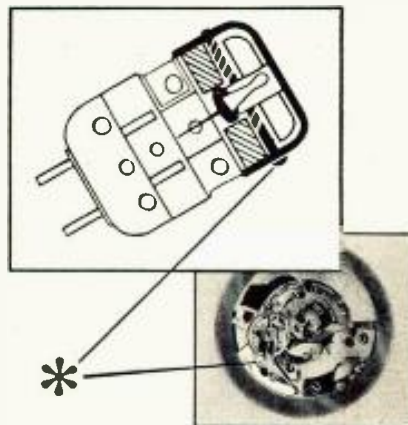
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Realistic High Fidelity
(Continued from page 53)

are!). You can mark off a rule of stiff paper, starting 1,2,3 etc. from a center point O, eleven millimeters apart on the left and nine millimeters apart on the right, which will enable you to pick the right load line position for 5% distortion, by putting the center zero of the rule on the mean grid voltage curve. Swinging the rule about point O on the 6L6 curve will indicate that you can't dodge that 5% distortion anyhow. If you moved the operating point O from the -15 volt curve to the -30 volt curve you only need to look at Fig. 38 to see that the distortion would become excessive owing to the crowding of the characteristic curves. And before I go on to the next step, remember that precisely the same rules apply to the curves of the tube when used as a tetrode. The curves have a different shape, but the "family" of curves is subject to the same considerations.

But, of course, you have heard that push-pull operation cancels out second harmonic distortion. Why should it do this? If you imagine the load line **XOY** bent upwards in its lower half so that it runs roughly parallel to the dissipation curve, you can also see that it would cut the grid voltage curves in a much more regular manner, and so reduce distortion. This is what, in effect, happens with push-pull operation, and is illustrated by Fig. 39, which shows two 6L6's in class A triode push-pull. This diagram is simply two Fig. 38's joined back to back, with the 400-plate-volt ordinates (the operating point) coinciding. The dotted families of curves are those of Fig. 38, but new solid lines (composite "curves") take up positions exactly between the corresponding pairs of curves of the two single tubes. These solid lines are the characteristics of the combined pair, and are cut by the load line **XOY**. This is the equivalent of the load line **XZ** shown in the upper half of the diagram, being that imaginary curved load line I mentioned before. I have also drawn the load line **AOB**, which will give a greater power output than **XOY**, but this particular value was chosen to show a considerable trespass into the region greater than 25 watts dissipation, so the tubes would be overloaded on large signal inputs.

In practice the position of the load line affects the distortion at third and fourth harmonics as well as second. The amount of distortion of each harmonic can be calculated from data on the diagram, but the easiest way to check this point is to refer to the distortion charts given in many tube manuals, where distortion harmonic and total is frequently given for any value of load line with related power output.

When the load is a speaker, as it must be if we are to get any sound

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from the audio power generated, the load is partly resistive, partly inductive, and partly capacitive. In practice, the capacitive component is not usually considered important (although capacitances are shown in so-called equivalent circuits of loudspeakers). The reactance of the inductive component depends on the frequency and combining the resistive component with the reactance involves consideration of the phase of the reactance. The inductive load line is elliptical, and the major axis can be considered to coincide with the zero current ordinate of Fig. 39. Combining this with the pure resistive load line will produce an elliptical load resultant whose major axis is at an angle with respect to the original major axis, but not at the same angle as the resistive load line. To explain how this comes about would involve a fairly long mathematical discussion, but a little reflection will indicate that at certain frequencies the load on the output stage will be seriously out even if the slope of the major axis has been set for minimum distortion. As tetrodes and pentodes are more critical as to exact loading for maximum power output than triodes, the bias against the former has resulted in the fairly widespread belief that only triodes can be considered for really true fidelity.

Triodes, Tetrodes and Pentodes

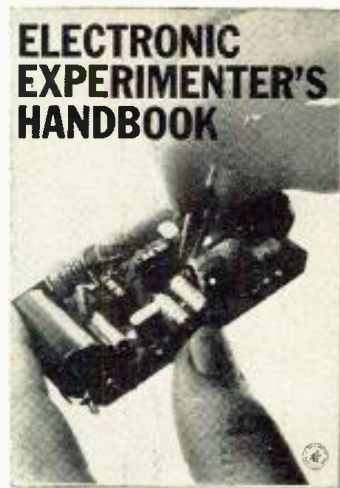
This belief is founded on misapprehensions as to what is involved. The accuracy of load for tetrodes and pentodes is only of importance when the maximum possible "undistorted" power is needed, and early in this part I have suggested that for normal listening fewer watts than many people say they want is all they really need. On the other hand it is undeniable that the high plate impedance of tetrodes and pentodes does not give a good damping factor, and if feedback hadn't been invented, then the triode would be absolutely essential for the best results. But feedback can reduce the plate impedance of a pentode to a figure comparable with that of a triode—provided you remember my warning that feedback is not a cure-all for every amplifier ailment.

A triode amplifier can sound very good indeed without any feedback at all. It can be made better with feedback, but triode amplifiers as well as those using beam power tubes can be badly designed and made to sound respectable by adding as much feedback as possible. In the process low-frequency instability can be set up, due to the excessive phase shift caused by several voltage amplifier stages, for the basic disadvantage of triode output tubes is that they need plenty of volts applied to the grid to get the maximum output power. The performance of a well designed triode amplifier without feedback can be paralleled by using a pentode output stage with feedback across the output stage only. I made such amplifiers more

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resistors. These need not be separate (in production this was found convenient) but what is more important is that the total plate resistance must equal the total cathode resistance. Similarly the output coupling capacitors and following grid resistors must be equal. Their exact value is not important; they must *match*.

If 807's are used to get maximum power, then, owing to the heat from the tubes (which have the plate connection on the top of the bulb) and the operating conditions, the 470 μ f.d. plate bypass capacitors have a very rough time of it and should be at least 2000 volt ceramics. Alternative tubes are 6L6 and 5881, and the r.f. capacitors can be the ordinary molded mica type.

Apart from the voltage control complication in the power supply, the circuit is very simple indeed, with the minimum number of stages. Because of this I have been able to apply as much as 28 db of feedback without running into trouble with low-frequency instability. The response is +1 db at 20 cps, -1 db at 50,000 cps and dead flat in between. Intermodulation distortion is negligible (almost unmeasurable) up to 15 watts, and only 1% at 20 watts. These figures may appear to be unimpressive, compared with some claims, but they are factual. Twenty watts is developed with an input of 1 volt r.m.s.

The now famous "Ultra-Linear" output stage was first described by Hasler and Keroes (*Audio Engineering*, Nov. 1951) and used conventional pentodes with taps on the output transformer connected to the screens of the tubes, thus distributing the load between plates and screens. This forms a hybrid sort of output stage, for the devisers of the circuit found that in altering the ratio of screen load to plate load from zero (pentode operation) to unity (triode operation) a point was reached when most of the disabilities of the pentode disappeared and the output stage took on the characteristics of triodes, without losing the high efficiency of the pentode. In a practical sense, therefore, the high power output and stage efficiency of pentodes is retained, but the tubes, from a low plate impedance and damping factor point of view, behave like triodes, and with a carefully designed amplifier, the distortion is less than can otherwise be obtained. The latest development of this circuit has been described by Hasler in *RADIO & TELEVISION NEWS* (June 1956) and need not be repeated here.

The design cannot be applied indiscriminately, for the amplifier as a whole has to be considered carefully. The design of the output transformer is critical, and only components specified for use with particular tubes should be used. The authors' original article suggested that a new tube was really wanted to get the best from the scheme, and such tubes are now available in the *Mullard EL34* and the *Tung-Sol 6550*.

-30-

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INDUSTRY FACT BOOK

The Radio - Electronics - Television Manufacturers Association, 1721 DeSales St., N. W., Washington, D. C., has issued a new edition of its electronics industry "Fact Book" which will be of wide interest.

The booklet contains information on radio and television receivers, including production and sales figures; picture and receiving tube statistics; with special chapters devoted to military and industrial electronics, tubes, and export data on the industry.

Those whose work involves statistics of this sort will find this slim volume a wonderful reference source. Copies are available for 50 cents each direct from the Association.

DIGITAL TECHNIQUES

The Electronic Instruments Division of Burroughs Corporation, 1209 Vine Street, Philadelphia 7, Pa. has issued a 16-page booklet on the art of using digital techniques for testing, information handling, and control.

Entitled "Four Dimensions in Digital Design-Pulse Techniques for Modern Control," the booklet is basic enough to serve as an introduction to digital techniques. The publication shows how digital techniques, as applied through the company's pulse control systems, provide increased measures of precision, control, and many other functions of research and manufacturing.

Free copies of the booklet are available on letterhead request to the manufacturer.

"DOLLAR SAVINGS THROUGH STANDARDS"

A proof of the value of standardization in the electrical manufacturing and electronics field is stressed in an extensive survey report, "Dollar Savings Through Standards," which highlights economic benefits to American industry resulting from the use of standards.

The 40-page survey is being made available by the American Standards Association, 70 East 45th St., New York 17, N. Y. as a public service. This report is an up-to-date version of the original edition of 1951 and contains 79 documented case studies covering 27 industrial fields.

MINIATURE VOLTMETER DATA

International Instruments, Inc., P.O. Box 2954, New Haven 15, Conn. has announced the publication of a new engineering data sheet covering its line of miniature, expanded-scale a.c. voltmeters.

The meters are available in standard ranges of 90-120, 90-130, and 90-140 volts a.c. Other ranges with the

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Free copies of any of these data sheets are available on request.

"ELMENCO" CAPACITORS

Arco Electronics Inc., 64 White St., New York 13, N.Y. has issued a 24-page catalogue covering the complete line of "Elmenco" capacitors which the firm is able to deliver immediately from stock.

Included in the listing is a complete line of micas, tubulars, ceramics, compression micas, and a line of capacitor kits for various applications. The information is presented in tabular and easy-to-use form. Photographs and dimensional diagrams of prototype units have been included.

POWER SUPPLIES

Lambda Electronics Corp., 11-11 131 Street, College Point 56, N.Y. has just released a new 34-page catalogue covering its line of power supplies for industry and laboratory use.

Nearly fifty models are pictured and described in some detail, including special features and complete specifications. Bench, portable, and rack-mounted regulated supplies are included in the line and in the catalogue.

Copies of Catalogue 57 are available on request. Write the manufacturer on your company letterhead.

1957 ZACK CATALOGUE

Zack Radio Supply Company, 1424 Market St., San Francisco, Cal., has announced the availability of its new 1957 general catalogue.

This 224-page publication, which includes a 64-page high-fidelity section, was prepared by *Electronic Publishing Company, Inc.* of Chicago. Copies of the catalogue are available from the parts distributor.

INDUSTRIAL TV DATA

General Precision Laboratory, Inc., 63 Bedford Road, Pleasantville, N.Y. has issued a four-page general application brochure on its closed-circuit television equipment for industrial and institutional applications.

The booklet pictures and describes the various components used in such a system and lists typical applications for such equipment. Copies of the new booklet are free on request to the manufacturer.

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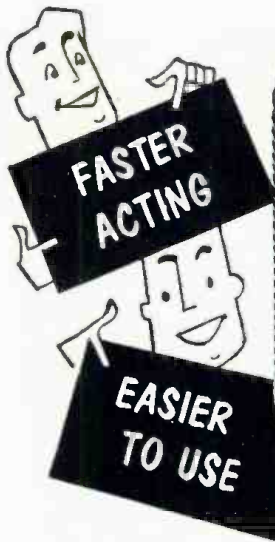
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Write the company for copies of Data Sheets 101 (1957) or details on how the brochure may be obtained.

"HEATHKITS FOR 1957"

Heath Company has just released an elaborate 55-page catalogue entitled "Heathkits for 1957."

The new publication pictures and describes some seventy kits and includes a complete line of hi-fi equipment, amateur radio gear, and service test instruments in kit form.

One item of particular interest to the audiophile is the new "Legato" speaker system kit featuring *Altec-Lansing* speakers. The new system is being offered in either contemporary or traditional design.

Copies of this new catalogue will be supplied without charge upon direct request to the company at 305 Territorial Road, Benton Harbor, Mich.

MORE RETMA STANDARDS

The Engineering Department of RETMA has released three new standards of interest to the electronics industry.

RS-166 covers miniature waveguide flanges, unpressurized contact type. This standard is priced at 40 cents. Type designations for receiver tube sockets is available at 80 cents a copy as the RS-167. The third standard covers thermoplastic insulated and jacketed hook-up wire. This standard, 60 cents, has been designated as RS-169.

Copies of any or all of these standards may be ordered direct from the RETMA Engineering Office, 11 West 42nd Street, New York 36, N. Y.

TRANSITRON BROCHURES

Transitron Electronic Corporation of Wakefield, Mass., has issued two new bulletins describing its products.

Bulletin TE 1351 covers high-temperature silicon rectifiers and consists of a series of data sheets providing pertinent electrical, mechanical, and circuit specifications. The second publication, Bulletin TE 1342, covers the firm's "TD" series of silicon rectifier stacks and provides complete specifications.

Either or both of these publications are available upon direct request to the manufacturer.

SPRAGUE WALL CATALOGUE

Of interest to service technicians is the new "wall catalogue" recently issued by *Sprague Products Company*, 51 Marshall St., North Adams, Mass.

The company's complete line of capacitors for radio-TV replacement has been compiled in an easy-to-read,

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SPEAKER New FRS Series

Plus New ARGOS BASS REFLEX CONSOLE

\$26.00

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WESTERN RADIO
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easy-to-handle catalogue. Made up in the popular wall-calendar style for hanging near the telephone or work bench, Catalogue C-455 makes ordering simple.

Covering all capacitors needed for radio and TV replacement, the catalogue eliminates all extraneous items which do not fall into this category. Copies of the catalogue will be supplied by the company's distributors without charge but can be ordered direct from the manufacturer for 10 cents, if more convenient.

PIC CATALOGUE

Pic Design Corporation, a division of *Benrus Watch Company, Inc.*, 477 Atlantic Avenue, East Rockaway, Long Island, N.Y. has announced the release of its Catalogue #11.

Listing over 4000 precision instrument and servo parts which are available from stock, the catalogue includes 128 pages of compact and concise engineering data for use in the electronic and instrumentation fields.

The company will supply a copy of this publication upon letterhead request.

"VIKING" HAM RADIO GEAR

E. F. Johnson Company, Waseca, Minnesota has issued an 18-page, two-color catalogue covering its complete "Viking" line of equipment for the radio amateur.

Designated as publication 956, the catalogue features the firm's new "Five Hundred" transmitter which covers the entire amateur spectrum from 80 through 10 meters. The new transmitter provides 600 watts c.w. and 500 watts on phone.

In addition, the catalogue pictures and describes nine other transmitters and a series of accessories, antennas, and rotators. The company will forward copies of this new publication upon request.

RCA "REFERENCE BOOK"

RCA's Tube Division distributors are now offering copies of the 1957 edition of the division's "Reference Book," a pocket-size book containing 200 pages of information on tubes, semiconductor devices, and electronic components, together with a daily reminder calendar, and a collection of world maps in color.


The section on tubes includes a "Quick Selection Guide" of the company's power, CR, phototubes, and special tubes for radio and industry; an interchangeability directory of tubes for communications and industry; and 37 pages of receiving tube characteristics with base and envelope connection diagrams. Picture tube characteristics and socket connections occupy 12 pages.

Contact local RCA tube distributors for copies.

TRANSFORMER REPLACEMENTS

Rogers Electronic Corp., 49 Bleecker St., New York 12, N.Y. has established a new TV transformer replacement manual and subscription service

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TV technicians, dealers, and shop owners may obtain the manual service free from the firm's local distributors or for 75 cents from the company direct.

"VARIAC" BULLETIN

General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass. has just issued "Bulletin 0" covering its line of "Variacs."

This 24-page publication lists several new models, portable types with overload protection, motor drives, completely enclosed units, and ball-bearing models. Each of the models is pictured and described in considerable detail. Electrical and mechanical specifications are included.

A tabulation of single and ganged "Variacs" is included on the back cover of the catalogue.

G-E RADIO SERVICE GUIDE

A service guide covering all of its radios manufactured from 1946 to 1956 has been issued by the radio receiver department of General Electric Company.

The 275-page, spiral-bound service guide contains schematic diagrams, replacement parts catalogue numbers, descriptions and list prices, tube complements, voltage measurements, and sensitivity and stage gains in order to provide the service technician with a condensed single source of reference for all postwar radios.

Write the division at 1285 Boston Ave., Bridgeport, Conn. for details on how to obtain a copy of this service guide.

CLOSED-CIRCUIT TV DATA

The Broadcast and TV Equipment Department of Radio Corporation of America, Camden, N.J. has issued a comprehensive, illustrated "guidebook" covering its latest broadcast equipment and systems for color and black-and-white closed-circuit TV service in medical, educational, industrial, and business fields.

Entitled "RCA High-Fidelity Television," the 28-page booklet uses color and monochrome photographs, diagrams, and sketches to describe the nature and applications of the company's line of such gear.

The booklet is available on telephone request from Department TV-1056, Building 15-1 of the company in Camden.

TUBE DATA BOOKLET

A 44-page booklet for service technicians, amateurs, and engineers containing essential data on its "Reliant" line of receiving tubes is now

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DM-28	28V	224V .07A	1.95	4.95
DM-32A	28V 1.1A	250 V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A	1.95	3.95
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 5.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A	7.95	
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250 V .050A	2.95	5.24
PE-103	6V	500V .160A		
	12V	500V .160A	19.50	34.50
PE-186	28V 11A	400V .400A	6.95	



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1—2V. 20 Amp. Hr. Willard Storage Battery. **\$2.45**
 1—2V. 7 prong Synchronous Plug-in Vibrator **1.49**
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 ALL **BRAND NEW!**
 Combination Price **\$4.99**

Willard 6-Volt Midget Storage Battery
 3 Amp. Hour. **BRAND NEW**. 3/8" x 1-13/16" x 2 3/4". Uses Standard Electrolyte. **Only \$2.22**

Ham Special! Famous BC-645 XMITTER-RECEIVER



With **MANUAL** for Easy Conversion to **CITIZENS' BAND!**

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. This swell rig originally cost over \$1000—yours for practically a song! You get it all, in original factory carton, **BRAND NEW**. Complete with 17 tubes, less power supply. Conversion instructions included. **\$29.50**
 Shpk. wt. 25 lbs.

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) only **\$7.95**

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 Complete set of 10 Plugs **\$5.50**

for BC-645
 CONTROL BOX for above **\$2.25**
 SHOCK MOUNT for above **1.25**
 CONVERSION BOOKLET, Instructions for most useful surplus rigs. **\$2.50**

ASB-5 RECEIVER FOR 420 Mc BAND!

As featured in "CQ" for October 1956. Easily converted, makes a marvelous receiver for 420 Mc band, with RF amplifier! Supplied complete with all tubes.
 OUR LOW PRICE. **\$16.95**
 ASB-5 INDICATOR **\$16.95**

\$1495

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, complete with all components. 200-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes. **\$33.33**

COMBINATION . . . Special

Receiver Only, with all tubes. **\$19.50**
 Transmitter Only, with all tubes. **\$22.25**

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100-156 Mc. Includes 2-832A, 2-1025 Tubes. **\$14.95**
 Excel. Used **\$21.50**
BRAND NEW **\$21.50**

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc **BRAND NEW** with 6 tubes. **\$16.95**
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NAVY RECEIVER TYPE ARB

Four Band. 195 to 9050 kc. Low Freq. Ship. Broadcast—40 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V. or 6 V. Schematic included. Excellent Condition. Overall: 8 1/4" x 7 1/4" x 15 1/4". Wt. 30 lbs.
COMPLETE WITH ALL TUBES. \$21.50
 Special.

AN/ARR-2 RECEIVER

BRAND NEW—A Terrific Value! Tuning Range 234 to 258 Mc. Tubes: 7-9001, 3-6AK5, 1-12AG. Only a few at this low price!
 Complete **\$8.88**



With 28 V. 1.6A Dynamotor, complete **\$12.98**
 110 VOLT AC POWER SUPPLY KIT for above **\$7.95**



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FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete. **BRAND NEW** installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export packed. **COMPLETE \$129.50**

SPECIAL APN-9A LORAN Receiver Indicator, less tubes, NEW (demilitarized) **\$29.50**

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520 to 1500 Kc. 6 tubes: 3-12SK7, 12SR7, 12AG, 12K8. For dynamotor operation. Easily converted to 110 or 32 volt. 2-IF stages. 3-gang tuning cond. Complete with all tubes, in original factory sealed carton. **\$19.95**



BRAND NEW
 BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. **BRAND NEW \$7.88**

BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. **\$7.88**

BRAND NEW
 BC-459 TRANSMITTER—7-0.1 Mc. complete with all tubes and crystal. **\$11.95**

BC-696 TRANSMITTER—3 to 4 Mc. **BRAND NEW** complete with all tubes & crystal. **\$8.88**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES Excellent Brand Type Description Used New
 BC-453 Receiver 190-550 KC. **\$9.95 \$11.95 \$14.95**
 BC-454 Receiver 3-6 Mc. **7.19 8.29 11.95**
 BC-455 Receiver 6-9 Mc. **5.25 7.95 9.95**
 BC-456 Modulator **2.24 2.75 4.23**
 BC-450 3-Receiver Control Box **1.49 1.95**
 BC-451 Transmitter Control Box **1.25 1.49**
 BC-606 Xmit 3-4-Mc (like new) **6.95 8.88**

110 VOLT AC POWER SUPPLY KIT

For All 274-N and ARC-5 Receivers
 Can be assembled quickly and easily, on pre-drilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts at 500 ma voltage. Complete kit of parts with metal case, instructions. **\$7.95**

SPINDLE TUNING KNOB for 274-N RECEIVERS. Fits BC-453, BC-454 and others. **49c**
 Only

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Satchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. **BRAND NEW \$8.88**
 Brand New, less tubes. **\$5.95**
 USED, with tubes. **\$5.95**
 USED, less tubes. **2.95**



BRAND NEW SPECIAL PURPOSE TUBES

In Original Individual Packing

JAN CRP-730A MAGNETRON, Raytheon	Each	Lots of 12	Lots of 100
616W	\$4.45	\$5.15	\$41.00
1625	.16	1.75	13.50
826	.44	4.95	39.50
21724B	.35	3.95	29.50

NEW! Cathode Ray Tubes NEW!

3CP1	.88	5BP4	\$2.22
3CP2	.88	9LP7	1.88
5BP1	2.22		

BUBBLE SEXTANT

Made for U. S. Armed Forces, by AGFA ANSCO. Actually worth \$160 or more! Has illuminated averaging disc for nighttime use. Complete with carrying case. **\$9.95**
 Only



DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—**BRAND NEW**, only **\$2.95**

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. **BRAND NEW**, special **\$2.95**

SOUND POWER Headphone with Dynamic Mike, **BRAND NEW \$3.95**

HI-FI DYNAMIC HEADSET with Cushions
 Freq. Range: 40-14000 CPS. No Distortion. **BRAND NEW \$5.95**

MICROPHONES

Model	Description	Used	BRAND NEW
T-17	Carbon Hand Mike	\$5.45	\$7.95
T-30	Carbon Throat Mike	.33	.69
T-45	Navy Lip Mike		4.95
PS-38	Navy Type	2.45	4.95
T-24	Carbon Mike		3.95
TS-9	Handset		4.95

HEADPHONES

Model	Description	Used	BRAND NEW
HS-23	High Impedance	\$2.25	\$4.35
HS-33	Low Impedance	1.99	4.65
HS-30	Low Imp. (featherwt.)	1.49	2.25
H-16/U	High Imp. (2 units)	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack		.99

BC-442 ANTENNA RELAY

Wonderful Value! Consists of 34 amp 2" RF Ammeter (antenna current indicator), 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. **BRAND NEW \$2.24**



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Type	Price	Type	Price	Type	Price	Type	Price
0A2	.74	6AM8	.78	65N7GT	.59	12K5	.65
0B2	.61	6AN4	.95	65Q7	.53	12J7	.49
0C3	.72	6AN8	.78	65R7GT	.45	12M8	.59
0D3	.70	6AD5	.50	65S7GT	.75	12L6	.51
0Z4M	.65	6B07	.70	6T4	.99	12Q7	.59
1A5	.59	6AR5	.45	6T8	.80	12S8GT	.62
1A7GT	.61	6A56	1.49	6U4	.70	12SA7	.65
1A85	.54	6AT6	.41	6U5	.57	12SC7M	.63
1AX2	.62	6AT8	.72	6U7	.48	12SF5	.50
1B3GT	.73	6AU4GT	.68	6U8	.78	12SF7	.69
1C5	.43	6AU6	.46	6V6GT	.50	12SH7	.49
1H5GT	.54	6AU7	.61	6V8	.86	12SJM7M	.67
1H6	.39	6AV6	.39	6WAGT	.47	12SK7GT	.63
1L4	.46	6AV6	.40	6W6GT	.57	12SL7GT	.57
1LA4	.59	6AW8	.83	6X4	.37	12SN7GT	.59
1LA6	.69	6AX4GT	.65	6X5GT	.37	12SQ7	.64
1LB4	.69	6AX7	.64	6X8	.75	12SR7M	.49
1LC5	.59	6B4	.54	6Y6	.65	12V6GT	.46
1LC6	.79	6BA6	.49	7A5	.59	12W6	.63
1LD5	.59	6B7	.37	7A6	.69	12X4	.38
1LE3	.59	6BC5	.54	7A7	.69	14A4	.69
1LG5	.69	6BC7	.82	7A7	.69	14A5	.59
1LM4	.69	6BC8	.95	7A8	.68	14AF7	.59
1LN5	.59	6BD5	.59	7AD7	.79	14B6	.63
1N5GT	.67	6BD6	.45	7AF7	.53	14B8	.63
1P5GT	.57	6BE6	.51	7AG7	.69	14C5	.79
1Q5GT	.58	6BF6	.57	7AH7	.70	14C7	.79
1R5	.62	6BG6G	1.25	7AU7	.61	14E6	.75
1S4	.59	6BH6	.53	7B4	.44	14E7	.88
1S5	.51	6BJ6	.49	7B6	.69	14F7	.65
1T4	.58	6BK5	.80	7C4	.59	14F8	.69
1T5	.59	6BK7	.80	7C7	.59	14H7	.59
1U4	.57	6BL7GT	.91	7E5	.59	14N7	.84
1U5	.50	6BN4	.57	7E7	.59	14R7	.79
1V	.43	6BN6	.74	7F7	.79	14S7	.89
1X2B	.82	6BQ1CU	1.25	7F8	.79	14V7	.49
2AF4	.96	6BQ6GT	.98	7G7	.89	14X7	.69
2D21	1.20	6BQ7	.90	7H7	.59	14Y4	.39
3A3	.80	6BR8	.78	7J7	.79	19AU4	.76
3A4	.45	6BS8	.90	7K7	.69	19BC6	1.39
3A5	.85	6BV6	.90	7L7	.59	19C8	.90
3A5L	.42	6BZ6	.54	7Q7	.66	19T8	.69
3AU6	.46	6BZ7	.90	7R7	.99	19V8	.79
3AV6	.41	6C4	.40	7S7	.79	2A4	.39
3BC5	.54	6C5	.39	7Y4	.54	25AV5GT	.83
3BE6	.52	6C6	.58	7Z4	.59	25B06GT	.98
3BZ6	.55	6CA5	.56	12A4	.59	25CA5	.56
3BY6	.55	6CB6	.60	12A6	.54	25CD6	1.44
3CB6	.54	6CD6	1.11	12AGT	.54	25CU6	1.01
3CF6	.60	6CF5	.84	12AB5	.50	25L6GT	1.06
3CS6	.52	6CF6	.64	12AC6	.49	25W4GT	.59
3DT6	.50	6CC7	.60	12AD6	.51	25Z5	.66
3LF4	.69	6CL8	.75	12AE6	.43	25Z6	.49
3Q4	.59	6CR6	.51	12AF6	.49	26	.45
3S4	.58	6CM7	.66	12AM7	.46	27	.39
3V4	.58	6CS6	.51	12AJ6	.47	3B5	.51
4BC8	.96	6CU6	1.08	12AL5	.37	3CC5	.51
4BQ7	.90	6D6	.59	12AQ5	.52	35L6GT	.51
4BZ7	.96	6DE6	.54	12AT6	.41	35W4	.47
5AM8	.75	6DG6GT	.51	12AT7	.72	35Y4	.54
5AN8	.78	6DQ6	1.03	12AU6	.46	35Z3	.59
5AQ5	.52	6DT6	.60	12AV7	.60	35Z4	.47
5AT8	.75	6E5	.48	12AV8	.39	35Z5GT	.47
5BK7A	.82	6F5GT	.39	12AV7	.73	36	.39
5BR8	.79	6F6	.59	12AW6	.67	45	.55
5CC8	.76	6F8	.98	12AX4	.67	45Z3	.54
5CL8	.76	6HG6GT	.41	12AX7	.63	45Z5	.49
5J6	.64	6J5GT	.48	12AY7	.69	46	.69
5T4	.79	6J6	.68	12AZ7	.59	50B5	.52
5T8	.81	6J7	.43	12BA6	.60	50C5	.51
5U4G	.55	6K6GT	.45	12BA6	.49	50L6GT	.61
5U4GB	.60	6K7	.44	12BA7	.60	50X6	.49
5U8	.78	6L5	.79	12BD6	.45	50Y7	.50
5V4	.71	6L6	.84	12BE6	.51	55	.49
5V6	.50	6L7M	.88	12BF6	.39	56	.49
5X6	.75	6R7	.69	12BH7	.63	57	.58
5Y3GT	.37	6S4	.48	12BK5	.70	58	.60
5Y4	.51	6S4	.48	12BL6	.49	70L7	.97
6A4	.51	6S7M	.79	12BQ6GT	.99	71A	.62
6A4B	.48	6S7	.90	12BY7	.65	76	.44
6AC5	.69	6S8GT	.53	12BZ7	.65	77	.47
6AC7M	.86	6A7GT	.41	12C5	.56	78	.57
6AF4	.90	6SD7GT	.41	12C8M	.34	80	.69
6AG5	.56	6SF5GT	.46	12CA5	.56	84/6Z4	.46
6AG7M	.99	6SG7GT	.41	12CR6	.51	85	.59
6AH4	.67	6SH7GT	.49	12CUB	.99	117L7	1.89
6AJ5	.65	6S7GT	.50	12DQ6	1.04	117P7	1.89
6AK5	.95	6SK7GT	.53	12F8	.63	117Z3	.45
6AL5	.42	6SL7GT	.67	12J5	.56	86A	1.39
					.42	866A	1.39

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6" PM SPEAKER
 With filter choke and resistor. Use as extra speaker for TV or as rear car speaker.

99¢

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 Not Affl. With Any Other Tube Mail Order Co.

WIRE KIT
 3 to 15 inch. Stranded, solid—hook-up wire, plastic, etc. Covered ends cleaned and some tinned. All usable lengths.
 1 lb. 50¢ 5 lbs. **\$1.50**
 2 lbs. 75¢

PACKAGE OF 100 ASSORTED RADIO TUBES \$11.89

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Allow for postage and save C.O.D. charges. Unused money refunded. Subject to prior sale.

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being offered by the electronic tube division of Westinghouse.

The booklet presents more than 450 of the company's receiving tubes representing more than 95 per-cent of the tubes involved in radio and television servicing. Features incorporated on the same page as the associated data; bold tube type numbers for quick location; and open style data for easy readability.

Priced at 35 cents a copy, the booklet (RU-020A) can be ordered from Dept. T-286 of the division at Route 17, Elmira, N. Y.

ENGINEERING DATA SHEETS

International Instruments Incorporated, P. O. Box 2954, New Haven 15, Conn., has issued two new engineering data sheets of interest to designers and industrial product engineers.

One sheet describes the firm's Model 104 line of 1" round flush-mounting panel meters. Details are given on both electrical and mechanical specifications along with a tabulation of the ranges and types in which the line is being offered. The second sheet covers the Series L7000 lever and the Series SRL7000 spring-return lever switches. Full details are provided on both of these subminiature components.

Either or both of these data sheets are available on request to the manufacturer.

SEMICONDUCTOR CONVERTERS

Power Sources, Inc., 8 Schouler Court, Arlington 74, Mass., has just issued a four-page brochure describing its newly developed d.c.-to-d.c. converters using semiconductor devices to replace the usual vibrator or dynamotor conversion.

The text included with Catalogue 56P is directed to the designer of mobile systems including missiles, beacons, airborne systems, and other items where severe operating conditions place a premium on efficient, rugged, and reliable operation.

The brochure is extensively illustrated and includes useful tables and circuit information. Write M. Comins in care of the company for a copy.

ACCESSORIES AND COMPONENTS

The Component Parts Sales Dept. of the *Allen B. Du Mont Laboratories'* Technical Products Division has issued a compilation of its complete line of accessories for electronic test equipment and components for electronic circuitry.

More than 200 items associated with CR oscillographs, oscillograph record cameras, and other electronic test equipment are described in the 20-page catalogue. Among these accessories are knobs, test probes, magnetic shields, viewing hoods, photographic developing equipment, CR tube and multiplier phototube base clamps, base sockets and connectors, movable tables, and rack mounting adapters, etc.

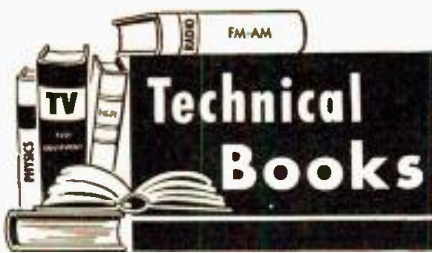
Requests for this catalogue, titled "Du Mont Catalog of Components and Accessories," must be made on company letterhead and be addressed to the department.

GUIDE TO INDUSTRIAL TV

Graybar Electric Company, Inc., 420 Lexington Ave., New York 17, N. Y., has issued a new 64-page booklet entitled "Graybar Guide to ITV—with Equipment Selector" of interest to industrialists.

The publication describes not only a wide selection of video, audio, lighting, transmission, and distribution equipment for industrial television systems but also contains a 15-page guide to the types and uses of such equipment and accessories, procedures for the servicing and maintenance of such gear, as well as several pages of engineering data permitting approximate layouts and system costs to be determined.

Equipment manufactured by *Diamond Power*, *Amplivision*, *Altec Lansing*, and *Benjamin Lighting* is covered, among others. Write the distributor for full details and a copy of this guide.



7. Sound Circuits & L-V Power Supplies)

This is the seventh in this publisher's current series dealing with circuit faults as reflected in the picture tube and on the scope screen. This particular volume deals with the low voltage circuits of the TV set, faults in a Foster-Seeley FM discriminator, sound i.f. amplifier troubles, ratio detector malfunction, and faults in gated-beam FM detectors.

As with the previous volumes, scope patterns and picture tube photos are used extensively to illustrate the effects of the troubles.

* * *

"TEACHING TYPEWRITING THROUGH TELEVISION" by William R. Pasewark. Published by Michigan State University, East Lansing, Mich. 53 pages. Price \$1.50. Paper bound.

In an experimental test, with rigid scientific controls, the author demonstrates the relative effectiveness of television typing instruction and conventional instruction. Results show that superior speed and at least equal accuracy are achieved by television students compared with students in the conventional classroom.

* * *

"RADIO VALVE DATA" compiled by the "Wireless World" staff. Published by Iliffe & Sons, Ltd., London. Available from *British Radio Electronics, Ltd.*, 1833 Jefferson Place, N.W., Wash-

ington 6, D. C. 126 pages. Price \$1.50 postpaid. Paper bound. Fifth Edition.

This handy reference book will be of interest to engineers and service technicians who have occasion to work on electronic gear using British tubes. The book gives in tabular form the characteristics and base connections of approximately 2500 British and American receiving tubes, over 300 CR tubes, and 37 transistors. There is also a section devoted to voltage stabilizers.

A complete index and a table of British-American equivalents are provided.

* * *

"RADIO" by J. D. Tucker & D. F. Wilkinson. Published by *The English Universities Press, Ltd.* London E.C. 1. 244 pages. Price 12/6. Vol. 3.

This is the third in the publisher's series of training manuals prepared for the instruction of would-be radio engineers in England. Coverage of the subject is based on the material included in local licensing examinations.

This volume covers aperiodic amplifiers, r.f. power amplifiers, v.h.f. and u.h.f. amplifiers, oscillators, modulation, radio transmitters, antennas and transmission lines, transmission of electromagnetic waves, receivers, measurements, power supplies, direction finding, and the principles of picture transmission.

Although the treatment is mathematical and the terminology British, many radio students in this country

"CIRCUIT THEORY AND DESIGN" by John L. Stewart. Published by *John Wiley & Sons, Inc.*, New York. 474 pages. Price \$9.50.

This work applies modern network theory and pole-zero design methods to the understanding of vacuum tubes and feedback systems. In doing so it assembles a great deal of information which has previously been scattered throughout the literature in relatively incomplete form. Extensive circuit analysis and network synthesis are included along with examples of practical system design.

In order to understand the author's presentation, a background in calculus and differential equations is required. The book is written at the level of the senior undergraduate or graduate engineering student.

* * *

"PICTURE BOOK OF TV TROUBLES" by Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 49 pages. Price \$1.50. Paper bound. (Vol.

COYNE QUALITY
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RADIO - COLOR TV
 Home Training
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The future is **YOURS** in TELEVISION!
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THIS EQUIPMENT WAS
SPECIALLY PURCHASED AT
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IN CHICAGO AND
CAPEHART IN FORT WAYNE.

KAY MODEL RF-P MARKA-SWEEP
Wide sweep, switchable, with crystal markers for aligning TV tuners, receivers. All 12 VHF channels. \$795.00 value.
Special price ea. **\$195.00**

KAY MODEL MEGA-PIX
Output signal frequencies: TV RF picture and sound frequencies. Maximum picture and sound carrier output: 250 MV across 72 ohms. All 12 VHF channels. \$495.00 value.
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COLOR TV CHASSIS
Here's a tremendous deal for you experimental! Color TV chassis mfg. by Scott, using many genuine RCA parts. These are brand new and about 75% complete. Worth at least \$150.00 in replacement parts alone! While they last you get type condensers, H.V. condensers, H.V. transf., yoke, power transf., output transf., controls, I.F. coils, resistors, condensers. \$39.50 etc. (no tubes) All for **\$39.50**

4.5 MC GENERATOR
Used to align sound I.F.'s. These are used but in wonderful condition. Bought at auction from Capehart. Worth much more than our low price **\$39.50** of

TV CHASSIS
Mfg. by American Television, 21" series string chassis, completely wired, least tubes and yoke. Buy them for replacement parts: flyback, tuner, 2-seleniums, condensers, resistors, controls, etc. All brand new, ideal for experimenting on latest type circuits.
Special price **\$15.95** ea.

Schematics are not available for these chassis, however, with some knowledge of TV these can be put in operation. These require tubes, yoke and alignment.

SAVE 75% ON KAY ELECTRIC TEST EQUIPMENT
THIS EQUIPMENT WAS SPECIALLY PURCHASED AT
AUCTION FROM RAYTHEON AND CAPEHART

ELECTROLYTIC BARGAINS
Cardboard insulated, with wire leads.

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will find this a worthwhile addition to their reference shelves.

"SERVICING TV AFC SYSTEMS" by John Russell, Jr. Published by John F. Rider Publisher, Inc., New York. 113 pages. Price \$2.70. Paper bound.

This book is written to help technicians locate and correct circuit faults involving the a.f.c. sections of television receivers.

The theory, waveforms, components, and common faults and their diagnosis are all covered in this handy volume. The presentation is clear and concise with the text material further enhanced by the use of 75 illustrations.

"THE RADIO-ELECTRONIC MASTER" compiled and published by United Catalog Publishers, Inc., 106 Lafayette St., New York 13, N. Y. 1546 pages. \$2.95. 21st Edition.

Once again this publication lives up to its industry reputation as the "Master" handbook of radio and electronic components. In addition to expanded coverage in almost every category, this newest edition provides a new and valuable section which lists the complete corporate name and main and branch office addresses of the manufacturers whose products are included in the catalogue. The thumb indexing of sections is another valuable time saver for the user.

Distribution of this book is being handled by local parts jobbers.

"REFERENCE DATA FOR RADIO ENGINEERS" compiled and published by International Telephone and Telegraph Corporation, New York. 1121 pages. Price \$6.00. Fourth Edition.

So much has happened in the electronics field since the Third Edition of this valuable reference manual made its appearance in 1949 that there was a real need for this improved and expanded edition.

Not only has the basic material of the earlier edition been brought up to date but new material has been added on the network design of filters, magnetic amplifiers, feedback control systems, semiconductors and transistors, scattering matrices, digital computers, nuclear physics, information theory, and probability and statistics.

A complete and cross-indexed listing of the book's contents makes this one of the easiest reference volumes for the engineer to use.

"MAN OF HIGH FIDELITY: EDWIN HOWARD ARMSTRONG" by Lawrence Lessing. Published by J. B. Lippincott, Philadelphia. 315 pages. Price \$5.00.

This is an interesting and sympathetic biography of Major Armstrong, whom the radio industry recognizes as one of its greatest inventors. He is credited with the development of the superheterodyne circuit and frequency modulation broadcasting as well as numerous other circuit improvements.

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for Armstrong's "rugged individualism" in the age of industrial giants was both his strength and his weakness. Some three years have elapsed since Armstrong ended his life in New York and the biographer feels that time alone will restore the luster that by rights belongs to Edwin Howard Armstrong.

"ANALYSIS OF BISTABLE MULTIVIBRATOR OPERATION" by P. A. Neeteson. Published by *Philips Technical Library*, Eindhoven, Holland. 82 pages. Price \$2.15 postage prepaid direct from the publisher.

This is volume ten in this publisher's series on tubes and covers the Eccles-Jordan flip-flop circuit. The careful and complete analysis of this useful circuit will be of particular interest to those working with electronic computers and allied equipment. The text material is divided into twelve chapters with mathematical calculations of the various circuit constants contained in five separate appendices.

"PICTORIAL MICROWAVE DICTIONARY" by Victor J. Young & Meredith W. Jones. Published by *John F. Rider Publisher, Inc.*, New York. 110 pages. Price \$2.95.

This is a specialized volume for both technical and lay persons interested in microwave techniques. Like a dictionary, terms are listed alphabetically and relatively concise definitions of the words given in italics but unlike usual dictionaries, explanations and circuit diagrams are included to amplify the term being defined.

"Presence" Equalizer
(Continued from page 42)

at 3000 cycles when the choke is shunted by the 100 μ fd. capacitor. If another make of choke is used, the value of C_2 may have to be changed to produce the required resonant frequency.

The location of the parts is not critical, and any other convenient arrangement can be used if desired, but as is usual with high-impedance, low-level devices, the leads should be kept as short as possible. The equalizer shown in the photographs was assembled in a 2 1/2" x 4" x 1 1/2" ICA aluminum "Flexi-mount" case. The 2 1/2" x 3 1/4" x 1 1/2" size case could also be used without difficulty.

The insertion loss varies between 4.8 db and 10.5 db, depending upon the amount of boost. The usual type of equipment used in home high-fidelity installations has enough spare gain to compensate for this loss.

As the choke is subject to hum pickup from the magnetic fields of power transformers and tape machine and record player motors, the equalizer should not be mounted permanently until it has been determined that its position in relation to such hum-producing fields is correct for minimum hum.

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Component Checking (Continued from page 66)

current allowed, and when the capacitor has reached its nominal charged voltage, it can then be removed from the charging arrangement. Then, after discharging the capacitor for the sake of safety, the capacitor is ready for installation in its intended circuit. Discharge should preferably be accomplished through a fairly large resistor. The common practice of short-circuiting a fully charged capacitor results in a very high discharge current that may damage the capacitor.

Sometimes a capacitor which has been in stock a long time will deteriorate in the quantity of electrolyte present, so the capacitance will fall low in value, even after it has been adequately reformed.

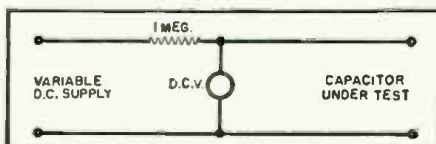
If it is not convenient to build a capacitance measuring arrangement incorporating the polarizing supply, a fairly legitimate result can usually be achieved by ensuring that the capacitor is correctly formed using the polarizing jig of Fig. 8, then discharging the capacitor and finally measuring it immediately with the aid of one of the conventional capacitance bridges without polarizing voltage.

If the electrolytic capacitor is reasonably stable, a null will be obtained which will not vary at a perceptible rate. If the capacitor is not sufficiently stable to be reliable in use, the null may be observed to vary perceptibly while the measurement is being taken. If the capacitance varies at a rate that can be noticed while making the measurement, then the capacitor should be discarded as insufficiently stable for reliable operation.

The foregoing discussion has covered the more common measurements necessary on resistance, inductance, and capacitance. Sometimes much more precise methods of measurement are necessary, especially where the equipment is for some kind of standard operation such as a precision oscillator. In this kind of application it is often necessary to make measurements, not only as to the precise value at room or ambient temperature, but to determine the effect of temperature on the component. To make such measurements, only precision bridge apparatus is satisfactory, and the component should be measured under carefully controlled conditions of temperature and the measurements repeated at different temperatures, to discover what temperature coefficient the component possesses.

-50-

Fig. 8. Details for constructing a simple jig for forming electrolytic capacitors up to their working voltage. See article.



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Miniature Scope (Continued from page 69)

Whether you build this device or one employing a larger tube, remember that the electron beam is quite sensitive to the presence of alternating-current fields. Be sure to use a galvanized sheet-metal shield, or one of the commercially available CRT shields! Always keep transformer and a.c. wiring fields well behind the CR tube.

Component placement is shown in Fig. 3. Midget pots R_2 , R_3 , and R_4 are secured to the front panel directly beneath the 913. Due to space restrictions, R_4 is screwdriver-adjusted through a hole in the front panel's center.

When doing miniaturized construction, wiring becomes easy, due to tricks of soldering one part to another and making "sandwiches" of components. Using short connections and clamping an occasional part to the chassis, this method of construction results in a solid non-vibrating package.

If you prefer to build a larger instrument than the one shown, the schematic of Fig. 1 may be applied to other CR tubes such as the 2AP1A, 2BP1A, etc. Proper operating voltages for such tubes may be determined by experimenting with the values of R_1 , R_2 , and R_3 .

Applications

Fig. 4 illustrates the method of connecting the trapezoidal scope to a transmitter. The connection between vertical plate (4) and the transmitter should be made with coaxial cable, using the outer shield as common ground return for one side of the r.f. pickup link and the ground side of the audio voltage. If shielded links are not used, you will probably encounter 60-cycle distortion on the spot trace.

After application of a.c. power, allow the tube to warm up. Advance intensity control R_5 until the spot appears; it may be large and fuzzy at first, so adjustment of focus control R_2 should bring it to a sharp, bright pinpoint. Do not allow the spot to remain in one position for more than a moment at a time. The concentrated beam will burn a permanent mark into the fluorescent screen. Run the intensity setting at a level just sufficient to produce a clearly visible trace.

Couple the r.f. link to the transmit-

Fig. 4. Connections for modulation check.

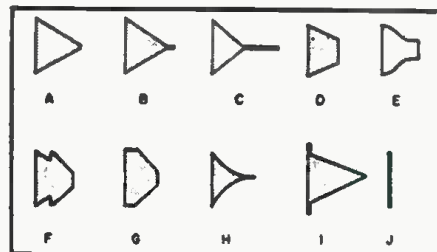
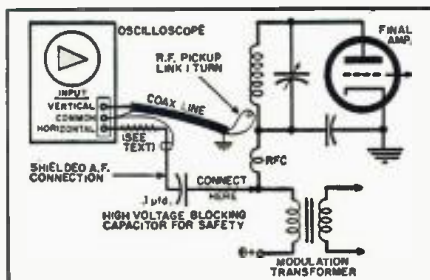


Fig. 5. Typical modulation patterns. Refer to the article for a complete discussion.

ter final tank. Too much coupling will result in a vertical line too long for the tube's screen. Decouple the link until the vertical deflection occupies about four-fifths of the screen. Using this line as a guide, rotate the tube into final operating position, and lock the clamp.

By whistling into the microphone while adjusting horizontal gain control R_4 , you'll see a triangle like that shown in Fig. 5A if your rig is properly adjusted. Once the vertical r.f. amplitude is fixed, adjust R_1 so that an even, three-cornered triangle is visible. Note: If your modulator delivers over 20 watts, better add two or three megohms in series with the a.f. lead as shown in Fig. 4. This scope will monitor a full kilowatt transmitter's output, but audio voltage to the device must be attenuated in proportion to modulator power.

You'll probably be primarily interested in modulation percentage. If you're overmodulating, the triangle's apex will extend outward in a thin line. By percentage interpolation, it's easy to ascertain approximately how much you're overdoing it, as shown in Fig. 5B.

Heavy overmodulation splatter due to severe negative peak clipping elicits a pattern such as Fig. 5C. If the rig is undermodulated, the triangle will not fill completely, interpolation showing by what approximate amount below 100%.

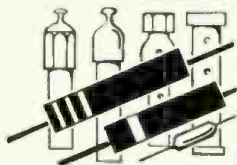
If the modulator isn't properly matched to the final (due to incorrect antenna loading, wrong impedance ratios, etc.) you'll get a pattern similar to Fig. 5E. If the modulator is regenerative, Fig. 5F results. With insufficient grid drive to the final, you'll see Fig. 5G.

Supposing the final isn't properly neutralized? Fig. 5H shows up. And when your transmitter develops parasitic oscillations only on modulation peaks, you'll see the pattern of Fig. 5I as well as hear about it. Fig. 5J shows the straight line produced by the unmodulated r.f. carrier.

It's very difficult to interpret all of the foregoing conditions when looking at a wave-envelope pattern. Therefore this scope was designed to use the triangular pattern, resulting in minimum parts but maximum utility.

WARNING! Note that one side of the power line connects to chassis ground. Be sure that the power plug is correctly inserted, otherwise 117 volts a.c. appears between the case and "house" ground.

What's



New in Radio

FERRITE YOKE CORES

Allen-Bradley Company, 136 West Greenfield Ave., Milwaukee 4, Wis. has developed a new ferrite "full-round" deflection yoke core for use in TV picture tube assemblies.

The yoke core is pressed as a ring of perfectly uniform section and circularity. It is then "cracked" into two halves for later assembly over deflection coils and fitting to the tube. The mated halves are shipped held together mechanically to avoid damage in transit. These yokes eliminate the grinding, fitting, and setting necessary with quarter-round sections.

Full details on this new component are available from the company or from the firm's distributors.

NEW "REJUVA-CHECK"

Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y. has added a new instrument to its line of service test gear.

Known as the "Rejuva-Check" Model RJC-1, the new unit is a compact, low-priced item that checks cathode emission, indicates shorts and leakage between elements, estimates the remaining useful life of the CRT, clears interelement shorts and leakage, re-



moves cathode surface contamination, and restores emission to give new life to weak and dim tubes.

Price information and additional data on this unit are available from the manufacturer.

TRANSISTOR CODE OSCILLATOR

Jackson Electrical Instrument Company, 16-18 S. Patterson Blvd., Dayton 2, Ohio has announced the availability of a transistorized code practice oscillator, which is compact and easy-to-operate.

Employing a *p-n-p* junction transistor, the new unit utilizes external magnetic phones and a key. The oscillator also includes special jacks for interconnecting two units to simulate station-to-station operation. With a few minor circuit changes, the instrument

may also be used to monitor a c.w. transmitter.

The unit weighs 1 1/4 pounds, less battery, and measures 6 1/4" x 3 3/4" x 2".



The case is of molded Bakelite. The unit is being merchandised through regular parts jobbers.

VOLTAGE DROPPING RESISTORS

G-C Electronics Mfg. Co., 400 S. Wyman St., Rockford, Ill. is now merchandising a pair of voltage dropping resistors which enables service technicians to connect 6-volt electrical accessories to the 12-volt ignition systems found in most new cars.

Two units are available, the No. 5225 is designed specifically for use with car radios while the No. 5226 is for wider voltage dropping requirements. Additional information on either of these units is available from the company.

V.H.F. SWEEP GENERATOR

Community Engineering Corporation, P. O. Box 824, State College, Pa.



is now in production on a new wide-band v.h.f. sweep generator for laboratory and field use.

The Model 100-T is a fixed frequency unit which can be specified for any

HARVEY'S famous hi-fi consultants RECOMMEND



... the DYNAKIT MARK II 50-WATT Power Amplifier Kit

This is the amazing do-it-yourself package that audio perfectionists have been choosing for over a year now in preference to more expensive amplifiers. Incorporating an ingeniously simple, unprecedentedly stable and utterly reliable circuit by David Hafler (of "Ultra-Linear" fame), plus premium-quality components such as the superb Dynaco A-430 output transformer, the DYNAKIT delivers 50 watts at any audible frequency with incredibly low distortion—harmonic, intermodulation, square-wave, phase, pulse or any other kind. Listening quality is unsurpassed; construction time is around three or four hours thanks to the pre-wired printed circuit board; price is still only **\$69.75**

... the W/B STENTORIAN

Model HF 1214
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A HARVEY Special!

Despite widely different tastes in loudspeakers, this beautifully made 12-inch single-cone unit has the virtually unanimous vote of critical high-fidelity enthusiasts as an exceptionally smooth and natural-sounding transducer. The 5 1/2 lb. Alcomax magnet system, the specially designed cone, the unusually low bass resonance (39 cps) all contribute to the de luxe performance of the HF 1214, which even at its regular price is easily the equal of many more costly loudspeakers. At the present limited-offer price, it is a bargain without a rival.

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'The Professional'

Among the many top-quality wow-and-rumble-free turntables available today, the GARRARD 301 seems to be the first choice of a large number of hi-fi authorities. The famous Mr. G. A. Briggs, for example, has been using it exclusively in all of his celebrated concert-hall demonstrations throughout the world. The variable + or - fine-speed control, operative on all 3 speeds, may have something to do with the 301's exceptional success—and the Swiss-watch-like precision construction, combined with components of the very highest quality, is quite irresistible.

So is the price—only **\$89.00**

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188

frequency sweep width ratio of 1.7 to 1 in the frequency range from 30 to 220 mc. One popular range is from 52 to 90 mc. to sweep TV channels 2 to 6 in equipment of community antenna TV systems. Output is greater than .5 volt r.m.s. and flat to less than $\pm .5$ db. The unit is highly portable, weighing only eleven pounds.

Details and specifications are available on request to the manufacturer.

CAPACITOR CHECKER

The Barjay Co., 145 W. 40th St., New York, N. Y., is now in production on a new "Capacitest" unit, the Series 11.

The new test instrument not only checks all types of capacitors but also offers a positive test of selenium rectifiers. With an applied voltage of 150 volts, approximating the working voltage of the components in the set, the instrument will show up open, inter-



mittent, shorted, or leaky capacitors. It will also indicate a faulty selenium rectifier.

The unit measures 4" x 4" x 2" and comes complete with test leads and full instructions.

MONITOR RECEIVER

Industrial Radio Corp., 428 N. Parkside Ave., Chicago 44, Ill., has designed a new monitoring receiver especially for police and fire department, utility, government, and industrial radio applications.

The small set, known as the "Volunteer," uses miniature tubes and transistors, an improved dual conversion superhet, and crystal control. A squelch circuit silences the receiver be-



tween calls. Because the set is designed for single channel use, the only adjustments are for volume and squelch setting.

The a.c. models use 15 tubes and have built-in speakers and power supplies. The mobile models are available for 6 or 12 volt electrical systems and use power transistors in the output to

reduce battery drain to a minimum. The antenna terminals are designed to accommodate ordinary car radio antennas.

There are six models in the line, all moderately priced. The crystal is extra. These receivers will be merchandised by two-way radio service organizations.

TRANSISTOR OSCILLATOR

Kay Electric Company, 14 Maple Ave., Pine Brook, N. J., has announced the availability of a new portable, crystal-controlled transistor oscillator, the Model 125A.

The "Transilator" employs a pair of transistors and a unique diode feed-



back system in a battery-operated unit. Output frequencies of 1, 2, and 5 mc. are available by rotating a selector switch. An external crystal jack is provided to furnish other frequencies falling between 1 and 5 mc.

The output is .25 volt at 1000 ohms impedance level. The entire instrument measures 2" x 1 3/4" x 4 1/2" and weighs 12 ounces. The company will supply any additional information required.

PLUG-IN BATTERY CHARGERS

American Television & Radio Co., 300 E. 4th St., St. Paul 1, Minn., is now offering a complete line of portable automobile plug-in type battery chargers for operation with 6- or 12-volt storage battery systems for 4, 6, and 10 amp capacities.

The units feature easy charging by simply plugging into cigarette lighter receptacles. Complete information is available directly from the factory.

COMMUNICATIONS MONITOR

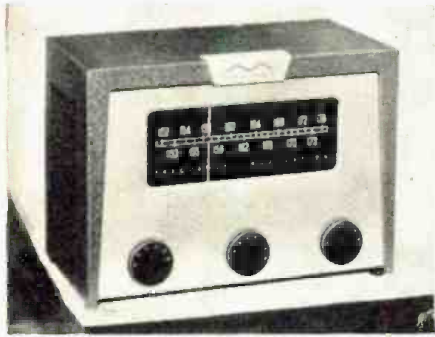
The Monitoradio Division of I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26, Ind., is now offering two new FM receivers which have been designed especially for police, fire, civil defense, etc. applications.

The "Minute Man" is a tunable unit which is available in two models. The MR-10 will monitor all frequencies on the 152-174 mc. band while the MR-33 is designed to cover the 30-50 mc. band. This 7-tube FM receiver includes a built-in electronic squelch, fully tuned r.f. stage, a 5" PM speaker, a transformer-type power supply—all housed in a rugged metal cabinet.

A fixed-frequency version of this

RADIO & TELEVISION NEWS

receiver is available as the "Signal Master." It, too, is available in two



models and comes with the crystal custom-ground and the circuit aligned.

WHITE DOT GENERATOR

The Special Products Division of *Admiral Corporation*, Chicago, Ill., is now offering a low-cost, compact white-dot generator which is designed for setting up color receivers during installation and servicing and for adjusting linearity on black-and-white sets.

The new instrument contains only three tubes and two semiconductor diodes. It features an a.c.-operated transformer-type power supply.

DIODE-TRANSISTOR TESTER

Fretco Incorporated, 406 N. Craig St., Pittsburgh 13, Pa., is now offering



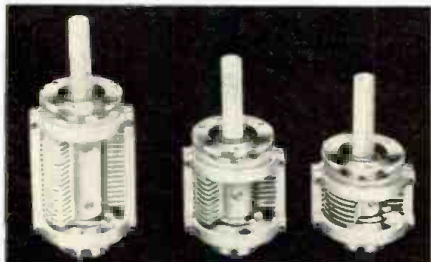
a new diode and transistor tester for service applications.

The new unit will measure and test characteristics of diodes, *p-n-p*, and *n-p-n* transistors. The instrument is battery powered and comes complete with test leads.

Full details on this moderately priced unit are available from the manufacturer.

VARIABLE AIR CAPACITORS

General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass., is



now offering a new line of variable air capacitors whose improvements in electrical and mechanical properties have been effected by machining them from solid metal.

With the Type 1420 units both ro-

February, 1957

NEW

HICKOK

CRYSTAL CONTROLLED WHITE DOT-BAR-COLOR DISPLAY GENERATOR

Model 660



The 660 features the necessary high degree of stability not found in variable white-dot generators. In the 660, the white dots are "locked" together to assure stability. This locking is achieved through the extremely stable (crystal controlled) timer circuit. Frequency of chrominance (color) signal is exactly crystal controlled to reduce possibility of alignment errors. This feature permits increased accuracy over ordinary color generators which use a free running oscillator. RF output frequency is in preset channels, 2 thru 6, to allow easy selection through a built-in switching arrangement. Small dot and crosshatch size down to two lines in both horizontal and vertical planes. Ratio of sync to video is variable from 10 to 90%.

• The circuit of the 660 is such that the instrument will be useable regardless of future color TV receiver design.

TECHNICAL SPECIFICATIONS:

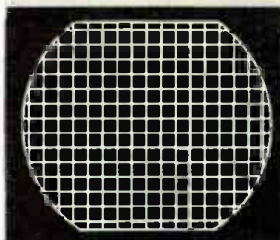
VIDEO OUTPUT: 0 to 4 volts Peak-to-Peak. 300 ohm output impedance. Black positive or negative. 300 white dots, less those in blanking. Crosshatch white lines, 20 vertical and 15 horizontal, less those in blanking. Sidelock color frequency crystal is 3.563795 MC output 1 volt Peak-to-Peak.

RF OUTPUT VOLTAGE: .05 volts maximum. .001 volts minimum.

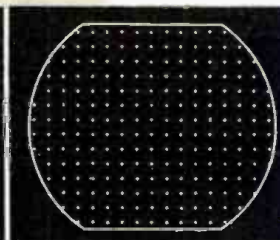
RF modulated by all video outputs (60% modulation).

- ★ The Model 660 is especially designed for Home service calls.
- ★ Light weight portable with detachable cover... weighs only 15 pounds.

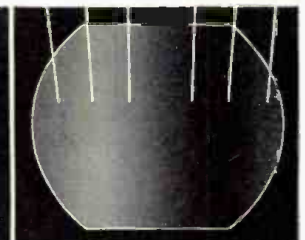
ORANGE RED MAGENTA BLUE CYAN GREEN



White line crosshatch pattern. 20 vertical and 15 horizontal, less those in blanking.



Small size white dot pattern. 300 white dots, less those in blanking.



Color display pattern with crystal accuracy. Color sequence: Orange, Red, Magenta, Blue, Cyan and Green.

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- 50 - ASST. CERAMIC CONDENSERS.....\$1
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- 5 - ASST. VOLUME CONTROLS with switch...\$1
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- 50 - ASST. TERMINAL STRIPS 1, 2, 3, 4 lug.....\$1
- 10 - ASST. RADIO ELECTRO. CONDENSERS...\$1
- 5 - ASST. TV ELECTROLYTIC CONDENSERS...\$1
- 10 - 6 FT. ELEC. LINE CORDS with plug.....\$1
- 5 - TV CHEATER CORDS with both plugs.....\$1
- 10 - ASST. WIREWOUND RES. 5, 10, 20 watts..\$1
- 200' - HOOK-UP WIRE & SOLDER KIT.....\$1
- 100' - TWIN 300Ω LEAD-IN heavy duty.....\$1
- 5 - TV CRT. SOCKETS with 18" leads.....\$1
- 10 - AC-DC ANTENNA HANKS each 20 feet.....\$1
- 25 - ASST. MICA TRIMMER CONDENSERS.....\$1
- 50 - TUBULAR CONDENSERS .1-200v.....\$1
- 50 - TUBULAR CONDENSERS .02-400v.....\$1
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- 25 - TUBULAR CONDENSERS .01-600v.....\$1
- 20 - TUBULAR CONDENSERS .25-600v.....\$1
- 20 - TUBULAR CONDENSERS .047-600v.....\$1
- 15 - H.V. CONDENSERS .015-1800v.....\$1
- 10 - H.V. CONDENSERS .006 or .03-2000v.....\$1
- 10 - H.V. CONDENSERS .005-3000v or .001-8000v..\$1
- 5 - H.V. CONDENSERS .005-6000v.....\$1
- 3 - I.F. MINIATURE TRANSFORMERS 456Kc.....\$1
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- 4 - ELECTROLYTIC COND. 40/10 - 450v.....\$1
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- 1 - BEST 4" PM SPK. 1.47 oz. alnico ±5 magnet..\$1
- 1 - 5" PM SPEAKER alnico ±5 magnet.....\$1
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- 1 - \$6 INDOOR TV ANTENNA hi-gain 3 sec.....\$1
- 50 - 100 OHM 1/2 WATT RESISTORS 5%.....\$1
- 75 - 680 OHM 1/2 WATT RESISTORS 10%.....\$1
- 75 - 470K OHM 1/2 WATT RESISTORS 10%.....\$1
- 50 - 3.3 OHM 1 WATT RESISTORS 10%.....\$1
- 50 - 3900 OHM 1 WATT RESISTORS 10%.....\$1
- 50 - 15K OHM 1 WATT RESISTORS 10%.....\$1
- 50 - 27K OHM 1 WATT RESISTORS 10%.....\$1
- 50 - 120K OHM 1 WATT RESISTORS 10%.....\$1
- 50 - 150K OHM 1 WATT RESISTORS 5%.....\$1
- 50 - 470K OHM 1 WATT RESISTORS 10%.....\$1
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- 25 - 2.2 OHM 2 WATT RESISTORS 5%.....\$1
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- 1 - LB SPOOL ROSIN CORE SOLDER 40/60.....\$1
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- 1 - 12" PM SPEAKER Alnico ±5 Mag 3.55
- 1 - SONORA AC-DC RADIO..... 10.55

3 TUBE PHONO-AMPLIFIER
complete with 3525-125Q7-80L6
ready to plug-in..... **\$4.94**

TV CONVERSION KIT
Matched 70" Defl. Yoke and Flyback Transformer with
Instruction Manual to Convert any Small
TV to 21" Picture..... **\$9.78**

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tors and stators are gang milled from shaped extruded aluminum rods. This method of manufacture allows close mechanical tolerances to be held and makes a sturdy structure with high mechanical stability.

At the present time, three sizes are available with 70, 130, and 250 μ fd. maximum capacitance. Write the manufacturer direct for full specifications on these air capacitors.

"KNIGHT" SWEEP GENERATOR

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has begun marketing a new r.f. sweep generator kit under its "Knight" label.

Designated as the 83-YX-123, the new unit can be used wherever coils or circuits must be adjusted for resonance and proper bandpass. It can be used on the production line, for repair work, incoming inspection, quality control, etc.

The circuit incorporates an exclusive electro-mechanical wobulator system designed to provide good sweep linearity. Frequency range is 300 kc. to 250 mc. on four fundamental ranges and sweep is fully variable from 0 to 13



mc. on any frequency within this range. A built-in crystal-controlled marker, accommodating any two crystals, is included in the kit.

The kit comes complete with tubes, punched chassis, all parts, wire, solder, "step-and-check" instructions and giant-size pictorial diagrams.

FILTERS FOR SSB

The RCA Electronic Products Division, Camden, N. J. has developed a small, 7 ounce electro-mechanical filter which is designed to reduce requirements for electron tubes and components in radio communications systems, especially SSB.

The new bandpass devices are designed to provide the extreme selectivity required for SSB and include a 250 kc. upper sideband type (MFU-250-1) and a 250 kc. lower sideband unit (MFL-250-1).

The filters, which measure a mere 1 1/2" x 1 1/4" x 3 3/4", will operate over a temperature range of -40 to +85 degrees C.

PRECISE "POWER-LAB"

Precise Development Corporation of Oceanside, Long Island, N. Y., has developed a new item of service test equipment, the "Power-Lab."

The new instrument is a combination

battery eliminator and d.c.-a.c. high-power supply that is said to do the work of at least eleven pieces of equipment. Among its functions are that of



a battery eliminator, battery charger, high-current variable line voltage supply, a.c. line voltage meter, a.c. line ammeter, a.c. line wattmeter, a.c. line isolation transformer, low-voltage high-current a.c. supply, d.c. line variable voltage supply, d.c. high-current ammeter, and a.c. bias box.

The unit is available in two models, each of which is offered in kit or factory-wired form. Write the company for complete specifications.

HICKOK AM GENERATOR

The Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio has released a new high-speed, low-cost AM generator which has been especially designed for radio service work.

The Model 290X provides an accurate and stable source of r.f. power for alignment of AM broadcast receivers. Five calibrated frequencies (262, 455, 465, 600, and 1400 kc.) are available by means of a selector switch on the front panel and r.f. output is modulated or unmodulated. The r.f. output is variable from 2 microvolts to 200 microvolts and audio output is 400 cps. If



desired, crystal accuracy may be obtained through the addition of a crystal in the holder provided.

Literature on the Model 290X is available on request.

REPLACEMENT CAPACITORS

Sprague Products Company, North Adams, Mass., has recently introduced a new capacitor kit in which just four of its new "Universal" ceramics will take the place of forty-two conventional ceramics rated from 400 μ fd. to .15 μ fd.

Although the new "Universal" line is available in individually packaged

bigger BETTER BARGAINS at VIDEO



EICO TUBE TESTER

Model 625K

- Illuminated gear-driven "Speed Rollchart"
- New lever-action switches for individual testing of every element
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Kit, **34⁹⁵**



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Lots of 3



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108P4	\$11.90	178P4	\$20.63
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148P4	\$16.86	21AP4	\$28.79
16RP4	\$19.38	21EP4	\$28.79
16LP4	\$19.38	24AP4	\$42.50

Picture tubes shipped P.O.B. Harrison, N.J. Above types are most popular. However, you may order any equivalent size at the same price!



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Fits all makes of picture tubes, AC parallel circuits. Completely automatic. Easy to install.

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RADIO PROJECTS. Build your own receivers! Gives you 10 easy-to-follow projects. Including crystal detector receiver—diode detector receiver—regenerative receiver—audio-frequency amplifier—tuned-radio-frequency tuner—AC-DC superheterodyne receiver—etc.

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COLORDAPTOR—A simple in-tube circuit and rotating color wheel converts any-size black-and-white TV, direct view or projection, to receive compatible color TV. **COLORDAPTOR** is simply attached to TV set, does not affect normal operation and can be built from parts experimenters have on hand.

Complete specifications including theory of operation, complete simplified construction plans, schematic and sample color filters **\$1.95**

Essential parts kit containing all special parts—coils, delay line, crystal, color filters—
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COLORDAPTOR, 3471 Ramona, Palo Alto, Calif.

form, the kit provides a good opportunity for the technician to become acquainted with the many uses to which the new capacitors can be put. Tables packed with the capacitors and



printed on the kit tell which unit to use for the desired capacitance, which of the four leads to use as terminals, which leads to solder together or clip off. No arithmetic is involved.

Kits and additional details are available from the company's distributors.

EXPANDED-SCALE VOLTMETERS

Phaotron Instrument and Electronic Co., 151 Pasadena Ave., South Pasadena, Cal. is now in production on a new line of expanded-scale voltmeters. The units can be supplied in either a.c. or d.c. models. They are available in a wide variety of ranges and case styles to meet production requirements.

Write the Products Development Department of the company for a data sheet and additional details on this new line.

RIGHT-ANGLE TUBE SOCKETS

A new alkyl-base tube socket that mounts tubes horizontally to reduce space requirements has been designed especially for use with printed circuits. Marketed by *Aerovox Corporation*, 2724



S. Peck Road, Monrovia, Cal. the new sockets permit greater miniaturization and more compact packaging and allows tubes to be placed closer to heat sinks.

Contacts are silver-plated beryllium copper while the mounting bracket, support, and shield are tin-plated steel. Write the manufacturer for full details and specifications on this new tube socket line.

DRIFT TRANSISTORS

The Semiconductor Division of *Radio Corporation of America*, Harrison, N. J. has announced the commercial availability of two new drift transistors for high-frequency applications.

The *RCA-2N247* and *RCA-2N267*, of the germanium *p-n-p* type, are intended for use as r.f. amplifiers in military and commercial equipment and in entertainment type receivers operating at frequencies covering the AM broadcast band and up into the short-wave bands. They are also useful as i.f. amplifiers or as mixer-oscillators.

TV-FM SWEEP GENERATOR

Eico, 84 Withers St.; Brooklyn 11, New York is now offering a new TV-FM sweep generator which is designed to speed and improve the alignment of FM, monochrome, and color television receivers.

The entirely electronic sweep circuit, with accurately biased Increductor, provides good linearity on both



sides of the center frequency. The newly designed a.g.c. circuit automatically adjusts the oscillator for maximum output on each band with minimum amplitude variations. The resonance-free r.f. choke eliminates "suck-out" points anywhere in the r.f. spectrum.

The sweep generator range is 3-216 mc. in five overlapping fundamental bands with the sweep continuously variable from 0-3 mc. lowest maximum deviation to 0-30 mc. highest maximum deviation. The variable marker generator range is from 2-75 mc. in three fundamental bands plus a calibrated harmonic band.

The Model 368 is being offered in both kit and factory-wired form. Write the manufacturer for full details.

VIDEO GENERATOR

American Scientific Development Company, 336 South Main, Ft. Atkinson, Wis., is marketing a low-priced, test pattern and picture generator, the Model TV-10.

Generating a 525-line, fully-interlaced picture or test pattern with a usable frequency response of over 4.5 mc., the TV-10 contains a multiplier-type phototube and high voltage power supply, video amplifier and high-fre-

quency compensator, and a modulator operating on the standard low-band TV channels.

This unit is actually the "second half" of a flying-spot TV system. The other half can be any inexpensive, sec-



ond hand 10" or 12" TV receiver. This economical "sweep section" provides the fully interlaced 525 line picture. This interlace is available only with systems using a complete TV set as a raster generator which can be interlaced by a signal from a local TV broadcasting station.

The manufacturer will supply additional details and a data sheet on the television video generator upon written request.

PRINTED CIRCUIT MODULE

Arthur Ansley Manufacturing Co., New Hope, Pa., is now offering a line of new plug-in modular units which are compact, rugged, flexible, and easily interchangeable.

Known as the "Plus Module," the standard size is approximately 1 3/8" square and 2 1/2" high, either with an octal plug-in base which makes the unit directly interchangeable with many hand-wired modules or with a new type of plug known as the "Plus" base that provides up to 32 contacts. A 7- or 9-pin tube socket is incorporated in the top of the unit or it can be adapted to transistors or subminiature



tubes. Other sizes and shapes can be supplied, supporting two or more tubes.

The manufacturer offers engineering assistance in solving special circuit problems. Firms are invited to write for additional information on the printed circuit module.

-50-

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Gov't. Avg. Cost \$300.00

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New 3 to 4 mc like new \$13.95
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30-41 mc. AM Crystal Controlled. \$14.95 each.

DYNAMOTOR FOR ABOVE

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BC-929 A Radar Indicator Scope. This unit could be rebuilt into a line test scope. It is an ideal size, 8x9x14 priced with tubes 2-6SN7, 2-6H6, 6G5, 6X5 and 2X2. This is a red hot buy. Scope Price, New. \$9.95

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Determine exact geographic position of your boat or plane! Complete BRAND NEW installation consists of: 1H-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plates; Visor for Indicator; Operation manual; \$129.50
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2500 Mc complete with 2C4, 2C40, 3E29, 1B27, VR105, 5Y3, 6AL5, 2 each \$39.50
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\$1.95 ea. 4 for \$7.00

DYNAMOTORS

Type	Input	Output	Excellent	New
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DM-34	12 VDC	220 V	80 MA	2.95 4.95
DM-65	12 VDC	140 VDC	400 MA	14.95 19.95
DA-1A	21 VDC	230 VDC	100 MA	4.95
DM-28	21 VDC	230 VDC	100 MA	4.95
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MOBILE HEAVY DUTY DYNAMOTOR: 14 V. INPUT-output: 1030 VDC 260 MA. Tapped 515 V. 215 MA. use or 6 V DC INPUT-500 V, 175 MA. While they last—10M-42-Excel. Condition. \$4.95
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Exc.
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RS-38 Navy Carbon Hand Mike. \$2.45 ea.
Exc.
1-96A Signal Generator 100-156 Mc. complete w/cords and cables, like new \$69.50

Variac General Radio—Model 200 1100-130V, 1 Amp. Brand new..... \$5.95 ea.

MN-26-C—Remote Control Navigational Direction finder and communication receiver. Manual 10P in any one of three freq. bands, 150 to 1500 KC, 24V. Self contained dynamotor supply. Complete installation including receiver, control box, loop, azimuth control. Left-Right Indicator, plugs, loop transmission line and flex. shafts, oper. & main manual. Ideal for use in boats, etc.

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MN-20-E Loop 4.95
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DYNAMOTORS for above, 12VDC, MN-26 9.95

METER—3" 0-5 Ma. 270° Indication—By Pass Shunt and add scale. Excellent Condition. \$1.25
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Cleans, lubricates, restores all tuners including water type. Won't change or affect capacitance or resistance. Won't harm insulations or precious metals, nor attack plastics. For television, radio and FM. Eliminates all noise, oxidation and dirt indefinitely.

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2 MFD. 3000 VDC. Pyralol W Mount. Oil. 3000 VDC. 1-1 Mid. removed from New. 42% x44% x 2 1/2"

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Service Industry



AN IMPORTANT series of association meetings were held in the Hotel Roosevelt in New York City during the first week of December.

The first of these sessions was a conference of delegates representing associations in seven of the northeastern states. The major objective of this luncheon was to discuss a dual 10-point program toward the improvement of Distributor-Service relations with members of the National Electronic Distributors Association. This plan was outlined in an article by William Leonard in the January issue of RADIO & TELEVISION NEWS. Because of some difficulties in making arrangements, the distributors were unable to meet with the association delegates.

The conference, under the chairmanship of Frank Silverman, president of the Television Service Association of Connecticut, officially formed a regional federation of service associations to embrace the New England States, New York, New Jersey, and Pennsylvania. The Federation, which is made up of associations affiliated with one or the other of the national organizations and including non-affiliated local associations, is primarily concerned with the problems of service peculiar to the heavily populated areas on the eastern seaboard. It will operate as a loosely knit, cooperative organization with delegates meeting at regularly scheduled intervals.

Following the regional conference, the first annual Electronics Fair to be sponsored by the Radio Television Guild of Long Island was held at the New York State Agricultural College at Farmingdale, L. I. The Fair, termed an outstanding success by Murray Barlowe, president of the RTG, including a comprehensive program of technical and business lectures presented by nationally known speakers. With attention focused primarily on the operation and servicing of color TV receivers, a wide range of service equipment and replacement products was shown and demonstrated at booths maintained by parts distributors and manufacturers.

The Guild Fair terminated in a panel discussion on captive service held at the Hotel Roosevelt, following a meeting of the Empire State Federation of Electronic Technicians Associations.

Termed by the Guild as a "fact-finding" forum, the purpose of the panel discussion was to develop information which could be presented to the Guild Board of Directors for consideration in recommending a stand for the organization on captive service.

Members of the panel included Mur-

ray Barlowe, president of the RTG, as moderator; John F. Rider, publisher of *Rider's* service manuals and books; Dan Creato, vice-president of the *RCA Service Company*; John Miller, manager of product service for the *General Electric Appliance and TV Division*; Pete Langer, national service manager for *Sylvania Electric Products*; Frank Moch, executive director of NATESA; John Wheaton, secretary of ESFETA; Sam Marshall, editor of *Service Dealer*; Paul H. Wendel, editor of *Service*; and Sidney C. Silver, service editor of RADIO & TELEVISION NEWS.

The panel discussions developed a clear line of demarcation between "captive" service and "factory" service, terms that have been widely confused in the discussions of the two plans used by manufacturers to provide their own service to consumers.

After opening statements by eight members of the panel, written questions directed to them were answered by individual members of the panel. The bulk of the questions were directed to Mr. Miller and to Mr. Creato for detailed information on their companies' policies in providing consumer service.

In his opening statement, Mr. Miller had pointed out that *G-E's* main reason for entering the service field was to "give maximum support to the sale of our sets." He emphasized that it was not the result of poor servicing on the part of the independent service dealers in any of the areas.

Mr. Miller also differentiated between the direct factory service depots, such as his organization has established in Fort Wayne, Indiana, and Toledo and Columbus, Ohio, and the consumer service activities of the *General Electric* appliances and television receivers in the retail trading areas surrounding the 107 U. S. cities with a population of 100,000 or more. Outside of these metropolitan markets, *G-E* recommends that its distributors provide for service through authorized and trained dealers and also independent servicing establishments.

Referring to their distributors' acceptance of these recommendations, Mr. Miller said: "On major appliances (white goods), retail service is presently being provided by our distributors in less than 70 per-cent of the 107 large metropolitan markets."

In his opening statement, Mr. Creato, of the *RCA Service Company*, traced the gradual loss of business to independent service dealers from the time television was introduced post-war in 1946. He pointed out that, during the 1946-47 period the *RCA Serv-*

ice Company handled service on all RCA TV sets. Since then, it has steadily lost ground to independent service dealers to the extent that it now handles consumer service on less than 10 per-cent of RCA sets now in use.

Mr. Creato pointed out that, while his service company was not "happy" about the trend, loss of business to independent service shops has been substantial since 1951. Answering a question relative to the servicing of color TV sets, he said that RCA encourages independent shops to service color receivers.

John Rider urged service dealers to diversify their activities so they do not have to rely entirely on consumer television service for their business. He pointed out that shop owners should take a leaf out of the book of big business by merging with other shops to provide for greater operating efficiency.

Mr. Rider said the independents must adopt the promotional tools that are used effectively by big companies. As an illustration he said that a dozen similar service trucks on the streets of a city from a single organization look like a much bigger service operation than several hundred trucks operated by independents, but with different company names on each. He urged service dealers to adopt a common identifying name that could be advertised nationally to make the public aware of the great industry of independent service businesses.

Frank Moch, executive director of NATESA, outlined the difference between "captive service" and "factory service." He said, "Captive service is a scheme foisted upon the public whereby they are led to believe they are getting something for nothing, and thus they are deprived of getting better service, quicker, more personal, and more economically."

Bert Bregenzler, chairman of the FRSA, said that television technicians do not fear a clean fight for business in competing with captive service. He said that certain types of ads which have appeared in newspaper and magazine advertising have tended to "degrade the independent serviceman."

-50-

The **NEW** YEATS "Shorty" STATION WAGON & PANEL PICK-UP appliance dolly



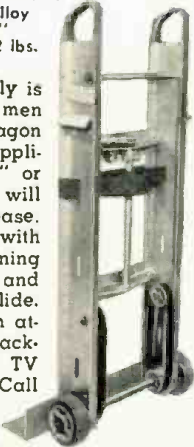
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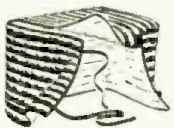


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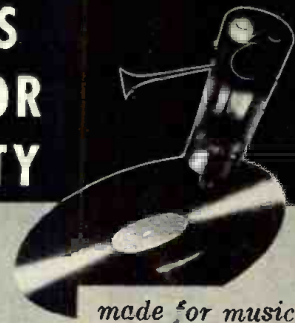
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Service Diversification (Continued from page 60)

erating from a central location in the city.

The partners in the new *Consolidated Services, Inc.*, are Forrest L. Baker, A. R. "Al" Niehaus, Paul W. Carter, W. L. Lehmborg, and H. M. Willman. Each of these men has operated his own independent TV service business for many years.

The partners all stress the fact that no one of them could afford or even obtain the supervisory ability and experience necessary to operate a business of the caliber of *Consolidated*. Neither was it economically advisable to develop a warehouse stock of parts sufficient to supply an operation of this magnitude. The same thing applied to testing and other technical equipment. After months of planning, they developed a physical plant that is a service technician's dream and accomplished a division of supervisory responsibilities that utilizes the maximum capabilities of each of the partners.

The managerial responsibility is divided roughly among Baker, vice-president of the corporation, in the capacity of business manager, Niehaus, secretary-treasurer of the firm, and Carter, dividing the duties of shop superintendent so that each heads an eight-hour shift in the 16-hour working day observed by the firm. Outside service, with four radio-dispatched mobile units, each fully equipped to do shop repair work, is also divided into eight-hour shifts with Lehmborg and Willman supervising.

The combined organization provides many operational advantages. The departmentalization of the organization enabled the partners to add a number of related electronic service activities and to handle factory warranty contract service for *Vornado* room air conditioners. By March, they will also be ready to assume the installation and maintenance work on *Vornado's* new automobile air conditioner. For the present, at least, *Consolidated* will confine its activities to radio and television with the exception of the *Vornado* contract service and hi-fi record player service.

From the standpoint of providing the top skills and employing the most advanced techniques, the consolidation is expected to have a remarkable effect. Although all five members of the firm do active supervisory work and turn out a sizable amount of personal servicing, they now have more freedom for attending factory schools and taking other advanced training. With the increase in personnel and the stepped-up individual efficiency, they plan to have key men in regular attendance in trade and factory schools and to foster a perpetual on-the-job training program for their experienced personnel.

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"Laying off the kidding," Barney said, "I think I see what you're driving at. You're saying it behooves a technician to be alert to the little dangers in his work as well as the big ones."

"That's it exactly," Mac applauded. "You don't need to tell a fellow clinging to the side of a TV tower to be careful; neither do you have to warn him about the dangers of implosion when he's handling picture tubes—at least not if he has deliberately broken a couple of burned out ones under controlled conditions just to see what happens. Most of us are pretty alert to the danger of being electrocuted by the sets we work on or the equipment we use. If we are not completely stupid, we guard ourselves against these serious, ever-present dangers; but where most of us fall down is in getting careless about the apparently little threats to our well-being such as we have been discussing. We just don't seem to realize that lockjaw developing from an infected burn can kill us just as dead as a fall from the top of a seventy-foot TV tower."

"The independent service technician has to think of such things more than people do who work in radio factories, and so on," Barney mused. "In a factory, there would be safety engineers constantly studying each job for hidden dangers and warning the worker against them. He would have to attend safety meetings, and safety slogans would be plastered all over the place. The independent in service, on the other hand, has to look out for himself and be his own safety engineer. That makes it a little tough since many of these independent technicians are already their own several-others. For example, many are their own office force, their own janitor, their own purchasing agent, their own advertising manager, and their own public relations department."

"Very true," Mac commented with a grin; "but just don't forget that they also have their own businesses." —30—

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2C53	.. 9.95	371B	.. .90	5517	.. 1.35
2E24	.. 2.35	403A	.. 1.75	5636	.. 1.15
2E24	.. 2.35	403B	.. 2.75	5636A	.. 2.95
2K25	.. 13.50	404A	.. 12.50	5642	.. 1.00
2K45	.. 35.00	416A	.. 29.00	5643	.. 5.00
2K55	.. 15.00	416B	.. 38.00	5648	.. 4.50
3B24	.. 1.50	417A	.. 2.75	5651	.. 1.40
3B24W	.. 5.00	417A	.. 2.75	5654	.. 1.40
3B29	.. 5.50	5842	.. 12.50	5656	.. 1.50
3BP1	.. 1.40	450TH	.. 44.00	5670	.. 1.00
3C23	.. 4.00	KU-610	.. 3.50	5675	.. 8.00
3C31	.. 4.00	WL655/	.. .60	5676	.. 1.15
3C45	.. 6.00	658	.. 90.00	5687	.. 2.75
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3K20000K	.. .00	701A	.. 1.25	5696	.. 1.15
.. .Write!		703A	.. 1.10	5693	.. 4.75
4-65A	.. 16.50	717A	.. .35	5703WA	.. 4.50
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4-400A	.. 58.50	*750TL	.. 35.00	5725	.. 2.75
4B24	.. 4.50	800	.. .90	5728	.. .60
4C35	.. 4.50	802	.. .30	5744	.. 1.25
4C35	.. 13.50	803	.. 2.00	5749	.. 1.25
4E27	.. 8.50	805	.. 5.00	5763	.. 1.20
4P60A	.. 4.00	807W	.. 1.20	5812	.. 1.00
5C22	.. 19.10	807W	.. .60	5814	.. .80
5R4WG	.. 3.00	8933	.. 1.50	5840	.. 6.00
6A4SW	.. 1.40	813	.. 8.00	5879	.. 1.40
6A4SW	.. 1.00	814	.. .65	5981	.. 2.95
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6J4W	.. 1.90	816	.. 1.50	5910	.. .45
6J4W	.. 1.00	836	.. 1.50	5915	.. .50
15E	.. 1.25	837	.. 1.25	6111	.. 4.95
FG22	.. 4.50	838	.. .70	6112	.. 4.95
*525G	.. 2.45	845	.. .50	6120	.. .60
VCS0	.. 2.45	866A	.. 1.25	6130	.. .60
32KV	.. 8.00	872A	.. 1.25	6161	.. 60.00
RR60	.. 1.35	917	.. 1.50	6189	.. 2.50
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RRK72 or	.. .75	930	.. 1.50	6539	.. 9.00
75	.. 40	954	.. .35	6540	.. 2.00
F123	.. 5.00	955	.. .35	8020	.. 2.00
VXR-130	.. 1.75	956	.. .35	9001	.. .85
203A	.. 2.50	957	.. .35	9002	.. .65
211	.. .50	991	.. .25	9003	.. 1.35
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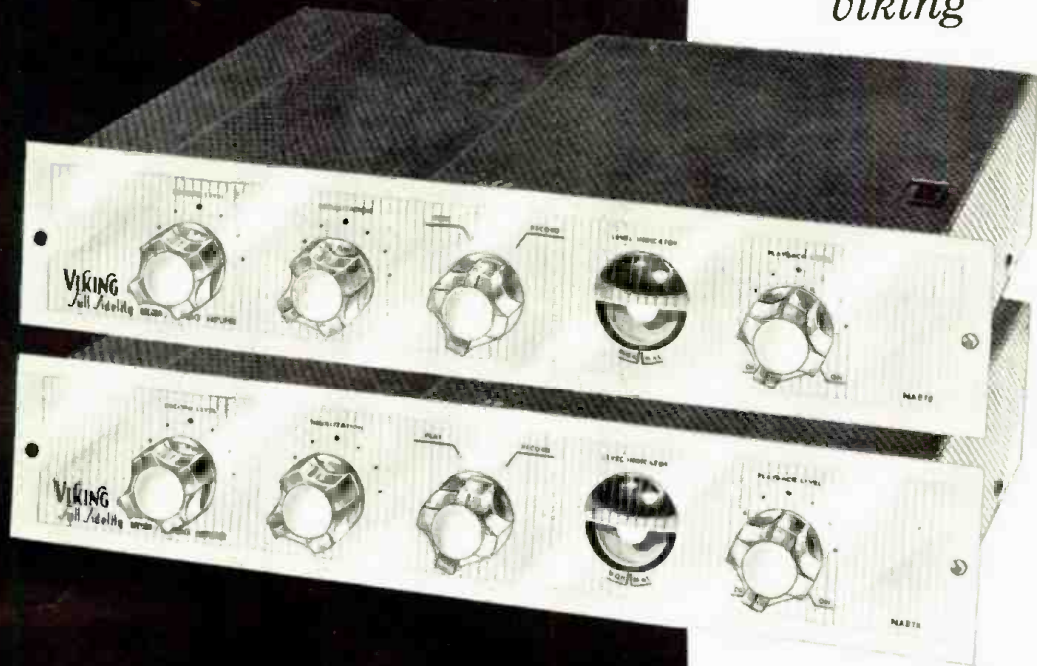
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0A2	.69	6AD7G	1.50	6L6G	.98	12BF6	.60	0A3/VR75	.86	5JP2	6.35	876	.72	5687	2.65	6099	1.35
0A4G	.95	6AF4	1.23	6L7	.95	12BH7	.89	0B3/VR90	.73	5JP5	9.95	878	.48	5692	5.10	6101	1.45
0B2	.65	6AF6G	.85	6N7	.89	12BK5	.95	0C3/VR105	.68	5LP1	7.40	884	.95	5693	4.65	6113	1.25
0Z4	.49	6AG5	.72	6O7	.85	12BQ6GT	1.35	0D3/VR150	.68	5NP1	4.95	885	.95	5696	.90	6146	4.75
1A3	.68	6AG7	.98	6Q7GT	.79	12BY7	.90	1B22	1.25	6ACTW	1.45	902	2.45	5702	1.95	6161	69.50
1A7	.52	6AH4	.85	6R7	.85	12BZ7	.95	1B23	2.68	6AK5W	1.45	918	1.65	5703	.95	6187	3.95
1AD4	1.20	6AH6	.85	6R7GT	.69	12C8	.69	1B24	1.85	6AL5W	.95	923	1.25	5704	1.85	6189	3.25
1AE4	.92	6AJ5	1.49	6S4	.87	12CU6	1.35	1B27	12.95	6AQ5W	1.70	929	1.50	5713	2.75	6203	11.45
1AX2	.95	6AK5	.69	6S8GT	1.05	12H6	.59	1B35	3.45	6A56W	2.69	927	.95	5718A	4.75	6264	11.45
1B3GT	.79	6AK6	.75	6SA7	.79	12J5GT	.65	1B38	33.50	6BF7W	3.45	930	1.19	5719	2.15	6539	2.95
1C5GT	.52	6AL5	.95	6SA7GT	.79	12K7GT	.85	1B40	3.45	6C4W	6.75	931A	2.95	5725	1.45	8005	4.75
1G4	.65	6AL7	.95	6SB7Y	.87	12K8	.69	1B41	14.95	6C21	14.95	954	.25	5726	.60	8008	3.95
1G6GT	.49	6AM4	1.50	6SC7	.72	12Q7GT	.75	1C21	1.89	6F4	2.65	955	.35	5727	1.25	8012	.98
1H5GT	.58	6AM8	1.10	6SF5	.72	12SA7	.69	1N21	1.45	6J4WA	4.45	956	.35	5732	2.95	8013	2.65
1I6GT	.69	6AN8	1.50	6SF5GT	.69	12SA7GT	.69	1N21B	1.45	6J5WGT	3.90	957	1.25	5744	1.75	8013A	3.75
1L4	.74	6AN5	2.75	6SF7	.92	12SC7	.75	1N23	.68	6J6W	2.20	958A	.35	5751	1.45	8018	67.50
1L6	.79	6AN8	1.15	6SG7	.65	12SG7	.79	1N23B	1.40	6J6WA	3.90	959	1.32	5762	99.50	8020	1.28
1LA4	.79	6AQ5	.57	6SH7	.74	12SH7	.65	1N34	.42	6K4	2.20	991	.29	5763	1.25	8025	1.45
1LA6	.85	6AQ6	.57	6SH7GT	.59	12SJ7	.65	1N34A	.48	6SN7WGT	1.85	1603	2.95	5783	4.45	9001	.82
1LB4	.85	6AQ7	1.15	6SJ7	.69	12SK7	.69	1P21	29.50	6X4W	1.20	1616	.50	5787CK	4.05	9002	.60
1LC5	.79	6AR5	.70	6SJTGT	.59	12SL7	.85	1P22	13.25	6X5W	1.35	1819	.30	5794	5.95	9003	1.20
1LC6	.79	6AR6	.54	6SK7	.69	12SN7	.75	1P23	11.85	6Y4W	4.45	1824	1.45	5812	2.70	9004	.35
1LD5	.85	6AS5	.70	6SK7GT	.59	12SQ7	.59	1P24	1.45	12DP7	14.95	1824	.95	5814	.95	9005	1.35
1LE3	.79	6AS6	1.95	6SL7GT	.75	12SR7	.59	1P25	64.50	15E	1.45	1825	.29	5819	32.50	9006	2.5
1LG5	.85	6AS7G	2.35	6SN7GT	.75	12SR7	.59	1P28	8.95	15R	.49	1826	.19	5820	495.00	C1JA	10.95
1LH4	.85	6AS8	1.15	6S07	.59	12V6GT	.73	1P30	1.95	28D7	.95	1833	.85	5823	1.35	CKJ	7.95
1LN5	.79	6AT6	.52	6SQ7GT	.59	12WG6T	.87	1P32	.95	100TH	6.25	1835	1.48	5829	1.35	CK1005	.32
1NSGT	.59	6AT8	1.05	6SR7	.55	14A4	.95	1P39	1.45	100TL	8.25	1841	1.35	5840	4.40	CK1006	3.45
1QS7	.59	6AU8	1.05	6SS7	.75	14A5	1.30	1P40	1.45	211	2.15	1854	1.75	5841	7.40	CK1007	.65
1R4	.65	6AU8	1.10	6ST7	.95	14A7	.75	1P41	2.45	249B	2.90	1857	8.95	5849	3.95	CK1038	4.70
1R5	.65	6AU6	.85	6T8	.95	14AF7	.95	1P42	2.35	249C	1.95	2051	.65	5851	3.45	CK1039	4.70
1S4	.65	6BA7	.85	6U5	.85	14B6	.69	2AP1	4.95	250TH	18.95	5516	6.45	5876	12.50	F123A	2.75
1S5	.65	6AV5	1.20	6U8	.95	14C7	.95	2B22	1.95	250TL	14.75	5517	1.65	5879	1.25	F127A	22.50
1T4	.65	6AV6	.53	6V3	1.25	14E6	1.05	2C21	.25	262B	4.95	5634	6.95	5881	2.95	F128A	14.95
1T5	.69	6AX4	.79	6V6	1.10	14E7	1.15	2C34	.25	274A	3.45	5636	2.90	5886	3.25	FG17	4.98
1U4	.67	6AX5	.69	6V6GT	.59	14F7	.85	2C39A	10.95	274B	.85	5637	4.95	5894	15.95	FG27A	10.90
1V5	.65	6B8	.67	6WG6T	.65	14F8	1.10	2C40	9.45	304TH	9.95	5638	7.45	5898	4.45	FG32	3.95
1V2	.59	6BA6	.63	6X4	.48	14H7	1.10	2C43	10.25	307A	1.10	5641	5.95	5902	5.95	FG95	17.50
1V6	1.49	6BA7	.85	6X5GT	.49	14H7	.85	2C52	2.95	350A	2.65	5642	.95	5905	8.75	FG105	12.95
1X2A	.85	6BC4	1.50	6X8	.95	14Q7	.85	2C53	10.75	350B	2.35	5643	5.95	5906	14.95	FG172	17.95
2A3	.95	6BC5	.68	6Y6G	.89	14R7	1.20	2D21	.65	371B	.85	5647	3.95	5908	7.88	HF100	6.95
2A6	.59	6BC7	1.20	7A4	.79	14S7	1.10	2E22	3.15	393A	4.50	5651	1.35	5932	3.95	HF200	9.95
2X2	.49	6BD5	2.75	7A5	.69	14W7	1.25	2E24	2.40	417A/5842	2.95	5654	1.25	5933	5.45	HF300	17.80
2X2A	1.35	6BD6	.73	7A6	.79	14W7	1.25	2E26	3.25	434A	14.95	5670	1.10	6021	4.45	WL616	47.50
3A3	1.08	6BE6	.65	7A7	.75	19B6GG	1.89	2E30	1.55	434A	2.95	5675	10.95	6080WA	7.95	RK65	7.50
3A4	.50	6BF5	.82	7A8	.75	19T8	.95	2G21	2.45	450TH	47.50	5676	1.25	6096	1.45	RK72	.50
3A5	.64	6BF6	.68	7AD7	1.65	25AV5	1.25	2J31	14.90	450TL	35.00	5678	1.25	6097	1.45	RX21	5.50
3AL5	.65	6BG6G	1.75	7AF7	.89	25AX4	1.05	2J32	12.50	575A	12.50	5686	1.95	6098	1.85	T240	4.95
3AU6	.70	6BH6	.79	7AG7	.95	25BK5	.95	2J33	14.00	707A	4.95	5686	1.95	6098	1.85		
3AV6	.60	6BJ6	.69	7AH7	.95	25BQ6GT	1.25	2J34	14.00	707A	4.95	5686	1.95	6098	1.85		
3B4	2.95	6BK5	.95	7B5	.65	25CD6G	1.75	2J36	14.95	707B	3.95	5686	1.95	6098	1.85		
3B7	.39	6BK7	1.05	7B6	.75	25CU6	1.30	2J51	97.50	715B	2.95	5686	1.95	6098	1.85		
3BC5	.80	6BL7	1.05	7B8	.75	25L6GT	.65	2J55	39.50	715C	10.95	5686	1.95	6098	1.85		
3BN6	1.05	6BN6	1.10	7B8	.85	25W4GT	.72	2J61	12.95	717A	.35	5686	1.95	6098	1.85		
3BY6	.75	6BQ6GT	1.15	7C5	.75	25Z5	.75	2J62	12.95	721A/B	.65	5686	1.95	6098	1.85		
3CB6	.80	6BQ7A	1.15	7C6	.75	25Z6	.62	2K25	11.95	723A/B	8.45	5686	1.95	6098	1.85		
3CF6	.85	6BX7	1.20	7D7	.79	30	.65	2K28	27.50	726A	4.95	5686	1.95	6098	1.85		
3D6	.39	6B5G	1.20	7E7	1.15	32L7	.85	2K33A	56.95	726B	32.50	5686	1.95	6098	1.85		
3FL4	.65	6C4	.38	7F7	.85	35A5	.69	3AP1	2.90	726C	32.50	5686	1.95	6098	1.85		
3Q4	.65	6C4	.38	7F7	.85	35B5	.68	3B24	1.50	750TL	65.00	5686	1.95	6098	1.85		
3Q5	.75	6C5	.48	7F8	1.10	35C5	.68	3B24W	4.95	801A	.38	5686	1.95	6098	1.85		
3S4	.65	6C5GT	.46	7G7	1.10	35S5	.68	3B25	4.95	801A	2.45	5686	1.95	6098	1.85		
3V4	.69	6C6	.49	7H7	.79	35C5	.68	3B26	7.45	803	1.45	5686	1.95	6098	1.85		
4BQ7A	1.30	6CBG	.85	7J7	1.25	35L6	.65	3B27	3.45	804	8.85	5686	1.95	6098	1.85		
4BZ7	1.35	6BD5	4.40	7K7	1.35	35W4	.44	3B29	5.95	805	3.95	5686	1.95	6098	1.85		
5AM8	1.05	6CB6	.65	7L7	1.10	35V4	.65	3BP1	2.45	806	4.85	5686	1.95	6098	1.85		
5AN8	1.10	6CD6G	1.75	7N7	.85	35Z3	.65	3C22	59.50	807	1.18	5686	1.95	6098	1.85		
5AQ5	.75	6CF6	.90	7Q7	.95	35Z5	.59	3C23	3.45	808	1.25	5686	1.95	6098	1.85		
5AS8	1.10	6CG7	.85	7R7	.95	41	.75	3C24	1.48	809	2.20	5686	1.95	6098	1.85		
5AT8	1.10	6CL6	1.10	7V7	.95	42	.69	3C45	5.95	809	1.25	5686	1.95	6098	1.85		
5AV8	1.15	6CM6	.85	7W7	.95	43	.79	3D1A	2.95	811	2.75	5686	1.95	6098	1.85		
5AW4	1.10	6CS6	.75	7X7	.90	45	.69	3DP1	3.25	811A	3.25	5686	1.95	6098	1.85		
5AZ4	.60	6CU6	1.30	7Y4	.65	50A5	.68	3E29	9.00	812	2.75	5686	1.95	6098	1.85		
5I6	.90	6D6	.59	7Z4	.65	50B5	.68	4-65A	13.25	812A	3.25	5686	1.95	6098	1.85		
5R4GY	1.45	6DC6	.95	12A4	.85	50C5	.68	4-125A	22.50	813	10.50	5686	1.95	6098	1.85		
5T4	.90	6E5	.75	12A6	.57	50L6	.62	4-250A	32.50	814	1.95	5686	1.95	6098	1.85		
5U4G	.58	6F5	.59	12A8GT	.79	50X6	.85	4C27	8.95								



STEREO RECORDING!

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SOME OF THE BEST THINGS COME IN PAIRS

A pair of matching RP61 and RP61S Record/Playback Preamplifiers for *stereo recording* as well as playback of stereo tapes — plus conventional erase-record operation.

A pair of in-line heads on the Viking "SR" Tape deck for *stereo realism*, plus the conventional erase and record/playback heads.

Viking tape system components and recorders are sold through dealers. Further technical information may be obtained by writing directly to Viking of Minneapolis.

ALL VIKING DECKS

frequency response: 30 to 14,000 cps plus, at 7½ ips. 40 to 7,000 cps plus, at 3¾ ips.

signal-to-noise: 50 db or better.

flutter: 0.2 percent average.

long term speed regulation: ½ of 1.0 percent.

capstan drive: belt driven from full-floated motor platform.

capstan flywheel: 1½ lb.

tape speed: 7½ ips (3¾ ips available by changing belt to smaller groove on motor pulley).

maximum reel size: 7".

motor: 4-pole, 60-cycle. (50-cycle motors available at \$2.00 additional charge.)

supply reel brake: mechanically actuated. Felt pad braking surface. Adjustable.

take-up reel brake: mechanically actuated. No adjustment required. Cork pad braking surface.

record/playback head characteristics: track width .090 inch. Gap width .00015 inch. Impedance 2000 ohms at 1000 cycles. Double coil hum bucking winding. Mu-metal shielded. Output 2.5 mv.

recommended bias current: .8 ma. at 68 kc.

erase head characteristics: track width .125 inch, double gap (each .005 inch), inductance 53 mh. at 1 kc, erase 60 db at 68 kc.

RP61 SERIES PREAMPLIFIERS

frequency response, playback: 30 to 14,000 cps ± 2 db.

frequency response, record-playback cycle: 30 to 12,000 cps ± 2 db.

distortion (tapes recorded 12 db below saturation): less than 2% within specified frequency range.

internal signal-to-noise ratio: 60 db minimum all units.

equalization: modified NARTB

output: 1 volt, high impedance.



Viking OF MINNEAPOLIS

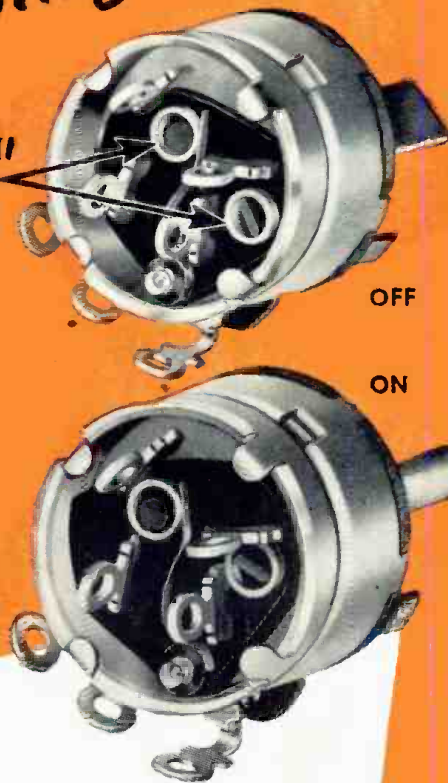
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