DECEMBER

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor-in-chief

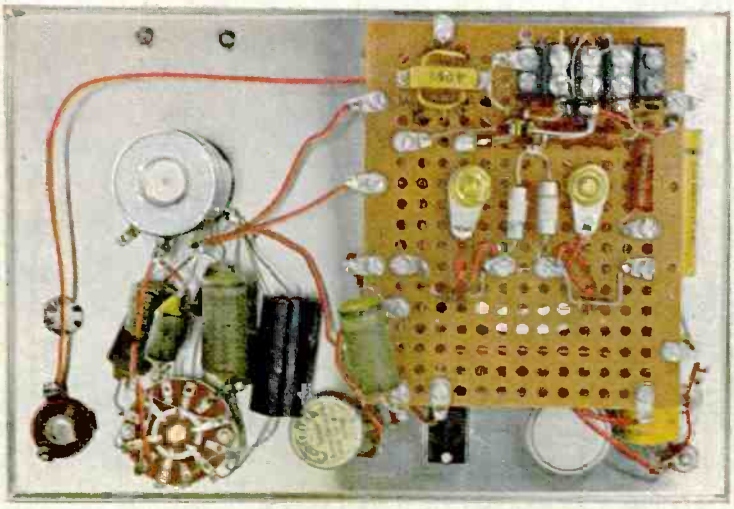
50c

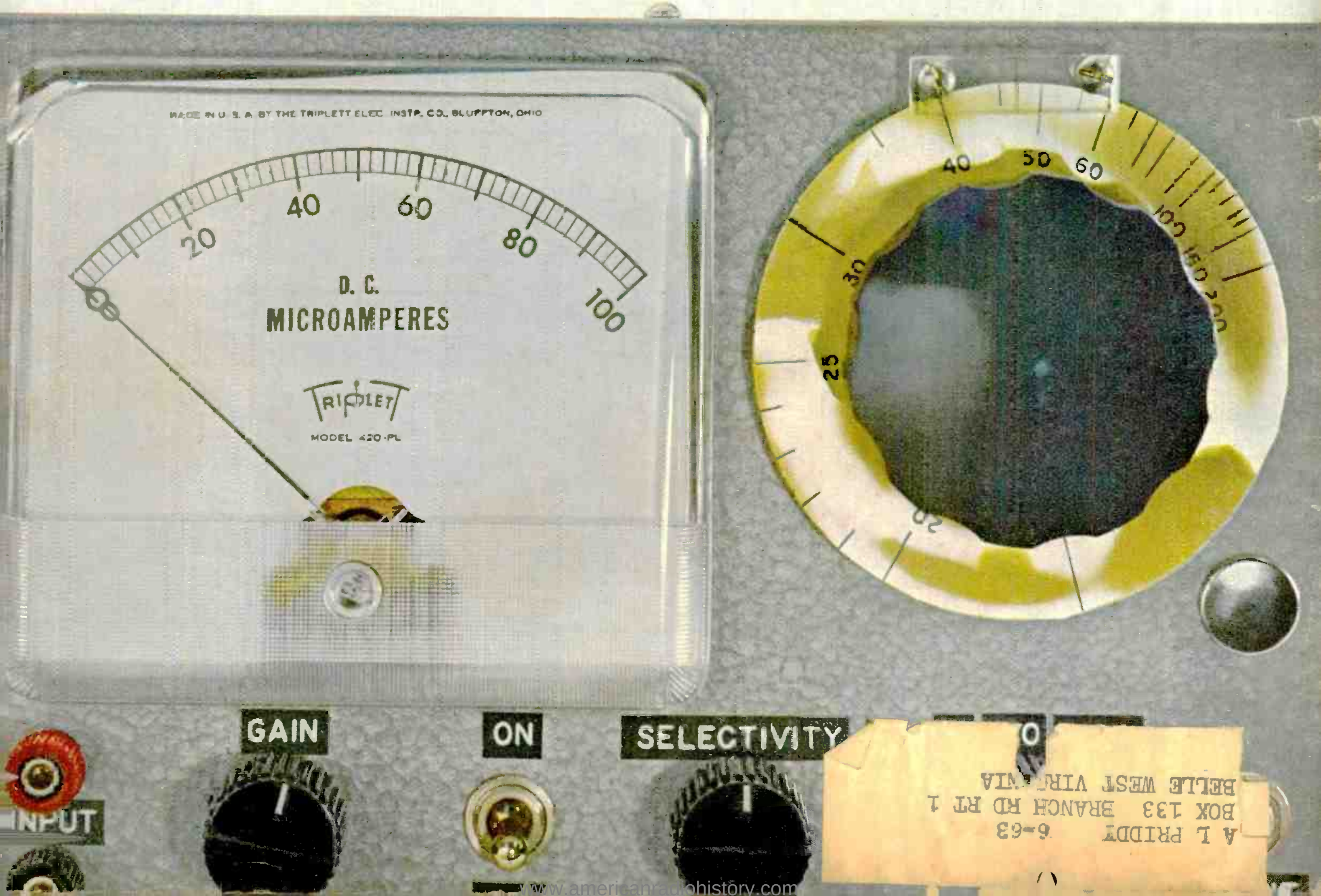
HI-FI FROM YOUR TV

ELECTRONIC STARTER THAWS FROZEN CARS

9 STEPS TO COLOR

TUNED SIGNAL TRACER





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MODEL 630 V-O-M

PRICE† $49.50

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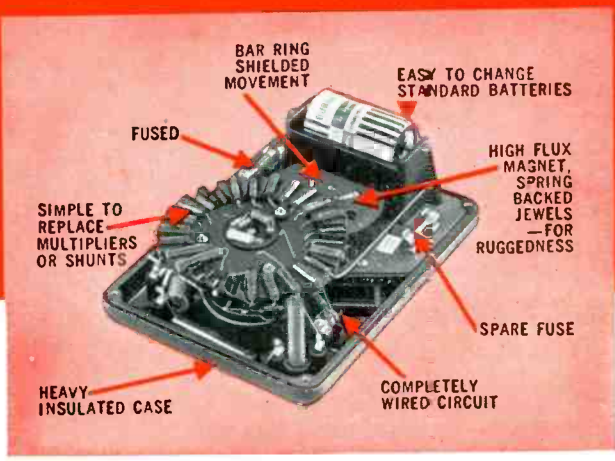
- Application Engineers
- Electrical, Radio, TV, and Appliance Servicemen
- Electrical Contractors
- Factory Maintenance Men
- Industrial Electronic Maintenance Technicians
- Home Owners, Hobbyists



FACTS MAKE FEATURES:

1. Popular streamlined tester with long meter scales arranged for easy reading. Fuse protected.
2. Single control knob selects any of 32 ranges—less chance of incorrect settings and burnouts.
3. Four resistance ranges—from .1 ohm reads direct; 4½ ohm center scale; high 100 megohms.

Attention to detail makes the Triplett Model 630 V-O-M a lifetime investment. It has an outstanding ohm scale; four ranges—low readings .1 ohm, high 100 megs. Fuse affords extra protection to the resistors in the ohmmeter circuit, especially the XI setting, should too high a voltage be applied. Accuracy 3% DC to 1200V. Heavy molded case for high impact, fully insulated.

†630A same as 630 plus 1½% accuracy and mirror scale only $59.50

TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

RANGES

DC VOLTS	0-3-12-60-300-1,200-6,000 at 20,000 ohms per volt.
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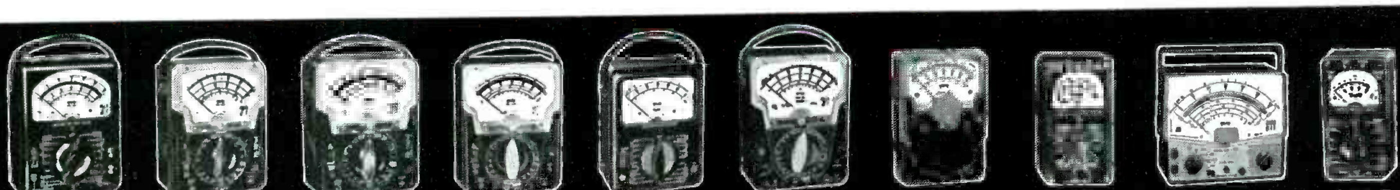

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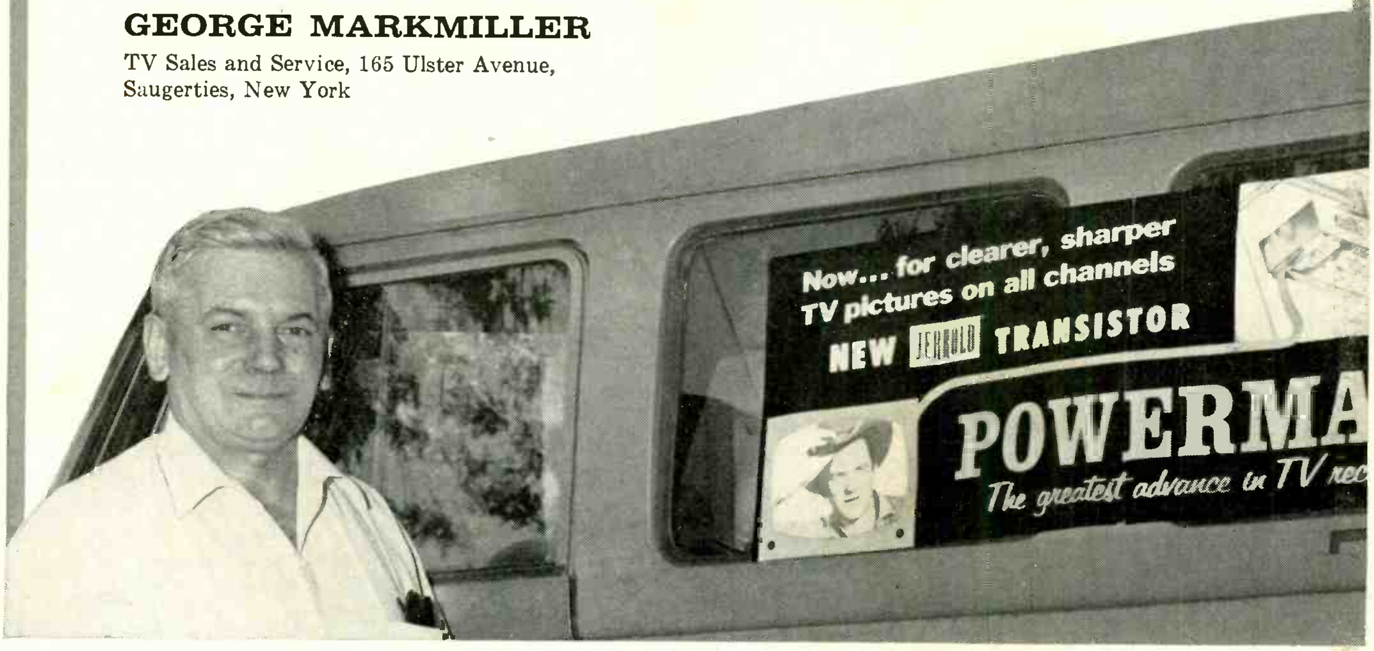
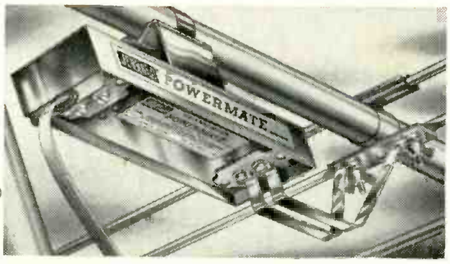


POWERMATE sells itself through its performance

George Markmiller's customers "were from Missouri" where TV reception was concerned. The products they had tried, in spite of high claims, had not produced snow-free TV from the distant New York stations. With the help of his Jerrold distributor, George used the potent promotional kit to tell his customers the POWERMATE performance story. Newspaper ads, truck banners, stuffers and store displays presold POWERMATE because the promotion was *custom-designed* for his area.

The real clincher came after the demonstration when one customer began to tell the other about POWERMATE's amazing reception. The Saugerties area had never seen such clarity in black and white *and in color*. As George says, "The performance of this unit has been the best advertising that has helped to sell it."

Jerrold's ready to set up a POWERMATE promotion designed for *your local area*. You can repeat George Markmiller's success story as hundreds are doing—all over the country. Write for the name of your nearest Jerrold distributor.



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Name____________________

Address____________________

City__________ Zone_____ State________

Radio-Electronics

DECEMBER 1962
VOL. XXXIII No. 12

Formerly RADIO CRAFT—Incorporating SHORT WAVE CRAFT—TELEVISION NEWS—RADIO & TELEVISION*

editorial

audio-high fidelity-stereo

electronics

industrial electronics

radio

television

test instruments

the departments

—on the cover—

(Story on page 36)

Veteran author and engineer, Rufus P. Turner, describes a simple, easy-to-build audio test instrument that features professional precision and innumerable uses in the shop and lab.

Color original by Habershaw Studios

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News Briefs

Space News Broadcasts

The Voice of America announces that interested short-wave listeners can receive up-to-date schedules for two broadcast series of wide interest. One of these, the Space News Broadcast, issued in conjunction with the US National Academy of Sciences, is heard on short wave 6 days a week, from 0330 to 0335 GMT, on six frequencies. The other is the Voice of America Amateur Radio Program, 15 minutes, transmitted weekly on a large number of frequencies and from a number of stations in different parts of the world. Broadcasts are in English and are written and delivered by Bill Leonard, W2SKE.

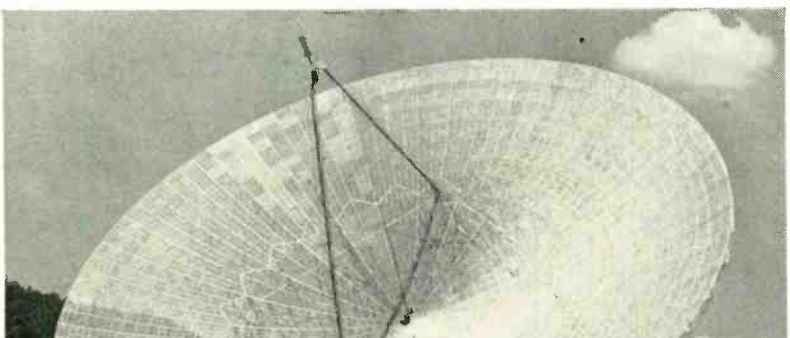
Full particulars as to stations, times and frequencies may be obtained by writing the Voice of America, Frequency Division, Washington 25, D. C.

Biggest Movable Antenna Starts to Scan Skies

The National Radio Astronomy Observatory at Green Bank, W. Va., has announced the completion of its new 300-foot antenna. The new dish is 50 feet wider in diameter than the one at Jodrell Bank in England, heretofore the largest steerable antenna. It stands some 23 stories high, when aimed at the zenith, and weighs 600 tons—not as much as the Jodrell Bank radiotelescope.

The new radiotelescope is not movable in all directions, being able to swing north and south only. Thus it can observe one point in the heavens for only 40 seconds each night. To make it fully steerable would have tripled its $800,000 cost.

Its probable first target will be Venus, and it is expected that the resolution of the new scope, 10 times as great as that of previous instruments, may make it possible to measure the temperature of that planet much more accurately than heretofore.



Unbreakable TV Tubes?

A new tough glass, demonstrated by Corning, may make possible TV picture tubes one-third of their present weight, according to a recent statement by *Television Digest*. It is possible that, instead of making tubes lighter, virtually unbreakable and implosion-proof tubes could be made at about the present weight. These would not need a safety shield.

The new tubes are still in the indefinite future, however, according to Corning research and development. The reason is that the new "Chemcor" glass would lose much of its strength when reheated at the tube plant to weld in the electron gun. Only when it is possible to reheat and rework the glass without losing its strength could it be used for TV picture tubes.

Transistor Microphone Is Pinhead Size

A microphone so small that some prototypes had to be viewed under a magnifying glass has been announced by Raytheon. The new transducer effect by which it works was discovered by Dr. William Rindner while studying surface defects on a transistor. He noted that scratching or tapping the transistor produced readings on a meter. With associate Roger Nelson, he embarked on a study that resulted in the new microphone.

They devised a miniature cap, resembling a pygmy thumbtack, for a chip of transistor material. Pressure applied to the head of the tack is converted to electrical energy by the transistor. Varying the pressure on the point on the transistor, or constructing transistors with special shallow junctions, increased the sensitivity of the microphone.

Since it is a transistor, the microphone amplifies as well as senses the vibrations transmitted through it, thereby falling in the class of amplifying transducers.

The advantage of the new microphone is that it responds to a very wide frequency range—from .01 to 120,000 cycles. A laboratory model of a phonograph pickup using the device produced sound quality comparable to commercial models. Output of the pickup was high, due to the transistor's amplifying effect. Mass was fantastically lower than that of average pickups.

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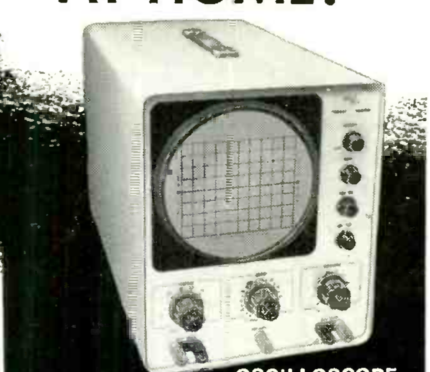

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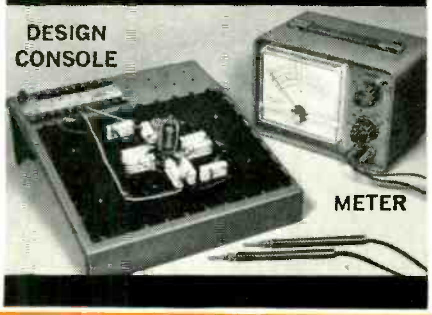

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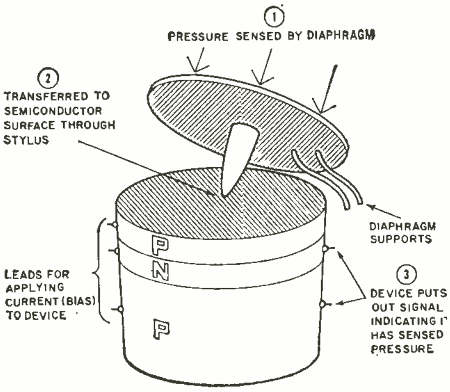
Other applications, according to Raytheon, may be used in seismology as sensitive weight and pressure



Detail of new transistor microphone.

measuring devices, strain gages, accelerometers, fusing devices for acoustical mines, or in medical work.

"Inert" Gas Xenon Believed Compounded

Xenon, considered an absolutely inert gas, has been combined chemically with fluorine by chemists at the Argonne National Laboratory. The compound produced was xenon tetrafluoride. Another compound, xenon-platinum hexafluride, was reported by Neil Bartlett, professor of chemistry at the University of British Columbia.

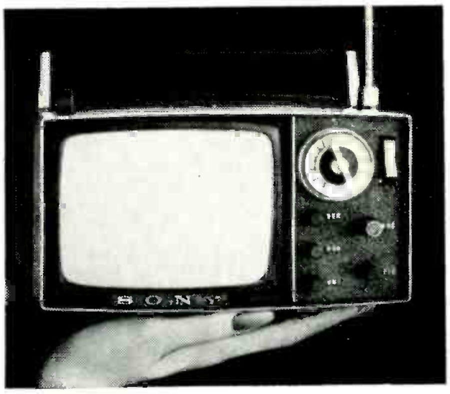
The Argonne scientists placed one part of xenon and five parts of fluorine in a sealed container, and heated it for an hour at 400° C. They cooled the container rapidly, and on opening the container, found colorless crystals of the xenon-tetrafluoride compound.

FCC Gets New Member

E. William Henry, Memphis, Tenn., has been selected by President Kennedy as a member of the Federal Communications Commission. Mr. Henry, a Democrat, will serve a 7-year term, succeeding John Cross. Born in 1929, he was graduated from Yale University in 1951, in 1957 received his law degree from Vanderbilt University, and is now a member of Chandler, Manire & Chandler, a Memphis law firm.

World's Smallest TV Set Is All-Transistor

A TV set that measures only 7⅝ x 7¼ x 4¼ inches and weighs 8 lb is now available in the United States. Introduced by the Sony Corp. of America, it uses a 5-inch picture tube and produces a remarkably



The New Sony Micro-TV

clear picture. An additional plug-in component (not yet available) permits tuning in the uhf band.

The new micro-TV has 24 transistors and 20 diodes. It operates on regular house current or from a 12-volt battery, battery drain being about 25% of that used by an ordinary car radio. An earphone is provided for private listening, as might be required in a bedroom or hospital room. The price of the new set was said to be about $230.

Bell Telephone Labs Unveils Switching Center

A new laboratory to be devoted entirely to the development of telephone switching equipment and systems, apparatus and systems for data transmission by telephone, and customer equipment (such as telephones and public booths) has been opened by Bell Telephone Laboratories at Holmdel, N. J. The new facility employs some 2,600 engineers, scientists, technicians and supporting personnel.

Designed by the late Eero Saarinen, the new construction is striking in appearance and pioneers in a number of functional features. The main corridors, for example, run around the perimeter of the building, reducing traffic past office and laboratory doors to a minimum.

The building is on historic Bell Telephone property. The site is that on which Karl Jansky first discovered radio waves from space, and in sight of the white farmhouse in which Southworth first developed microwaves. A mile and a half away is the famous Crawford Hill, used for many years for antenna experiments, and recently very much in the news in connection with Telstar.

NY Hi-Fi Music Show

Thirty-two thousand audiophiles packed the New York Trade Show building to see the latest in high-fidelity equipment. FM stereo stole the show, with great emphasis being placed upon it by a large number of exhibitors. More than 100 manufacturers displayed their wares, with special exhibits for interest.

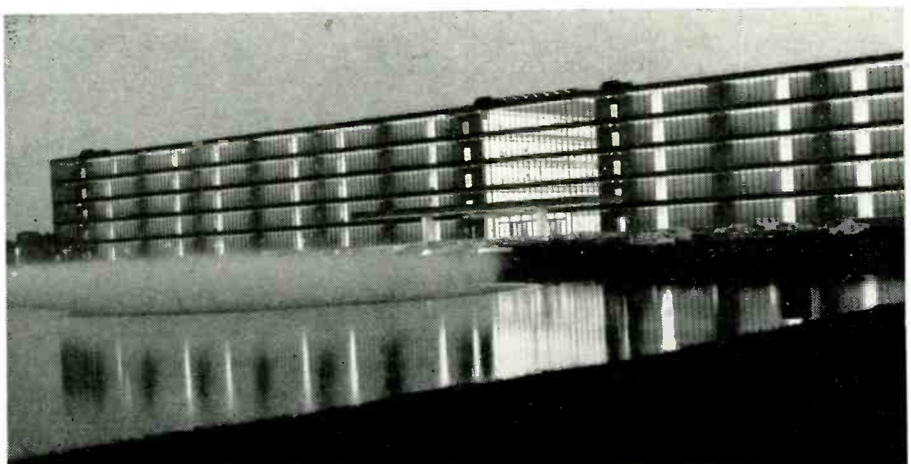
Bell Telephone displayed a model of the Telstar communications satellite. The Ford Motor Co. showed its Concert Hall on Wheels. A group of professional and student artists painted while listening to hi-fi music for inspiration. Three special rooms were set up to show how hi-fi components can be blended into various decors.

Astronauts' Radio Blackouts Out?

Space pilots, troubled by silent radios during re-entry from orbit, may have their problems solved by this new high-power amplifier tube. Existing radios black out when they meet the heat-induced ion shields produced as the spacecraft enters the atmosphere, but the new tube, operating at previously untapped frequencies in the range between microwaves and light waves, will cut through with a millimeter wave beam. The tube was developed by Hughes Aircraft Co.

Made of metal and ceramic materials, the tube with its permanent magnet weighs about 16 pounds. It produces about 10 times the continu-

(*Continued on page 14*)



The Bell Labs facility at Holmdel, as photographed by moonlight.

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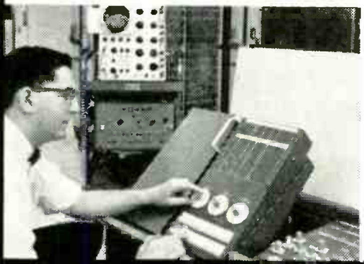
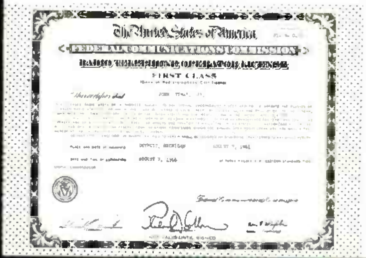
Electronics Technology



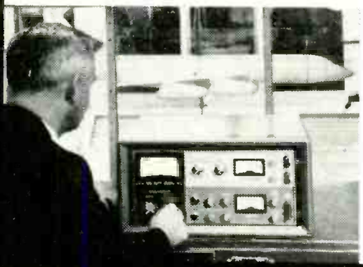
A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

First Class FCC License



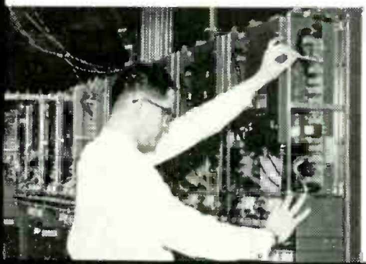
If you want a 1st Class FCC ticket quickly, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

Industrial Electronics & Automation



This exciting program includes many important subjects as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.

Electronic Communications



Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

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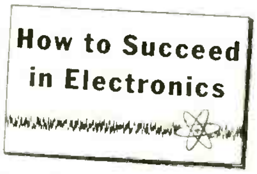

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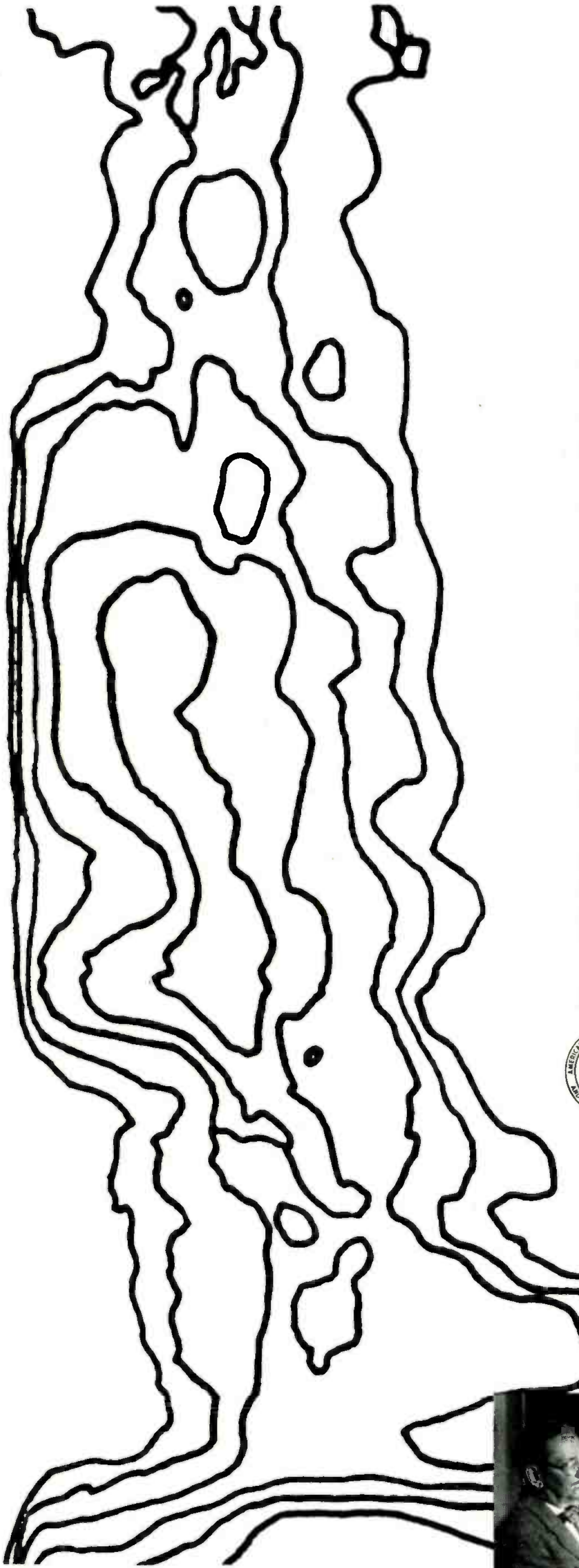

News from Bell Telephone Laboratories

WE'RE "FINGERPRINTING" VOICES...TO FIND BETTER WAYS OF TRANSMITTING THEM

Acoustics scientists at Bell Telephone Laboratories study voices to learn how one voice differs from all others, what makes yours instantly recognizable to friends and family, and what the elements of a voice are that give it the elusive qualities of "naturalness."

To enable us to examine speech closely, we devised a method of making spectrograms of spoken words. We call them voiceprints. They are actual pictures of sound, revealing the patterns of voice energy. Each pattern is distinctive and identifiable. They are so distinctive that voiceprints may have a place, along with fingerprint and handwriting identification, as an important tool of law enforcement.

The shape and size of a person's mouth, throat and nasal cavities cause his voice energy to be concentrated into bands of frequencies. The pattern of these bands remains essentially the same despite modifications which may result from loss of teeth or tonsils, the advancement of age, or attempts to disguise the voice.

Study of voiceprints and recognition factors is part of our exploration of new techniques to extract and transmit the minimum essentials of a person's voice and from these reconstruct the original voice at the receiving end, retaining its factors of naturalness.

Our ultimate goal, as always, is to learn how to improve your telephone service and make it a better value.

BELL TELEPHONE LABORATORIES

World center of communications research and development

Word Picture. This is a picture of the spoken word "you." By analyzing the sound with a spectrograph, the Laboratories' Lawrence G. Kersta makes a print of the word in graph form. Graph shows frequency, time taken, and intensity used in making speech sound.

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4. Complete Transistor Radio Servicing Course
5. Test Equipment Guide

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4. Complete Transistor Radio Servicing Course
5. Test Equipment Guide

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2. 8-Volume Set of "101 Ways" Test Instrument books, covering scopes, sweep generator, VOM-VTVM, signal generator, audio test equipment, etc. Worth $18.50
3. Color TV Servicing Course
4. 2nd Class Radiotelephone Course
5. Transistor Radio Servicing Course
6. Test Equipment Guide

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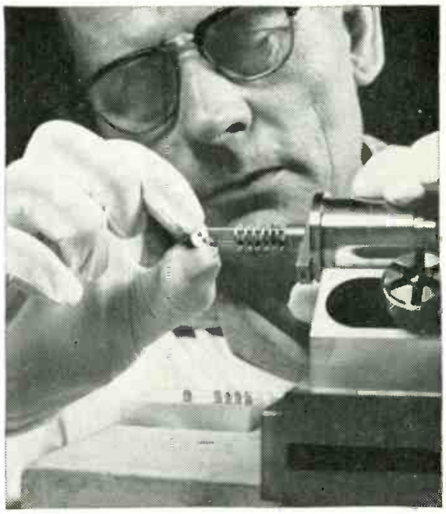
City __________ Zone ____ State ______

(*Continued from page 10*)



ous power output of any tube previously developed for the same frequency range.

Dr. Malcom R. Currie, associate director of Hughes Research Labs, cites other uses for the tube. It can amplify and transmit telephone, telegraph and television messages over private ground links using small line-of-sight antennas. Due to small antenna sizes, a mobile communications system could be built around it for portable battlefield ranging.

"The millimeter portion of the electromagnetic spectrum," says Dr. Currie, "lies between 30,000 and 300,000 mc, and has hardly begun to be tapped as yet for communications or radar use."

CALENDAR OF EVENTS

2nd Canadian IRE Communications Symposium, Nov. 16–17; Queen Elizabeth Hotel, Montreal, P. Q., Canada.

MAECON (Mid-American Electronics Conference), Nov. 19–20; Hotel Continental, Kansas City, Mo.

1962 Ultrasonics Symposium, Nov. 28–30; Columbia University, New York, N. Y.

First International Communications Fair, Nov. 28–Dec. 2; New York Coliseum, New York, N. Y.

FJCC (Fall Joint Computer Conference), Dec. 4–6; Sheraton Hotel, Philadelphia, Pa.

PGVC (PG on Vehicular Communications) Conf., Dec. 6–7; Disneyland Motel, Anaheim, Calif.

Millimeter and Submillimeter Conference, Jan. 8–10; Cherry Plaza Hotel, Orlando, Fla.

9th National Symposium on Reliability and Quality Control, Jan. 21–24; Sheraton Palace Hotel, San Francisco, Calif.

12th Southwestern Electronic Conference (SWELCON), Jan. 27–31; Baker Hotel, Dallas, Tex.

Brief Briefs

Closed-circuit color TV is being used in the veterinary courses at the University of California, to give a larger number of students an opportunity to observe surgical operations on large and small animals.

A new ultra-thin magnetic tape, which enables 3,600 feet to be contained on a 7-inch reel, has been announced by Agfa Inc. The new tape, called PE-65, is said to be virtually stretch-proof. END

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Gary DeLeo, 9219 N.E. 76th St., Vancouver, Wash.	1st	12
Dennis P. Miller, 416 W. Oak St., Alexandria, Va.	1st	12
Cecil C. Hironimus, 113 Berwick Rd., Johnstown, Pa. ..	1st	12
Max D. Reece, 4222 Fremont Ave. N., Seattle 3, Wash. ..	1st	20
Robert Benns, 3802 Military Rd. N.W., Washington, D.C.	1st	12
Jon M. Martin, 7913 Sausalito Ave., Canoga Park, Calif.	1st	24
Kline H. Mengle, 401 Granville Dr., Silver Spring, Md. ..	1st	24
Gary D. Burnard, Johnson Rd., Kirkwood, RD #1, N. Y.	1st	12
Newton E. Hastings, 318 Poplar Hill Ave., Salisbury, Md.	1st	12
Larry L. Tracewell, 1509 43rd St., Parkersburg, W. Va. ..	1st	12

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Correspondence

We Flubbed One

Dear Editor:

Please confess to our readers the mistakes edited into my short note on a "Low-Amplitude Linear Oscillator" in the July 1962 issue. Other reader-authors will understand, but the rest will think me a fool.

Corrections, text: 3rd paragraph: "C2 (not C4) being kept small enough." Same paragraph, "5 μμf with a 6.2-mc crystal" (not 6.2-kc "rock"). Last paragraph: ". . . for the frequency and *decrement* of the tuned circuit."

Corrections, diagram: Legend "15–30 *μμf if used*" applies to C1, not C4; G4 does not have −10 volts bias.

Apparently, somebody not only changed my careful notation without understanding the circuit, but tried to telescope two items together—this one and another which appeared in the August 1961 issue as "Coilless Crystal Oscillator." Readers interested in the crystal version should refer to the 1961 note, and those wishing to build the variable oscillator may write to me.

ALBERT H. TAYLOR

Read Island, B.C.
Canada

Yes You Can!!!

Dear Editor:

Mr. J. C. Nielsen's comment on page 21 of the September issue concerning the little tape recorders—*the tapes cannot be interchanged between machines*"—needs clarification.

Since tape speed is not calibrated, it must be adjusted for playback to correspond with recording speed. This is quite easy to do.

Originally, both volume and clarity were better when tapes were played back on the machine that did the recording. I recently realigned the heads on our own two machines, and now each plays tapes made on the other loud and clear. It was necessary to install a .016-inch thick shim under one side of the record-play head on one machine to correct poor "azimuth alignment". Evidently, the manufacturer does not attempt to align the heads accurately, and this alignment is surprisingly critical when interchanging tapes.

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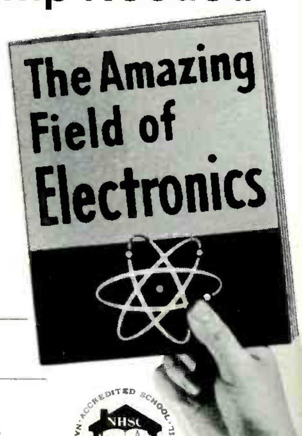

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However, I think these tape recorders are worth their cost.

BURTON A. NOBLE
San Leandro, Calif.

Misunderstood Microphones

Dear Editor:

I'm afraid that the author of "Understanding the Microphone" (August 1962) doesn't understand microphones as well as he ought to. This is apparent since he classifies the condenser microphone along with the carbon microphone as a type which derives much of its output energy from its electric supply.

The truth is that the dc polarizing supply of a condenser microphone supplies absolutely none of the power in its ac output—all such power is transduced from acoustical power. If anyone wants to argue this statement, I'll be glad to prove it analytically, but its truth should be evident from the fact that a variable capacitor provides no power sink. Also, since there is no net or direct current from the power supply, it obviously is not delivering any power. And the author's specific reference to the "supply of external power" is clearly erroneous.

ROBERT LYNN
Beverly Hills, Calif.

Mr. Carr Replies

My thanks are due to Mr. Lynn for pointing out that the form of presentation of the condenser microphone material may be ambiguous. I do not agree, however, that it is incorrect, for the following reasons:

1. The text nowhere states (as for the carbon microphone) that the capacitive element dissipates power. In fact, the reference in the "Principle" section properly refers to "change in charge."

2. The text here (and in the entire article) has reference to complete and practical microphones. The condenser mike in this regard *does* require a power source to establish the operating condition (bias), and to provide the high output voltage at low impedances (through active impedance conversion).

3. The term "modulating" is correctly applied to the condenser structure when it is used (as mentioned in the text) for frequency modulation of an ac bias carrier. This use, incidentally, has been growing in popularity.

Perhaps clarity could have been better served by classifying ac bias usage under "Modulating Types" and the dc bias version under a third classification. The selected form, however, seemed to best serve the purpose of the article.

ROBERT W. CARR
Manager, Product Development
Shure Brothers Inc.
Evanston, Ill.

END

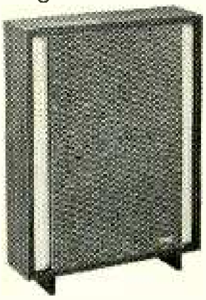
NEW LOOK FROM PACO

IN LOUDSPEAKERS:
REVOLUTIONARY NEW PACO SPEAKER SYSTEM DARES TO USE 6" CONES!

PACO is proud to present the Model L4 System, a revolutionary new development in loudspeaker design that offers a degree of brilliance, clarity and quality unequaled by speakers selling for as much as $300. Yet this remarkable speaker system costs only $99.95 net.

Here's the secret. Developed by a brilliant and famous audio designer, the new system consists of three 6-inch woofer mid-range speakers in close configuration and a tweeter. Normally, 6-inch speakers have very high cone resonance, no bass response and low power capacity. In this system, however, a special ball diffuser, bonded to the voice coil form, disperses sound in the middle frequency and widens the normally narrow axis beam of the speaker. The result is an extremely smooth response in the middle range.

Each speaker cone also has three struts bonded to it, and to each diffuser. This produces a rigid diaphragm which eliminates edge distortion and provides the much-desired "piston effect" up to 7,000-8,000 cycles. The arrangement also produces a cone resonance in the mid-range woofers of approximately 40 cycles —comparable to the most expensive woofer.



Model L4 by PACO:
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Because of their close proximity, the three speakers act as a single mass in moving air, but without the sluggishness often associated with large speakers. And, each individual speaker remains light enough to produce an accurate mid-range. This elimination of the cross-over between bass and mid-range affords an even greater degree of clarity and fidelity. With a response of 45-18,000 cycles, the system is capable of reproducing every nuance of even the mos intricate musical passage. Designed to operate with all amplifiers, its impedance is 8 ohms. See and hear it at your dealer or write today to PACO Electronics Co., Inc., Glendale 27, New York.

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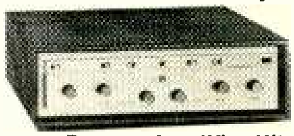

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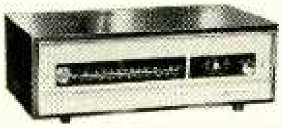

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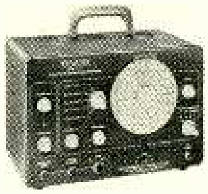

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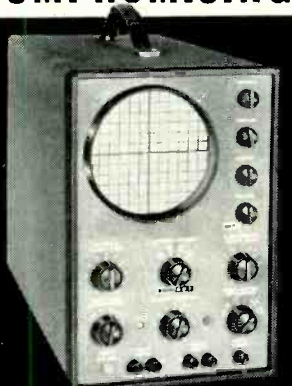

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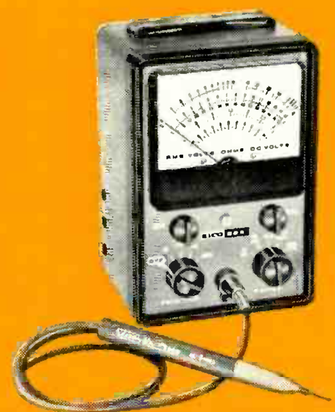

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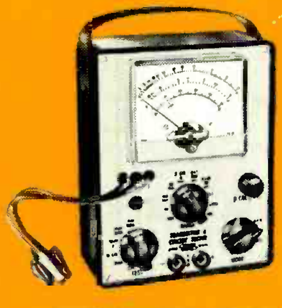

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Radio-Electronics
Hugo Gernsback, Editor-in-Chief

SENSELESS ORBITING

. . . Aping the Soviets Doesn't Get Us to the Moon . . .

AFTER an unnecessarily late start into the space age on Feb. 1, 1958, four months after Sputnik I, the US is still slavishly imitating the course of the Soviets.

When the Russians orbited a man around the earth on Aug. 6, 1961, then another on Aug. 12, 1961, we followed suit on Feb. 20, 1962, and May 24, 1962. But the Russians made 1, then 17-½ orbits against our 3 each. On Aug. 11 and Aug. 12, 1962, the Soviets accomplished 64 and 48 orbits against our 6 on Oct. 3, 1962. This makes a total of 4 Soviet manned orbits against our 3. But the Russians' orbits far exceeded ours—130-½ against the US' only 12.

Why all this frantic orbiting around the earth? Because airless space is a totally new experience to man, it must be well tested to make certain that he can survive long space trips. On top of the deadly vacuum of space, another totally new experience was added when man first began orbiting in space—weightlessness. Could he stand this too? Yes, he could and did.

All these facts had been predicted as feasible by physicists, astronomers and others for many decades. Fifty years ago, the present writer, in his magazine *Modern Electrics* (March 1912), spoke of weightlessness in space and *space sickness*. Recent experiences have shown that like seasickness, space sickness is suffered not by all individuals but only by a certain percentage. Today, too, we have medicines to counteract space nausea.

The point is that modern space flying is not a new or recent art—it is indeed over 100 years old. Many scientists have occupied themselves with all its phases for a long time. Its laws, its physics have been thoroughly known and discussed in textbooks for decades. Astronomers and mathematicians have solved the laws of space flight, trajectories, orbits and the elapsed time of all contemplated interplanetary flights.

Then why do the Russians lead and we follow in space? Their longer experience in rocketry has given them an edge. Unfortunately, when our own Prof. R. H. Goddard, of Clark University—the father of space rocketry—did his celebrated pioneer work during 1914 to 1945, nobody in high government listened to him and to his epoch-making discoveries. A few men in our War Department did appreciate his work, but the astronomically high costs of going into space research discouraged our Government. *Had we started at that time, we probably would now be ahead of the Soviets.*

In our opinion, we should stop NOW the senseless earth-orbiting manned rocket experiments. We do not believe that any further such orbiting will enhance our space knowledge to a large degree.

We know and are fully convinced that we are ahead in electronics and all its know-how. It is axiomatic that rocketry and space exploration is unthinkable without electronics.

We know, too, that our astronauts are well trained and do not lack in courage as explorers into the unknown, any more than Columbus or Lindbergh did.

We know, too, that our real goal in space is the moon. But we are wasting too much time on nonessentials. Washington space people tell us that, at present, imagination, vision and urgency are lacking in many of our space departments. What we need is a new approach to the moon problem, NOW—not in 1965 or 1967.

The money and effort spent in useless earth orbiting could better be used in doing first things first.

Most scientists and space technicians are convinced that what is urgently needed now is to place an *unmanned* exploring pilot vehicle on the moon immediately. Fortunately we are working in that direction now.

Moreover, we have the means to accomplish it now—particularly when it comes to electronic telemetry and guidance.

We have multiple rockets with sufficient thrust to orbit the moon, either instrumented or manned; then by telemetered television we can pick the best location to land an electronic explorer from the same rocket.

This is the prime requisite for landing a manned moon crew subsequently. No one today knows the consistency of the moon's surface. Scientists speculate that in the several billions of years of existence it may be covered with a layer of quicksand-like dust that could be hundreds of feet deep, or only a foot thick. Patently, men should not make a lunar landing under such hazardous conditions.

And that is the chief reason for a fully electronically instrumented explorer in advance of a manned landing.

In the exploration of the moon, we should also speak of low moon orbiting. Such orbits can either be polar or equatorial. The moon being airless, lunar satellites are not hampered by an atmosphere. Thus, such orbits could be extremely low, if it were not for the moon's mountains which rise to peaks of 30,000 feet, or more than 5 miles. The orbiting satellite must clear such elevations. Perhaps the lowest moon orbiter should be at least 20 miles above the surface. The time of revolution at such an altitude is about 1 hour 52 minutes. But the orbiting speed of such a low satellite is nearly 1 mile a second—too fast for visual observation of the lunar topography. The solution: Make a taped cinematographic record which later can be inspected at a slower speed.

In résumé: **1.** Stop aping the Russian manned earth orbits. Our goal is the moon as the first vital space objective.

2. Fire into a low moon orbit a rocket that carries an electronic-instrumented explorer.

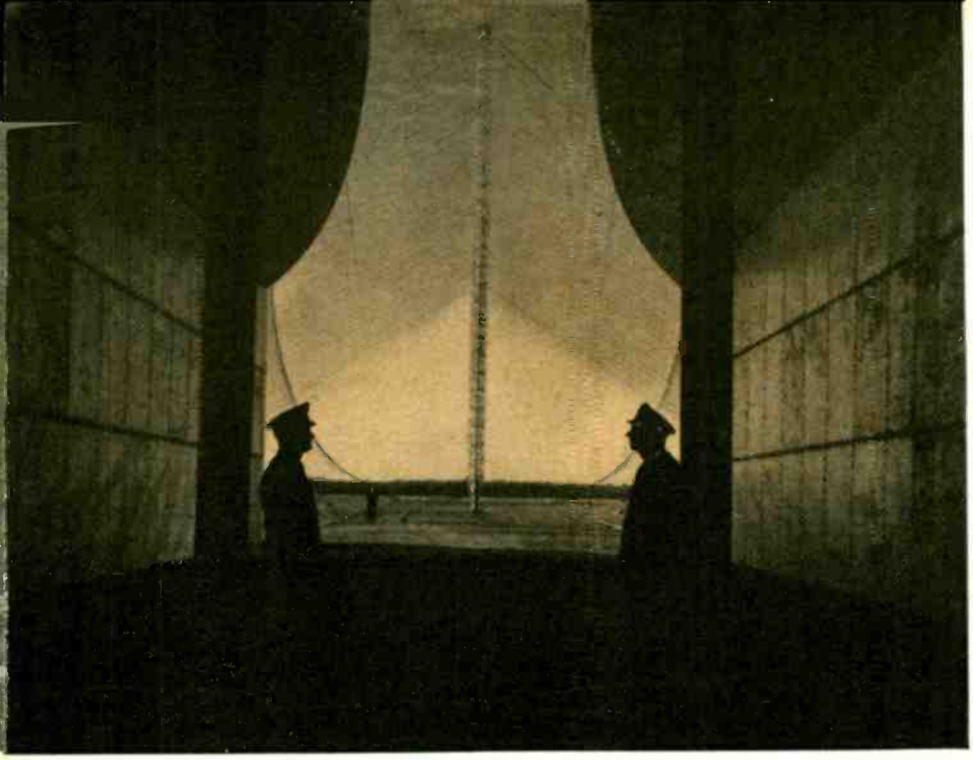
3. Release the manless robot explorer from its mother rocket and set it onto the moon to make hundreds of tests, including a television survey of the moon's surface, these to be sent electronically coded to earth for evaluation.

Once we have complete data on the moon's surface and its consistency—then and only then should we undertake a manned lunar landing, for which we should be ready then.

—*H. G.*

Merry Christmas—Happy New Year

The Staff of Radio-Electronics



TAHA Tapered Aperture Horn Antenna

Longest, largest single antenna for point-to-point fixed communications

By JORDAN McQUAY

WORLD'S LARGEST AND MOST UNIQUE DIrectional antenna is the TAHA—*T*apered *A*perture *H*orn *A*ntenna—now regularly used for long-range hf (high-frequency) fixed reception at the Army Signal Corps station, La Plata, Md.

At this giant site—terminal receiving point for overseas circuits of the Army global communications system—are many rhombics and special antennas that are usually effective for hf dx signal reception.

In the event of international hostilities, however, none of these may provide the high degree of directivity and selectivity required for extremely reliable—particularly jam-proof and interference-proof—global communications.

This critical and strategic need led to the design and development of the TAHA, an immense structure with all the advantages of a conventional rhombic *plus* greater directivity and selectivity, and broader bandwidth.

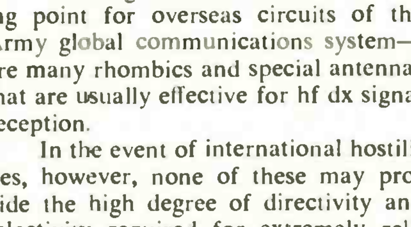
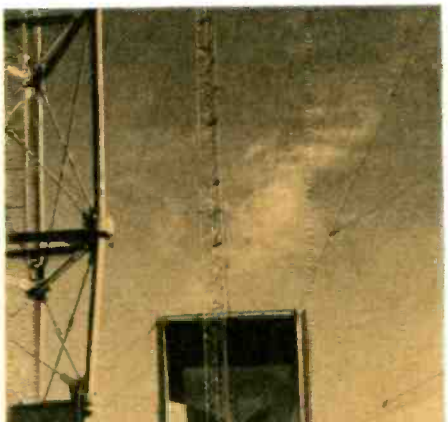


Fig. 1—Electric field distribution at horn aperture.



View of TAHA from ground inside reflecting horn, looking toward waveguide feed.

Operating within a range of 5 to 25 mc, the TAHA is permanently oriented to "work" with one, and only one, of the several, distant, fixed transmitting stations of the Army global system.

These transmitting stations are variously located in Eastern Africa, the Near East, the Philippines and elsewhere around the world. Thus, the TAHA requires an individual antenna to link with each of the distant transmitting sites. In the meantime, conventional rhombics are used for routine reception on these international circuits.

As with a rhombic, the larger the size of the TAHA, the greater its directivity and selectivity. This is an oversimplification, of course, because a practical limit to increasing physical size is set by factors of mechanical construction.

That limit is reached in the present size of the TAHA, which has the desired characteristics of directivity and selectivity for long-range hf global communications.

The complete antenna—tapered horn, waveguide feed and supporting structure—is nearly a quarter of a mile long.

Looking at the open mouth, the aperture is over 500 feet wide and 250 feet high. The opposite or terminal end of the horn is 40 feet wide and 80 feet high—precisely matching the size of the open waveguide feed, contained in a metal housing 40 x 80 x 80 feet.

Total ground area encompassed by the TAHA and supporting system is nearly 17 acres. The tapered horn, excluding guy wires, covers nearly 7 acres.

Horn characteristics

The tapered horn operates essentially as any open-ended horn antenna.

The electric field distribution at the aperture is shown in Fig. 1. Despite truncation, the E-field intensity across the aperture is maximum at center, and tapers smoothly to zero at all edges.

Characteristics of the reception (and radiation) pattern are influenced primarily by the large *size* and the truncated *shape* of the aperture. This pattern has a 10° beam width in the horizontal plane—similar to an equivalent rhombic, but almost devoid of sidelobes. Sidelobes of the TAHA are down more than 20 db from the maximum of the main lobe.

Broad bandwidth characteristics of the TAHA are on the order of 3.5 to 1—better than an equivalent rhombic.

The TAHA can be operated at any frequency within the high-frequency range of 5 to 25 mc, because the entire antenna has no resonant elements.

High-gain directivity coupled with broad bandwidth make the TAHA invaluable as an interference-rejecting antenna for long-range point-to-point reception, despite its fixed azimuth and elevation.

Waveguide feed

Upon entering the aperture, received radio waves pass along the inside of the tapered horn to the terminal, where the waveguide feed is located. The waveguide feed couples the tapered antenna to a 72-ohm coaxial transmission line leading to conventional high-frequency receivers.

The terminal opening of the horn is an upright rectangle 40 feet wide and 80 feet high. Coupled directly to this is an 80-foot length of rectangular waveguide, having the same 40 x 80-foot opening and an identical tapered ridge on each side wall (Fig. 2). Top, bottom, side and back surfaces are covered with galvanized sheet steel. Only the front surface is open, where it connects electrically and mechanically with the terminal of the tapered horn antenna.

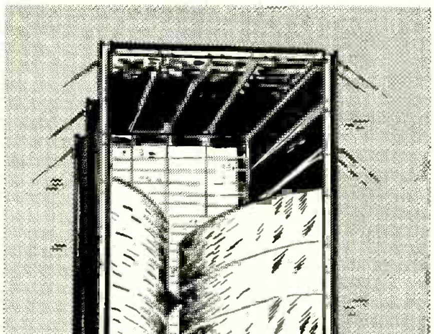
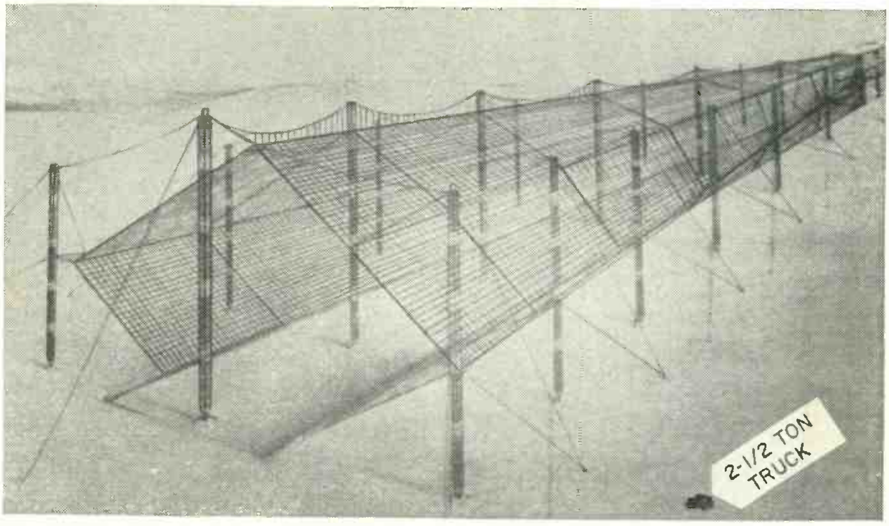


Fig. 2—Heart of the antenna, the waveguide feed.



The completed TAHA.

Each of the two ridges is about 30 feet in height. They taper back until they are separated by about 6 feet—at which distance they are removed about 5 feet from the metal surface of the back wall.

Mounted on one of the ridges, about 6 feet from the back wall, is a 5-foot conical probe. The entire cone is active, and therefore the apex is mounted physically well beyond the center point between the two metal ridges. The base of the cone is positioned about 1 inch from the actual surface of the mounting ridge. The center conductor of a standard 72-ohm coaxial transmission line is connected to the conical base. The outer conductor is attached to the metal ridge. The only insulator in the entire TAHA assembly is a small bushing at the point where the transmission line connects with the conical probe.

Received radio waves passing through the terminal of the tapered horn impinge upon the metal surfaces inside the waveguide feed, and are collected by the conical probe mounted horizontally across the gap at the rear of the two metal ridges. From that point, the signals travel via the transmission line to conventional hf receivers.

Construction

The aperture of the tapered horn antenna is truncated by the ground, mainly to minimize structural problems.

The ground is actually the bottom of the antenna, consisting of copper mesh imbedded in a flat asphalt surface, which runs beneath the entire horn and the waveguide feed. The copper mesh is bonded to the wire-grid sides of the horn antenna.

The sides and top of the tapered horn antenna are constructed of wire-grid panels of No. 8 Copperweld wire. Transverse wires are uniformly spaced at 24-inch intervals. Longitudinal wires are spaced at varying distances—from about 10 inches at the waveguide feed to as much as 8 feet near the horn aperture.

The sides and top of the horn are supported by a guyed structure composed of 18 steel towers of graduated height—plus catenaries, stays, hangars and secondary cables. All guy wires are outside the horn antenna—eliminating the need for strain insulators.

All parts and components of the TAHA—the horn antenna, the waveguide feed, and all towers, guys, stays and supports—are connected together *and grounded together.*

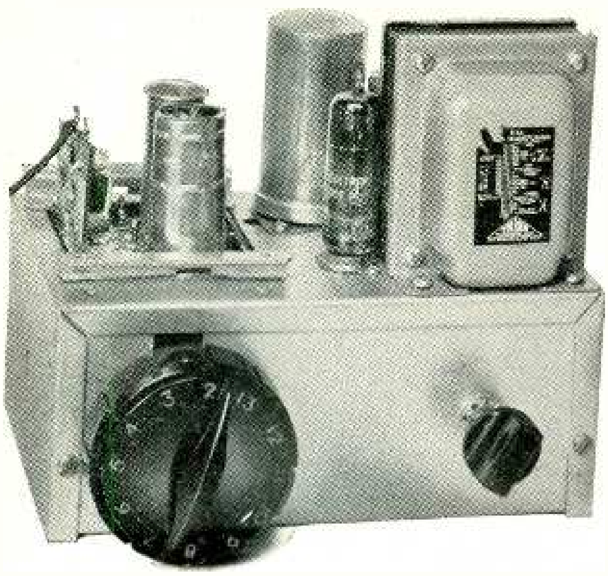
Future types

Principal characteristics of the first TAHA have been evaluated and verified during actual operation over considerable periods of time. Comparison tests were also made between the TAHA and equivalent rhombics.

Collated data from these various dynamic tests are now being applied to research and development of improved designs and modifications of the TAHA. Areas of current study include changes in density of wire grids of the horn antenna, use of wire screens to enclose the waveguide feed, use of various types of probes in the waveguide feed, and use of polarization diversity reception.

A TAHA for transmitting purposes is also under development—requiring only minor design modifications in the receiving type. It will have similar electrical characteristics, but will be capable of handling almost unlimited power. It will operate from a 300-ohm balanced transmission line, and in the same high-frequency range.

The TAHA was designed, developed and constructed for the Army Signal Corps by the Developmental Engineering Corp. Cost of the first TAHA, including engineering design and development, exceeded $900,000. END



The converter is a neat little package about twice the size of a TV tuner.

Simple converter adds TV sound to your FM tuner

high-fidelity TV sound

By M. HARVEY GERNSBACK
EDITOR

Have you ever tried piping TV sound through your hi-fi system when a particularly good program was on? Taking the sound from the ratio detector of the typical intercarrier TV leaves a lot to be desired. Sync buzz, distortion and background noise show up like a sore thumb when fed through a good audio system.

If you own a good FM broadcast tuner, you can build a converter to provide high-fidelity, noise-free reception from the sound channels of your local TV stations. If the FM receiver is sensitive and you have a reasonably good TV antenna, it will provide good sound reception from TV stations up to 75 miles away.

The unit converts the TV sound carrier of any TV channel to 88 mc. This is within the tuning range of any FM receiver or tuner (tuning range 88–108 mc). The FM tuner picks up the 88-mc output of the converter and handles it as though it were an FM station operating on 88 mc.

Unlike previous converters this one does not require two local oscillators to convert the TV sound carrier to 88 mc. Only one is necessary.

Suppose your local TV station is channel 4. The sound carrier of channel 4 is at 71.75 mc. We use an ordinary 44-mc i.f. TV front end at the input of our converter to change this to a 41.25-mc sound i.f. But we need 88 mc. Suppose we added a doubler–amplifier to the TV front-end output. This would produce a new i.f. at two times 41.25, or 82.5 mc. That's better, but it's still not 88 mc.

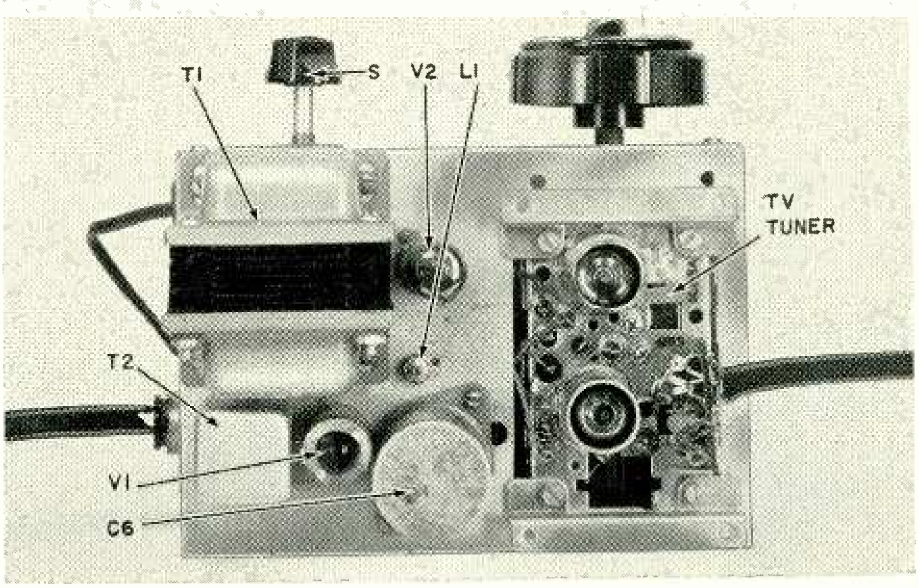
But we can change the i.f. output of the TV front end by changing the local oscillator frequency (adjusting the oscillator slugs or trimmers) and retuning the i.f. output slug to match. Suppose we raise the oscillator frequency by 2.75 mc. This will raise the sound i.f. output by the same amount to 44 mc. Now if we double 44 mc we should have the 88-mc i.f. we want! This sounds fine—but will it work? The answer is yes! The tuning range of the slugs on most TV front ends permit a shift of 4 or 5 mc, and a simple one-tube doubler–amplifier (an overbiased i.f. amplifier with its grid tuned to 44 mc and its plate to 88 mc) is all we need to complete the job.

Why not use a 21-mc front end?

"Fine," you say. "I've got an old 21-mc TV front end stashed away in the corner. I'll set its output to *22 mc and double twice* (quadruple to you) to get my 88-mc output!" I've got sad news for you: The output on your FM tuner will probably sound very distorted! Here's why.

An FM signal swings back and forth across its nominal carrier frequency, the amount of swing corresponding to strength of modulation. FCC rules for FM *broadcast* stations specify a maximum swing of ±75 kc at 100% modulation (a total band of 150 kc) and the FCC assigns station channels 200 kc apart, providing a 50-kc guard band between channels. FM receiver designers take this into account and provide a selectivity characteristic which will pass a bandwidth of from 150 to 200 kc so that the modulation peaks won't be chopped off.

Unlike FM broadcast stations, the FM sound channel of a TV station is allowed to swing only ±25 kc (50 kc total bandwidth) at 100% modulation



Top chassis view showing parts layout.

to conserve channel space.

Now let's go back to our i.f. amplifier–frequency-doubler stage. When we doubled the 44-mc TV sound carrier, *we also doubled its frequency swing.* The resulting 88-mc signal has a frequency swing of ±50 kc around 88 mc. (Remember that TV sound transmissions swing only ±25 kc.) This swing is still less than the ±75 kc of FM *broadcast* stations so the FM receiver will handle it with no trouble. But suppose we used a 22-mc i.f. and quadrupled it. *Our frequency swing would also be quadrupled* so we would have an 88-mc signal swinging ±100 kc. This is 25% greater swing than FM broadcast stations; the selectivity of most FM receivers would be too great to handle it. Serious distortion of a clipping type would occur every time the signal swung to its maximum during modulation peaks. Another objection to the 21-mc front end: Quadrupling would require a two-stage doubler, adding another tube and i.f. transformer and complicating construction.

The final circuit

The finished converter is a four-tube job: two tubes in the TV front end—a 6ER5 rf amplifier, and a 6CG8-A oscillator-mixer—and a 6EW6 44- to 88-mc doubler-amplifier, and a 6X4 rectifier.

The front end is a Standard-Kollsman GG-4290-A guided-grid replacement type 40-mc TV front end. We used it because of its compactness, general availability and good performance. An earlier converter using a surplus RCA KRK-29 cascode tuner gave equally good performance. However, the RCA tuner is much bulkier and readjusting the oscillator slugs is trickier. Also, it may no longer be generally available. *Any* 40-mc TV front end should work out satisfactorily. (If you are in a uhf TV area, uhf strips are available for the GG-4290A front end.)

We show two schematics—one for use with the Standard tuner (Fig. 1), the other for the earlier RCA job (Fig. 2). The only differences are in the resistors in the B-supply and in the method of coupling the TV front-end outputs to the 6EW6 grid.

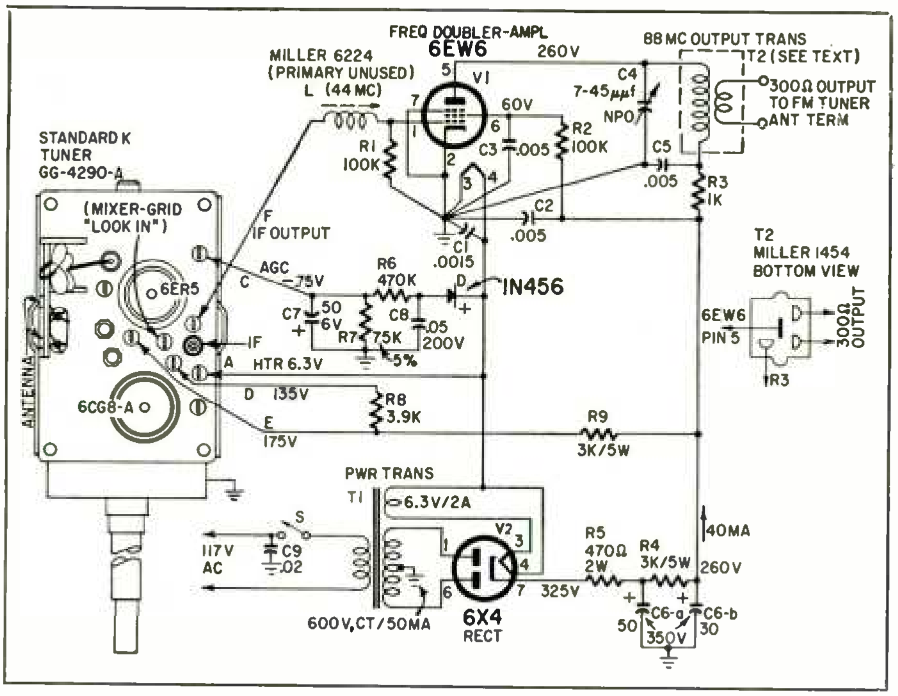
Construction

A one stage amplifier–doubler does not present any real construction problems. But the high frequencies require careful parts placement and one-point grounding to the chassis. Note that R1, C1, C2, C3, C4 and C5 ground to a common point at the socket of V1. This is important and must be done.

The Standard tuner is mounted in a 3½ x 2½-inch cutout in the 3 x 5 x 7-inch aluminum Minibox. It is clamped to the Minibox with the mounting brackets supplied with the tuner. The original converter had the KRK-29 tuner mounted outside the Minibox and secured to its side by a metal bracket. The KRK-29 tuner is larger than the Standard tuner.

In wiring output transformer T2, note that, although it is a standard FM antenna coil, we are using it with reversed connections. The normal secondary is used as the primary, tuned by ceramic trimmer C4. The 300-ohm primary is used as our secondary to couple the converter to the FM receiver antenna terminals.

The type 1454 transformer that we used was dropped from the 1962 Miller catalog but your dealer may still have one in stock. If not, you may use the Miller type 1447. This is an unshielded slug-tuned FM antenna transformer. In this case, replace trimmer



R1, R2—100,000 ohms
R3—1,000 ohms
R4, R9—3,000 ohms, 5 watts
R5—470 ohms, 2 watts
R6—470,000 ohms
R7—75,000 ohms, 5%
R8—3,900 ohms
All resistors ½-watt 10% unless noted
C1—.0015 μf, ceramic disc
C2, C3, C5—.005 μf, ceramic disc
C4—7–45 μμf, NPO, ceramic trimmer
C6—50-30 μf, 350 volts, electrolytic
C7—50 μf, 6 volts, electrolytic
C8—.05 μf, 200 volts, paper
C9—.02 μf, disc ceramic
D—1N456
L—44-mc coil (secondary of Miller No. 6224 transformer, primary not used)
S—spst toggle
T1—power transformer: primary, 117 volts; secondary, 650 volts ct, 50 ma; 6.3 volts, 2 amps (see text for data on optional transformer or use Triad R-7A or equivalent)
T2—88-mc transformer (Miller No. 1454 or 1447, see text)
V1—6EW6
V2—6X4
Tuner—Standard Kollsman GG-4290-A or RCA KRK-29
Chassis, 3 x 5 x 7 inches
Miscellaneous hardware

Fig. 1—Converter circuit using Standard Kollsman GG-4290-A TV tuner.

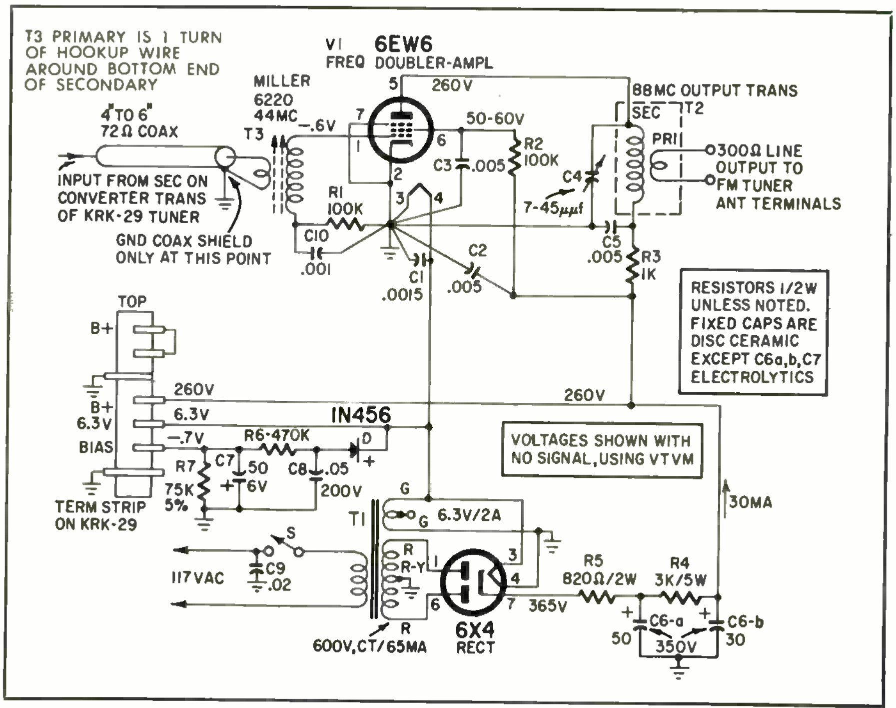


Fig. 2—Circuit for using RCA KRK-29 TV tuner.

C4 with a mica capacitor of around 25 μμf and peak the coil with the slug. Add a shield can (Miller S-32 or equivalent), if needed, for stability.

Power supply

B-supply voltage should be within 15% of the value shown on the schematics. However, the B-voltages applied to the TV front ends are *maximum* values and should not be exceeded, unless you plan to replace the tubes frequently!

We used a 600-volt center-tapped power transformer because our original unit required 260 volts for the KRK-29 tuner. The 6EW6 doubler–amplifier tube can operate with its plate voltage as low as 175 with only a slight reduction in gain. Since the Standard tuner needs a maximum of only 175 volts, you can substitute a lower-voltage transformer for T1, such as a 470 or 500-volt center-tapped 40-ma unit (Stancor PC8401, Triad R4A, etc.), and operate the 6EW6 plate at the same voltage as that supplied to the TV tuner (175 volts). In this event, omit R9.

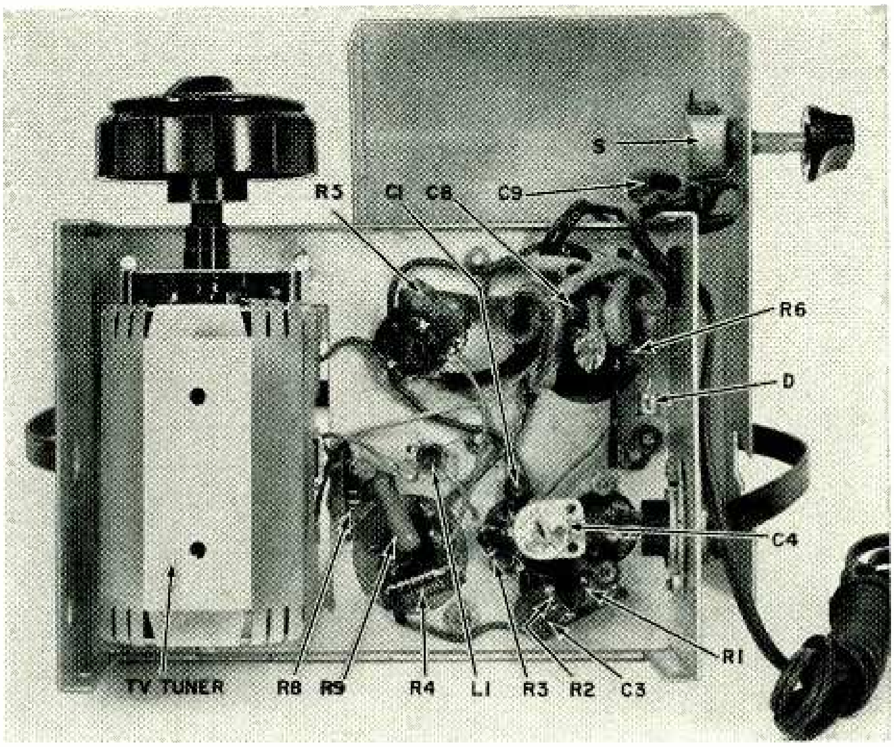
Alter the value of R5 by small amounts to set the B voltage at the proper value. We used a 2,000-ohm 5-watt potentiometer as a variable R5 in designing the converter. It was replaced with a fixed resistor after proper voltages were established and the correct value found for R5. (In some cases R5 may be unnecessary.)

Although we found it unnecessary to bias the tuner rf tube to prevent overloading at our location 25 miles from New York City, it may be necessary if you are close to a TV station. The bias arrangement shown in the schematics (silicon rectifier D and R6, R7, C7 and C8) provides a negative bias of about −0.75 volt. This is needed in the Standard tuner to prevent damage to the 6ER5. Although not strictly necessary if you use a cascode tuner such as the RCA KRK-29, it will extend the life of the 6BQ7-A with only a slight reduction in weak signal sensitivity. And this bias circuitry can be simply modified to provide up to −4 or −5 volts (by increasing the value of R7) if you need to reduce sensitivity to prevent overloading in very strong signal areas.

Alignment

The oscillator frequency on each channel of the front end must be raised by 2.75 mc (assuming that the front end was originally aligned to a sound i.f. of 41.25 mc, the commonest one used). (If you have a strong FM station on 88.1 mc, or one local TV station on channel 6—sound at 87.75 mc, you may select an i.f. slightly above or below 88 mc. Adjust the oscillator slugs and converter i.f. to the particular i.f. you select.) The procedure varies with different tuners. An *accurate* marker generator (preferably with a heterodyne detector) is essential.

Set the marker at the new oscillator frequency for each channel in turn (see chart). Place the converter



A look under the chassis.

in operation (with the 6EW6 i.f. tube removed), loosely couple an insulated wire from the if input of the marker generator detector to the oscillator tube of the front end (loop the wire around the oscillator tube inside the shield and leave the tube shield in place). Tune the front end to the same channel that the marker is tuned to. Set the front-end fine-tuning control at its mid-point and *slowly* raise the front end's oscillator frequency by adjusting the oscillator slug at the front of the Standard tuner for less inductance. If you use other tuners, follow the manufacturers' instructions.

When the oscillator frequency reaches that of the marker, you will hear an audible beat through the marker's loudspeaker or headset. Adjust for zero beat. Then switch both marker and front end to the next channel and repeat the procedure until all channels have had the oscillator frequency raised 2.75 mc. *Do not touch the rf or mixer trimmers on the front end.*

On some channels it may be necessary to change the fine-tuning control setting to a point near one end or the other of its travel to hit the new frequency. In my case this occurred only on channel 2 which comes in near the counterclockwise position. Next

Oscillator Frequency Alignment Chart

Chan.	Sound Chan. (mc)		Osc. Freq. (mc) for 44-mc if
2	59.75	+ 44 mc =	103.75
3	65.75	+ 44 mc =	109.75
4	71.75	+ 44 mc =	115.75
5	81.75	+ 44 mc =	125.75
6	87.75	+ 44 mc =	131.75
7	179.75	+ 44 mc =	223.75
8	185.75	+ 44 mc =	229.75
9	191.75	+ 44 mc =	235.75
10	197.75	+ 44 mc =	241.75
11	203.75	+ 44 mc =	247.75
12	209.75	+ 44 mc =	253.75
13	215.75	+ 44 mc =	259.75

(uhf channels follow same procedure.)

insert the 6EW6 i.f. amplifier–doubler tube and tune the marker to 44 mc.

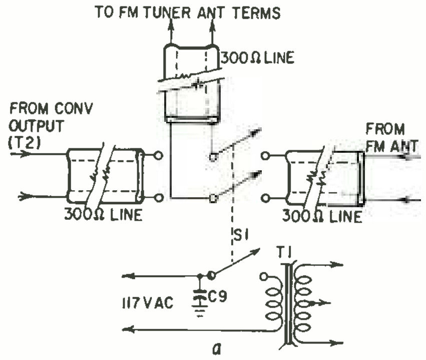
Feed the 44-mc signal into the TV front-end mixer grid through the usual grid "look-in" point. Connect a vtvm with a crystal demodulator probe to the plate of the 6EW6. Adjust the i.f. slug on the front end (Fig. 1) for maximum output. Do the same with the slug on L (Fig. 1) (T3 on Fig. 2). Next, connect the crystal demodulator probe across the 300-ohm secondary of T2 and adjust C4 for maximum output. (If a sweep generator and oscilloscope are available, a more accurate alignment can be performed in conjunction with the marker generator.)

Operation

Connect the TV antenna to the converter's antenna terminals. (In my location, an outdoor FM antenna works well as the source of TV signals for the converter.) Connect T2's secondary through a length of 300-ohm lead to the FM receiver's antenna terminals. Tune the FM receiver to 88 mc (make sure your receiver dial calibration is accurate and that you are actually tuned to the converter's intermediate frequency). Now set the converter channel changer to the desired TV channel and adjust the fine-tuning control till the TV sound comes out of the speaker of your FM set.

That's all there is to it! There is no output unless the converter is tuned to a TV station. Adjust volume at the FM set. At some settings of the converter fine-tuning control you may hear buzzing. You are tuning in the video portion of your TV station. CAUTION: If your FM set has warmup drift, it may be necessary to retune to 88 mc after warmup to insure good reception from the converter. The converter itself may show a small amount of warmup drift, too, particularly on the high band.

One final point. If one of your TV stations is on channel 6, you may have difficulty receiving it with this unit. Channel 6 sound transmission is at 87.75 mc, very close to our 88 mc i.f. You *may* have feedback from the converter output to input. However, most FM tuners can tune in channel 6 directly without a converter. In this case, you may have to listen to channel 6 directly and other channels through the converter. In our case we had no difficulty in receiving channel 6, Philadelphia (about 60 miles distant), on the converter.



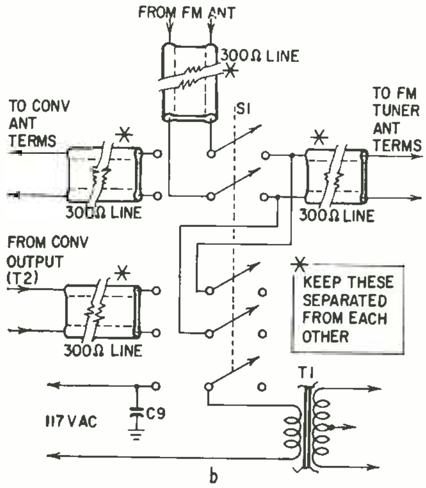


Fig. 3—Two options for making the unit more flexible: a—Combination antenna–power switch bypasses the converter and connects the antenna directly to to the FM tuner when the converter is turned off. b—This switching circuit is used if you can use your FM antenna with the converter.

Two minor refinements can be added by the perfectionist—a pilot light to remind you that the converter is on, and a combination antenna transfer-power switch which will bypass the converter and connect the FM antenna directly to the FM tuner in the *off* position (Fig. 3-a). The TV antenna is used for the converter input.

If you find it possible to use your FM antenna with the converter, use the circuit of Fig. 3-b.

With this unit you will find that TV sound will be of as good quality as the output of your FM tuner. It will be limited only by the fidelity of your TV station's sound, which, like the little girl, is very good indeed when it's good, but when it's bad it's terrible! END

SW PROPAGATION FORECAST

Nov. 15—Dec. 15

By STANLEY LIENWOLL*

The nighttime maximum usable frequencies (MUF's) are normally lower at this time of the year. This, combined with the continued decrease in sun spot activity, will make useful nighttime frequencies lower than at anytime since 1955. A 5 to 7 mc range will be the best to most areas of the world during the hours of darkness. In daylight hours, the range of optimum frequencies will increase. Frequencies as high as the 10-meter amateur band will be open during short periods over some circuits. By next winter, however, 10 meters should not be open to any area of the world via normal F-layer propagation.

The tables here show the optimum frequency in mc for short-wave propagation between locations shown during the time periods indicated.

Select the table most suitable for your location, read down the left side to the region in which you are interested, follow the line to the right until you are under the appropriate time. (Time is given in 2-hour intervals from midnight to 10 pm, in local standard time.) This figure is the optimum working frequency in mc. The best band is the one nearest the optimum working frequency.

These tables are designed to serve primarily as a guide, since day-to-day variations in receiving conditions can be significant. At certain hours, propagation over some paths given in the tables may be extremely difficult or impossible. This will depend on the type of service, antenna characteristics, transmitter power, etc. The curves from which the data in the tables are derived are based on an effective radiated power of 10 kw. These curves are representative for the paths given. Thus, the data over the Eastern USA to Western Europe path is based on a circuit analysis curve over the Washington, D. C., to Bern, Switzerland circuit. On circuits further north (e.g., Bangor, Maine to London, England) frequencies will be somewhat lower than those shown, while a circuit from Miami, Florida to Rome, Italy will require frequencies one or two mc higher than those given.

EASTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	5	5	8	21	22	23	14	9	7	7	6
East Europe	5	5	6	7	20	21	13	8	7	7	6	6
Central America	11	10	9	14	24	24	25	28	28	22	12	11
South America	10	10	7	9	22	23	23	24	22	15	12	11
Near East	6	6	5	8	22	22	13	10	9	9	8	6
North Africa	7	6	6	10	23	27	22	16	10	9	9	8
South & Central Africa	7	7	7	14	26	27	26	23	20	13	9	8
Far East	8	7	6	6	7	7	8	7	7	15	15	8
Australia & New Zealand	9	9	8	7	12	12	18	22	24	23	13	12

CENTRAL US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	5	6	6	7	22	23	15	9	7	7	6	5
East Europe	6	7	6	7	16	12	8	7	7	7	7	6
Central America	9	9	7	16	24	25	24	23	20	14	10	9
South America	9	8	7	16	25	25	25	24	18	14	11	10
Near East	7	7	6	8	17	14	9	9	8	7	6	6
North Africa	6	7	6	10	24	25	14	10	8	7	7	7
South & Central Africa	8	7	7	15	24	28	28	26	20	14	10	9
Far East	6	6	6	5	7	8	6	8	22	22	10	7
Australia & New Zealand	11	10	8	7	12	18	23	26	26	20	14	11

WESTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	5	6	6	7	20	17	9	8	6	6	6	5
East Europe	7	7	7	7	14	8	8	8	8	7	7	7
Central America	9	8	7	16	23	24	27	27	28	20	12	10
South America	9	8	7	18	27	24	24	23	19	12	11	10
North Africa	7	6	6	10	20	20	12	8	7	7	7	6
South & Central Africa	8	8	7	15	26	26	24	18	16	12	9	9
Far East	6	6	6	6	6	7	7	19	27	18	12	7
South Asia	6	5	5	5	7	13	11	9	15	19	11	7
Australia & New Zealand	11	9	6	5	14	21	26	27	27	26	16	12

* Radio-frequency and propagation manager, Radio Free Europe.

By ROBERT G. MIDDLETON

9 Steps to chroma circuit servicing

A color TV servicing procedure worth remembering . . . and using

TUBES HAVE BEEN REPLACED, BUT WE still have rainbows (Fig. 1)—color sync is unstable or completely lost. The first step is a signal-tracing procedure, to locate the defective stage. With a wide-band scope and a low-capacitance probe, we check the waveform at the input of the burst amplifier—(1) in Fig. 2. This tells us whether the trouble is in the chroma section or in the preceding video section. (The video section includes the video amplifier, i.f. amplifier and rf tuner).

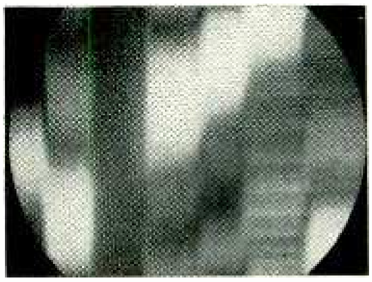


Fig. 1—Rainbows in a color-bar pattern.

Here we are concerned with the burst amplitude (Fig. 3). The burst normally has the same peak-to-peak amplitude as the horizontal sync pulse. Although we can use a color TV station signal in this test, a color bar generator is preferred. The generator has a normal output signal which is not affected by characteristics of the antenna, by technical difficulties in the station network or by propagation anomalies.

First step

Burst attenuation points to poor i.f. or rf alignment, or to inadequate high-frequency response in the video amplifier.

Second step

Now we check the keyer pulse from the flyback transformer, (2) in Fig. 2. The burst amplifier can be compared with a keyed-agc tube—it conducts only when the keying pulse is present. If there is no keying pulse, the burst signal cannot pass through the burst amplifier. If the keying pulse is weak, the output from the burst amplifier is weak. A typical keying pulse is shown in Fig. 4. Use a calibrated scope, and check the pulse amplitude against the value specified in the service data. If the pulse is weak or absent, stop here and trace back into the flyback section. The keyer winding may be broken down, or there may be a defective capacitor or resistor in the keyer circuit.

Third step

When burst and keying signals to

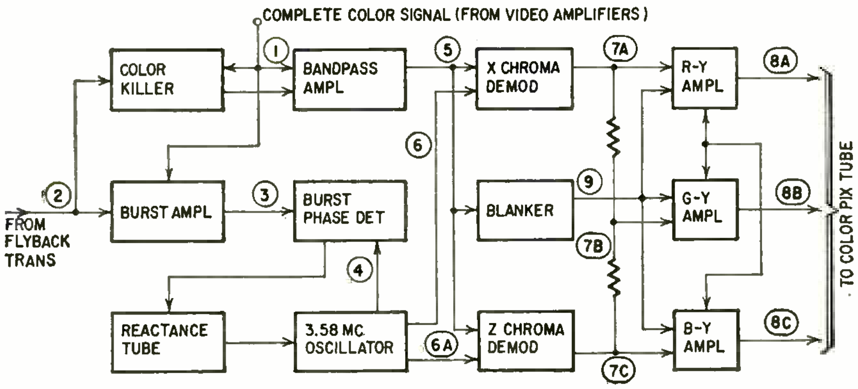


Fig. 2—Nine chief chroma-signal test points.

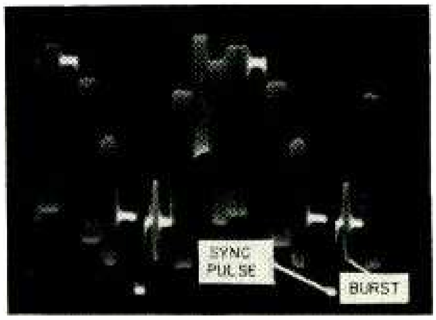


Fig. 3—Burst and sync pulse normally have the same peak-to-peak amplitude.

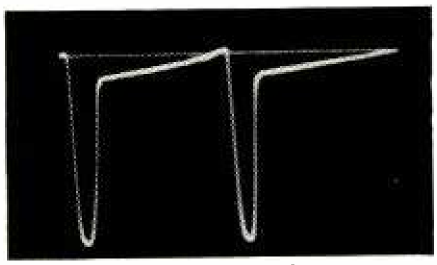


Fig. 4—Typical keying pulses.

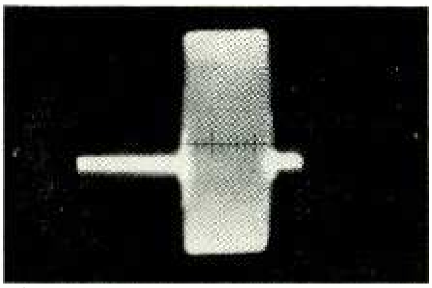


Fig. 5—Output from a typical burst amplifier.

the burst amplifier are normal, we should see the output waveform shown in Fig. 5 from the burst amplifier. Check with a wide-band scope and low-capacitance probe at (3) in Fig. 2. Although the waveform in Fig. 5 is unsymmetrical, this is not a matter for concern. Many burst amplifiers are nonlinear. What we *are* interested in here is the amplitude of the output waveform—check its peak-to-peak voltage against the service data. If its amplitude is down more than 20%, the trouble will be in the burst amplifier. Use a vtvm to measure the dc voltages in the burst-amplifier circuitry, just as in black-and-white troubleshooting. Check capacitors for leakage, shorts or opens. Look for off-value resistors. Investigate alignment last, because it is least likely to be at fault. However, there is a possibility that the slug(s) in the burst-amplifier transformer may need touching up.

Fourth step

When burst amplifier output is normal, we go to the burst phase detector in tracking down the loss of color sync. The burst phase detector has two signal inputs—the burst-amplifier output and the 3.58-mc oscillator signal. The latter is checked at (4) in Fig. 2. You should see the pattern of Fig. 6. Note that, although this is actually a sine wave, it appears very cramped on most scopes, because of its comparatively high frequency. Also, in Fig. 6, there is a jitter in the scope sync action which makes the waveform appear somewhat as a series of vertical lines—many service scopes do not lock tightly on a 3.58-mc frequency.

However, we are concerned only with the amplitude of the waveform. Compare its peak-to-peak voltage with the value specified in the service data. If low, check the coupling capacitor between the 3.58-mc oscillator and the burst phase detector. It may be leaky or open. Of course, there may be a defect in the oscillator circuit, such as low plate-supply voltage. So make dc voltage and resistance measurements in the oscillator circuitry, if necessary.

But color sync can be lost even with normal amplitude, if the oscillator *frequency* is incorrect. Modern color receivers generally have an L-C oscillator circuit, provided with a tuning slug. Do not forget to touch up the oscillator tuning slug, to try and lock in the color sync. An ideal check here is to place the input lead of a heterodyne frequency meter near the oscillator tube, and measure the operating frequency on the meter scale. Unfortunately, many shops do not have a calibrated frequency meter, and the oscillator frequency can be judged only indirectly by observing receiver circuit action.

Note that oscillator section is associated with the reactance-tube circuit (Fig. 2). If there is a defective capacitor, off-value resistor or incorrect supply voltage to the reactance-tube circuit, it will be impossible to make the 3.58-mc oscillator zero-beat with the burst. In most receivers, the output circuit of the reactance tube contains a tunable coil, which is also the input of the oscillator circuit. We will have tried to adjust it when checking out the oscillator. Capacitors are the most common trouble makers.

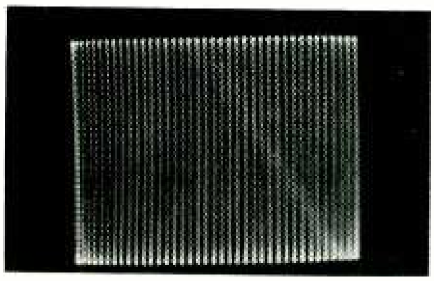


Fig. 6—Subcarrier input to burst phase detector.

Final tests in tracking down loss of color sync are made in the burst phase-detector circuit, a comparatively simple section consisting of a duo-diode and a few resistors and capacitors. With normal inputs feeding into the phase detector, loss of color sync is necessarily due to a simple circuit defect—often an off-value resistor which unbalances the dc control voltages to the diodes. Of course, a leaky capacitor in this section will cause the same difficulty. In printed circuits, look for leakage across the board between conductors, because this is a comparatively high-impedance circuit. It doesn't take much surface leakage to impair the function of an 8.2-megohm resistor!

Fifth step

In this step, we leave the problem of tracking down loss of color sync, and investigate poor color reproduction. Start by checking the output from the bandpass amplifier with a wide-band scope and low-capacitance probe, (5) in Fig. 2. The typical waveform is shown in Fig. 7. Note how the Y-signal is removed from the Fig. 3 waveform by the bandpass amplifier, permitting entry of chroma information only to the X and Z demodulators. Our chief interest here is in the amplitude of the Fig. 7 waveform. If its peak-to-peak voltage is low, the colors will be weak.

The bandpass amplifier is a tuned stage like an i.f. amplifier, but it processes a 3.58-mc signal like a video amplifier. It differs from both, however, in that it has a *bandpass* response, such as from 3.1 to 4.1 mc. We *check alignment last.* If the output waveform from the bandpass amplifier is weak, measure the dc control voltage from the color killer—it may be too negative and running the amplifier near cutoff. If the control voltage does not check correctly against the service data, make the necessary tests in the killer circuitry, just as if you were checking a keyed-agc stage. A defective capacitor or resistor is most likely to cause trouble.

However, with correct dc voltages supplied to the bandpass amplifier and the possibility of a defective capacitor eliminated, we will finally make an alignment check. Ideally, this should be done with a video-frequency sweep and marker generator. Since most shops still do not have suitable equipment, we must often fall back upon touching up the bandpass tuning slug(s), and judge alignment indirectly on the basis of receiver response. In rare cases, there will be a broken slug, shorted or open coil, or leakage between coil turns. These possibilities are investigated only if you can't get correct alignment.

Sixth step

When the chroma demodulators are fed a normal chroma signal, colors on the picture-tube screen can still be weak, absent or distorted, if the 3.58-mc injection voltage is subnormal. This brings us to step (6), Fig. 2. A scope check should show the same waveform as in Fig. 6, but at the amplitude specified in the service data. Check *both* injection voltages, because there is individual circuitry for the input demodulator stages. Note that (6) is repeated in Fig. 2. One injection waveform (6), might have normal amplitude, with the other (6A), weak or absent. If so, make the usual capacitor and resistor tests—and do not forget to check the small inductor often found in the common portion of the demodulator inputs. A dc resistance measurement usually reveals a bad coil, but if its resistance is not specified, make a substitution test.

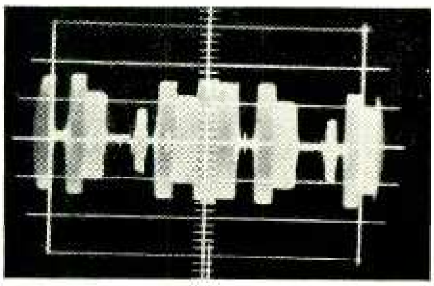


Fig. 7—Typical output waveform from burst amplifier.

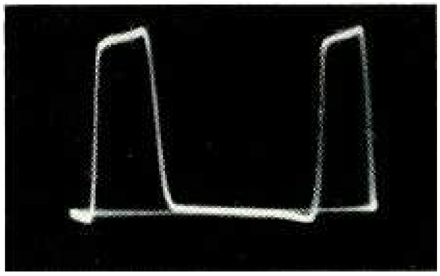


Fig. 8—Typical demodulator output waveform.

These injection voltages may be out of phase, even though their amplitude is normal. This sounds like a difficult matter, but it is really a very simple test procedure, provided you have a color bar generator.

Seventh step

Apply an $X \angle 90^\circ$ signal (a signal 90° from the X base line) from the color-bar generator to the receiver and connect a scope and low-capacitance probe at (7A) of Fig. 2. What should the scope show? Nothing! Only a horizontal trace should appear on the scope screen. On the other hand, if you get vertical deflection as in Fig. 8, try adjusting the receiver's color-phasing control (tint control). If the vertical deflection can be minimized, but not eliminated, we are not yet finished with the burst phase detector and reactance-tube stages! Some defective component causing an abnormal phase shift has been overlooked.

With normal output at the X demodulator, shift the low-capacitance probe to (7B) and then to (7C), Fig. 2. You should find vertical deflection at these points, because of feed from the Z demodulator. The check at (7C) is particularly useful. Drive the receiver with a $Z \angle 90^\circ$ signal from the color bar generator, and look for a null output from the Z-demodulator. If the Z-demodulator nulls at the same setting of the color-phase control as was found for the X demodulator, all is fine. But if a Z-null is unsatisfactory, check capacitors, resistors, and inductors in the demodulator stages to close in on the culprit. Note that $X \angle 90^\circ$ and $Z \angle 90^\circ$ signals are specified bars in a keyed-rainbow generator signal.

If your color bar generator does not have the X and Z outputs, you can check the demodulators indirectly by going to the next step.

Eighth step

Connect the scope and low-capacitance probe at (8A), Fig. 2. Feed a $B - Y$ signal into the receiver. There should be a null at the output of the $R - Y$ amplifier when the color phase control is suitably adjusted. If you don't get a satisfactory null, follow the foregoing track-down procedures. Note that we are working through the $R - Y$ amplifier, which is interconnected with $G - Y$ and $B - Y$ amplifiers. This indirect method of demodulator testing *could* show an unsatisfactory scope pattern caused by trouble in one of the amplifiers.

The amplifiers are quite straightforward, aside from their interacting feature, and trouble localization reduces to dc voltage measurements, plus resistance and capacitance checks. The latest amplifiers do not even have peaking coils to confuse the issue. Here are the normal nulls from the amplifier outputs:

1. The $R - Y$ amplifier nulls on a $B - Y$ signal.
2. The $B - Y$ amplifier nulls on an $R - Y$ signal.
3. The $G - Y$ amplifier nulls on a $G - Y \angle 90^\circ$ signal.

When we use a rainbow generator, we can easily check the amplifier outputs for correct relative amplitudes. These are often specified in the receiver service data. They are just as important as correct nulls for good color reproduction. In X and Z systems, correct circuit phases usually go with correct amplitudes, because of the system interaction.

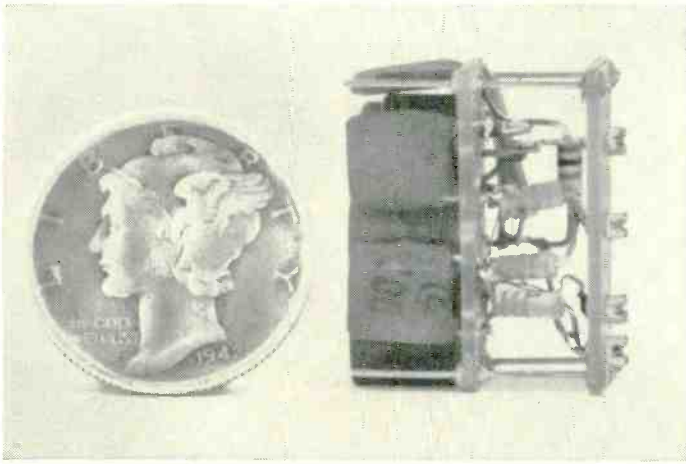
Ninth step

The blanker simply cuts off the picture-tube beam during horizontal retrace, so the burst does not contaminate the color picture. Connect the scope at point (9) in Fig. 2, and observe the blanking pulse for proper amplitude as specified in the service data. If the pulse is weak or absent, there are only a few resistors and capacitors to check in the blanker circuit.

You will find that the scope is the most useful signal-tracing instrument for localizing a faulty section in a chroma system. Without its help, a vast amount of time can be wasted in making random trial-and-error tests with a meter and by component substitution. After the faulty section is located, the vtvm is needed to check voltages and resistances. A capacitor tester is very useful, unless you have a large stock on hand, and don't mind cutting out the suspects and replacing them. END

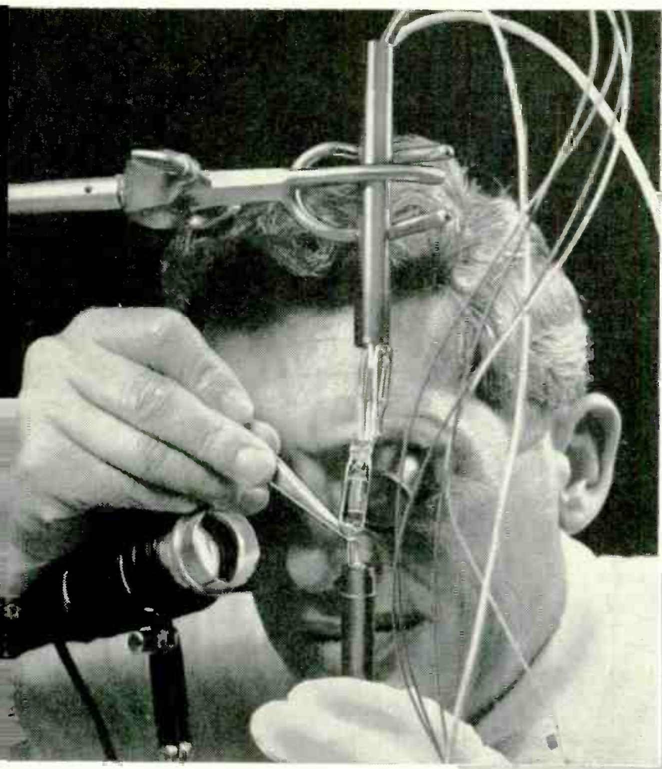
"You take these two empty tin cans and a long piece of string. Then . . ."

What's New



DIME-SIZE MODULES form the circuitry of ITT Kellogg's tiny Kel-O-Rad transceiver. No larger than a pack of cigarettes, the 9-ounce device permits "hands-free" two-way communication for firefighters, missile-refueling teams, space-probe crews. A crystal-controlled 20–50-mc transmitter, consisting of five modules, and a matching seven-module receiver, powered by two rechargeable batteries, are contained in one small package. A voice-actuated switch turns on the transmitter when user talks into mike.

MAMMOTH RADAR ANTENNA LENS is examined by Sperry Gyroscope engineers. The molded plastic-impregnated Fiberglas lens, silver-coated to make it electrically conductive, consists of 4,100 cells put together like a giant egg crate, which focus high-energy radar beams. Its light weight and electrical efficiency make it ideal for shipboard missile guidance antennas. The process, developed by Sperry, can also be used to build radar reflectors.



HUMAN TISSUE SIMULATOR, a tiny ionization chamber, is studied by Hughes Aircraft scientist. It and four similar units will be placed at various body points inside "plastinauts"—man-size dummies made of plastic—to simulate human tissue. When launched by the Air Force, they will measure the radiation met by astronauts in outer space.

GIANT UHF TELEVISION ANTENNA radiates 5,000,000 watts of effective power. Its 114-foot cylinder weighs 13½ tons. The 232 oblong slots spout power in varying amounts to create a shaped TV signal; an "electrical beam tilt" device directs the main signal to the right spot near the horizon. The antenna, one of the most powerful ever built, will be installed by WSBT-TV, South Bend, Ind. The antenna was built by RCA.

COVER STORY

Tunable AF Signal Tracer Has Many Uses

It's a tuned bandpass filter, sharply tuned null filter, audio frequency meter, telemetry amplifier, intermodulation analyzer and audio circuit troubleshooter

By **RUFUS P. TURNER**

Constructional details of a selective amplifier continuously tunable from 20 cycles to 20 kc. Has many uses for both experimenter and engineer.

Conventional untuned audio signal tracers do not discriminate between the test signal, extraneous signals, hum, and noise; test results can be confused and misinterpreted. Even when the tracer output is monitored by ear, there is no way of significantly separating the signal from trash or of determining the level of each.

The serious audio technician needs a tracer that can be tuned sharply to any test signal in the 20- to 20,000-cycle spectrum. But tunable af instruments have been available only as laboratory wave analyzers, priced way beyond the reach of small budgets.

The instrument described here tunes smoothly from 20 to 20,000 cycles in three ranges: 20-200, 200-2,000 and 2,000-20,000. Selectivity is adjustable so sharpness of rejection is at the control of the operator. The curves in Fig. 1 show response at minimum and maximum selectivity. Deflection of the indicating meter is proportional to the af input voltage. The meter reads 0 to 100, which may be interpreted as 0% to 100%. Input impedance varies from 1,000 ohms to 5 megohms, depending upon the GAIN control setting. An output jack is provided for aural monitoring or for driving an external millivoltmeter, oscilloscope or other instrument. (At full scale of the internal meter, output is 1 volt rms across a minimum of 10,000 ohms, representing a voltage gain of 20 at maximum selectivity and peak output.) Only one transistor and two diodes are used. A 12-volt battery (eight 1.5-volt C flashlight cells in series) supplies the 5 ma required for operation.

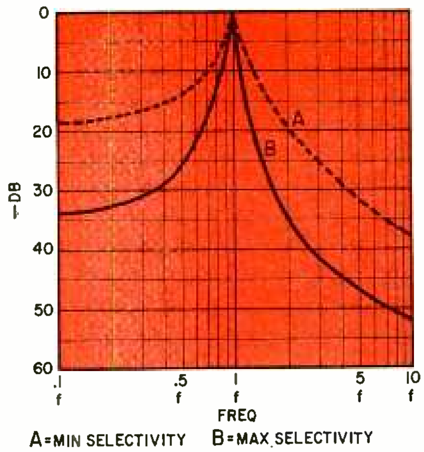


Fig. 1—Response of the tunable amplifier.

In addition to being a signal tracer, the instrument may be used in any of the myriad applications which require a sharply tuned af amplifier. These include use as a wave analyzer, tunable bandpass filter, sharply tuned CW filter, sharply tuned null detector, tunable indicator for vswr measurements, tunable af amplifier with output indicator, audio-frequency meter for identifying unknown frequencies, sharply tuned electronic voltmeter, sound analyzer, vibration analyzer, and in telemetering.

Operating principle

The instrument consists of a tunable af amplifier followed by an electronic af voltmeter (Fig. 2-a). Tuning is by a parallel-T R-C circuit in the negative feedback loop of a single-stage amplifier (Fig. 2-b). Tuning is sharpened by positive feedback provided by transformer T, capacitor C14, and resistor R6. Commercial laboratory instruments use a similar system.

The parallel-T is a null network, so there is enough negative feedback to suppress the gain of the amplifier on all frequencies except the null frequency, at which the gain is maximum. The amplifier output consequently peaks at this frequency. The amplifier is tuned continuously by varying R2.

Transformer T is poled correctly for positive feedback. Capacitor C14 prevents the transformer secondary from dc-shorting the amplifier bias circuit. Positive feedback is controlled by adjusting R6.

Capacitors C2 through C10 (Fig. 3) must be as close as possible to their specified values. Take your freshly calibrated bridge or capacitance meter to the store with you. Although metallized paper units have rather wide tolerance, many are right on the nose. If you cannot find exact values, choose lower ones and build up the values you need by connecting suitable capacitances in parallel. If they do not coincide exactly, you will have to make a separate dial

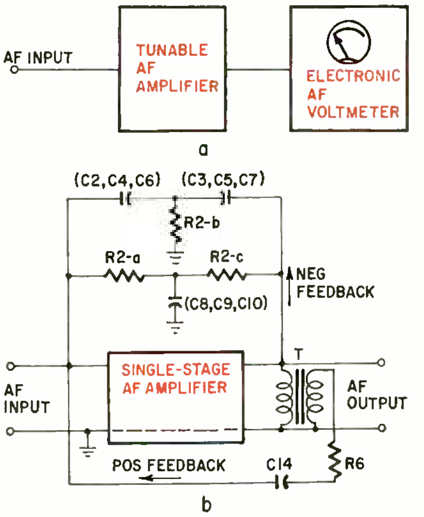


Fig. 2-a—Basic circuit arrangement. b—How the amplifier is tuned through feedback loops.

scale for each of the three frequency ranges.

Transformer T supplies positive voltage. This voltage level and accordingly the selectivity of the amplifier are adjusted with R6. C14 prevents the transformer secondary from grounding the 2N190 dc base bias. The transformer must have good frequency response over the entire range of the instrument (20–20,000 cycles).

The voltmeter circuit consists of a bridge rectifier and a 0–100 dc microammeter. The diodes may be any general-purpose point-contact germanium units such as 1N34, 1N56 or 1N57. If their characteristics are matched, so much the better. Resistors R7 and R8 should be identical in value. Their absolute resistance is not as important as the requirement that they have the *same* resistance. The 10-μf value of C13 insures good frequency response down to 20 cycles.

Open-circuit jack J3, allows the tuned output of the instrument to be monitored aurally or to be applied to an oscilloscope, ac millivoltmeter, recorder or other instrument or control device. High-impedance headphones (magnetic or crystal) may be plugged in directly.

Building and wiring

Wiring and construction techniques are the same as those used in building any high-gain audio voltage amplifier, but the job is considerably simplified by the one-stage circuit.

The first task after assembling the three-gang potentiometer is to wire the tuning unit. Connect capacitors (C2 through C10) between proper points of switch S1 and potentiometer R2 without trying to make a pretty job of it. (Run the capacitors by the most direct route.) To minimize stray capacitance, wire the unit exactly as shown in Fig. 3. The straight lines of the capacitor symbols for C2 through C10 represent the outside foils, which are clearly marked on the capacitor labels.

Test the assembled tuning unit before wiring it into the amplifier circuit. To do this, connect an audio signal generator between lead X and ground. (Fig. 3), and connect an ac vtvm between lead Y and ground. Set S1 to ×10 and the generator to 1,000 cycles. Adjust R2 for null. Using the most sensitive vtvm scale, note the voltage reading at exact null. Swap the generator and vtvm, and readjust the potentiometer for null. If your components are closely matched, the parallel-T network will be symmetrical and the null voltage will be the same each way.

If there is a difference select the setup which gives the lowest null reading and mark the lead which goes to the vtvm "X" and the lead which goes to the generator "Y". These will be the proper X and Y leads in Fig. 3. Then set the generator successively to 200 and 2,000 cycles and tune the potentiometer for null to check the extremes of the ×10 range. Set the switch to ×1 and check the extremes (20 and 200 cycles) of that range. Set the switch to ×100 and check the extremes (2,000 and 20,000 cycles) of that range.

Some amplifier components are mounted on a 5 x 4 x 1/16-inch perforated phenolic panel held by the meter terminal screws. They include C12, C13, C14, R3, R4, R5, T and Q. For

BENCH TESTED

This instrument was checked and found as described. Amplification was about the same at 60, 600 and 6,000 cycles. Sensitivity varied with scale setting rather than frequency, being more sensitive on low settings of all three ranges. Calibration at the low end of the low scale was off. The author knew this, and stated in a letter that it was caused by a capacitor that had changed value; a replacement had not arrived in time to be installed.

solid mounting, the transistor is held by a three-terminal barrier type terminal strip. C1, R1, R6 and S2 are mounted on the front panel. C1 is connected directly between the hot input binding post and potentiometer R1. To prevent ground loops, run all ground return leads to a single point on the front panel.

To avoid damaging the transistor, finish wiring the terminal strip before installing it. Pole capacitors C12, C13 and C14 as shown. Transformer T must be poled correctly, otherwise the feedback will be negative instead of positive. Simply follow the color coding shown in Fig. 3. The center tap (yellow lead) is not used and should be clipped short.

The voltmeter components (D1, D2, R7, R8) are also mounted on the perforated board. When wiring this circuit, be sure to pole the diodes and meter exactly as shown. To prevent heat damage to the diodes, grip their pigtails with pliers while soldering, and hold them until completely cooled.

A large meter (4½-inch rectangu-

R1—pot, 5 megohms, audio taper
R2—3-gang pot, 5,000-ohm front section (IRC WP 5000 or equivalent) and two 10,000-ohm rear sections (IRC W11-116 or equivalent) plus two IRC WM multisection kits or equivalent. All sections have a linear taper.
R3—10,000 ohms
R4—47 ohms
R5—100,000 ohms
R6—pot, 250,000 ohms
R7, R8—4,700 ohms, match to 1% or better (see text)
All resistors 1-watt 10% unless noted
C1—10 μf, 450 volts, midget tubular electrolytic
C2—C3—1 μf
C4, C5—0.1 μf
C6, C7—.01 μf
C8—2μf
C9—0.2 μf (two 0.1-μf units in parallel)
C10—.02 μf
C11—50 μf, 25 volts, midget tubular electrolytic
C12, C13—10 μf, 15 volts, tantalum electrolytic
C14—1 μf
All capacitors 200-volt miniature metallized tubular unless noted
BATT—12 volts, eight 1.5-volt C-cells in series
D1, D2—1N34 or other general-purpose germanium diodes, matched units if possible (see text)
J1, J2—binding posts
J3—phone jack
M—4½-inch rectangular microammeter, 0–100-μa dc (Triplett 420-PL)
S1—3-pole 3-position single-gang nonshorting rotary switch
S2—spst toggle switch
T—miniature transistor driver transformer: primary, 1,000 ohms, 10 ma; secondary, 200 ohms, ct not used (Triad T-41X)
Q—2N190
Battery holders, 2 C-cells each (4)
Dial, 3½ inch (National type O)
Barrier type terminal strip (3 screws for mounting transistor)
Rubber feet for cabinet (4)
Perforated phenolic boards, 5 x 4 x 1/16 inch
Aluminum chassis box, 9 x 6 x 5 inches
Miscellaneous hardware

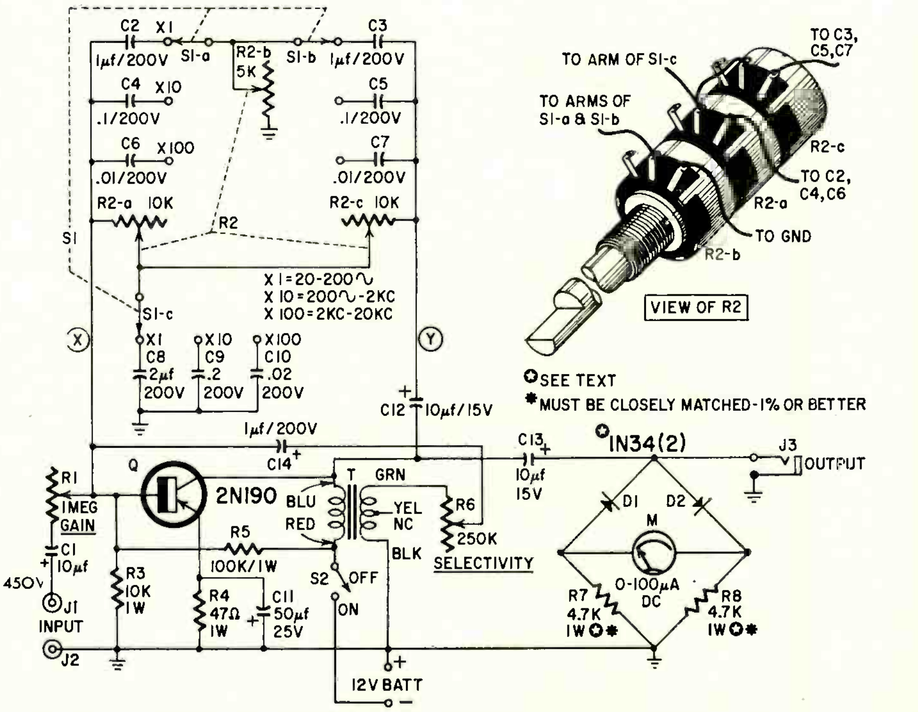
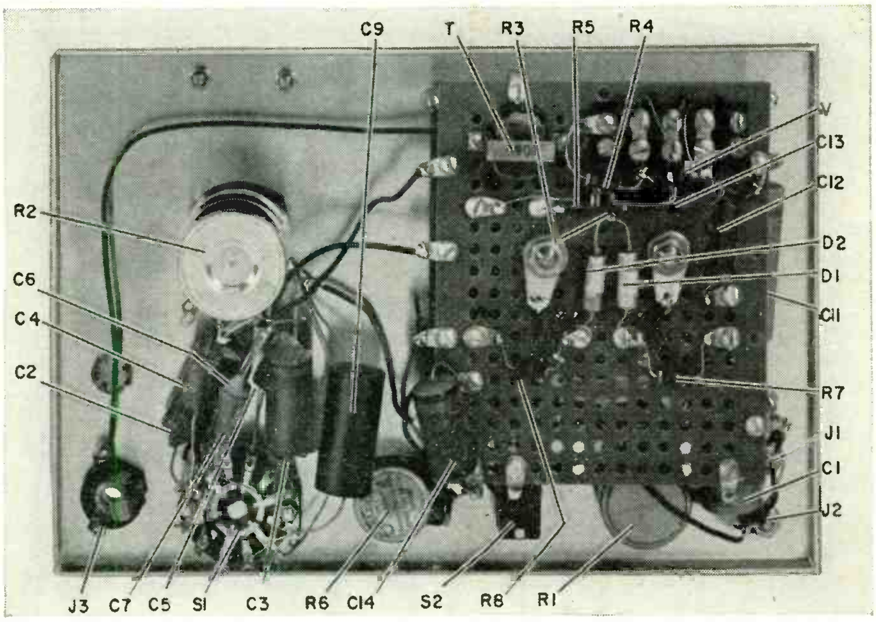


Fig. 3—Circuit of the entire multipurpose unit.



Most components are on perforated phenolic board attached to meter.

lar) is used for good readability down to 1% of full scale. A smaller-size meter may be used if desired, but will reduce reading accuracy somewhat.

The four two-cell battery holders are fastened to the floor of the case. Run both battery leads to the instrument circuit. Do not depend upon the metal case for the positive return path.

A 3½-inch diameter dial (National type O) is used. A vernier drive is available for it, but we feel that the large knob takes care of close tuning.

A disc of white cardboard was glued to the dial for marking calibration. The long line at the bottom of the dial is the setup line. It is lined up with the index when the potentiometer is set to its highest resistance position.

Run all leads as directly as possible. Keep input and output leads as far apart as you can to prevent unwanted feedback, especially at 20,000 cycles. Bolt all components solidly.

Calibration

After wiring has been verified, check the instrument and calibrate its tuning dial. For the initial check connect an audio signal generator to the INPUT terminals; switch S1 to ×1; set generator to 20 cycles; set SELECTIVITY control to its highest resistance; set GAIN control to its lowest resistance; set S2 to ON. Tune for peak meter deflection. Adjust generator output or R1 for exact full-scale meter deflection. Tune back and forth, noting tuning sharpness. Reduce the resistance setting of R6, noting any increase in sharpness of tuning. If R6 is advanced too far, the circuit will oscillate, pinning the meter.

For the calibration, connect the generator as above; set R6 for maximum resistance; switch S1 to ×1; set the generator to 20 cycles. Tune in a signal by adjusting the instrument dial. Adjust R1 or generator output for peak meter deflection. Mark this point "20" on the dial. Repeat at as many generator frequencies as practicable between 20 and 200 cycles.

NOTE: There is a slight amount of backlash in the tuning potentiometer, but the attendant error may be circumvented by always tuning in the same direction.

After the dial has been completely calibrated for this range, set it to 20, switch S1 to ×10, and set the generator to 200 cycles. Peak meter deflection should be obtained here. Other frequencies in the 200- to 2,000-cycle range should also coincide with the graduations on the dial. If not, a separate dial scale must be drawn for this range. Now repeat the procedure for the ×100 range with the generator delivering signals from 2,000 to 20,000 cycles. If the frequencies do not coincide with the dial graduations, a separate dial scale must also be drawn for this range.

Auxiliary uses

The instrument also acts as a:

Wave analyzer. The fundamental frequency and each of its harmonics in a complex wave may be tuned in successively. With the fundamental tuned in, set the gain control for full-scale meter deflection. The strength of each harmonic may then be read, as the frequency is tuned in, directly in percent of fundamental. For closer readings of lower scale values, plug an ac vacuum-tube millivoltmeter into J3.

At maximum selectivity, the smallest second-harmonic percentage which may be read is 1.8% (−35 db); third harmonic, 0.4%.

In this application, the instrument suffers somewhat because its gain is not constant over the tuning range but decreases gradually as the frequency increases. For constant gain, the gain control must be advanced as the instrument is tuned upward. However, a close calibration of the gain-control settings vs frequency will permit fairly close measurements in wave analysis.

Tuned bandpass filter with indicator. At a selected frequency, bandwidth is adjustable between the limits indicated by curves A and B in Fig. 1.

Sharply tuned CW filter. In this application, the instrument may be operated between audio amplifier stages of a receiver or from the receiver output. Plug headphones or speaker amplifier into jack J. Vary selectivity by adjusting R6.

Sharply tuned null detector. This is invaluable for close adjustment of impedance bridges and similar measurement circuits, especially when the signal generator has an impure waveform.

Tunable indicator for vswr measurement. Here, the af signal presented to the instrument is delivered by a bolometer or crystal diode operated from a microwave slotted line driven by an amplitude-modulated signal. A tuned af amplifier-indicator enhances the measurement.

Tunable af amplifier. There are numerous applications for such an instrument in the laboratory, shop and field. At maximum gain and maximum selectivity, 50-mv rms input drives the meter to full-scale deflection and delivers 1 volt rms to the output jack.

Audio-frequency meter. The unknown frequency is read directly from the dial when the instrument is tuned for peak deflection of the meter. Sharp tuning increases accuracy.

Sharply tuned electronic voltmeter. The instrument may be used after being voltage-calibrated at a given setting of the GAIN control. At maximum gain and maximum selectivity, full-scale deflection of the meter corresponds to an input of 50 mv rms.

Vibration and sound analysis. With a vibration transducer connected to the INPUT terminals, the instrument may be tuned successively to the fundamental and other frequency components of vibration, and their relative amplitudes read from the meter, as in wave analysis. In sound analysis, procedure is the same but a microphone is connected to the INPUT terminals.

Intermodulation measurements. In intermodulation checking, sum and difference frequencies may be tuned in separately and the amplitudes checked from the meter deflection.

Telemetering. In some phases of telemetry practice and strain-gage operation, a sharply tuned amplifier is required for selecting a particular signal frequency in the 20- to 20,000-cycle spectrum. END

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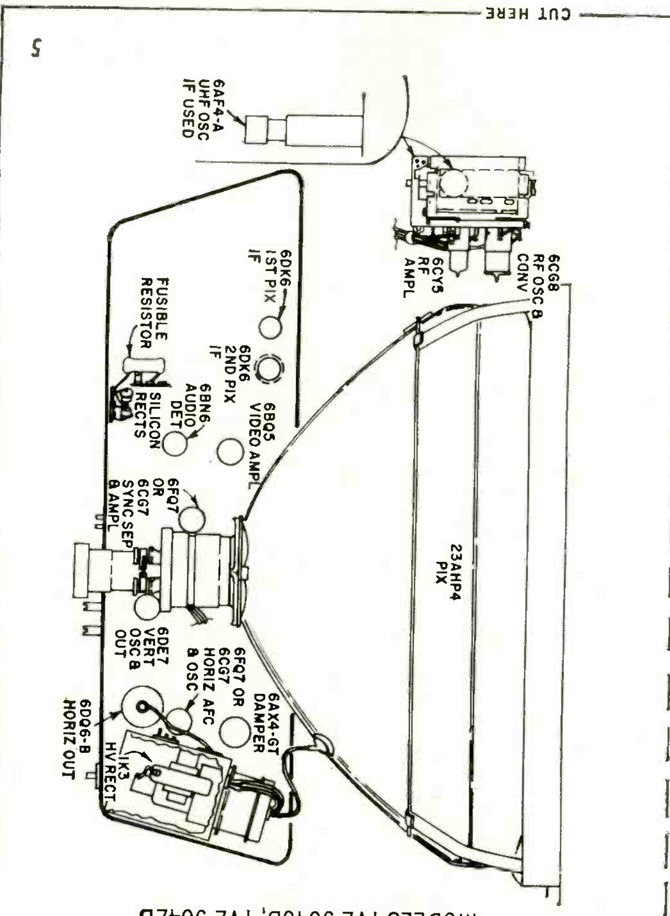
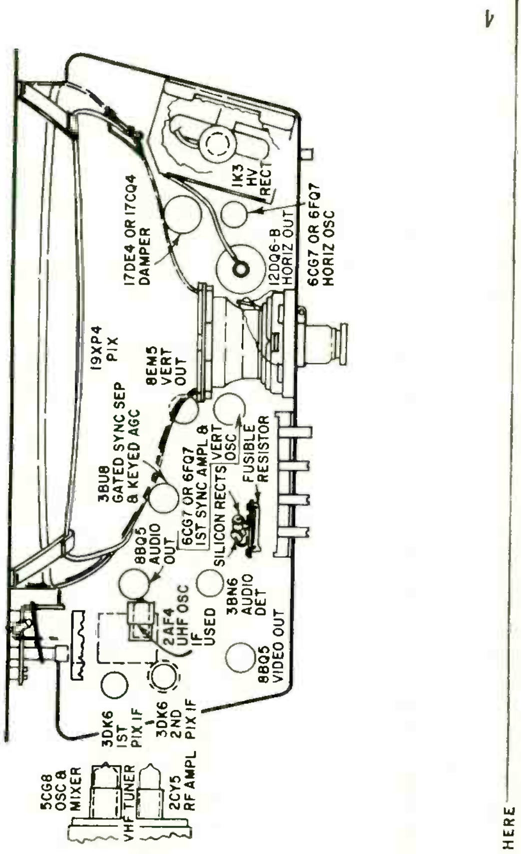


MODELS TV2-9640B, TV2-9642B



MODEL TV2-9496A

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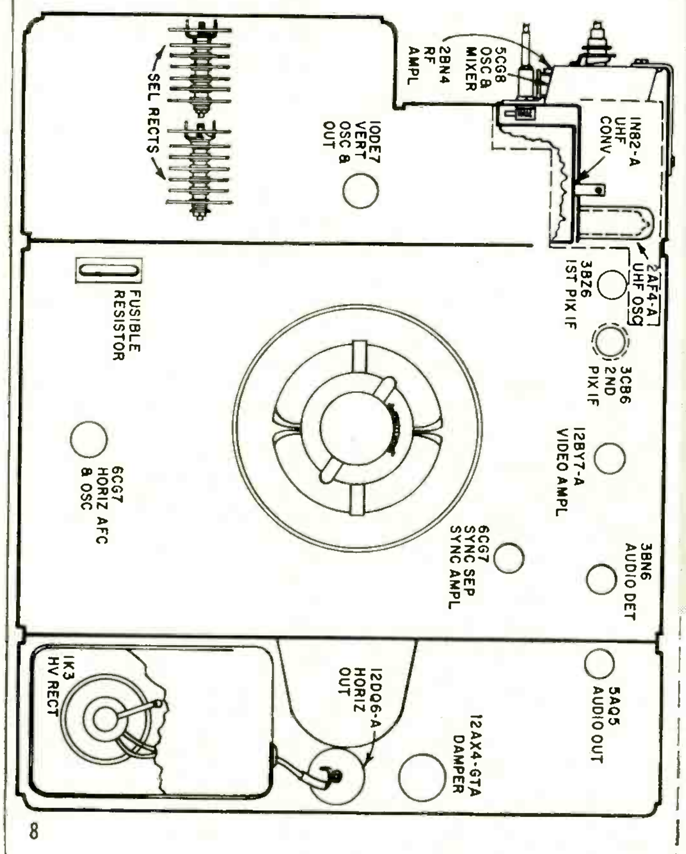
MODEL TV2-9540A



TUBE LAYOUTS

IN TV SETS

Compiled by **Larry Steckler**, Associate Editor

HOW TO FOLD

Fold the top down and back, keeping the cover facing you. Then trim the right and left edges. Now staple the booklet along the vertical center fold, about ¾ inch from the top and bottom. Now fold from left to right, keeping the cover facing you. Trim a fraction of an inch off the top and trim the bottom to size and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS.

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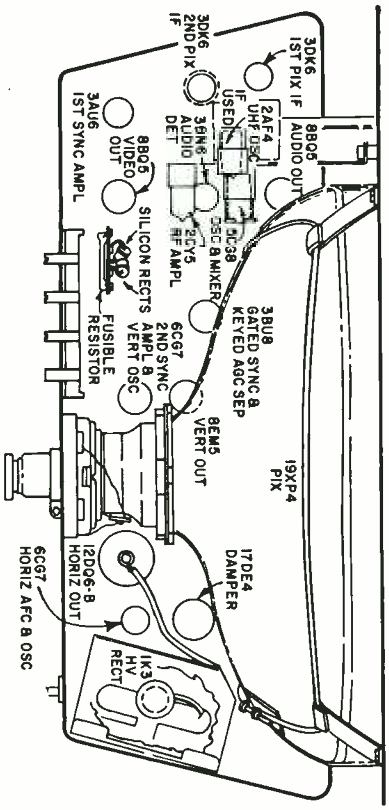

MODEL TV2-9491A

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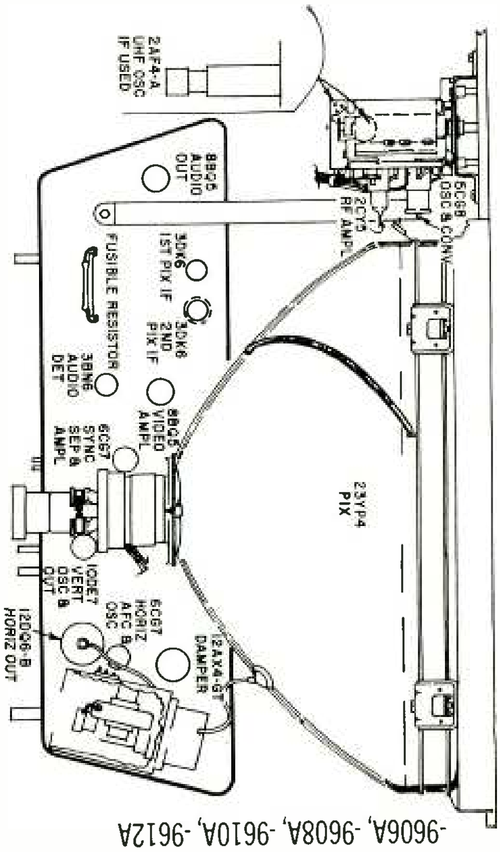
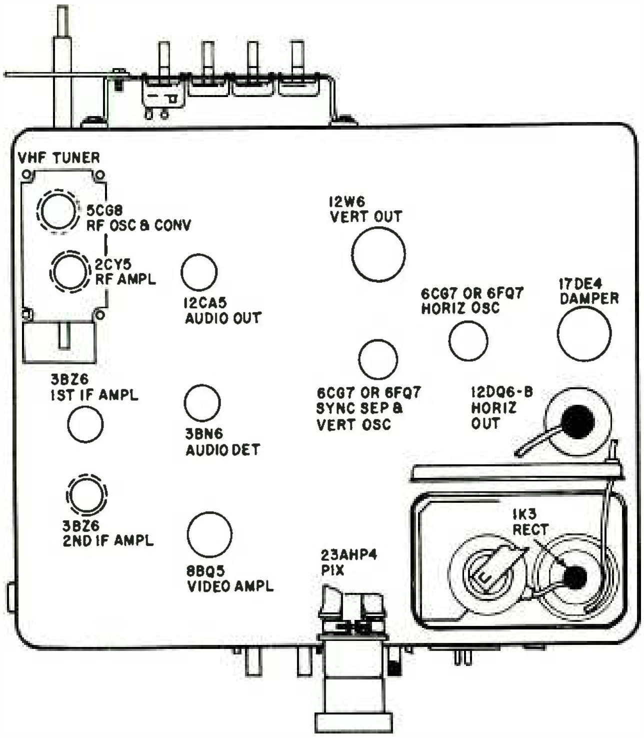


MODELS TV2-9596A, -9598A, -9600A, -9602A, -9604A, -9606A, -9608A, -9610A, -9612A

MODEL TV2-9542A



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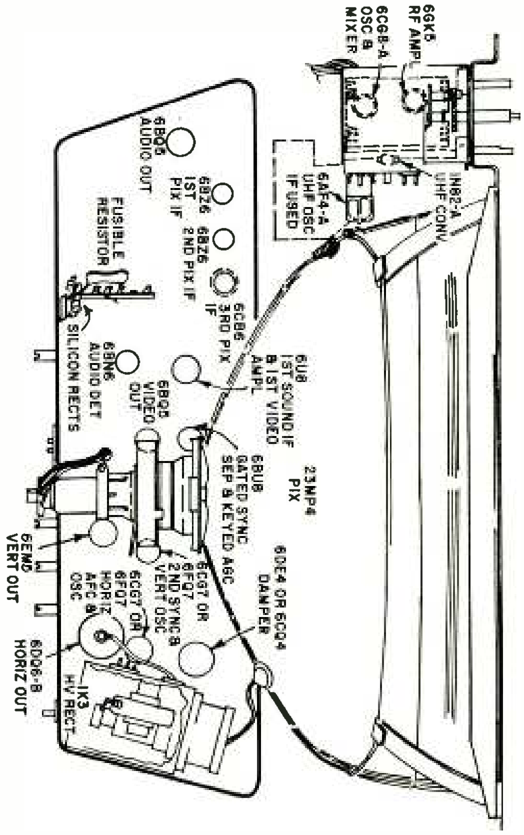
MODELS TV2-9616B, -9618B, -9614B



7

the FM tuner that buzzed

A TV station's sync signal can show up as a humlike buzz on an FM receiver. This technician found it out the hard way

By L. W. BORN*

WE were unpacking a new FM tuner when the phone rang in the front office. Shortly thereafter the intercom clunked on, carrying the glad tidings from our Girl Saturday (she refused the traditional title of Girl Friday as a pointed and frequent reminder of her firm dislike of Saturday hours).

"It's the engineer at the new FM station and he sounds pretty mad! He wants to palaver with you, please."

We picked up the extension phone.

"Yes?"

"This is the chief engineer of K@@P-FM," he said, confirming our preliminary report.

"Welcome to our fair city," we replied in a tone calculated to promote goodwill and brotherly love. "What can we do for you?"

"Well, it would help a load if you'd stop peddling lousy FM tuners!" he replied in a manner that made it obvious that he wasn't interested in winning friends nor influencing people, not even hi-fi people.

"Whatayah mean, lousy tuners? We handle the best tuners in the business," we shot back with some emotion. "What's your gripe, anyway?"

"Well, we've had at least a dozen complaints from guys that bought their FM tuners from your shop. They get a bad hum on our station and our manager is convinced there's something haywire with our transmitter. Now, I've just pulled our proof for the FCC and I know blank well that our noise and hum are way down. So there must be something goofed up in your tuners that's causing the trouble and what are you going to do about it?"

We were tempted to outline in vivid terms what we proposed to do, but by this time Saturday was on hand waving a warning finger. And then, there was also the outside possibility that the guy was right. So we obtained the names of the troubled ones and promised to look into the situation.

At the scene

After lunch, we drove out to the first case on our list and explained our mission to the Mrs.

"What puzzles my husband and makes him simply furious is that our next door neighbor has a little $15 tuner and gets simply wonderful reception, while our big stereo tuner has this awful hum on the local FM station," she explained as she ushered us into the family room.

She was so right! Even the most careful tuning would not eliminate the hum. Yet the tuner was quiet on the other four out-of-town stations. We went next door and listened to the tuner. It was perfect, not a hint of hum. Back we went to grapple with the troublemaker.

No amount of tube replacements, grounding, ac plug reversals, cussing, or any other trick made the slightest difference . . . the hum remained. Actually, we noted, it wasn't really a hum, more like a buzz. As a matter of fact, it sounded very much like the 60-cycle sync buzz we had heard many times from mistuned or misaligned television sets. Suddenly the incandescent switched on in our foggy noggin.

We tuned up from the 100.3-mc local FM station where we noted with satisfaction the strong audio signal from our one local TV station operating on channel 13. The tuner was probably picking up the 60-cycle sync pulses transmitted with the video signal and that was causing the hum. We hotfooted it next door to check the tuner there. There was no trace of the sync buzz nor of the television audio signal!

Back at the problem-child tuner, we disconnected the outdoor FM antenna from the tuner and substituted a simple dipole which we attached to the wall with pressure tape. Stuck to this wall, the dipole antenna gave maximum pickup north toward the FM station and minimum pickup west toward the TV station. Voilà! Buzz-free reception from the FM station. It was then a simple matter to install a tunable trap on the outdoor FM antenna and knock out the sync buzz from the television transmitter while not impairing FM reception from the out-of-town FM stations.

In this particular instance, the video signal of the channel 13 television station produced a spurious signal on the FM tuner at almost precisely the same spot on the dial that the local FM station was assigned. Since the video signal is amplitude-modulated and contains sync pulses in addition to video information, the FM tuner produces

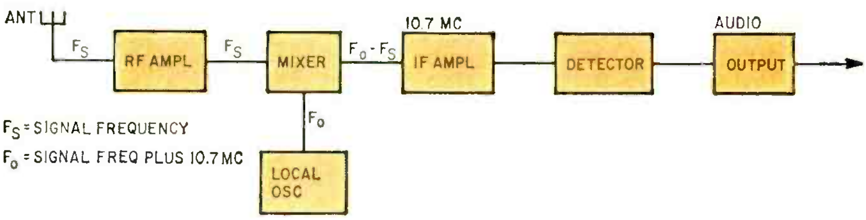


Fig. 1—Block diagram of superhet circuit used in FM tuners and receivers.

*Plaza Television & Hi-Fi, Topeka, Kan.

only the lower-frequency components and these only when the tuner is detuned slightly from the spurious frequency. This interference condition prevails in numerous other instances involving TV channels from 9 to 13.

What happens

To understand how FM tuners, which are supposed to accept only signals between 88 and 108 mc, also receive television signals broadcast on a much higher frequency, let's refer to Fig. 1, a block diagram of the familiar superheterodyne circuit used in FM tuners and receivers.

In this type circuit, the incoming signal of frequency F_s is mixed with a local oscillator of frequency F_o which is higher in frequency by precisely 10.7 mc. The mixer produces a difference frequency of $F_o - F_s = 10.7$ mc. The if amplifier is, of course, tuned to 10.7 mc and additional amplification and eventual detection follows.

So far, everything is straightforward. But consider what occurs if another incoming signal reaches the mixer stage and if that signal happens to be 10.7 mc higher than the local-oscillator frequency. This situation is shown in Fig. 2. The tuned circuits of the rf amplifier provide maximum amplification at the desired signal frequency. But they do not completely reject other frequencies—they attenuate them and discriminate against them, but cannot completely eliminate them. Hence, if the intensity of the undesired signal is great enough, it will ride through to mix with the local oscillator to produce a difference frequency of 10.7 mc.

Thus we have two 10.7-mc difference frequencies—one from the mixing of the desired 100.3-mc signal with the local oscillator tuned to 111.0 mc, and the other from the mixing of the undesired 121.7-mc signal with the local oscillator. Both difference signals are fed to the intermediate-frequency amplifier and it amplifies both signals with no concern as to the interference that results. The undesired signal, 10.7 mc higher than the local oscillator and twice this amount higher than the desired signal, is called the image frequency. With the FM tuner operating within the assigned limits of 88 to 108 mc, the images will necessarily be within the range of 109.4 to 129.4 mc. Images within this range may be called the first-order images.

Now the local oscillator, in addition to generating a fundamental frequency 10.7 mc above the desired signal frequency, also generates harmonics or overtones. These are simple multiples of the fundamental frequency such as 2, 3, 4, 5, etc. times the fundamental frequency. Usually, only the second harmonic is strong enough to become a problem, although in some instances, third or fourth harmonics may cause difficulties. Taking into consideration only the second harmonic, we have the situation shown in Fig. 3.

Second-order images

Leaving the tuner adjusted to receive an FM station on 100.3 mc, we know the local oscillator is tuned to 111.0 mc and that the first-order image is located at 121.7 mc. The second harmonic of the local oscillator is twice its fundamental frequency or $2 \times 111.0 = 222.0$ mc. Now if other signals located 10.7 mc above or below this 222.0-mc second harmonic reach the mixer stage, additional difference frequency signals of 10.7 mc are generated and passed on to the if amplifier, where they are as cordially received as any other 10.7-mc signal. Thus signal frequencies of 211.3 and 232.7 mc can cause interference and are called second-order image frequencies. Because the video frequency of a channel 13 television station is 211.25 mc or only .05 mc from the second-order image frequency when the FM tuner is tuned to receive a FM station on 100.3 mc, there may be sync-buzz interference.

Second-order images are possible only when (1) there is insufficient selectivity in the rf amplifier, (2) there is inadequate shielding in the tuner front end, or (3) there is substantial second-harmonic content in the local oscillator output. Naturally, if the tuner is being operated within the virtual shadow of the television transmitting antenna, the second-order image signal may be so intense compared to the weaker FM signals that no amount of shielding or any reasonable degree of selectivity will eliminate it. Within a range of 10 miles from a channel 13 television antenna radiating full power of 316 kilowatts, some 40 FM tuners and receivers of 17 makers have been evaluated.

Only the tuners made by one of the 17 manufacturers have been found free of second-order image reception from the video and audio transmissions of the channel 13 television station, although quite probably there are others. The "next-door neighbor" had a tuner made by this one manufacturer and hence had no interference problem.

If the if amplifier is tuned to a slightly different frequency than the standard 10.7 mc, the exact frequency of the first- and second-order images will differ slightly from the values given here. The table shows the several television channels that will produce second-order images in standard FM tuners. For each TV channel, the table also shows the image frequencies for sound and picture carriers and the nearest FM frequency allocation with which interference may result. Tabulations are based upon the precise alignment of the FM if amplifier on 10.7 mc although some deviation from this figure can be expected in practice. END

Spurious Response

TELEVISION CHANNEL	VIDEO FREQ. (MC)	APPARENT 2ND-ORDER IMAGE FREQ.* (MC)	NEAREST FM FREQ. (MC)	AUDIO FREQ. (MC)	APPARENT 2ND-ORDER IMAGE FREQ.* (MC	NEAREST FM FREQ. (MC)
13	211.25	89.575	89.5	215.75	91.825	91.9
		100.275	100.3		102.525	102.5
12	205.25	86.575	—	209.75	88.825	88.9
		97.275	97.3		99.525	99.5
11	199.25	83.575	—	203.75	85.825	—
		94.275	94.3		96.525	96.5
10	193.25	80.575	—	197.75	82.825	—
		91.275	91.3		93.525	93.5
9	187.25	77.525	—	191.75	79.825	—
		88.275	88.3		90.525	90.5
8	181.25	74.525	—	185.75	76.825	—
		85.275	—		87.525	88.1

*Apparent 2nd-order image frequency means the dial reading in mc at which the FM tuner responds to the image signal. Thus, with a dial readinng of 102.525 mc, the second-order image received from the audio signal of a channel 13 TV station is 215.75 mc.

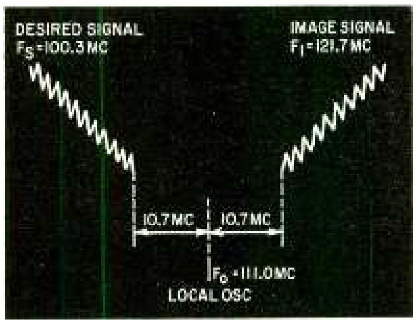


Fig. 2—Relationship of signal, local-oscillator, first-order image frequencies.

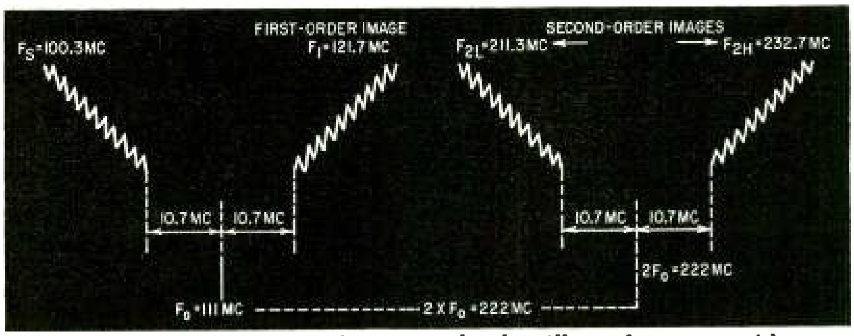


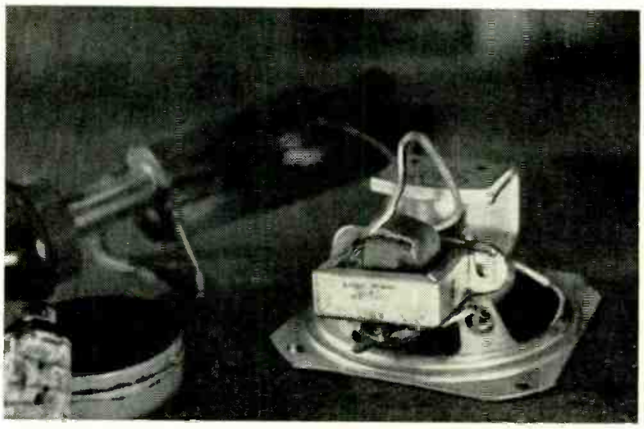
Fig. 3—Relationship of signal frequency, local-oscillator frequency with second harmonic, and first- and second-order image frequencies.

THE QUICK FIX

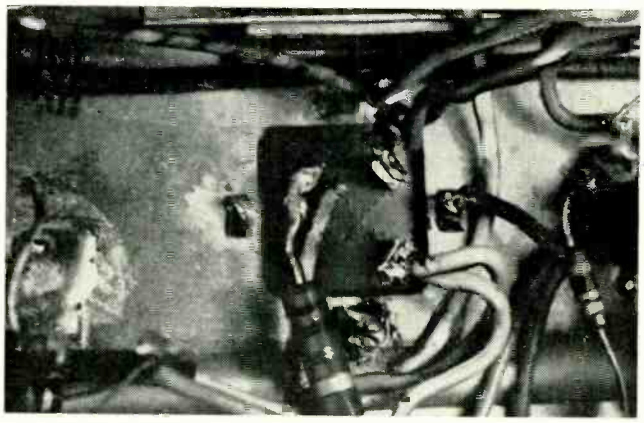
By ROY E. PAFENBERG

Photos by Jack Darr

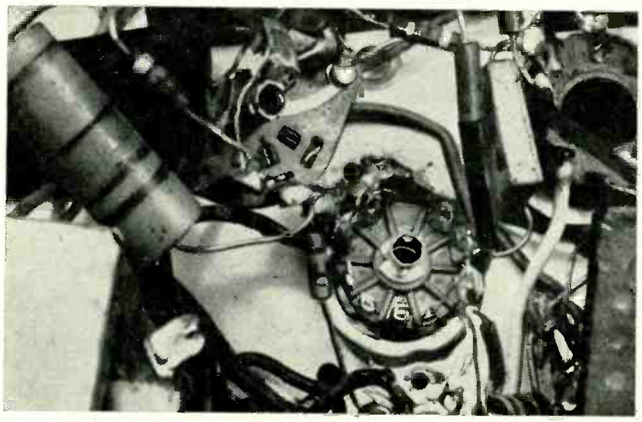
Many radio-TV repairs are routine parts replacements—a new speaker, an electrolytic, a volume control. But, the replacement isn't always an exact duplicate of the original and some unusual mounting procedure may be called for. Even when an exact replacement is on hand, keeping track of a dozen leads while replacing a tube socket isn't easy. Some of the more valuable time-saving approaches are shown here.



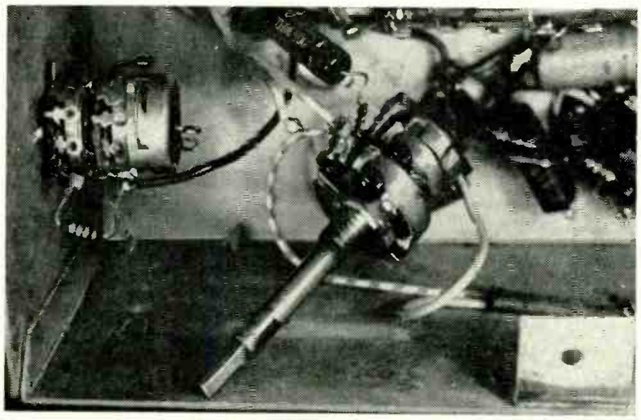
When replacing a strap-mounted transformer, how much time do you spend drilling new mounting holes? Use a heavy-duty soldering iron to solder the transformer to the speaker or chassis—presto! no drilling. You'll also avoid perforating the cone or that occasional paper tubular hiding just under your drill bit. And no time is needed to select nuts and bolts and secure them in place. A 200- or 300-watt iron makes this a cinch.



Replacing a multiterminal component like a multisection electrolytic capacitor is another time-consuming task, and there are a lot of leads to keep track of. Unsoldering each one separately is tedious and unnecessary. Next time you have to replace one of these, take your dykes and clip each terminal lug as close to the chassis as possible. Then break the capacitor loose from its mounting and install the new unit. All that's left is to solder the old lugs to the new ones.



That clip-and-solder technique we used on electrolytics also works for tube sockets. Of course, you'll have to drill out the rivets holding the old socket. If the new socket is a wafer type, use nuts and bolts to hold it in place. Solder metal-shell or plate type sockets to the chassis. As with the electrolytics, solder the old tube terminals to the new ones to complete the job. This gimmick also works on if transformers and similar components.



The clip technique also works well on multiple-section pots. Remove the mounting hardware and swing the defective unit clear of the chassis. Insert the replacement and transfer the leads one at a time. Just clip the lug and solder it to the respective lug on the new control. You'll be surprised at how much time you save. END

AUTOMATED SEQUENCE CONTROL

By MATTHEW MANDL

AUTOMATIC PROCESSING OF MATERIALS often consists of a series of operations which must be performed step by step. To do this, sequential control methods are used so one type of work is completed before the next one starts. Sequential control in industry consists of electronic, electrical or mechanical systems, or combinations of them for performing a particular series of tasks.

The type of sequential control depends on whether various operations are performed on a single item or a number of items on an assembly line. The nature of the work also has a bearing on equipment choice. A variety of control systems can be set up, using timers, photocells and associated circuits. Such devices are used when the sequence of steps is rarely reset or rearranged.

If the work process on an item is changed periodically, paper- or magnetic-tape control devices may be employed. The sequence of steps—machining, drilling, milling or stamping—can be placed on the tape in coded form and the tape used to actuate the machinery for carrying out the processes necessary. The tape can be stored and reused when the same step-by-step work is done again.

To give you a clearer understanding of these various methods, we'll examine some practical applications of the timer, photocell and tape control unit in sequential control systems. Similar arrangements can be used in many manufacturing processes other than the specific examples.

Clocks with built-in switches are the simplest type of control system.

You may already be familiar with photographic timers. Similar units are used in industry. Some are intended for intervals measured in seconds, others in minutes and still others in hours. Built-in relays and switches turn circuits on or off, or turn on another timer after the first has permitted a certain process to continue for a specified length of time. Some timers are interval types—they can be used to start a process at some particular time and continue the process for a definite period. Such timers have a dual dial—one to set the start of the cycle, and the other to stop the cycle.

Fig. 1 shows a typical timer. It is the series 305 Atcotrol timer made by the Automatic Temperature Control Co., Inc. Ten standard dial ranges are available, ranging from 0–15 seconds to 0–240 minutes. Since one timer can trip another one at the end of its timing cycle, a number of units can be connected in series for sequential control. Applications include molding, heating and forming processes of plastics and rubber, as well as the sequential control of valve operations for oil, water or fluid chemicals.

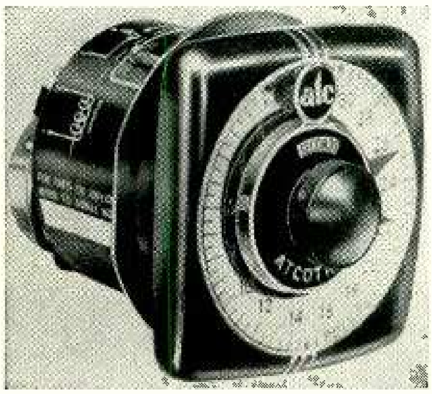


Fig. 1—Series 305 Atcontrol timer.

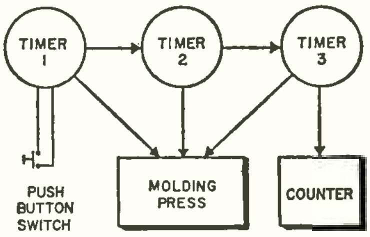
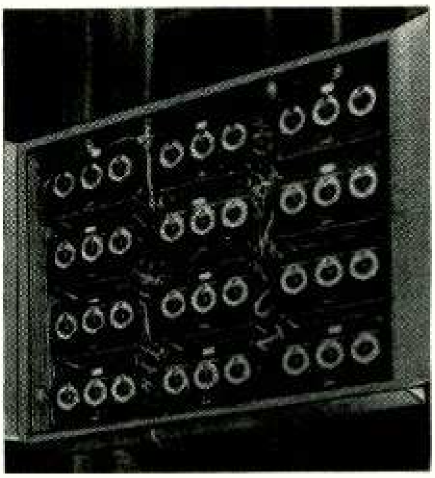


Fig. 2—Three timers control this simple molding process.

One application for Atcotrol timers is in the automatic operation of rubber molding presses (see photo). Since three timers are required to control a single press, the panel shown operates 12 presses simultaneously. The system is illustrated in Fig. 2. Initially, the rubber sheet stock is placed between the molding press dies and the push-button switch is depressed to start the process. As soon as the circuit to the first timer is closed, it turns on the press-closing mechanism and the initial heating cycle begins. This cycle continues for several minutes. When it is completed, the first timer automatically starts the second timer. It causes the molding press to open partially for degassing, which lasts as long as the interval of time set on the second timer. When the degassing process is completed, the second timer turns on the third. It closes the molding press for about an hour for curing. When the hour is up, the third timer opens the press and the automatically processed molded piece is removed. The third timer also actuates a counter that records the number of processed pieces.

Once the actual molding time is established for a particular material thickness and shape, the timer settings are recorded for future reference, when the same material may be processed again.



Bank of 36 timers controls rubber molding presses.

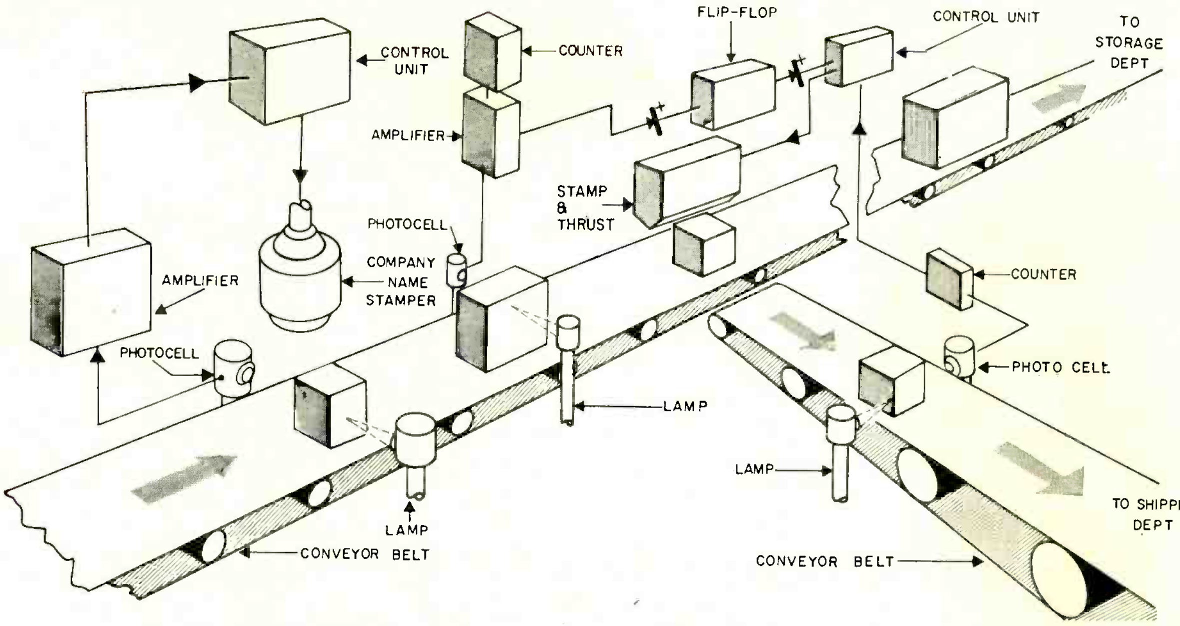


Fig. 3—Several photocells are used to handle a variety of sequental processes.

A broken beam of light can trigger counters, package handling devices and name stampers.

Items on an assembly line lend themselves readily to sequential control because their continuous progress establishes the necessary time relationship. Photocells are used for counting, packaging, sealing, selecting, stamping and other similar processes. When several photocells are used, as shown in Fig. 3, various sequential operations can be performed as required.

The sequential control process in Fig. 3 handles packages on an assembly line. These packages could all be the same size, with alternate ones containing different items. They could also be assorted sizes, as shown, and contain similar items, with more units in one package than the other. Regardless of such variables (or the lack of them) sequential control can be initiated with the photocells and the circuits shown.

Assume that the items have already been packaged and sealed and arrive at the left of the assembly line shown in Fig. 3. Each package breaks the beam of light and the photocell sends a signal to a control unit to stamp the company's name on the top of the box. The container then moves on to the right and breaks the second light beam. The second photocell actuates a counter that records the total number of packages that go down the line.

The photocell used for counting can also select alternate packages if required to fill a particular order. Assume that a regular customer has placed a large order for the smaller packages. A stamp bearing his name and address is placed in the assembly for automatically printing the customer's name on the selected packages.

As shown in Fig. 3, a flip-flop circuit is connected between the amplifier and the control unit. A flip-flop produces one output pulse for every two input pulses. When a large package interrupts the light beam, the customer's name is stamped on the adjacent small package which is then thrust aside and goes down a chute to the shipping department. When a second package interrupts the light beam, the flip-flop circuit produces no output and hence the large package is ignored.

The small packages which are diverted to the chute also intercept a photocell beam and are counted. When the required number have been diverted to shipping, the counter shuts off the control unit and the selection process stops automatically. If desired, of course the larger packages could have been selected by manually interrupting the light beam once in addition to the normal interruptions caused by the packages. The additional interruption of the beam resets the selection cycle and only the large packages are stamped and diverted to the shipping room. The process works even when the packages are all the same size. With two sizes of packages, one photocell can be placed higher than another so one light beam is interrupted only when a larger package passes. The method shown, however, lends itself to an assembly line handling either dissimilar sizes or equal sizes, and no changes need be made when different packages are used.

When a customer places an order for both kinds of packages, the flip-flop stage is bypassed, switching the amplifier output directly to the control unit. Now every package is stamped with the customer's name and address and diverted to the shipping room. When the predetermined number has been selected, the counter again shuts off the control unit and the packages continue to the storage room.

Coded tapes form the heart of a control system that can give directions to a drill press or other machine tool.

When a number of processing steps are to be performed on a single item, a convenient control method uses either perforated paper or magnetic tape. Information regarding the sequence of operations is placed on the tape in coded form, and a tape reader interprets the code and regulates control circuits for the automated industrial machinery doing the work.

A typical example of this method is shown in Fig. 4 where a metal or wood rod is being shaped by a lathe under control of a tape system. By replaying the same tape, hundreds of pieces can be shaped exactly the same. Once the material has been placed in the lathe and the process started, the tape control unit automatically regulates the movement of the servo table. The same control principle can be applied to the automatic operation of a drill press as shown in Fig. 5. Here, a series of holes must be drilled in the material. First, the sequence of drilling operations is determined, as well as the direction which the drill must take to reach each

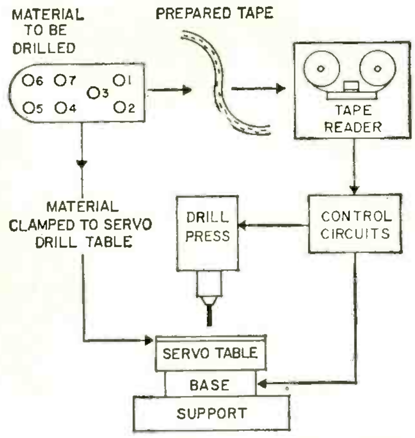
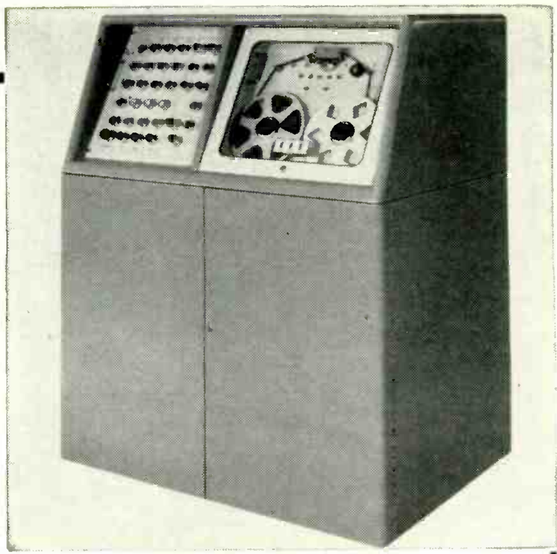


Fig. 5—Control system for a drill press.



Control system uses magnetic tape recordings.

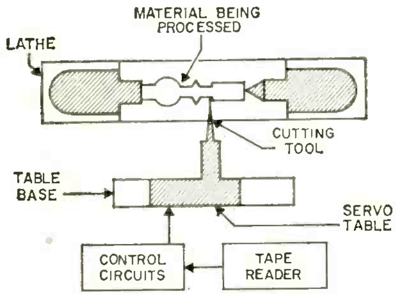


Fig. 4—Tape system controls a lathe shaping a metal or wood rod.

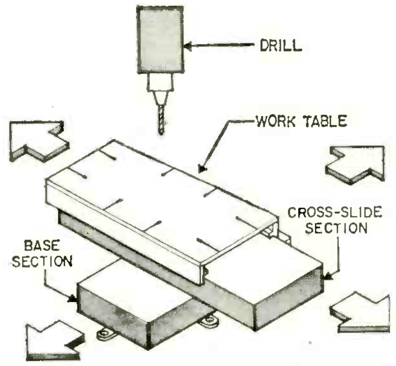


Fig. 6—Principles of the compound servo table.

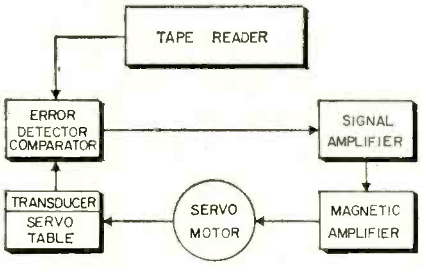


Fig. 7—Block diagram of the basic circuit needed for sequence drilling and servo table control.

prospective hole position. This information is used to prepare a paper tape, using a special typewriterlike machine. The tape is then inserted into the tape reader, and the material to be drilled is clamped to the servo table. As the tape is being read, the control circuits cause the servo table to move around under the drill until the proper position is reached for the first hole. The drill press is then automatically put into operation, after which the servo table repositions the material for drilling the second hole.

One might wonder how a so-called servo table can move around under a drill press or other work device. Its operation can be understood by referring to the makeup of a typical one. The principles of the compound servo table (the Digimatic model 202) of the Electronic Control Systems Co. are illustrated in Fig. 6.

This servo unit consists of a base, a cross-slide section and a work table. The cross slide and the work table move in the directions shown with respect to the base section. By combining the movements of the cross slide and the work table, the material being processed can be placed accurately in the exact position required for drilling.

The motor drive mechanism, including rollers which move on steel bars, the magnetic brakes and transducers are all mounted inside the table castings. The rollers support the table weight and also guide the travel under control of the servo motor. The table can support a thrust of up to 1,700 pounds without disturbing position accuracy.

A block diagram of the basic circuit needed for sequence drilling and servo-table control is shown in Fig. 7. The tape reader feeds instructions through the control circuits to the magnetic amplifier, where relatively low-power signals control the servo motor.

As the servo-motor drive mechanism moves the work table, two position-sensing transducers check the exact horizontal position. One transducer senses the right and left movement, and the other makes a position check on the other horizontal axis. The signal voltages produced by these transducers are compared with the signals from the tape reader. Thus, any table movement which is not in strict accordance with the signals from the tape reader is immediately determined electronically. The error-detection circuit sends a correction signal to the magnetic-amplifier section in order to insure positioning accuracy.

In the system just described, the servo table moves only along a horizontal plane, and paper tape control is satisfactory. In milling-machine operations involving horizontal and vertical movement, the additional signal information required makes magnetic tape necessary. The sequence control system can then be used for contour machining by providing a three-axis coordinated control.

The sequence control processes used in industrial electronic automation speed up production. As an illustration, assume that a piece of material is to be machined so that it has the general shape of the letter D and is 6 inches high and 4 inches wide. By conventional methods, the study and design time, setup and machining would take approximately 16 hours. Using electronic controls, the total time would only be about 3½ hours, including the necessary preparation of a planning sheet and programming the information for tape preparation. When larger and more complex objects must be machined, time savings are even greater. Hence, automatic electronic control systems are being widely adopted in industry at an ever-increasing rate for all phases of machining, processing, packaging and related applications. END

Radio Makes Doll Talk

By PAUL J. WALKER*

IF ANYONE NEEDED TO BE CONVINCED that we are living in the Electronic Age, he would only have to look at childrens' toys. Radio kits and science projects are grabbed up eagerly by older children and pre-adolescents. Simpler toys, with an electronic slant, are available for the younger ones. Here's one of the more dramatic ones—Saranade, the Westinghouse Talking Doll.

Saranade, a young lady of 22 inches, cannot really talk all by herself. She needs another unit—a four-speed record player that can be used either as a straight phonograph or—by turning a switch—a low-power transmitter that sends the sound on the record to a miniature transistor receiver in the doll. The phonograph has a tuning knob to adjust the transmitter frequency—the doll is fixed-tuned and has only a concealed ON–OFF switch.

To get Saranade into the groove, the phonograph is turned on and a record put on the turntable. With the DOLL–PHONO switch turned to DOLL and the doll turned on, and placed about 5 feet away, the TUNING control is adjusted for maximum sound. Saranade can then be carried farther from the phonograph. This unit is both a phonograph amplifier and an oscillator circuit (Fig. 1). When the DOLL–PHONO switch is in the PHONO position, R3 becomes the cathode resistor, and the circuit functions as a standard audio amplifier.

When the switch is turned to DOLL, the amplifier circuit becomes a low-power transmitter. Resistor R4 becomes the cathode bias resistor. V's plate is connected to the antenna through C6 and to the oscillator transformer, T1. Plate current flows through the tank circuit of C5 and T1's primary. T1's secondary regeneratively couples the signal back to the screen grid to sustain oscillation. The TUNING control, actually a slug in the coil, varies the frequency of the tank to match the 180-kc fixed-tuned receiver in the doll.

Output at the antenna is a 180-kc signal, modulated by the audio from the phono cartridge. Radiation from the antenna is well within FCC limits.

Receiver

The 180-kc rf signal from the phonograph is picked up by the doll's antenna, which runs down inside its legs. A three-transistor receiver is mounted behind a cover in the front of the doll.

The antenna wire is connected to the tuned tank of C1, T1 (Fig. 2). The rf signal is coupled to Q1, where it is amplified, fed to Q2 for additional amplification and on to the detector, a IN60 diode. The audio signal from the detector is coupled back to Q2's base through C5. Thus, Q2 is a reflex circuit that amplifies both the 180-kc rf signal and the detected audio. T3's primary has practically no reactance at audio frequencies. R7 is the audio load resistor. The signal across it is then amplified by Q3 and applied to the 8-ohm speaker.

Troubleshooting

Distorted or low sound, or no output at all, can be checked as for any standard phonograph. If the phonograph plays, but there is no sound from the doll, either the oscillator circuit or the doll's receiver may be at fault.

Check the doll's receiver first, by radiating a modulated 180-kc rf signal into it. Make sure the battery is good and the switch is on. If there is no output, remove the two screws holding the receiver mounting plate in the front of the doll and make a visual check of the receiver. A slip-on connector joins the antenna to T1. Use a signal generator and a vtvm to check the receiver. Use an audio signal for the audio sections and a modulated 180-kc rf signal for the rf sections. After any repair job, touch up the three transformer slugs to insure good receiver gain.

Now suppose the phonograph works properly but no signal reaches the doll's receiver. Since the input circuit to the tube does not change during switching, the trouble must be in either the switch or one of the oscillator circuit components. This circuit is very simple and there should be no difficulty in finding a defective component.

Electronic units, as they are used in toys, are not difficult to understand or troubleshoot. The greatest cause of trouble will probably be rough handling. A careful visual check, therefore, should locate many of the problems that may arise.

END

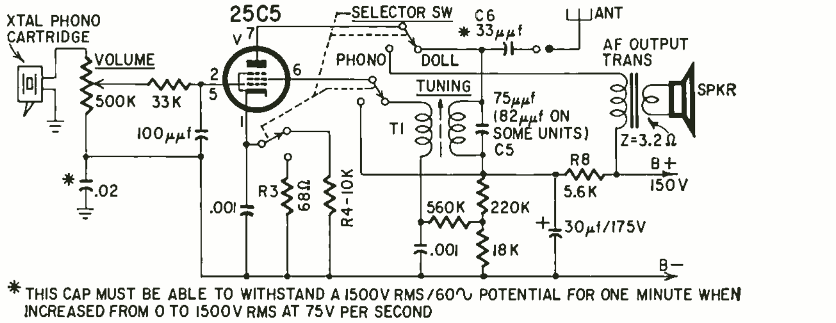


Fig. 1—Partial circuit of single-tube amplifier that converts into oscillator with flip of switch.

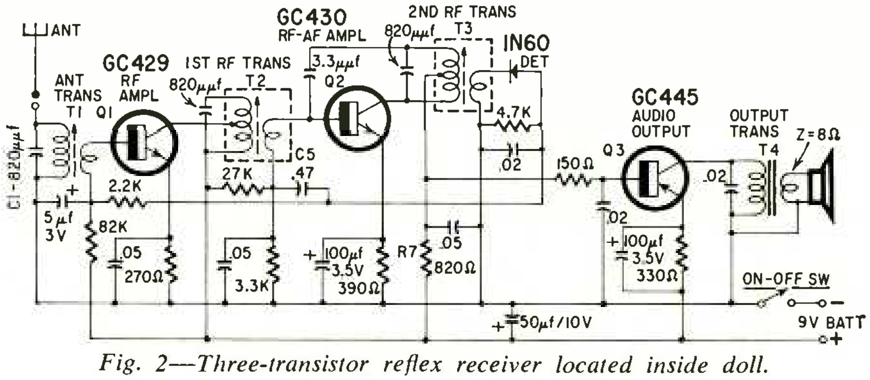


Fig. 2—Three-transistor reflex receiver located inside doll.

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* Technical writer, Westinghouse Television-Radio Div., Metuchen, N. J.

start your car FAST

Build this 3-transistor unit and start your car easily, even on the coldest mornings

AS THE WEATHER GETS COLDER, YOU'LL find it increasingly difficult to start your car in the mornings. The cold motor and thickened grease and crankcase oil put a tremendous load on the starter, which in turn draws a heavy current from the battery. The result is lowered battery voltage and a spark that is often too weak to do any good. The little gadget described here* avoids this by inserting a separate battery into the ignition circuit when you start your car. As soon as the motor is running, it turns itself off, reconnects the auto battery and waits for its next call to duty.

The diagram shows the circuit of the electronic starting aid, as installed in your car. You've just come out of the house, climbed into the driver's seat and are ready to go to work. You've switched the unit on and inserted your key in the ignition switch and turned it on.

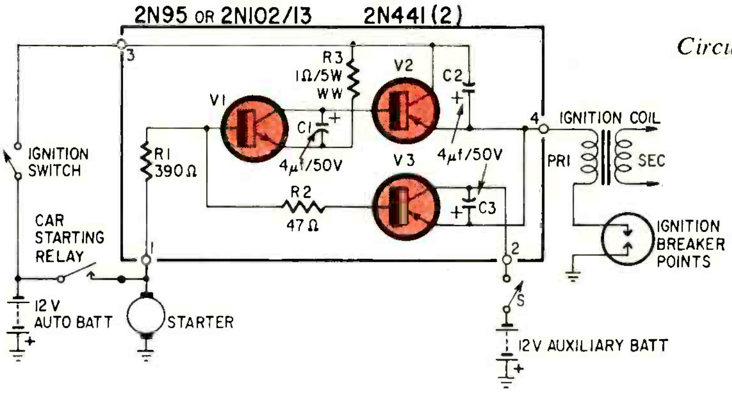
At this point let's examine the circuit. V3 is not conducting because no negative bias has been applied to its base. Conversely, V2 is conducting because V1 is supplying base bias to V2. V1 is conducting because of the bias applied to its base through the windings of the starter motor. So far, the car battery is still connected to the ignition system. (True, ignition-coil current must flow through the collector–emitter circuit of V2, but V2 is saturated and the voltage drop it introduces is negligible —in the order of 1/3 volt.)

Next the starting motor is actuated, introducing a negative voltage at the starting motor terminal. This reverses the conductive states of all transistors in the starting aid. V1 is biased to cutoff; it in turn cuts off V2, disconnecting the car battery from the ignition coil. At the same time, V3 is triggered into conduction and connects the auxiliary battery to the ignition coil.

Once the engine starts, the starting motor is, of course, disengaged. The negative voltage is removed from the starter-motor terminal and the transistors revert to their original states. This disconnects the auxiliary battery and reconnects the car battery. Operation is now normal. However, should the engine die and you restart it, the auxiliary battery is switched in automatically.

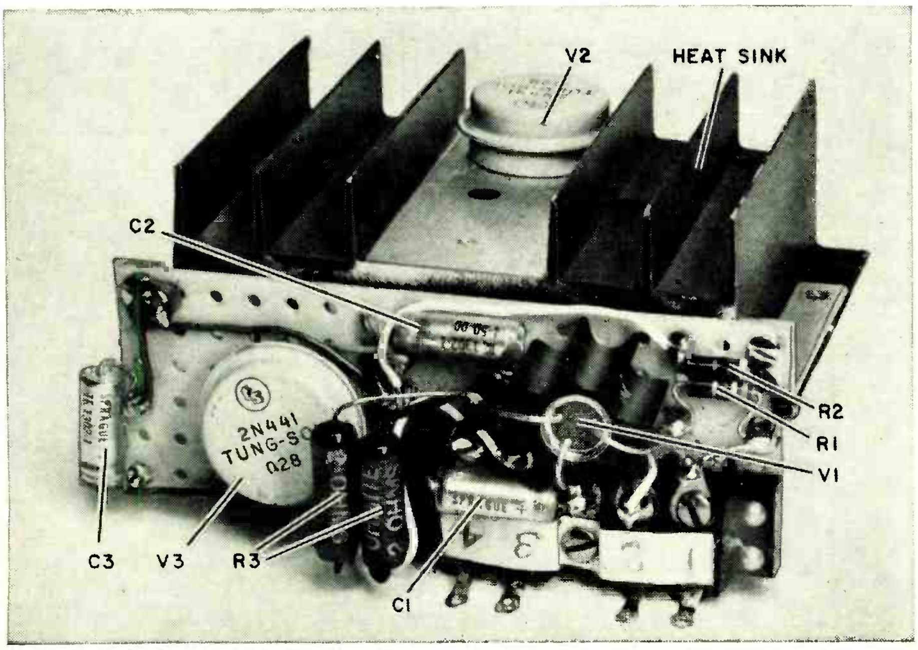
Once the motor has warmed up a little, you can turn the quick-start device off. It will do no harm if you leave it on, but to conserve the life of the auxiliary battery it is best to turn it off. Whenever the device is on, there is some leakage through V3.

The three electrolytic capacitors (C1, C2 and C3) bypass ignition transients which might otherwise injure the transistors. Note the polarity for C1 is not the same as for C2 and C3.



Circuit of the quick-starting unit.

R1—390 ohms, 1/2 watt, 10%
R2—47 ohms, 1/2 watt, 10%
R3—1 ohm, 5 watts, wirewound, 10%
C1, C2, C3—4 μf, 50 volts, electrolytics
Auxiliary BATT—12 volts (2 Burgess F4BP 6-volt batteries or equivalent)
S—spst toggle switch
V1—2N95 or 2N102/13
V2, V3—2N441
Heat sink—Delta NC-401 (available from Allied Radio) or a 3 x 4 x 1/8-inch sheet of aluminum. Insulate from car chassis.
Miscellaneous hardware

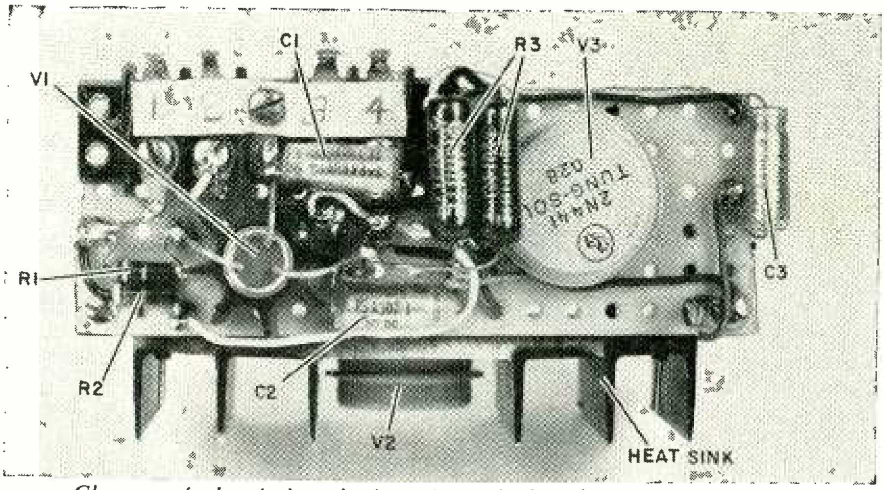


Parts layout is clearly visible in photo of completed unit.

Installation

You can locate the device in either the engine or passenger compartment. Just make sure you keep it away from the engine manifold if it goes in under the hood. Also, insulate the heat sink from the car chassis. When making connections between the quick-starter and the ignition system, be sure to break the proper ignition coil lead. One lead goes to the breaker points in the distributor. Do not touch this one. Lift the connection to the other and, as shown in the diagram, connect this coil terminal to

* The device was developed by Irving M. Gottlieb, Menlo Park, Calif.



Closeup of chassis board. A perforated phenolic chassis was used.

BENCH TESTED

This starting aid was installed in a 1960 Ford Falcon and tested for 2 weeks. While in colder climates the test would have been more valid, it was easy to tell that, though the starter turned the motor at the same rate as without the unit, yet on cold mornings the motor caught faster.

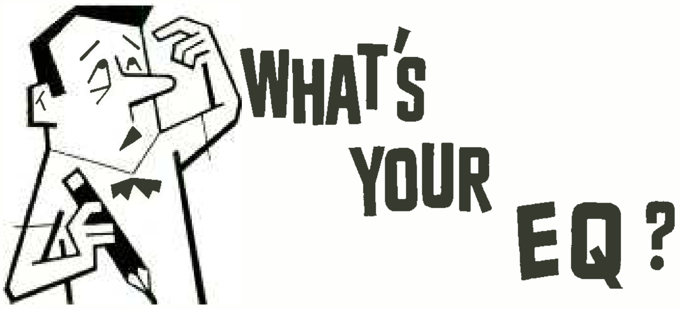
Basically, this is an electronic switching device. It is comparatively simple and works well. While it may be somewhat expensive, considering the task it performs, the auto bug and experimenter will find it a fascinating project.

The only difficulty encountered was in installation. No metal parts of the unit should be allowed to touch any part of the auto chassis. Therefore, it was necessary to first mount the unit to a wood board before installation. The board was attached to the car body.

terminal 4 of the starting aid. The lead you disconnected from the coil goes to terminal 3 of the starting aid. Terminal 1 goes to the single large terminal protruding from the housing of the starter motor.

Make sure that you have a good ground return for the auxiliary battery. To avoid any resistive path, use a substantial body bolt free from rust and corrosion and use a fairly heavy stranded cable to connect to it. Tin the connecting end of the cable with solder and clamp it firmly in place.

One word of caution: The electronic starting aid is intended for use only with automobiles having a 12-volt grounded-positive battery system. END

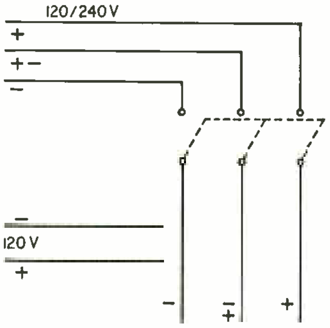


Three puzzlers for the student, theoretician and practical man. They may look simple, but double-check your answers before you say you've solved them. If you've got an interesting or unusual answer send it to us. We are especially interested in service stinkers or engineering stumpers on actual electronic equipment. We are getting so many letters we can't answer individual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). We will pay $10 and up for each one accepted. Write EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

Answers for this month's puzzlers are on page 63.

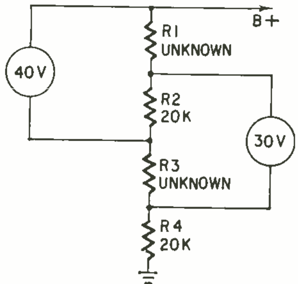
120-240 Switchover

A 120/240-volt dc generator supplies the power for a balanced 3-wire 120-volt load as shown. A 120-volt generator is to be installed for emergency use. What must be done, using a knife-



switch arrangement, to switch the entire load from the 3-wire generator to the 2-wire generator without reversing the polarity, and making certain that one generator cannot inadvertently be connected to the other or that 240 volts cannot be inadvertently connected to a 120-volt load?—*Z. L. Langly*

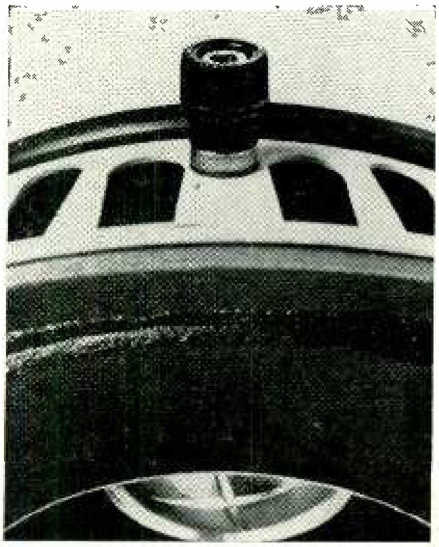
Voltage Quandary



Without writing any equations (by inspection), what is the B-plus voltage? —*Rudolf H. Schorsch*

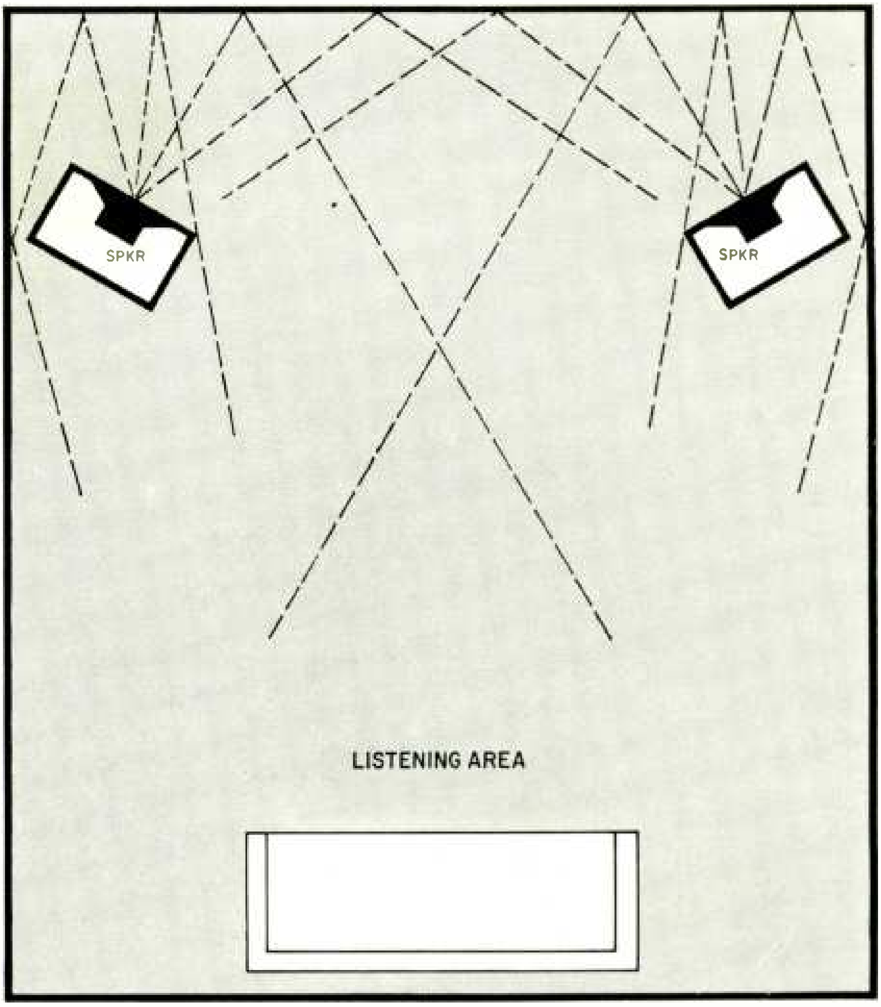
What Am I?

This is a photographic one. Do you recognize it?—*Larry Steckler.*



PHASING AND BALANCING SPEAKER SYSTEMS

It's simple when you know how



Speakers can be turned to reflect sound from the walls to form a wider and more diffuse sound source.

By GEORGE L. AUGSPURGER

For some reason, speaker phasing and balancing remain an impenetrable mystery to the average music lover, and to altogether too many service technicians. They're really not hard to understand at all. You can phase and balance your own speakers without too much trouble.

The signal from the amplifier makes the speaker cone move back and forth—no problem so far. Now, if you reverse the wires from the speaker where they connect to the amplifier, you won't hear a bit of difference. But the cone is actually moving in a mirror image of its previous excursions. In other words, it is now going forth and back.

In a monophonic installation it doesn't make a bit of difference which way the wires are connected between the speaker and the amplifier. But in a stereo system the two speakers must be connected the same way so the cones swing back and forth together.

You can check speaker phasing with little trouble. First, set the function selector switch on your stereo amplifier to "A + B." Feed in a mono or stereo program source. Adjust the balance control so the speakers are playing at about the same loudness. Listen, then flip the "phase" switch (or reverse connections to just one speaker system).

One connection generally gives stronger bass and a definite sense that the sound is coming from a point midway between the two speakers. If the two systems are out of phase, bass will be thin and there will be a hole in the middle with sound clearly coming from two separate speakers.

Note that this test is made with the system operating monophonically, that is, with both speakers reproducing exactly the same signal. This makes it considerably easier to hear the two effects described. As you listen to stereo and become more critical, however, you'll find that you can spot out-of-phase trouble even when the system is operating in its normal stereo mode.

One other point regarding phasing: If you are using two- or three-way speaker systems, the individual drivers in each system must be phased properly. If you get firmest bass with the phase switch in one position, but the correct single blended sound source in the other position, chances are that the two woofers are phased together but the mid-range units are not. Reverse connections to the mid-range driver in one speaker system and see if this doesn't correct the trouble.

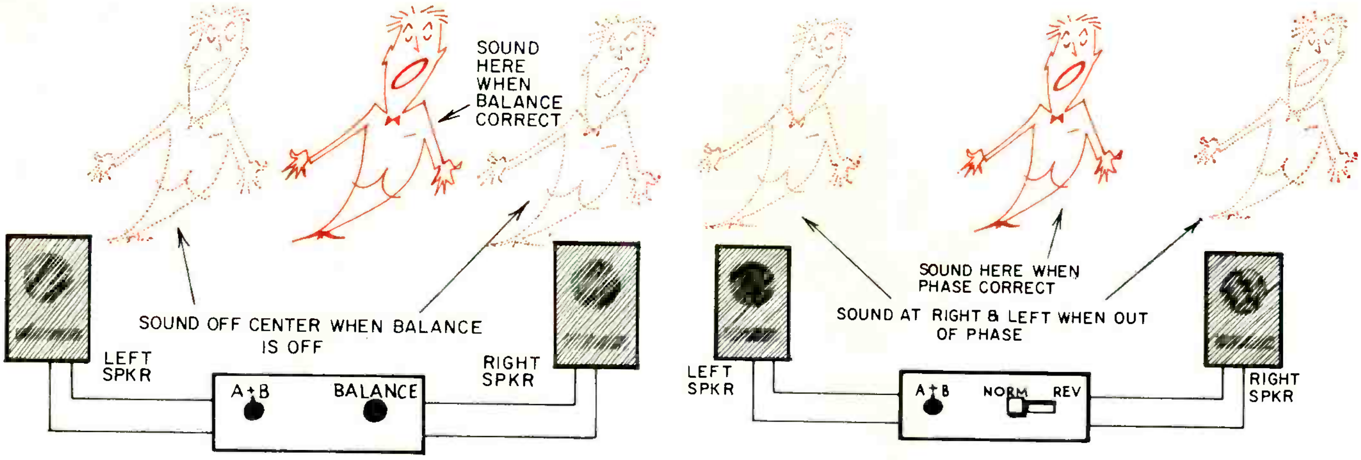
Fortunately, if you are using matched equipment all the way along—speakers, amplifiers, preamp — then you can simply follow the hookup directions supplied. Once in a while, however, a stereo record is released with the two channels in reverse phase. This is why a phase switch is often provided on stereo amplifiers. Phasing mixups may occur on some FM stereo broadcasts, too, until the broadcasts have all the bugs out of their systems.

Are the channels balanced?

Generally speaking, the two loudspeaker systems should be operating at about the same loudness for proper stereo reproduction. This isn't quite true really . . . what is required is that the two channels be balanced *at the listening location.* If you are sitting nearer the left speaker, the right channel will have to be cranked up a little louder.

The easiest way to set balance is again to turn the switch to "A + B" and then listen for the point at which the sound seems to come from a source midway between the two speakers as you adjust the balance control. Flip back to "stereo" and you're set.

It would be simpler if the balance control could be left off the amplifier altogether, but it is needed for two purposes. One is to compensate for differences in loudspeaker efficiency or listening location. The other is to make



Unbalanced or out-of-phase stereo produces sound that seems to come from source at right or left of center.

slight adjustments which may be required for different broadcasts or recordings. If you don't have a balance control, separate volume controls for the two channels will do the same thing, but the adjustment is more awkward.

Don't be afraid to experiment

Time and time again, manufacturers of high-fidelity components get letters, "I have a room 13 by 18. Please tell me what equipment I need and where it should be installed for stereo." There is nothing wrong with this man's desire for good music reproduction, but he needn't be so timid about it.

First of all, if you live in a fairly large city with several audio dealers, why not visit them and see what they suggest? For some reason, there is a reluctance to "intrude" into a dealer's showroom for fear he may not have what you want or be rude or stupid or a high-pressure salesman. It is possible that any of these may be true, but that is his misfortune, not yours. You are the master of the hour: a potential customer, or at least a goodwill emissary. If you don't like the way you are treated, walk out and try someone else.

Secondly, once you have picked your equipment, don't be afraid to play with it. I have never been able to understand the man who pays $200 for a super multi-control edge-lighted pushbutton stereo preamp and then wants someone to tell him exactly where all the knobs should be set.

No one takes this approach with an electric range. All the little chrome gadgets can be set different to do different things. Same thing with a stereo system. Play with all the knobs and switches and terminal strips to find out the things you can do to make individual programs sound just the way you want them to.

Play with the locations of your speaker systems. Room placement is vitally important to the operation of any speaker. Sometimes moving it a few feet will make all the difference in the world. This is especially true of stereo speakers. Even if the rest of the furniture prevents you from placing the speakers in the very best arrangement, you know at least the limitations of your room acoustics and can mentally adjust your listening impressions accordingly.

Sometimes, if you can work it out from a practical standpoint, you can get exciting stereo sound by turning the speakers backward and listening to the sound reflected from the wall, as in the diagram. Sometimes you can get a closer approach to the concert hall by using a third speaker, not between the other two, but behind the listening area and played at low volume.

There are all sorts of things you can try with little or no additional cash outlay. Have fun! Experiment! You'll get more enjoyment out of your equipment!

It seems to me that multiplex stereo will pretty well establish stereophonic sound as *the* type of program material for most serious listening. Don't be afraid to take the time and trouble to get the most enjoyment out of it you can. It's worth it. END

Electronic Activators for Motion-Picture Matrix Printers

By MARY VIVIAN SMALL

[WE HAVE OFTEN NOTED A STRANGE EXPRESSION on our nontechnical friends' faces when we discuss something electronic, and have decided that we must sound rather obscure to them. Just how obscure we sound was made clear to us by a poem received from an operator in motion picture processing.—Editor]

These things designed to activate
the light boards and the cams
(when printing special fade effects)
can cause a lot of jams.

Sometimes the little silver bloops
dissolve the shadow scenes
and light the moving images
upon the silver screens;

but copper bloops, and rivet pins,
and nicks will trip the switch.
There's short, and square, and longer
bloops
which works the best—oh, which???

Glossary

Matrix: A pattern made from an original negative.

Light Board: The machine that regulates the amount of light passing through the negative as it is being printed.

Cam: Heart-shaped piece of flat metal, used to regulate the manner in which a shutter is opened or closed. Fade and dissolve operations require the use of cams. (Fade is understood by every picture-goer. Dissolve is the effect created when two scenes overlap, the first gradually disappearing altogether as it is replaced by the second.)

Bloop: Mixture of ground metal and chemicals, brushed onto the edge of the negative while in semi-solid form. As the bloop comes into contact with the roller, it shorts out a circuit by connecting with the poles inside the bloop roller, causing an impulse.

Rivet Pin: Small metal bolt fitted through a hole in the film. Rivets and rivet pins are placed on the film, or the "cueing matte" (a control film) in such a position to direct an impulse to any one of many solenoids and microswitches, either by direct contact bypassing between the fingers or by proximity detector. END

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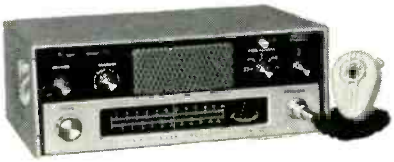

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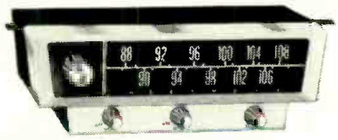


NEW 10-Transistor FM Car Radio

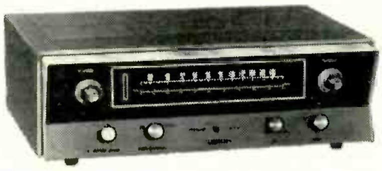
88 to 108 mc coverage; better than 1.25 microvolt sensitivity; AFC for drift-free FM reception; tone control. Factory-assembled tuning unit; easy circuit board assembly. 7 lbs.

Kit GR-41 . . . no money dn.. $7 mo. . **$64.95**

NEW FM Portable Radio

10-transistor, 2-diode circuit; vernier tuning; AFC for drift-free reception; tone control; 4" x 6" speaker; built-in antenna; prebuilt tuning unit. Battery lasts to 500 hrs. 6 lbs.

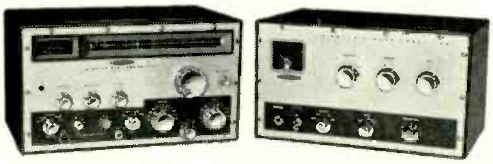
Kit GR-61 . . . no money dn., $6 mo. . . **$54.95**



NEW FM/FM Stereo Tuner

Stereo Indicator light; phase control for max. separation and lowest distortion; adjustable AFC for drift-free reception; bar-type tuning indicator; filtered outputs for stereo tape recording. Factory assembled tuning unit. 16 lbs.

Kit AJ-12 . . . no money dn., $7 mo. **$69.95**



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out anywhere, you can find out why.

SERVICE CLINIC

By JACK DARR
SERVICE EDITOR

This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.
We've changed our target a little and are no longer restricted to TV. Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here So if you have a service problem, send it here. We'll do our very best to help you solve it

WE CONTINUE TO RECEIVE NUMEROUS inquiries concerning picture-tube conversions. Hence, we are listing pertinent data here:

7JP4 to 8-inch 90° tube: not a practical conversion.

10BP4 to 24-inch tube: difficult—21EP4 is better advised. Use with a Merit HVO 7 flyback and matching yoke.

12KP4 to 21EP4: OK, with change of flyback, yoke, and vertical output transformer.

12LP4 to 16RP4: conversion from a 53° tube to a 90° is not advisable.

12LP4 to 17BP4: conversion practical—use a conversion kit.

12LP4 to 17LP4: difficult—use 17BP4.

12WP4 to 12LP4: not practical, because of thin neck on the 12WP4.

14CP4 to 17BP4: OK, although high voltage is a bit low and pix will be a trifle dim.

15GP22 to 12AXP22: not practical.

16LP4 to 16LP4-A: OK, but high voltage is a bit low.

17CP4 to 17YP4: OK.

19VP22 to 21AXP22: OK.

20CP4 to 21ECP4: OK—use Merit MDF 110 yoke, HVO 126 flyback.

21ALP4-A to 21YP4-A: practical conversion.

21ALP4-A to 24DP4-A: picture will be narrow, unless heavier flyback is used.

21AMP4-A to 24CP4-A: can be done, if flyback, yoke and vertical output transformer are replaced.

21AP4 to 21ACP4-A: OK—the 21EP4 is another possibility here.

21EP4 to 24CP4: requires yoke and flyback change.

21KP4-A to 21FP4-C: OK.

27AP4 to 24DP4: practical conversion—both are 90° tubes.

Picture collapse

The picture collapses intermittently, in a Magnavox CT-CMU-427 TV. It looks as if there is complete loss of vertical deflection followed by loss of brightness. If you're near the set, you can hear a slight "snap." All tubes replaced; no help.—J. J. H., Grand Forks, N. D.

Look into the high-voltage cage and inspect the rectifier socket, flyback and then the yoke for any signs of arcing to nearby metal. Such arcs usually leave a tiny discolored spot and are caused by a minute breakdown or open spot in the insulation. Watch for this in a darkened room. Clean out the whole cage, and spray with an acrylic insulating compound, or anti-corona dope. Give the whole thing several thin coats, letting each one dry for at least four hours.

A product known as High-Voltage Putty (Colman) is very helpful in repairing loosened or melted "tires" on flybacks suffering from this complaint.

Vertical retrace lines

The vertical retrace lines in a Sylvania 1-518 show up about halfway down the picture. The blanking seems to be all right most of the time, but there shouldn't be this much retrace. I have checked the blanking network and it seems OK.—F. B., Allenhurst, N. J.

The vertical blanking pulse in this chassis is picked up from the vertical linearity control, as you can see in Fig. 1, and fed to the CRT grid, through the 12,000-ohm resistor and .0033-μf capacitor. There is also a .01-μf bypass. If the 12,000-ohm resistor or the .0033-μf capacitor are bad, you will get improper retrace blanking. Also check the .01-μf capacitor for leakage.

To be certain, pick up the blanking pulse at the linearity control and follow it to the CRT. If it's dropping out anywhere, you can find out why.

Sentinel tuner

I've an old Sentinel with no model number. The trouble is in the oscillator circuit. It uses a 12AT7, and it will not start on the low band until you touch something—anything—in the oscillator circuit. Then it starts and keeps working until the set is turned off.—B. D., Denver, Colo.

This seems to be marginal oscillator operation. It could be caused by a bad capacitor, but the most likely cause is low plate voltage. Try checking the plate resistor. It is 22,000 ohms in most of these tuners. It may have been burned by a short in a previous oscillator tube. Plate voltage ought to be around 150.

Give the whole tuner a good cleaning, and check the bias resistor. It ought to be about 220 ohms. Also, try another tube or two. In some of these older tuners, tubes were critical.

Needs replacement control

I need a volume control for a Tech-Master 2431P, and I can't find it anywhere. Where is this control tapped; in ohms, that is? Also, the contrast control is on the same shaft.—C.H.S., Hannibal, Mo.

The actual position of the tap on a compensated volume control isn't too critical, especially to the naked ear. The average positioning for this is about 300,000 ohms from the top end. The volume control in this chassis is a standard audio curve taper C or D, 1 meg., contrast control, 5,000 ohms.

Any parts distributor can make up one of these from stock units, but will probably have one in any of several lines: Mallory, Centralab, etc. This combination is quite popular. I can think of at least three chassis that use the same values.

Color pop-in and out

Although this set is in a strong signal area, within 5 miles of a station, I've always had trouble getting the color to stay on. The picture is good, but the color wants to pop in and out.—R. K., Tulsa, Okla.

This is one of two things: either agc or antenna trouble. Under most cir-

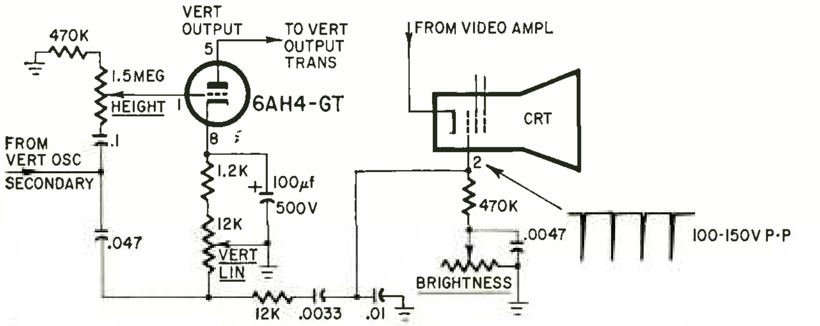
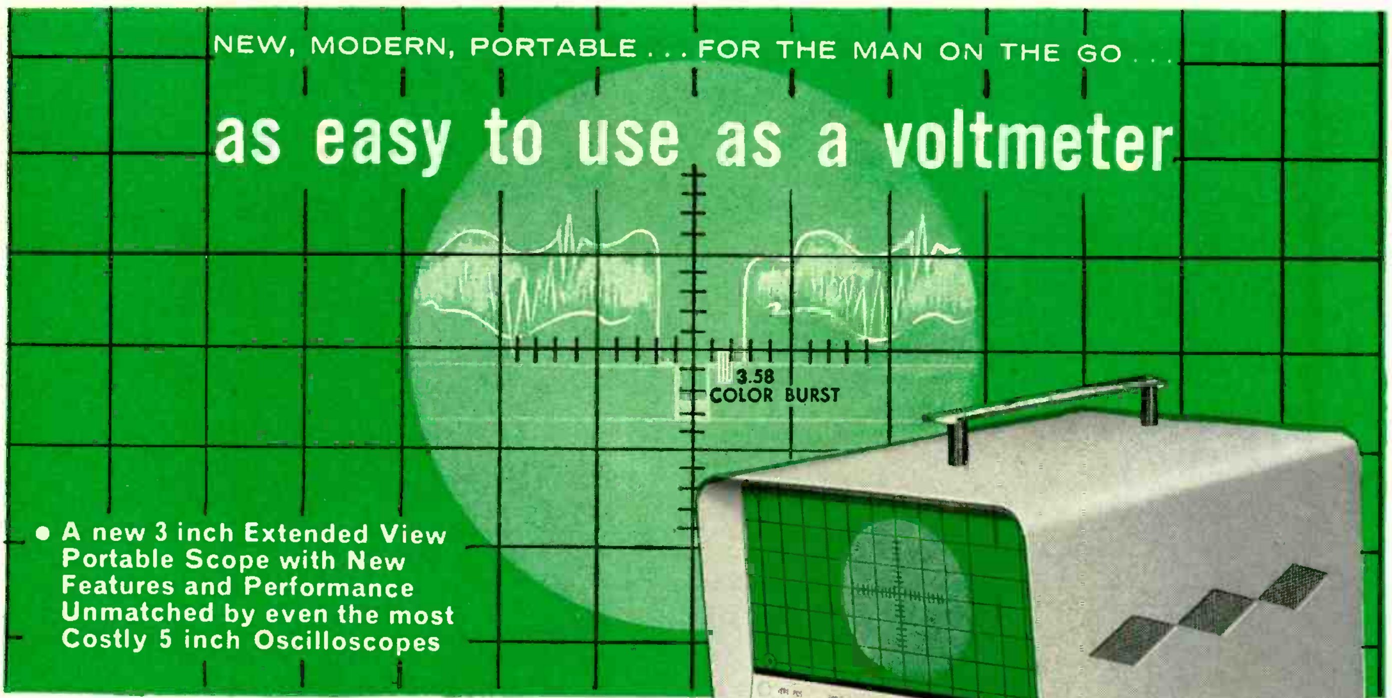


Fig. 1—Source is actually the secondary of the vertical oscillator transformer.



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Here it is, the scope that technicians, engineers and servicemen from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest laboratory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job. • The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes . . all the way. Vertical amplifier sensitivity is .035 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectedly. Another Sencore first is the Automatic Range Indication on Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:
Vertical Amplifier—flat within ½ DB from 20 cycles to 5.5 MC, down —3 DB at 7.5 MC, usable up to 12 MC.
Horizontal Amplifier—flat within —3 DB from 45 to 330 KC, flat within —6 DB from 20 to 500 KC.

HIGH DEFLECTION SENSITIVITY:

		RMS	P/P
Vertical Amplifier—	Vert. input cable	.035V/IN.	0.1V/IN.
	Aux. vert. jack	.035V/IN.	0.1V/IN.
	Through hi-imped. probe	.35V/IN.	1.0V/IN.
Horizontal Amplifier—		.51V/IN.	1.44V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 85 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 20 MMF
Through hi-imped. probe	27 Meg. shunted by 8.6 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

Frequency range—	4 ranges, 15 cycles—150 KC
Sync Range—	15 cycles to 8 MC usable to 12 MC

MAXIMUM AC INPUT VOLTAGE:

Vertical input cable— Aux. vert. jack— Hi-imped. probe—	1000 VPP (in presence of 600 VDC)
Horiz. input jack—	approx. 15 VPP (in presence of 400 VDC)

POWER REQUIREMENTS:

Voltage—	105-125 volts, 50-60 cycle
Power consumption—	On pos. 82 watts
	Stby. pos. 10 watts

SIZE: 7″ wide x 9″ high x 11¼″ deep—weight 12 lbs.

The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

SENCORE
ADDISON 2, ILLINOIS

cumstances, too much signal is just as bad for color reception as too little. In the location you describe, you've probably got tremendous signal strength, and the sensitive tuners used in modern color sets will be beaten to their knees by

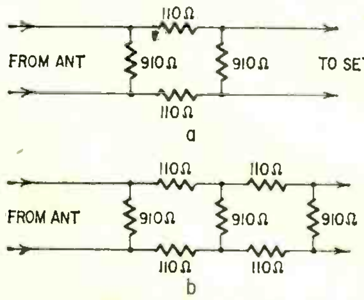

Fig. 2—Two pads for reducing signal strength in strong-signal areas. Pad in (a) drops signal 6 db. For additional attenuation, add another section as in (b).

it! Unless, that is, you set the agc properly and, if necessary, reduce the signal level applied to the input with pads. If you try to pad, always use resistive pads (Fig. 2), never inductive, to avoid forming traps for the color signals.

In the second case, you could have a trap in the antenna. Try disconnecting one side of the lead-in. If this brings the color back steadily, you'll either have to cool off that lead-in with metal foil or put up a less sensitive antenna.

Red smear

In an RCA 21CS7815 color TV, the black-and-white picture is perfect. On color, I get a smearing of the reds. This makes a girl's lips smear to the right, and so on.—R. P., Clio, S. C.

Transmitter trouble! Or, trouble in a stabilizing amplifier in the telephone company's office, where the coaxial cable or microwave link is terminated.

This is caused by a phase shift in the cable, or some similar component. It is delaying the blue and green or introducing a lead into the red.

This cannot be in your receiver! Why? Because it makes a good monochrome picture. The only thing that could cause this particular trouble in the receiver would be a severe misconvergence. But either one of these would cause the red fringing to show up on monochrome too!

Vertical bars

I've got vertical bars on the screen of an Olympic 17TW27. They look like yoke ringing, but I've replaced and tested the yoke-balancing capacitor with no results.—J. G., Dothan, Ala.

Let's get basic: obviously, the cause must be ringing in or around the flyback somewhere, not due to the standard cause, yoke unbalance. So, get out the scope and check everything in that circuit. Chances are, you'll find something in the secondary circuit of the flyback is causing the damper cir-

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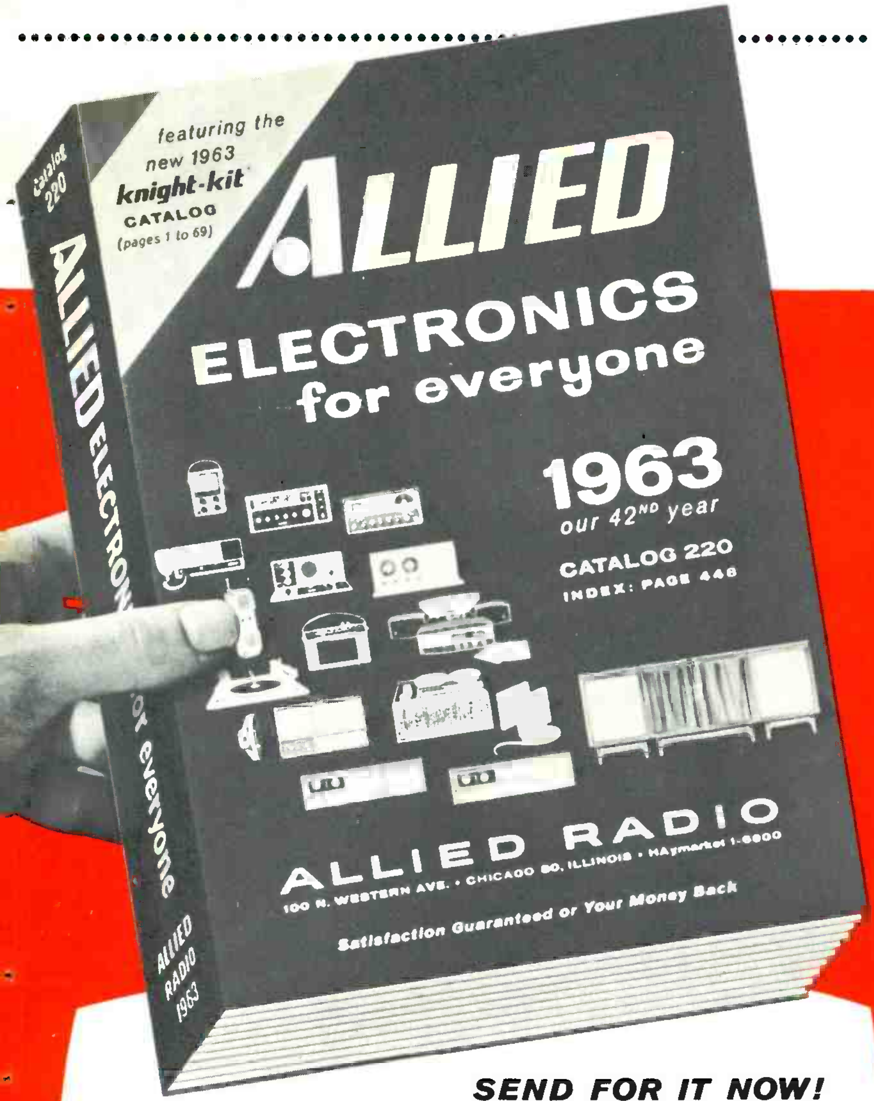

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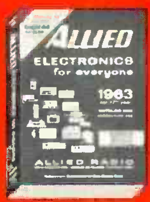

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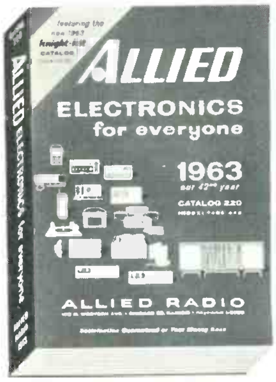

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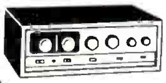

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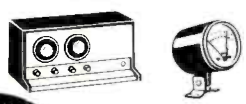

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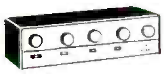

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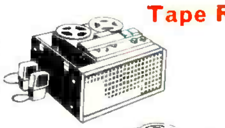

Complete recorders, tape decks, recording and pre-recorded tapes at big savings.

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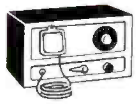

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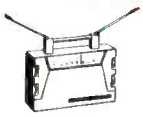

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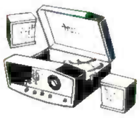

Big values in phonographs; latest stereo portables; famous-brand records at amazing discounts.

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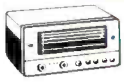
Ham Station Equipment



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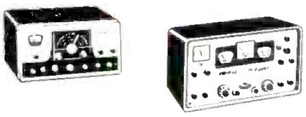

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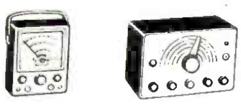

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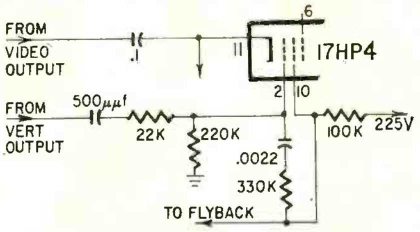


Fig. 3—CRT circuit of Olympic 17TW27.

cuit to ring excessively. Or something that is allowing the ringing to get into the raster when it shouldn't.

Suggestion: check the voltage on grid 2, pin 10, of the CRT (Fig. 3). This ordinarily comes directly from boost. If it is insufficiently filtered, it could cause such bars by beam-modulating the CRT. Even this grid, if there is enough modulation on it, can affect the raster. Look for high-amplitude horizontal spikes on this pin, also on the signal grid and cathode.

Horizontal drift

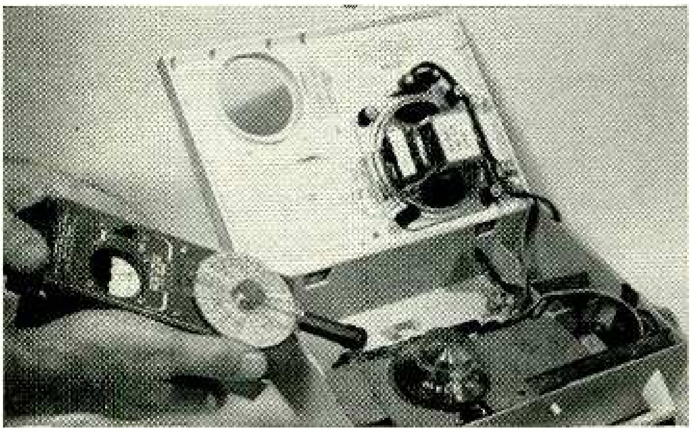
I have a Freed-Eisemann Model, CHT-1916 on the bench and I can't find service data for it anywhere. It has horizontal drift, which takes place over about 15 or 20 minutes. I did have some arcing in the flyback, but cleaning the high-voltage cage and spraying with Krylon stopped that. However, I still hear a slight frying in it. The flyback is marked 77J1 and TRB-41.—E. M., Detroit, Mich.

I expect you're going to find the cause of the horizontal drift is a temperature-sensitive resistor. From the time constant of the defect, the resistor is the most likely cause. Any resistor which could affect the frequency of the oscillator should be suspected—grid resistors, plate load resistors, time-constant or R-C network shaping resistors, etc. To pin it down quickly, cool the set, turn it on and rapidly apply heat to each suspected resistor with the tip of a soldering iron. The guilty resistor will cause the drift to show up immediately. Don't stop with the first one you find, either; check them all!

The original flyback in this set was evidently bought from G-E, from the 77J1 number, which is characteristically G-E. However, my catalogue lists a Triad D-14R for this chassis, and gives the original model number as TRB-41. This is shown as being used in the 1610 and 1620 chassis. This was probably due to a manufacturing change in that run of these receivers. The 77J1 G-E flyback is very popular and not expensive. If it must be replaced, which I doubt, use that. The frying you hear is a bit of corona which didn't get covered up on the first spraying. Examine the high-voltage cage in a darkened room and you'll probably see it. A material called highvoltage putty is very good for this trouble. END

EQUIPMENT REPORT

Grid-Dip Meters
PACO G-15
EICO 710



Using PACO G-15 to check ferrite antenna in portable radio.

By **WAYNE LEMONS**

The grid-dip oscillator (GDO), an unusually versatile instrument widely used by designers and engineers, seems never to have caught on as it should with the service technician. It seems a shame that such a useful yet inexpensive instrument should be regarded so lightly by so many. Part of the reason may be that earlier GDO's did not reach down into the broadcast band.

Two kit or wired instruments that go down to 400 kc and up to 250 mc are the PACO model G-15 (Fig. 1) and the EICO model 710 (Fig. 2).

A grid-dip oscillator, or if you prefer, a grid-dip meter, is basically a variable-frequency oscillator with a microammeter in the grid-return circuit to indicate relative power. The oscillator tank coils plug in externally so they can be used as a probe. The tank ca-

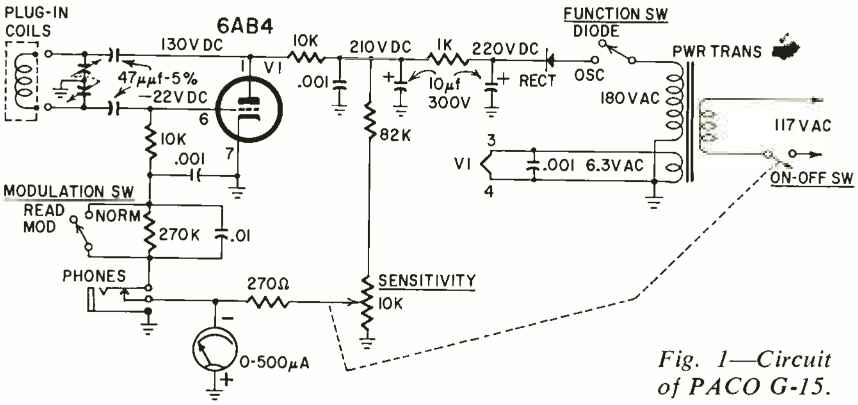


Fig. 1—Circuit of PACO G-15.

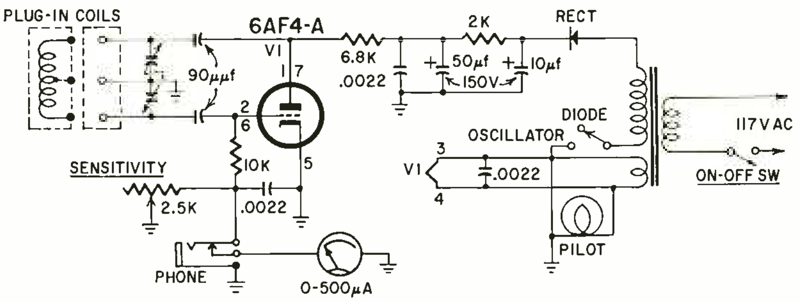


Fig. 2—Circuit of the EICO 710.

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Tips for Technicians

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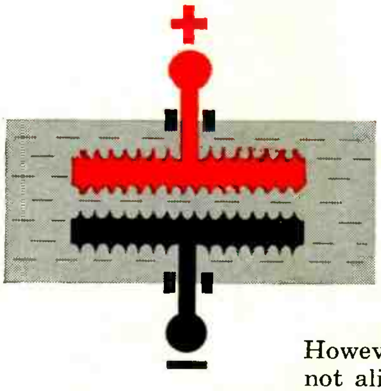
Why some filter capacitors develop hum... and some don't



Aluminum electrolytic capacitors are widely used as filters in DC Power Supplies. This is because of their large capacitance in relatively small size. All in all, they do an efficient job of reducing ripple (hum) to acceptable levels.

However, all electrolytic capacitors are not alike. This is often why some types seem to allow hum to rise to objectionable levels more quickly than do others. In order to understand why, we must investigate actual construction methods.

As you know, electrolytics are basically made by depositing a film of aluminum oxide on aluminum foil to form the positive anode. The oxide is the dielectric. A semi-liquid electrolyte surrounds the anode and is actually the negative cathode. In order to connect this semi-liquid cathode to a terminal, a second piece of aluminum foil is used. This is often *called* the cathode, but it is not. It is actually only the *cathodic connection*. (The preceding describes a "polarized" electrolytic capacitor.)

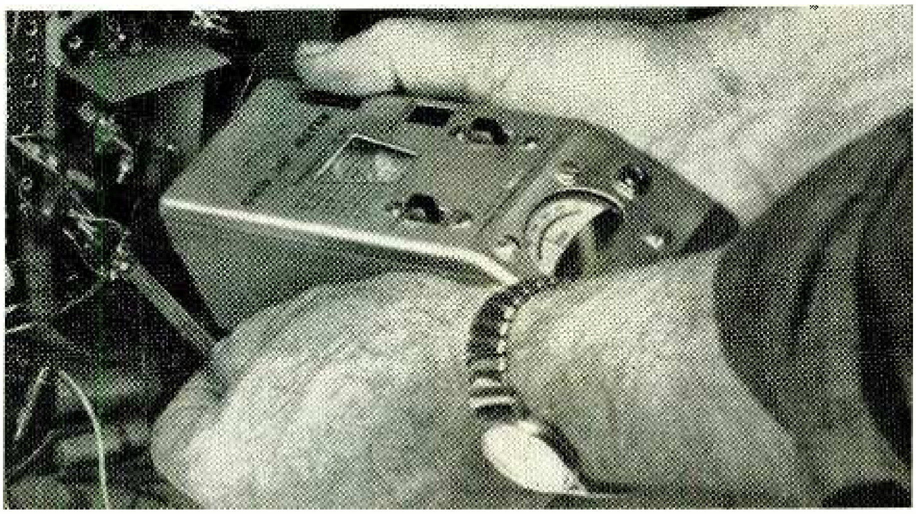
When high ripple currents are applied to polarized electrolytics, a thin oxide film forms on the so-called "cathode". It begins to assume the characteristics of a second anode. This in turn, has the same effect as placing two capacitors in series. Consequently, overall capacitance is reduced. Inevitably hum increases.

This action is especially noticeable in electrolytics which use plain foil as the "cathode". This is simply because the oxide builds up over a relatively small area.

Mallory avoids this problem by etching the "cathode" on electrolytics. As a result, oxide build-up is spread over a vastly increased area. Therefore, ripple currents are maintained at very low levels for very long time periods.

Of course etched "cathodes" cost a lot more to make. But you get them from Mallory at *no extra cost.* There's much more to the Mallory capacitor story, but we'll leave that to another TIP.

Meanwhile, see your local Franchised Mallory Distributor for capacitors, resistors, controls, switches, semiconductors, and batteries. In fact, he's the man to see for *all* of your electronic component requirements.



Using EICO 710 to pre-align sound trap in TV receiver.

pacitor is variable and its dial is calibrated in frequency.

To check resonance of unknown tuned circuits. the probe coil is inductively (sometimes capacitively) coupled to the unknown circuit. The GDO dial is then rotated for a dip in meter reading. This dip indicates that the unknown circuit is absorbing power from the oscillator and so is resonant with it. The GDO dial then indicates the resonant frequency of the unknown circuit.

The units mentioned here have eight plug-in coils to cover the desired frequency range. By switching off the B-plus to the oscillator tube (DIODE position), the GDO becomes an absorption wavemeter, and the frequency of an rf *source*, such as in a transmitter, can be determined. The oscillator tube becomes an equivalent diode and the meter reads the circulating current picked up by the probe coil.

These instruments have phone jacks for headphones converting the GDO to an oscillating detector. You can zero-beat the GDO with an unknown frequency source for an even more sensitive indication.

Servicing radios

The GDO is ideal for checking tube or transistor radios. Use it to check loop or ferrite antennas and oscillator coils, for substituting a local oscillator and even as a signal generator for alignment.

If you suspect the antenna coil is not tracking or if you need to rewind one that has been damaged, the GDO makes the job a snap. Set the radio dial to say 1,000 kc. Hold the GDO probe coil near the loop and check for a dip at about 1,000 kc. If you do get the dip, and it is not too far off in frequency, you know the coil is resonant at this point and will probably track OK. For further proof, you can spot-check at a couple of other frequencies, say at 600 and 1,400 kc.

If you are rewinding a loop, the GDO will tell you whether you have too few or too many turns. Just check the resonant frequency with the loop across the set's tuning capacitor (normal hookup). With a little practise you can get the correct number of turns with only one or two tries after the first check. For a small reduction in inductance you can spread the turns and the GDO will indicate whether the change is great enough.

Check the oscillator coil the same way. Remember that it will be resonant at the radio dial setting plus the i.f. (minus the i.f. in a very few sets). The i.f. is usually 455 kc, so, for example, with the radio dial set to 1,000 kc the oscillator coil should be resonant at 1,455 kc.

If the set's local oscillator isn't working but the signal circuits are OK, as evidenced by normal hiss or liveness but no stations, hold the GDO close to the set's loop antenna to substitute for the local oscillator. Tune the GDO to the correct frequency (station frequency plus i.f.) and you should hear the station. By moving the radio dial you can tell whether the rf circuits are tracking (peaking at the correct place on the dial).

Checking alignment and tracking of FM or short-wave radios with a GDO is easy, especially if the coils are unshielded and accessible, as they usually are.

Servicing TV

In TV the GDO can speed nearly any alignment job, especially where the trouble is the electronic-twiddler-who-should - never - have - been - given - that gold - plated - alignment - tool - for - Christmas sort of thing. At least you can soon find out whether resonance is possible any more!

You can reset all the unshielded coils and traps to near their correct frequency without ever turning the set on. This can eliminate a lot of frustration when trying to realign a "twiddled" set.

The GDO is indispensable for such rare service jobs as resetting or readjusting German TV's brought back by returning soldiers. These sets are aligned for 5.5-mc sound. Either shunt capacitors or extra windings must be used to bring the frequency down to the 4.5-mc American standard. Trying to align them with a 4.5-mc signal source gets sticky since you have no idea whether you have added too much or too little capacitance or too many or too few turns when the coil refuses to speak.

You can still grid-dip shielded or inaccessible coils by using link coupling as shown in Fig. 3. A single-turn link is enough at all except perhaps the lowest frequencies, where it may be desirable to use more turns. Whatever coupling method is used, it should be the minimum that will give a readable indication on the meter if utmost accuracy is desirable. END

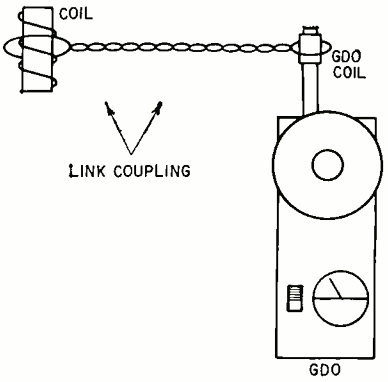


Fig. 3—Link coupling can often be used where coil is shielded or otherwise inaccessible.

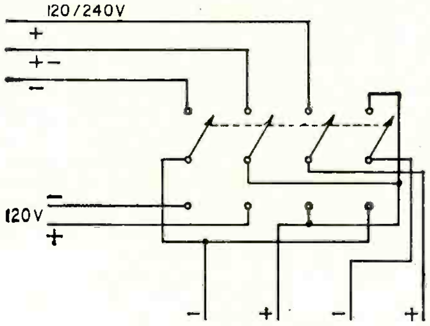
	PACO model G-15	EICO model 710
Frequency Range	400 kc–250 mc	400 kc–250 mc
Meter	500 μa	500 μa
Plug-in Coils	8	8
Circuit	6AB4 Colpitts Oscillator	6AF4 Colpitts Oscillator
Tuning	Direct Drive	1:7 Vernier Drive
Power Supply	Transformer—silicon	Transformer—selenium
Size	2¾ x 2½ x 7½ inches	2¼ x 2 9/16 x 6⅞ in.
Weight	2½ lbs	3 lbs
Price	$31.95 kit. $49.95 wired.	$29.95 kit. $49.95 wired.

WHAT'S YOUR EQ?

These are the answers! The puzzles are on page 49.

120-140 Switchover . .

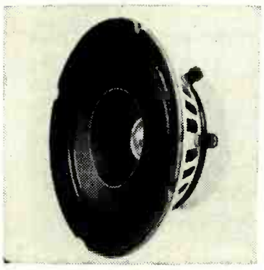
Split the neutral and install a 4-pole double-throw switch as shown. This problem actually arose, and an arrangement similar to the one shown here was used in the construction of a distribution panel for a large dredge.



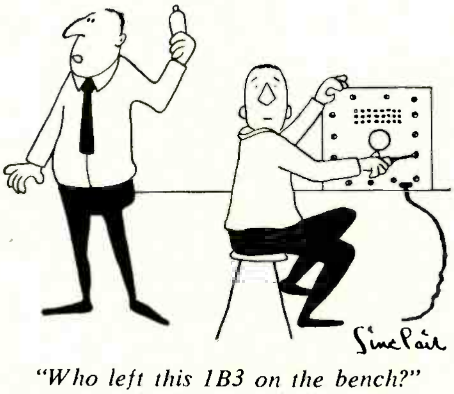
Voltage Quandary

Since this is a series circuit, there is only one current path. Therefore, the voltage drop across R3 plus R4 must equal the voltage drop across R2 plus R3, because R2 equals R4 and R3 is common to both combinations. So, with a 40-volt drop across R1 plus R2 and a 30-volt drop across R3 plus R4, we get a total of 70 volts.

What Am I?



A coax speaker, of course!



"Who left this 1B3 on the bench?"

New Video Tape Recorders

Unique head design makes them simpler

By **JERRY L. OGDIN**

For the past 9 years, recording research has been directed toward improving the original Ampex system of video recording, and developing new methods. Toshiba of Tokyo, Japan, has recently announced a video tape recorder which needs only one video head, has head rotation speeds one-fourth those encountered in conventional systems (3,600 vs 14,400 rpm), and requires no vacuum tape control system.

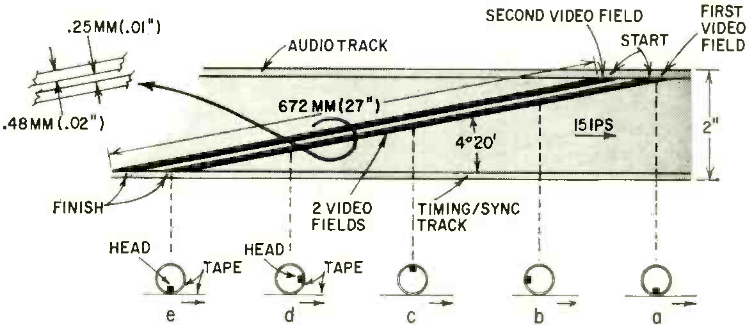


Fig. 2—Video as recorded from right to left. Drawings a *through* e *are head positions inside guide cylinder at indicated recorded spots.*

Basic operation is illustrated in Fig. 1. The 2-inch tape is supplied from the left. The chassis is constructed so that the supply reel is on a shelf about 4 inches above the main deck. The tape spirals down around a guide cylinder about 1 foot in diameter.

A head disk, driven at 3,600 rpm, rotates clockwise within the guide cylinder. With the tape not in motion, the horizontally spinning head disk with the head attached scribes a line which begins at the top edge and progresses toward the bottom edge of the tape. This, in addition to the linear speed of the tape, provides a recorded line about 27 inches long and at a small angle to the tape length.

A typical recording (Fig. 2) has the video tracks recorded at an angle of 4°20′ to the length of the tape. Each video track in this system is one complete picture field, rather than one scanning line. When the head is located at that point on the guide cylinder at which the tape spiral begins and ends, the recording (or playback) begins at the top of the tape. After the head has rotated clockwise 90°, and the tape has advanced at a rate of 15 ips, the track being recorded has "fallen" to a position approximately one-fourth the width of the tape.

When the head returns to the original position, it begins to scribe the next video track.

Actually, the tape is slightly overlapped, the incoming tape inside, to provide absolute picture continuity. That is, the rotating head is *always* in contact with tape. The gap of the video head is aligned to be perpendicular with the video track, rather than the tape.

Another video tape recorder under construction permits easier tape handling and loading, but requires two heads. In this model, the tape wraps only halfway around the guide cylinder, and is formed by two guide rollers at 180° opposition on the periphery of this cylinder. The tape is half-spiraled—that is, it falls about 2 inches in traveling the 180° around the guide cylinder. The recorded video track is at twice the angle to the length of the tape as in the one-head system, and the recorded line is shorter.

Each video track is 0.48 mm wide, and the space between tracks is 0.25 mm. Audio is recorded on the top edge of the tape, and sync or cue signals on the lower edge.

The video input to the recorder is frequency-modulated before recording —to be demodulated upon playback. Video frequency response is in excess of 4 mc, and audio is recorded up to 20 kc.

An electronic tachometer measures the rotation of the head disk drive motor, and its speed is compared to the vertical sync pulse and drives the amplifier which in turn powers the motor. The capstan motor is also locked to the vertical sync pulse rate of the video input when recording. The recorded vertical pulse is amplified and compared to a standard to drive the capstan motor during playback. This makes for perfect sync during playback. END

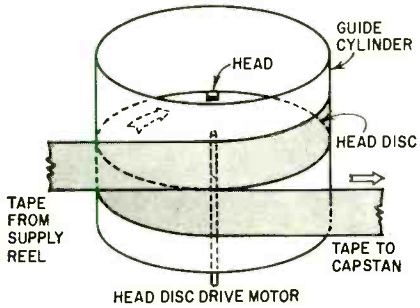
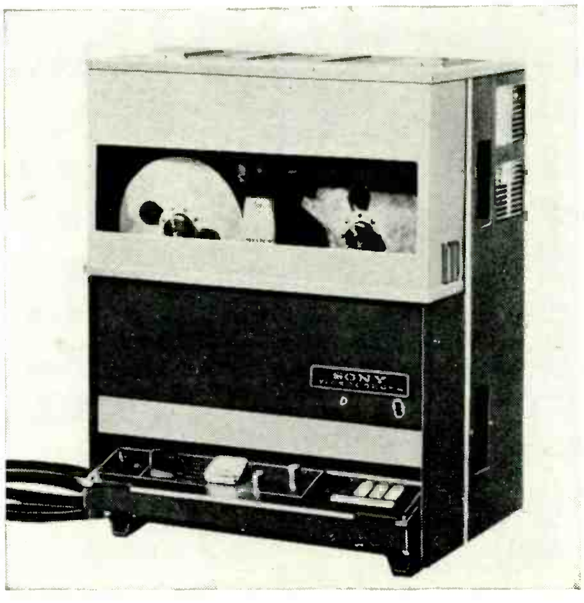


Fig. 1—Toshiba video tape recorder spirals 2-inch tape around guide cylinder. Head rotates clockwise to record and playback.



Another single-head system, the Sony, demonstrated recently in New York, has a single head for video, 360° tape rotation, and a speed of 5.75 inches per second. Resolution is 250 lines, weight 145 lb.

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- Highly selective superheterodyne receiver with one rf and two if amplifier stages
- Operates from standard 117-volt AC; separate DC power supply (optional) for mobile installations (you don't pay for unnecessary power supplies)
- Electronic switching—no relay noise or chatter
- Illuminated "working channel" feature
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Improved Sound from Small FM Radios

Two simple modifications smooth the set's frequency response

AC-DC TABLE-MODEL FM RADIOS ARE NOT noted for their good audio quality, although they are an improvement over their AM counterparts.

Here's a modification that will improve response. The usual audio output stage is shown in Fig. 1-a. The .01-μf capacitor C across the primary of the output transformer is used to flatten the high-frequency response of the audio amplifier-speaker combination. It almost invariably overcompensates, causing a sharp cutoff above about 4 or 5 kc as shown in curve 1 of Fig. 1-b.

The impedance of a loudspeaker voice coil increases as frequency rises (curve 2 of Fig. 1-b.) The increased voice-coil impedance is reflected to the primary of the output transformer. If the output tube has a high plate resistance (a pentode or beam power tube does), the rising impedance of the output transformer causes the gain of the stage to rise. Result—too much treble!

Enter our friend, capacitor C. A capacitor's reactance drops as frequency rises. In theory we should be able to select a capacitor which exactly compensates for the increasing voice coil impedance.

In practice a capacitor alone won't do it. What's needed is a resistor in series with the capacitor as in Fig. 2-a. The resistor establishes a minimum value for the capacitive reactance shunt across the output transformer, eliminating the sharp cutoff of curve 1.

A good starting value for the resistor is 1.3 times the recommended plate-load impedance for the output tube used. A 50C5, for example, calls for a 2,500-ohm load. The resistor needed is 2,500 × 1.3, or 3,250 ohms. Use a 3,300-ohm 0.5-watt unit. The value of C must be found by experiment. Connect an audio oscillator to the first audio tube's grid. Connect a vtvm (ac setting) or a scope across the voice coil. Vary the audio oscillator from 400 to 10,000 or 12,000 cycles. Select a value for C giving the smallest change in output. The capacitor will be in the range of .003 to .025 μf, in all likelihood. A small change in the value of the resistor may be necessary to achieve flattest response.

One further change in the audio amplifier is necessary. FM stations are required to boost or *pre-emphasize* the higher audio frequencies. The receiver is supposed to include a simple R-C circuit which rolls off or *de-emphasizes* the highs in exactly the same degree to give flat response. Note that we said "*supposed to*." Many manufacturers of small table FM sets don't bother. They figure that the sharp high-frequency cutoff of that little capacitor C across the output transformer will take care of it! Take another look at curve 1 in Fig. 1-b. Now look at curve 3 in the same figure. It is the required de-emphasis to match the FM station's pre-emphasis. Any resemblance between curves 1 and 3 is strictly accidental! The audible result of trying to use curve 1 to compensate for curve 3 is overemphasis of frequencies between 1 and 4 kc and elimination of most frequencies above 5 kc. Result? The well known squawk-box sound!

The remedy is simple: Since we have corrected for curve 1, we now add an R-C de-emphasis circuit at the input to the first audio stage (ahead of the volume control)—if there isn't one already (Fig. 2-b). The product of the value of C (in $\mu\mu$f) and R (in megohms) should equal 68 to 75. For example: 680 or 750 $\mu\mu$f and 0.1 meg-

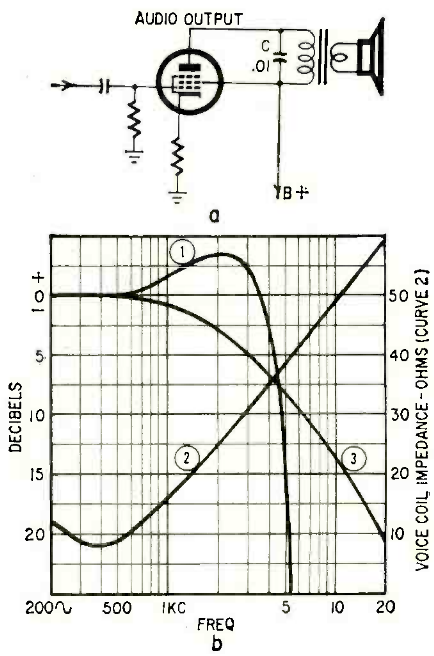


Fig. 1-a—Typical audio output stage of table-model FM radio. b—Three frequency curves relating to it.

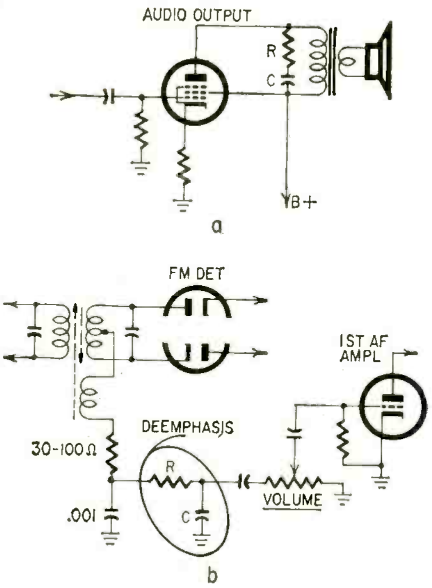


Fig. 2a—In modified stage, resistor is added in series with capacitor across output transformer primary. b—Where de-emphasis network is added.

ohm. This will produce a response that matches curve 3. Some receivers have the R-C pair, but the values usually are wrong. (Generally they don't de-emphasize enough; the product of R and C is much less than 75.)

We've made these modifications in several table model FM receivers. Although the sets still lack bass response, they sound much better after the changes. Try it yourself! Even AM sets are improved by the first of these modifications. Of course, the R-C de-emphasis circuit of Fig. 2-b applies only to FM.—*MHG*

New Abbreviations

Radio-Electronics is adopting the modern abbreviation "pf" for "μμf". (The "p" in this case is short for pico, meaning "very small." Both the "p" and the "μμ" represent 10^{-12}.) This abbreviation has been coming into more and more common use in the past year or two, and is especially handy for people who do not have the character "μ" on their typewriter keyboard.

We are also beginning to use "Q" instead of "V" to designate transistors. While usage has been split on this, "Q" is now used by the majority of American publications.

Since much material is already set up in type, readers will probably see both sets of abbreviations side by side in the magazine for a few months, but ultimately the newer ones will prevail.

use your SCOPE

Let your scope help you cut servicing time.

By JACK DARR
SERVICE EDITOR

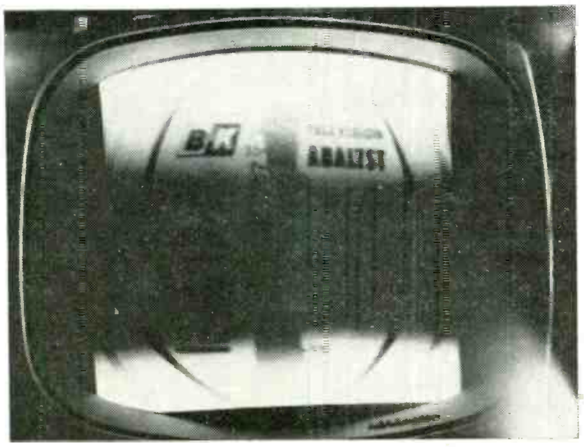


Fig. 1—Single hum bar. Cause: bad electrolytic. Set has half-wave rectifier, so the hum pattern is a 60-cycle bar and not the expected 120-cycle two-bar pattern.

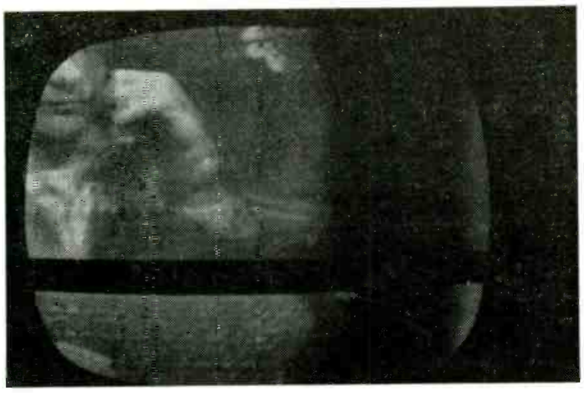


Fig. 2—Is this trouble caused by a defective horizontal phase detector?

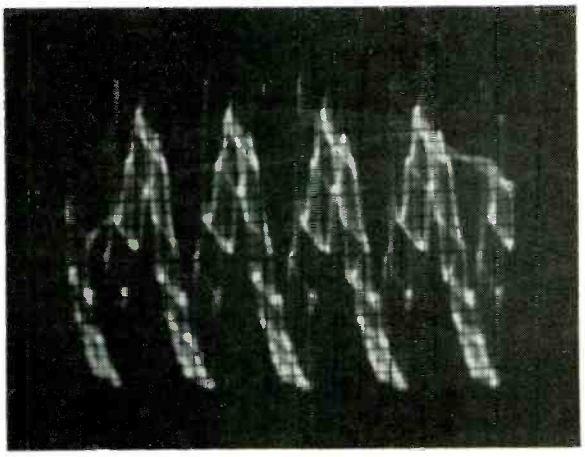


Fig. 3—Hash on B-plus line which feeds the horizontal oscillator. This caused the pattern shown in Fig. 2. Open electrolytic was at fault.

The scope does one thing superlatively well. It tells you what ac waveforms are in a given circuit, and their frequencies. With simple extra equipment, it will also tell you the peak-to-peak voltage of these waveforms. In TV servicing, this is something we need to know. So if you've got an instrument on the bench that'll tell you these things, why aren't you using it? The expert technician uses a scope just as matter of factly as he does a voltmeter or ohmmeter. Not for very complicated tests or waveform analyses, but for quick checks and short cuts. And, he gets results a heck of a lot faster than the man who won't use the instrument!

Let's look at a few common service jobs and see how a scope can speed up servicing. How about a real good common trouble, loss of capacitance in an electrolytic? Most of the time, this is pretty obvious (Fig. 1). (Obvious, eh? Only one hum bar? This set happened to have a half-wave rectifier!) Now, how about Fig. 2? Why, everybody knows what causes that—horizontal phase-detector diodes. Yeah? Guess again. This is also caused by a weak electrolytic filter. How do I know? Because I put a scope on the horizontal oscillator B-plus feed line, and it looked like this (Fig. 3) instead of being a nice smooth line as it ought to be.

Maybe you can't get a picture at all, no matter how wiggly. What if the screen looks like Fig. 4. Oh, sure—everybody knows that one. Internal arcing in the high-voltage filter capacitor. Yeah? Look at Fig. 5. See that pattern on the scope? Same thing—open electrolytic filter capacitor.

So, there's one quick check you can make on any TV set that will show up lots of assorted troubles. Just pick up the probe, and check the B-plus circuits for hash. You'd best use some kind of low-capacitance probe for this, preferably one matched to your scope.

New Heavy Duty RFI Suppression Kit For Mobile Radio

RADIO HAMS, fleet owners, and CB operators can now enjoy clearer, more readable, less tiring mobile communications at longer effective ranges.

Sprague's new Type SK-1 SUPPRESSIKIT provides effective R-F Interference suppression—at moderate cost—up through 400 megacycles. Designed for easy installation on automobile, truck, or boat engines with either 6-volt or 12-volt generators, the Suppressikit makes possible high frequency interference control by means of Sprague's new, extended range, Thru-pass® capacitors.

The components in the SK-1 Suppressikit are neatly marked and packaged, complete with easy-to-follow installation instructions. All capacitors are especially designed for quick, simple installation.

The generator capacitor is a heavy-duty unit rated at 60 amperes, and will operate at temperatures to 125°C (257°F). This means you'll have no trouble with an SK-1 installation in the terrific temperatures found "under the hood" on a hot summer's day. There's no chance of generator failures from capacitor "short outs," as with general purpose capacitors. The Thru-pass capacitors for use on voltage regulators are also rated at a full 60 amperes.

The Deluxe Suppressikit is furnished complete with an 8-foot shielded lead on the generator capacitor which can be trimmed to necessary length for any car or small truck, preventing R-F radiation from armature and field leads.

Containing only 5 easy-to-install capacitors, the Deluxe Suppressikit is a well-engineered kit. The net price is a little higher than that of many thrown-together kits, but it saves you so much time and aggravation it's well worth the slight extra cost.

For additional information on the Type SK-1 Suppressikit, see your Sprague Electronic Parts Distributor.

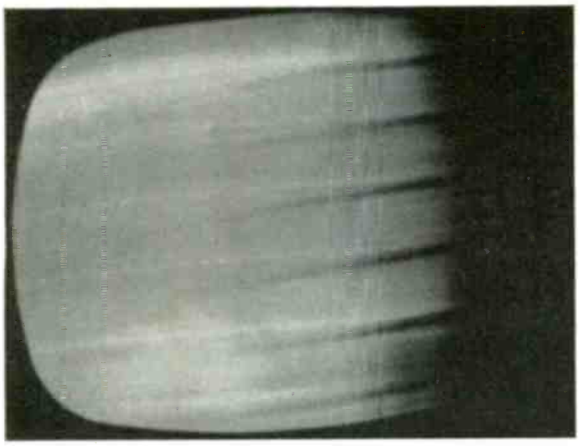


Fig. 4—Is this pattern caused by arcing in the high-voltage filter capacitor?

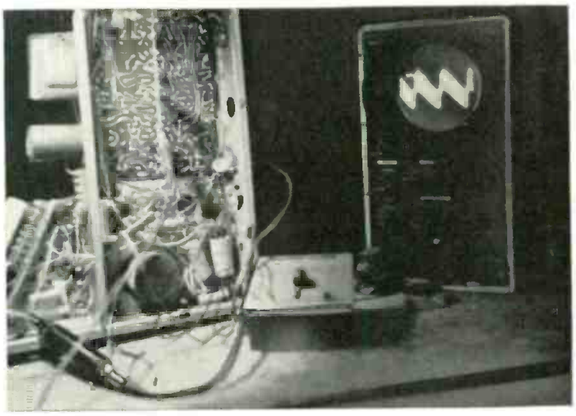


Fig. 5—The scope patterns reveals an improperly filtered B-plus line. That's what caused the trouble shown in Fig. 4

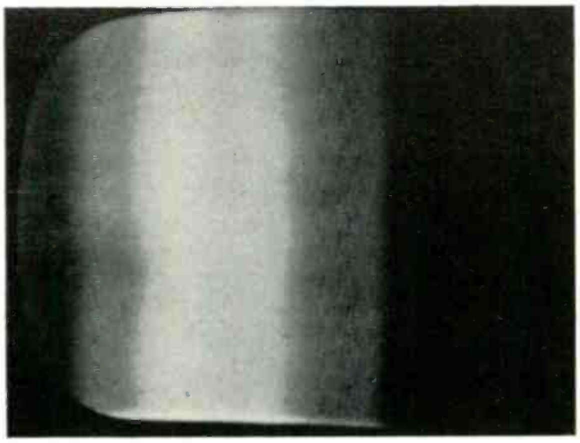


Fig. 6—CRT pattern when horizontal pulses get into the B-plus lines.

You can check the waveforms at a 30-cycle sweep rate to find 60-cycle hum. Use 7,875-cycle sweep if you suspect horizontal pulses where they shouldn't be. Fig. 6 shows the screen appearance, and Fig. 7 the pattern found on the B-plus line feeding a horizontal oscillator. One of the electrolytics nearest the voltage-feed point for the horizontal oscillator was open.

The main point to remember in making this test is that hash, *any hash at all*, on your B-plus lines means trouble. Even if the set has a fair picture now, it won't be too long before you *will* have troubles. Make as many tests as you can on sets in good operating condition, to get used to the normal patterns and the amount of hum, etc., that can be tolerated. In the average well filtered set, something like 0.2 to 0.5 volt, peak to peak, of hum is found at the filter output capacitor. More than that, or horizontal spikes out along the major B-plus feed lines, means insufficient filtering. This is a quick test. You can pick up a probe and check out practically the whole B-plus system in about 1 minute. If you don't find any trouble, you at least know one place not to look!

Sound circuits

A scope can quickly pinpoint the cause of buzz and hum in sound circuits. Fig. 8 shows a 400-cycle signal, with a 60-cycle spike riding on it. This particular one was caused by a defective agc circuit, but intercarrier buzz and other sound troubles can be spotted the same way. Intercarrier buzz, for example, instead of the sharp spike, will show a complete vertical blanking pulse, flat top and all, riding on top of your test signal, or even on the composite sound signal if it is strong enough. So you would immediately check alignment, video i.f. plate voltages, tubes, video detectors, etc. This pattern can be seen more easily if a low-capacitance probe

Fig. 7—Scope pattern found on B-plus line feeding the horizontal oscillator. Scope is set for 7,875-cycle sweep. The spikes are horizontal sync pulses. The broadened base line is caused by 60-cycle hum.

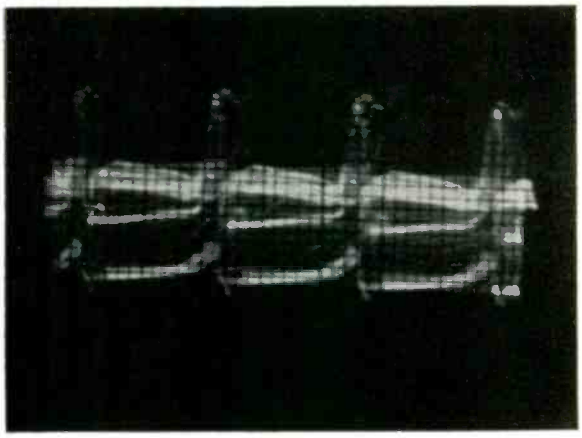
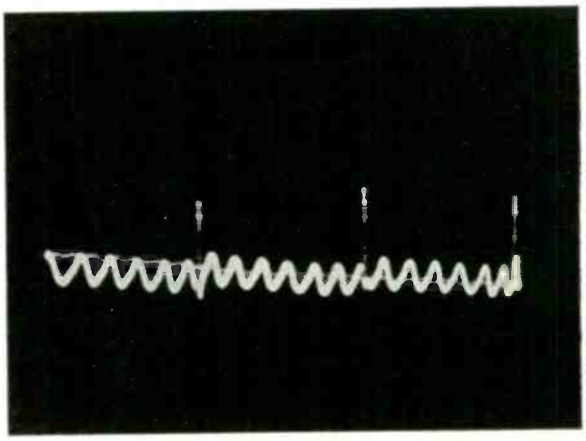
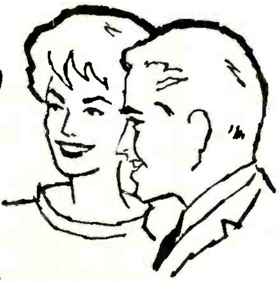


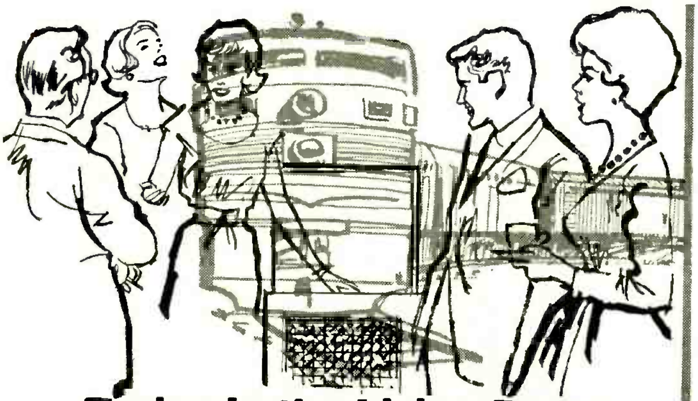
Fig. 8—400-cycle signal in audio circuits with 60-cycle spike riding on it.



THE FUN IS IN THE KNOWING



More Uses for Versatile Tarzian Tape



Trains in the Living Room

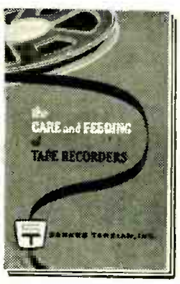
Tape belongs at parties—to provide pre-taped entertainment, and to record activities while they happen. If you have a stereo machine, how about suddenly interrupting taped background music with the sound of a freight train that seems to be running right through the party room? Don't forget that many people have never heard themselves talk. Let your guests take turns recording for later playback...on Tarzian Tape, of course.

Double Your Pleasure With an Extra 1/4 Inch

Here's good news for owners of battery-operated tape recorders. If you feel restricted by the standard 3-inch reel capacity, try the new Tarzian 3¼ inch reel for ½-mil "tensilized" Mylar* tape. Tape footage and available recording time are doubled. You get 600 feet of Tarzian Tape and one full hour of recording at 3¾ i.p.s.—compared to 300 feet and 30 minutes with the old-fashioned 3-inch reel.

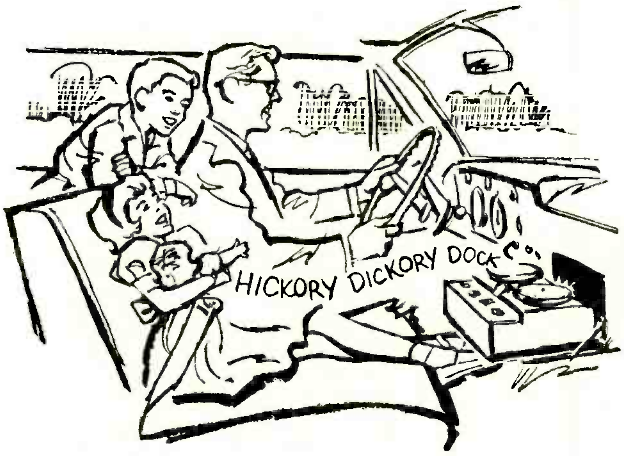
Tarzian's Free Booklet

"The Care and Feeding of Tape Recorders," has 16 pages of additional ideas for using and maintaining your tape recorder. Get your copy from your tape dealer, or write to the address below. Meanwhile, depend on Tarzian Tape to capture every sound with professional fidelity. Available in 1½-mil and 1-mil acetate, and in 1-mil and ½-mil tensilized Mylar—on 3, 3¼, 5, and 7-inch reels to meet every recording requirement. The price is competitive—the quality is unchallenged.



Read While You Drive?

Not really...sometimes it's just impossible for you to give the children a "live" reading performance. But you can keep them happy during lengthy auto trips, or any other time when boredom sets in. Play their favorite stories, pre-recorded on Tarzian Tape at a more convenient time. When the kids begin to read for themselves—erase the stories and let them record their homework!



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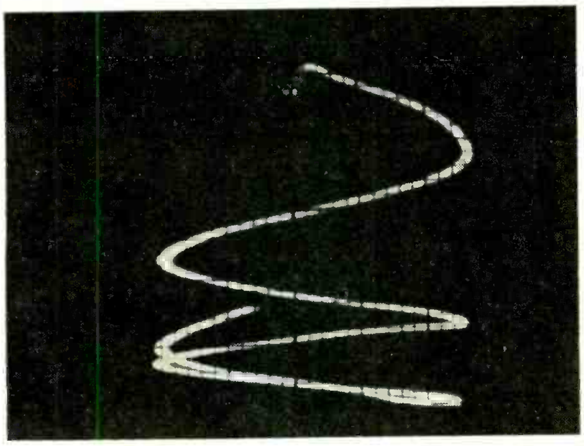

Fig. 9—Lissajous figure seen when off-frequency vertical spike is fed into scope using sine-wave 60-cycle sweep.

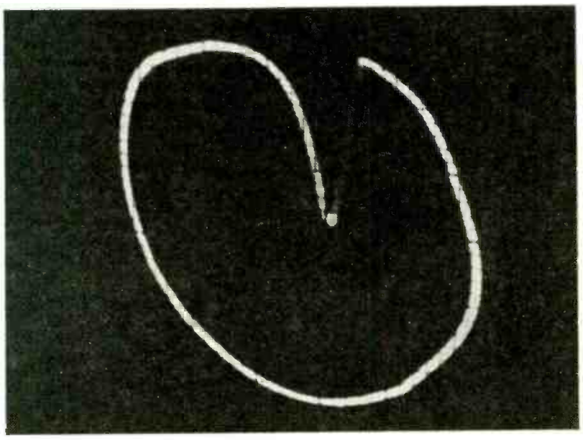

Fig. 10—Scope pattern when vertical oscillator spike is fed to scope using 60-cycle sine-wave sweep. The circle does not have to be perfectly round as long as there is only one full turn and only one notch in it.

is used, but a direct connection from your scope can be made to either grid or plate of the audio output tube without any trouble.

Video amplifier checks

No picture on the screen, and sound is OK? Put the low-capacitance probe on the input element of the CRT —grid or cathode. If you find a good-size video signal at that point (average value 50 volts peak to peak), but still no picture on the screen, you've probably got a defective picture tube. Same thing with a video amplifier stage. Normal readings here, about 0.3 to 0.5 volt peak to peak on the grid, and about 50 volts peak to peak on the plate. You can follow the signal through the video plate output networks with the low-capacitance probe, watching for unusual changes in amplitude.

Horizontal oscillator output tests

No light on screen, no high voltage? Hold the tip of the probe near the horizontal output tube plate lead. You should see spikes at the horizontal frequency. Check a few operating sets to get an idea of the average height. Is the horizontal oscillator operating? Pull the output tube and check at the grid connection for a horizontal drive signal, at the proper amplitude. It should be at least 80 to 100 volts peak to peak. If there's a TV set in working order nearby, you can hold the probe near the horizontal output tube plate lead, and set your scope sweep to produce say 3 cycles on the screen. Then, check the first set again. By counting the number of cycles you see on the screen you can easily tell whether the horizontal oscillator's right on frequency, high or low.

Vertical oscillator output stages

Brought the chassis and yoke, but left the picture tube in the cabinet? Want to know whether the vertical oscillator's running on frequency? Set your scope sweep to line sweep, which means a 60-cycle sinusoidal sweep taken from the ac line. Now, couple the probe into the vertical circuit somehow: hold it close to the vertical yoke lead or touch the grid of the vertical output tube. If you get something that looks like Fig. 9, your vertical oscillator's quite a ways off. Adjust the vertical hold until you can get something like Fig. 10. If we fed two identical sinusoidal signals into the vertical and horizontal inputs of a scope, we'd get a circle. Here, we have one sinusoid and one spike, so we get a circle with a notch in it. What we want is only one circle with only one notch. Then the vertical oscillator is running at exactly line frequency, 60 cycles, if the notch stands still. This, by the way, checks nothing but the *frequency* of the signal—the waveform can be badly distorted.

Other tests

If you have unusual symptoms, check the screen grids of the tubes in the circuit with the low-capacitance probe. Too much signal or hum voltages appearing on the screen means trouble. Usually, open screen bypasses or inadequate filtering somewhere. Check back through the B-plus network for too much hash or hum.

Peak-to-peak measurements

We've been measuring peak-to-peak voltages for the past few minutes, haven't we? To measure ac voltage with a scope, just think of the screen as a voltmeter with a completely blank face. To read a given voltage, you take a reading, then feed in a controllable voltage until the needle reaches the same point. Then you read the voltage from the calibrated voltage source. Well, we do exactly the same thing with a scope.

To measure peak-to-peak voltage, clip the probe to the point where you want to measure, then turn the horizontal gain of the scope down to zero, leaving only a vertical line on the scope screen. Now, adjust the vertical gain until this line is some convenient height, say four divisions on the cross-hatched screen on the scope (Fig. 11) (the "graticule" if you want to be nasty-nice about it).

Now, disconnect the probe and connect it to a source of variable 60-cycle ac, which you can read on a regular shop meter. Vary the output of this source until the vertical line is the same height as the unknown signal or hum voltage, read the value of the second voltage, and there you are.

Special scope calibrators are made. However, if you don't have one of these handy instruments, you do have the filament circuit of your tube tester! Make up an adapter consisting of an old tube base with two leads connected to the filament pins. These may be connected to

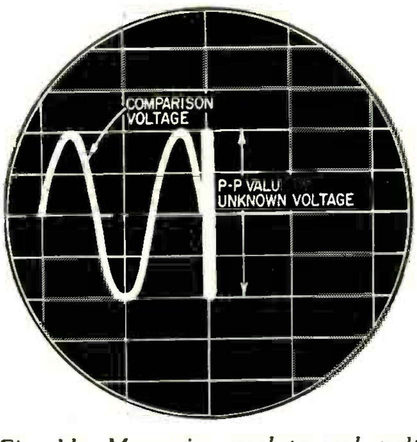

Fig. 11—Measuring peak-to-peak voltages on the scope screen.

the scope input and the voltage adjusted with the filament voltage selector switch.

Remember, this voltage is calibrated in rms values, and what you want is peak to peak. Peak-to-peak voltage is rms voltage multiplied by 1.414; 10 volts rms, 14.14 volts peak to peak, and so on. If you want to, you can make up a calibration chart and keep it handy. For instance, it seems that quite a few TV sets specify a reading of 50 volts peak to peak at the input of the picture tube. This will work out something like 35 volts rms. Actually, it is 35.3606, but we aren't interested in laboratory accuracy. All we want to know is are there 50 volts peak to peak at the picture tube or is the voltage nearer to 30? What we need is a close measurement, not an exact one. If you want to read any of these voltages with pretty good accuracy, take the reading, set the tube tester to match it, then read the ac voltage across the tube-tester filament leads with an accurate peak-to-peak ac voltmeter. This will give you readings accurate to within about 1%—it depends on the ac voltmeter used.

So, there you are. Each of the tests given can be made as quickly and easily as reading the plate voltage and will usually be a heck of a lot more informative. So keep that scope turned on and ready. Practice using it on a few sets in good condition, and you'll soon find your way around. Properly used, a scope can be the handiest single instrument in the shop. END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In December, 1912, *Modern Electrics*

Naval Wireless Station at Washington.

Static Electric Motor, by H. B. Dailey.

Wireless Amateur and the Wireless Law, by C. A. LeQuesne, Jr. (Part One)

New Wireless Clubs. (List)

Regulations of the London Wireless Conference.

Wireless Club Directory.

A Good Loose Coupler, by Howard Danner.

Portable Receiving Outfit, by Howard A. Thompson.

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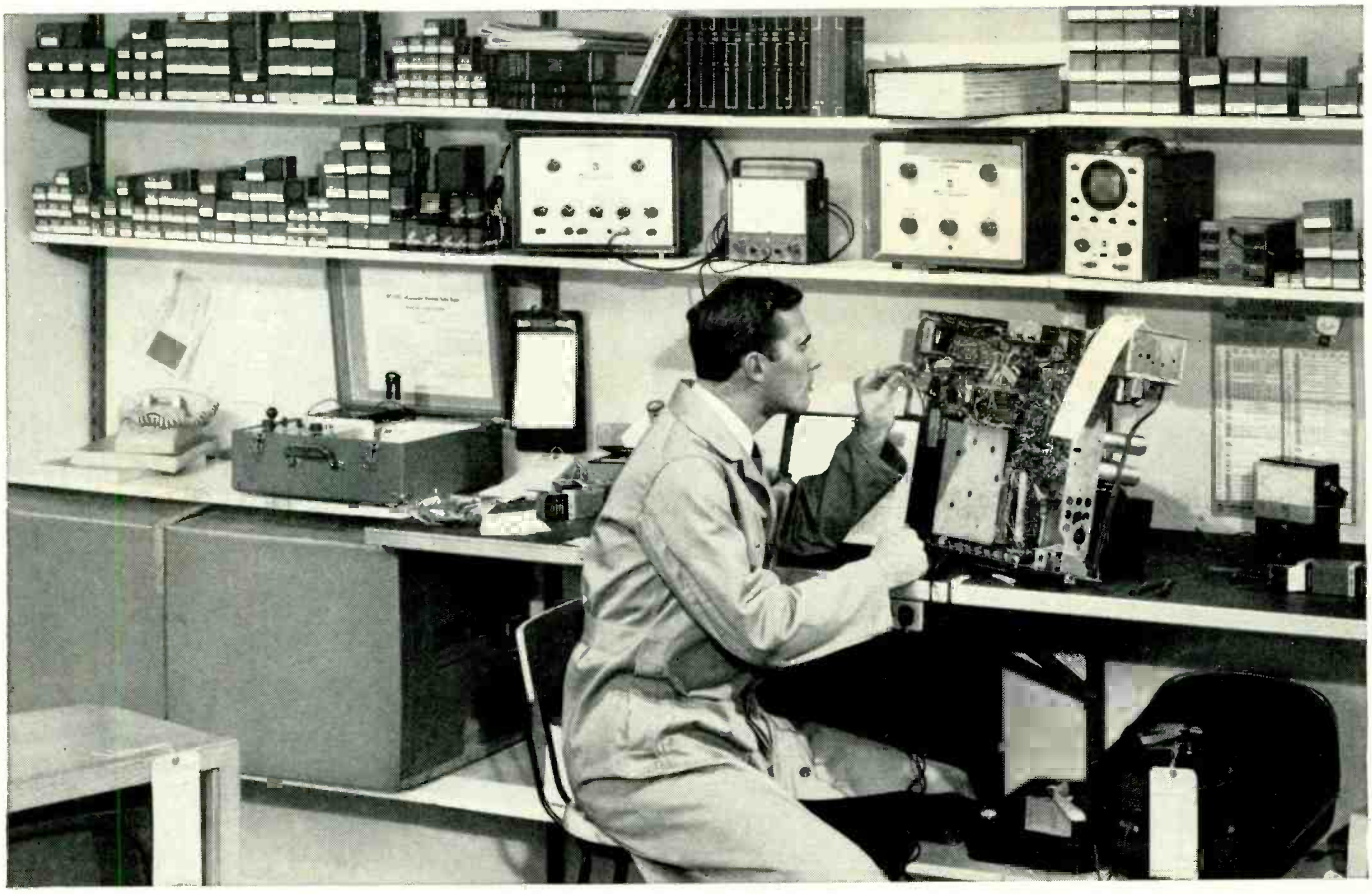

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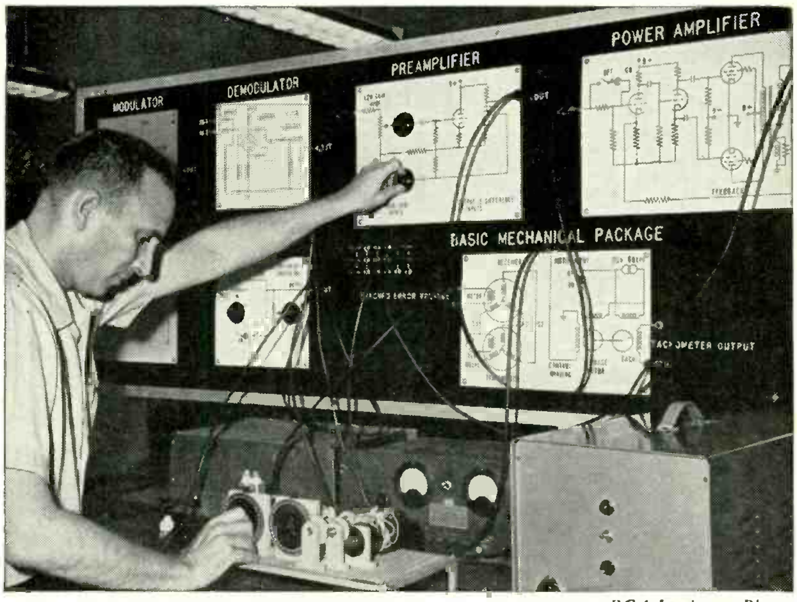

RCA Institutes Photo

YOU can learn Electronics

I'm 54 and I've just finished my first profitable three weeks in school

By A. L. ARMSTRONG

AFTER SPENDING MANY YEARS IN BUSINESS I had to quit for reasons of health, and was advised to enter a field completely foreign to what I'd been doing. After carefully considering many possibilities I decided on *electronics*.

Why electronics? Well, I'd always been a bit envious of the fellows who understood electricity, radio and so forth. It seemed to me that these people were making the modern world go around while we business people were just tagging along, never really understanding what made things tick. Also, I wanted to get into technical writing and, in spite of what one technical writing school said, I was convinced that one who proposed to write on a technical subject must be well grounded in it first.

Before entering school, I'd read just one book on the subject: *Introduction to Electronics*, by Robert J. Hughes and Peter Pipe. To some of you old-timers it would probably be kid stuff, but I found it fascinating.

So I entered school and began taking the resident course. After three weeks, where do I stand? No, I can't even go into a fairly simple radio and follow the circuit with any accuracy. If the set were haywire, I'd have a heck of a time figuring out what was wrong. Remember, I started with almost no knowledge at all of the subject and the best of schools can't perform miracles. So what *have* I learned? Plenty!

I understand basic electrical circuits and I know the difference between them—series, parallel, series-parallel. What's more I know how to calculate voltage, current and resistance in these circuits. I'd been a bit doubtful about my ability to cope with the math. But, so far at least, I've had no trouble at all and I'm sure no Einstein. The class has Ohm's law backed into a corner and, if the instructor were to ask me to give the formula for finding power when only current and resistance were known, I'd have to stall for only half a minute before coming up with the right answer. Offhand, can you give it?

A month ago, if I'd run onto the abbreviation vtvm, I might have thought they were the initials of the Russian secret police. Now I know what they mean. More important, I've learned how to use the instrument itself. Not only that, I know *how* the thing works and how it is put together. The same goes for the multimeter.

One of the mysteries of my former life whenever I happened to notice them were the colored bands and dots on so many of the components in a radio. I thought they were for decoration. Now I know what they represent and can figure the values they indicate.

On the very first day we were given a small square can with a mess of wires, resistors and capacitors in it. We were told that it was a two-tube amplifier, and were asked to measure the resistance of all the component parts. Willy-nilly, we were forced to learn something about tubes almost immediately and the term space charge no longer evokes an image of a futuristic military operation.

You might think that with all the foregoing, and much more besides, we students have no time left for anything else. Well, you're wrong! In addition to learning the fundamentals of electronics physics, we are being taught how to read a slide rule and to do necessary electrical figuring. Those megs and micros and millis with their zeros strung out like beads still throw us at times, but we're learning how to tame them with powers of 10 so that even I can keep up.

We've learned that Greek letters are used for purposes other than naming college fraternities. We haven't worked with all of them but we know that mu is overworked, and what omega and pi and lambda mean. We know something about farads, and ohms, maxwells, gilberts, henries and gausses. Direct current has been kicked around so much it no longer bothers us and some of the mysteries of magnetism have been revealed.

We have already been introduced to the behavior of ac. This is to be followed by our initiation into the mysteries of inductance, capacitance, resonance and heaven only knows how many other 'ances. (We already know the words, even though the veil has not been lifted.)

As we freshmen pass through the school corridors we see in the advanced classes shelves sagging under the weight of expensive electronic equipment, and we look forward to the time when we too shall be able to use such fine instruments. We notice the students listening earnestly to the instructor's lecture. Incidentally, an Oscar for patience should be awarded to our instructor. He doesn't seem to mind going over a point half a dozen times if necessary to make it clear to the entire class.

I'd thought that at my age I would be the old man of the class, but I found several men my age and one much older when school started. I figure if a man wants to learn something his age has nothing to do with it; so, if you want to learn electronics and have a touch of silver in your hair, don't let it bother you. In class, you will just be one of the boys.

I know that so far we've made only a ripple on the broad sea of electronics, but I'm certain that if we continue to learn as we have these past three weeks, the end of the term will find all of us highly qualified electronic technicians. In my case, at least I'll know what I'm writing about. END

Guide to Semiconductor Terms

By Sylvania Semiconductor Div.

Absolute Maximum Ratings—Ratings which if exceeded will damage the semiconductor device.

Alloyed Junction—A p-n junction in which a material such as indium (p-type dopant) is placed in contact with n-type germanium and heated. The indium melts and dissolves some of the germanium. Upon cooling, the germanium recrystallizes with some of the indium and is therefore p-type.

Alpha—Current gain of a transistor connected as a common-base amplifier.

Alpha Cutoff Frequency—The frequency at which the current gain of a common-base transistor stage has decreased 30% from its low-frequency value. It gives a rough indication of the useful frequency range of the device.

Barrier—In a semiconductor, the electric field between the acceptor ions and donor ions at a junction.

Barrier Region—See Depletion Region.

Base (Junction Transistor)—The center semiconductor region of a double-junction (n-p-n or p-n-p) transistor. The base is comparable to the grid of an electron tube.

Beta (Gain)—This is also known as the current transfer ratio in the common-emitter circuit arrangement. This is the ratio of collector alternating current to base current. In switching applications it is the ratio of direct currents.

Biasing—Application of proper dc voltage to various elements of a transistor to set up the proper operating conditions. At the transistor input, the proper biasing voltage must be established between the base and emitter elements. In the transistor output, the biasing voltage must be applied to the collector.

Breakdown Voltage—The reverse voltage which applied to a junction, is large enough to cause significantly increased current to flow. Below breakdown voltage a reverse-biased junction conducts very little current.

Collector—The end semiconductor material of a double-junction transistor that is normally reverse-biased with respect to the base. The collector is comparable to the plate of an electron tube.

Collector Cutoff Current—Leakage current from collector to base when no emitter current is being applied. This leakage current varies with temperature changes and must be taken into account whenever any semiconductor device is designed into equipment.

Collector Capacitance—The capacitance appearing in the device between collector and base. It is determined by the area and type of collector junction.

Conductors—Metals whose atoms are bound together so that one or more of the outer electrons is free to move easily through the solid. This enables the solid to be a good conductor of electricity.

Current Transfer Ratio—The ratio of output current to input current. The most common current transfer ratio is known as beta (gain) and is the ratio of the collector alternating current to the base current when the transistor is connected in a common-emitter amplifier circuit.

Another current transfer ratio involves static or dc values. In the common-emitter switch, the ratio of the collector dc to the base dc is termed dc gain. This is referred to as switching-transistor beta.

Depletion Region—The region in a semiconductor containing the acceptor and donor ions whose excess holes or electrons have been removed. This also is referred to as the space-charge or barrier region.

Diffused Base—A type of transistor construction in which the base-layer region is produced by diffusion. Other names for the diffused-base transistor are drift, graded-base and meltback transistors.

Diode—A type of "valve" permitting current to flow easily in one direction and offering considerable resistance to current flow in the opposite direction. It is a two-terminal device.

Emitter (Junction Transistor)—The end semiconductor material of a double-junction transistor that is forward-biased with respect to the base. The emitter is comparable to the cathode of an electron tube.

Epitaxial Growing—The process of producing an additional single crystal layer of semiconductor material on a semiconductor substrate surface. The crystalline structure is continued from the substrate into the layer. The impurity concentration in the substrate and in the layer can be made to differ greatly.

Epitaxial Device Structure—A semiconductor device made with an epitaxial layer in the semiconductor body to obtain much improved characteristics not possible without the layer.

Forward Bias—In a transistor, an external potential applied to a p-n junction so that the depletion region is narrowed and relatively high current flows across the junction.

Forward Current—The current which flows across a p-n junction when a forward bias voltage is applied.

Insulators — Nonconducting solids whose atoms are bound tightly with bonds involving all of the outer shell electrons and, consequently, leaving very few electrons available for electrical conductivity.

Intrinsic Semiconductor—A semiconductor in which some hole and electron pairs are created by thermal energy at room temperature, even without impurities present in the semiconductor.

Junction—The boundary between a p-section and an n-section in contact with each other.

Junction Diode—Consists of a junction between two dissimilar sections of semiconductor material. One section is called a p-type semiconductor and the other an n-type. External connections consist of a lead to the p-type semiconductor and a lead to the n-type semiconductor.

Junction Transistor—A device having three alternate sections of p-type or n-type semiconductor material. See also P-n-p Transistor and N-p-n Transistor.

Majority Carriers—The holes in a p-type semiconductor or free electrons in an n-type semiconductor.

Mesa Transistor (Diode)—A diffused-base transistor (diode) that receives its name from its resemblance to the geological formation known as a mesa. During production, any etching process leaves little mounds on the structure.

Minority Carriers—The holes in an n-type semiconductor or excess electrons found in p-type semiconductors.

Mobility—Ease of movement of carriers through the semiconductor when they are subjected to electric forces. In general, electrons and holes have higher mobilities in germanium than in silicon.

TO BE CONTINUED

1962 ANNUAL INDEX

Vol. XXXIII, January-December, 1962 RADIO-ELECTRONICS

KEY TO SYMBOLS AND ABBREVIATIONS

* Construction Articles
† Section of full-length article
§ Transistorized

CI .... Service Clinic
Corr .... Correction
Corres .... Correspondence
NB .... News Briefs
NC .... Noteworthy Circuits
Pat .... New Patents
Tech .... Technotes
TTO .... Try This One
WN .... What's New

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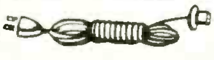

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___	1J3	.79	___	6BA6	.50	___	6SK7GT	.95	___	12DL8	.88
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___	5J6	.72	___	6DQ6	1.10	___	12AU6	.51	___	25AX4	.70
___	5T8	.86	___	6DT5	.81	___	12AU7	.61	___	25C5	.53
___	5U4	.60	___	6DT6	.53	___	12AV6	.41	___	25CA5	.59
___	5U8	.84	___	6DT8	.94	___	12AV7	.82	___	25CD6	1.52
___	5V6	.56	___	6EA8	.79	___	12AX4	.67	___	25CU6	1.11
___	5X8	.82	___	6EB5	.73	___	12AX7	.63	___	25DN6	1.42
___	5Y3	.46	___	6EB8	.94	___	12AY7	1.44	___	25EH5	.55
___	6AB4	.46	___	6EM5	.77	___	12AZ7	.86	___	25L6	.57
___	6AC7	.96	___	6EM7	.82	___	12B4	.68	___	25W4	.68
___	6AF4	1.01	___	6EU8	.79	___	12BD6	.50	___	32ET5	.55
___	6AG5	.70	___	6EV5	.75	___	12BE6	.53	___	35C5	.51
___	6AH4	.81	___	6EW6	.57	___	12BF6	.60	___	35L6	.60
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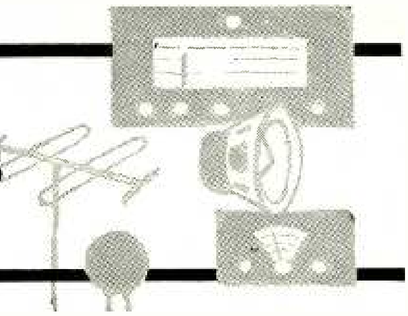
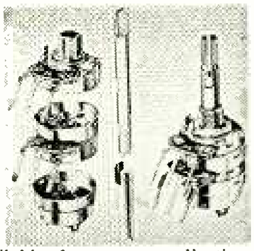
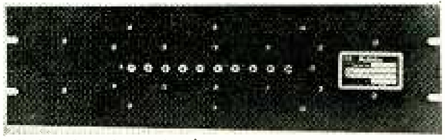


15/16-INCH REPLACEMENT CONTROLS, *Fastatch II.* For all dual concentric types, plus single and dual controls. Components plug in, snap together, permanently lock. Replacement



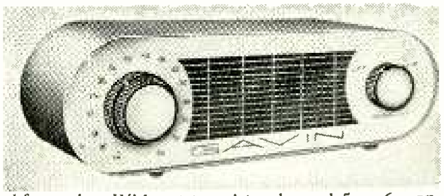
shafts available for every application. Universal terminals replace all other types.—**Centralab,** 900 E. Keefe Ave.. Milwaukee 1, Wis.

VIDEO/RF DISTRIBUTION SWITCHER, *model VS-1, Thru Line Switcher.* Contains 10 isolated through lines with push-button switches, allows any of 10 inputs to be connected to a separate "switched input" terminal. Corresponding output is then connected to "switched output" terminal. Combines closed-circuit TV channel with



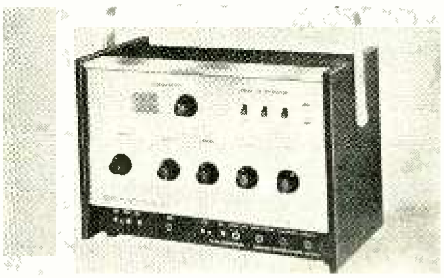
off-the-air channels in master antenna system. Can be used as 10-circuit video switcher, changing video monitor to any of 10 circuits on loop-through basis. Frequency range 0—216 mc, input and output impedance 75 ohms. For 19-inch rack panel mounting.—**Blonder-Tongue Labs, Inc.,** 9 Alling St., Newark 2, N. J.

UHF CONVERTER, *model G-2.* Adds all 70 uhf channels to vhf TV set. Features uhf tuner, nuvistor circuit, isolation transformer, built-in uhf-



vhf coupler. With set tuned to channel 5 or 6, converter tunes in any available uhf channel.—**Gavin Instruments, Inc.,** Depot Square, Somerville, N. J.

COLOR CIRCUIT ANALYZER, *model CA-122.* All required test patterns, signals for test from TV tuner to tri-color tube. Additional analyzing signals for injection at audio, video, sync stages.

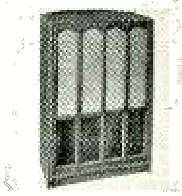


Tests: 10 standard color bars; white dots; crosshatch pattern; vertical and horizontal bars; shading bars, showing ability of video amplifier to produce shades and make color adjustments; colo1 gun interrupter; analyzing signals. Rf and i.f. signals modulated with any pattern for injection into grid circuits from antenna to detector. I.f. attenuator adjusts for minimum signal for each i.f. stage to produce pattern on CRT, providing check on individual stage gain. Sync and video, ±0 to 30 volts peak to peak, have separate calibrated controls for quick checks on video and sync circuits. Crystal-controlled 4.5-mc and 900-cycle audio. Illuminated pattern indicator for color patterns that should be seen on receiver.—**Sencore, Inc.,** 426 S. Westgate Dr., Addison, Ill.

NUVISTOR ANTENNA AMPLIFIER, *Colortron.* Two nuvistors amplify weak signals from faraway stations in spite of strong local TV and FM signals. Ultra-low-noise circuit, flat frequency response, impedance match VSWR 1.5 to 1, no

phase distortion. Handles 6 to 10 TV sets. Weather-sealed. Built-in heat sink, 300-ohm, 75-ohm models. All-ac power supply with 2-set coupler.—**Winegard Co.,** Burlington, Iowa.

LOUDSPEAKER SYSTEM, *Patrician 800,* restyled. Frequency response 20-35,000 cycles, power handling capacity 100 watts. Uses 30-inch woofer for 30 to 100 cycles, 12-inch mid-bass speaker



(100-800 cycles), T250 treble driver (800 cycles to 3.5 kc), T350 vhf driver (3.5-35 kc).—**Electro-Voice Inc.,** Buchanan, Mich.

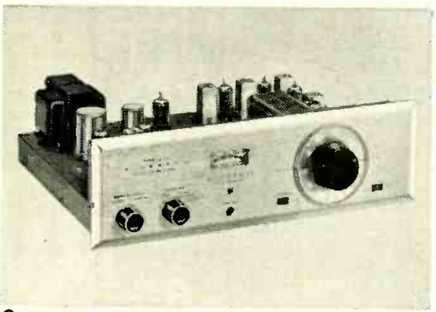
STEREO TAPE RECORDER, *kit model AD-22.* 4-track stereo/mono, record/playback. Two record playback VU meters, two inputs per channel with mixing controls. Fast forward and rewind, 3-digit counter. 4-pole motor, tape speeds 3¾

and 7½ ips, push-pull bias oscillator. Circuit boards reduce construction time. Supplied with head alignment tape. Also available as AD-12 for playback only through audio system.—**Heath Co.,** Benton Harbor, Mich.

PORTABLE STEREO TAPE RECORDER, *model TG 12 SK.* 4-track stereo/mono record and playback. Speeds: 1⅞, 3¾, 7½ ips. 10-watt dual amplifier. Direct output for use with hi-fi component system, monitoring facilities for recording on both channels. Stereo/mono sound-on-sound recording. 2 speaker systems in removable lids of carrying case. Equipped for automatic control of slide or movie projectors. Supplied with two mikes. 3-digit tape counter. Specs for 7½ ips: Frequency range 40-20,000 cycles ±3 db. Signal-to-noise ratio 46 db; wow and flutter ±0.15%; channel separation 60 db, 30 to 25,000 cycles; cross talk 38 db. Max.

Scott Stereo Tuner Kit Wins Rave Reviews from every Leading Hi-Fi Expert!

Just one year ago Scott introduced the LT-110 FM Stereo Tuner Kit. High Fidelity Dealers built this superb kit themselves, examined its many features, and recommended it without reservation. Enthusiastic kit builders deluged us with mail. Now the verdict is in from all the leading technical experts. Never before in the history of the industry has a single kit received such unanimous praise. We reprint a few excerpts below.



from POPULAR ELECTRONICS

"No commentary on *Scott Kits* would be complete without first mentioning that this company pioneered new areas in the hi-fi kit market and brought forth several (then-radical) innovations. One of them continues to fascinate all purchasers of a *Scott Kit* — the full-color instruction manual. . . . Scott also pioneered the Kit-Pak — a shipping container which serves as a temporary workbench and storage box . . . a test model of the LT-110 was wired at POPULAR ELECTRONICS in just under five hours. Another 40 minutes was used for careful alignment and the tuner was "on the air." . . . The LT-110 met or exceeded all the manufacturer's detailed specifications on sensitivity, distortion, output level, a.c. hum, and capture ratio . . . the audio response is excellent, being within ± 1 db, from approximately 20 to 16,000 cycles. . . . Channel-to-channel crosstalk is particularly excellent both in terms of uniformity and the fact that it holds up well above 10,000 cycles. . . . Frequency drift of the LT-110 from a cold start is extraordinarily low — less than 5 kc. The a.c. hum level (referred to 100% modulation) is low and exceeds the manufacturer's rating by 5 db. . . . It's difficult to imagine a kit much simpler to assemble than the LT-110. The full-color instruction book eliminates just about the last possible chance of wiring errors. . . . From a plain and simple operational standpoint, the LT-110 *works well and sounds good.*"

Popular Electronics, Oct. 1962

from ELECTRONICS WORLD

"Construction time for the unit we tested was 6½ hours, without alignment . . . in listening tests, the tuner showed its high useable sensitivity to good advantage. Using an in-door antenna which produced marginal signal to noise ratios on most other tuners we were able to get noise-free, undistorted stereo reception. It's quite non-critical to tune, hardly requiring the use of its tuning meter."

Electronics World, Nov. 1962

from AUDIO

"The LT-110 (is) so simple to build that we unhesitatingly recommend it for even the novice. . . . We found that the useable sensitivity (IHFM) was 2.1μv . . . a fine stereo tuner and an unusually easy kit to build."

Audio, April 1962

from RECORD GUIDE

"It seems to me that every time I turn around I am building another of H. H. Scott's kits. And each time I end up praising the unit to the skies.

The Scott instruction books should be a model for the industry. They feature full-color, step-by-step, illustrated directions. Each resistor or other component is shown in the progressive phases in its color code and in its proper position. . . .

There is no audible drift in the LT-110 whatever. You can shut the tuner off on a station and pick it up the next day, perfectly tuned, without touching the tuning dial. No AFC circuits are included in this tuner and none are needed.

This tuner kit has to be ranked on the same plane as H. H. Scott's factory-wired units. It is an excellent product, and because of its conservative parts very likely to give long, trouble-free service."

American Record Guide, Sept. 1962

Now Sonic Monitor* Added

Scott's unique Sonic Monitor has now been added to the LT-110. This foolproof stereo signaling device tells you audibly when you are tuned to a stereo station. Just turn the switch to "Monitor", and tune across the dial. When you hear the monitor tone from your speakers you know you've tuned to a station broadcasting new FM Stereo. Now switch the Monitor knob back to "Listen" to enjoy perfect stereo sound.

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*Patent Pending

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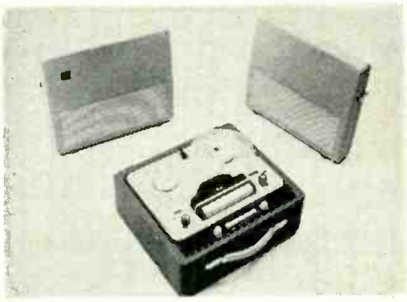
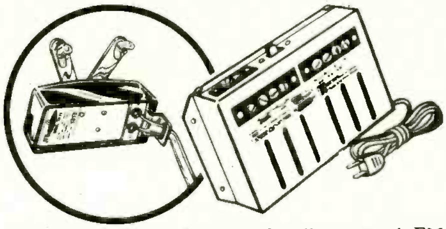


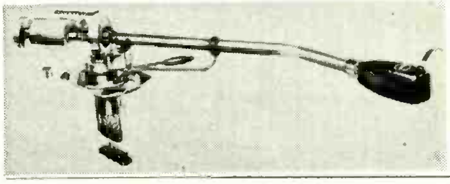
tape reel size 7 inches.—**United Audio,** 12-14 W. 18 St., New York 11, N. Y.

FM STEREO ANTENNA AMPLIFIER, *model TNT106FM.* Transistor FM stereo/mono signal amplifier adds up to 25 db gain to antenna with uniform frequency response across FM band.



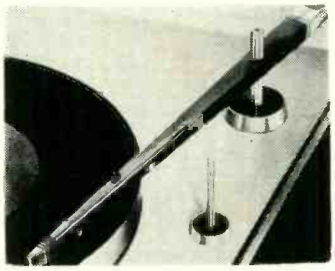
Enables any FM antenna to handle up to 4 FM sets. Includes amplifier, power supply and distribution system.—**JFD Electronics Corp.,** 6101 16th Ave., Brooklyn 4, N. Y.

PICK-UP ARM, *model SME 3009,* 12-inch records; *model 3012,* 16-inch records. Accommo-



dates all stereo and mono cartridges. Pivot friction less than 20 milligrams, horizontal and vertical. Stylus tracking force 0.25-5 grams, adjusted by moving rider weight. Device prevents arm from skating to center of record, hydraulic lever-operated control allows gentle lowering and raising of arm anywhere on disc. Models complete with one shell, mounting template, alignment protractor, mounting screws.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

INTEGRATED PICKUP ARM/CARTRIDGE, *model M222.* Tracking force 0.75-1.5 grams. Compliance, vertical and lateral, 22 x 10^{-6} cm/dyne. Frequency response 20-20,000 cycles.



Channel separation at 1,000 cycles 22.5 db. Output voltage 3.4 mv. Tubular .005-in diamond stylus in *model N22D* cartridge.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

THREE-IN-ONE RECORD CHANGER, *model 1007A.* Operates as automatic turntable, manual turntable, automatic changer. Push-button controls. *Pickup arm*: One piece, removable pickup head, tracking wt. 5–6 grams; weight adjustment. 3-pole wiring of plug-in head and tone arm, individual muting switches, manual tone arm lock. *Cartridge*: Crystal turn-over; plays 33- and 78-rpm records. Channel separation min. 20 db at 1,000 cycles; frequency range 20-16,000 cycles. Unit also available without cartridge.—**United Audio,** 12-14 W. 18 St., New York 11, N. Y.

DISK-WHISK KIT. Cleans records while they play. Brush sweeps grooves. cylinder pad deposits coating of anti-static fluid. Device clips to arm of any record changer or turntable. Replacement kit,

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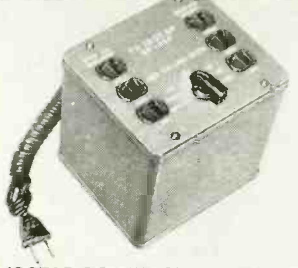

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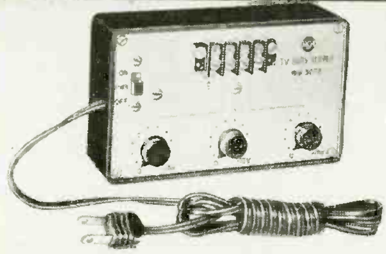

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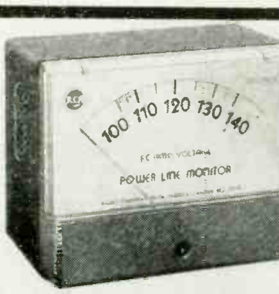
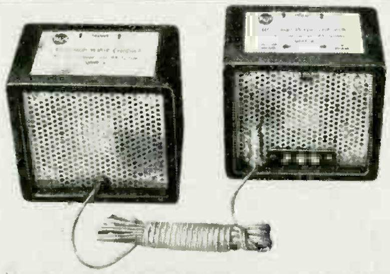
VIDEO MULTIMARKER RCA WG-295C Provides 7 simultaneous absorption-type marker signals at accurately preset frequencies for marking video response curves in COLOR receivers. $32.50*



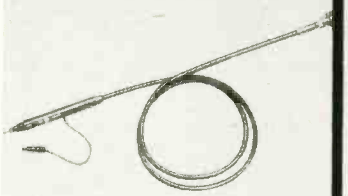
POWER LINE MONITOR RCA WV-120A Provides a constant check on incoming line voltage. Responds to every voltage fluctuation. Highly accurate (±2% at 120 volts). Gives true rms reading. 5" wide meter. $14.95*



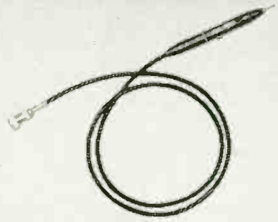
STEREO PHASE CHECKER RCA WG-360A A quick, simple, positive way to check phase alignment of low and mid-range speakers in stereo systems. Completely "sound-powered" Snag-proof recessed grille design. $14.95*

RF MODULATOR RCA WG-304B Used to check overall frequency response of TV receivers, including COLOR. Permits modulation of a signal from a marker generator by a signal from a sweep generator. $16.50*

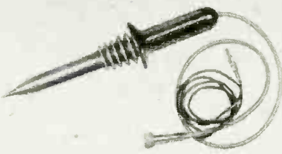
RCA ELECTRONIC PROBES



DIRECT/LOW CAPACITANCE PROBE WG-300B 48" cable. Switch provides instant selection of direct or low capacitance operations. For use with RCA scopes. $9.95*



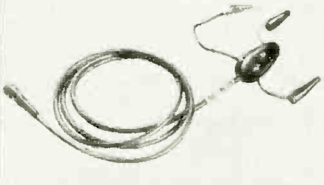
DC/AC-OHMS PROBE WG-299D Fingertip switch for instant selection of dc or ac/ohms. Insulated. For use with all RCA VoltOhmysts® except WV-77E. $7.95*



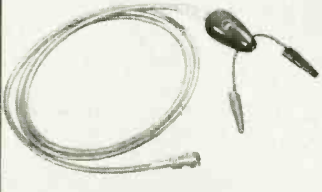
HIGH VOLTAGE PROBES WG-289 OR WG-297 Extend the DC range of RCA VoltOhmysts® to 50,000 volts. Either microphone-type or banana-plug connectors. $11.95*

CRYSTAL-DIODE PROBE WG-301A "Slip-on" type for use with WG-299D. Extends frequency range of RCA VoltOhmysts® (except WV-77E) to 250 Mc. $7.75*

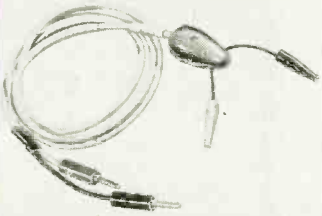
RF/IF/VF SIGNAL TRACING PROBE WG-302A Slip-on hf probe for WG-300B and RCA oscilloscopes for troubleshooting radios, TV, IF and video stages. $8.50*



DIRECT/LOW CAPACITANCE PROBE WG-349A A flexible 48-inch unit, fully shielded, designed for use with the RCA 3-inch oscilloscope (WO-33A). $5.95*



DEMODULATOR PROBE WG-350A For use with RCA 3-inch oscilloscope (WO-33A) for demodulation and signal tracing of radio/TV RF and IF signals. $4.95*



CRYSTAL DIODE PROBE WG-351A Extends the frequency range of the RCA WV-77E VoltOhmyst® to over 100 Mc. $4.95*

SEE THEM ALL AT YOUR AUTHORIZED RCA ELECTRONIC INSTRUMENT DISTRIBUTOR

RCA Electron Tube Division, Harrison, New Jersey.

The Most Trusted Name in Electronics

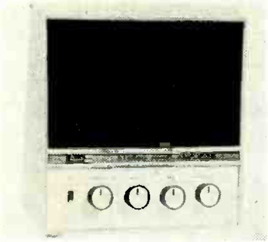
*User Price (Optional)

model ESK-8, contains roller and fluid.—**Robins Industries Corp.**, 36-27 Prince St., Flushing 56, N. Y.

SLIM-LINE SPEAKER SYSTEM, *Regina 200*. Less than 6 inches deep, may be used monaurally or paired for stereo. Electrical crossover at

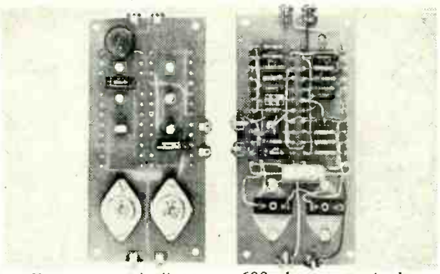
800 cycles splits signal between 5-inch dynamic cone-type tweeter and 10-inch woofer.—**Electro-Voice, Inc.**, Buchanan, Mich.

HI-FI AMPLIFIER/SPEAKER KIT, *model Y-8001*. Use with existing audio equipment. Treble and bass boost circuitry; volume, treble, bass con-



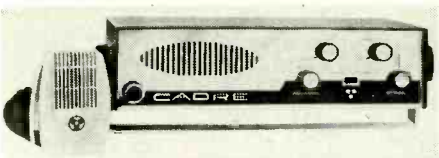
trols; 3 transistors including power transistor; 4 x 6-in PM speaker; input jacks for tuner, mike, record player; output terminals for extension speakers. Solderless, printed-circuit assembly. Only tool needed is screwdriver, supplied with kit.—**Revell, Inc.**, 4223 Glendoe Ave., Venice, Calif.

MODULAR 100-MW AMPLIFIER. Direct-coupled modules with low damping factors for multiple earphone installations (to 100). Tandem or series-connected low-level drivers, wide-range low-power amplifiers for audio systems, instrumentation networks, control devices, activation of



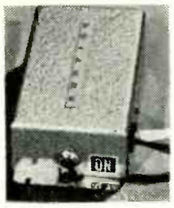
medium-power indicators. 600-ohm output, lower or higher load impedances allowable. No output transformer. 5-stage direct-coupled quasi-complementary-symmetry circuit with 7 transistors, 1 diode. Ac, dc feedback loops. Operate to 140°F, deliver 100 mw, less than 1% distortion into 600-ohm load. *Model WR-100, wide-range module*: Response ±1 db 10 cycles to 100 kc; input impedance 25,000 ohms; power gain 25 db; signal-to-noise ratio 75 db; supply required 24 v at 25 ma. *Model GP-100, general-purpose module*: Response ±1 db 20 cycles to 15 kc; input impedance 35,000 ohms, power gain 60 db; signal-to-noise ratio 70 db, supply required 24 v at 15 ma.—**Amplifier Corp. of America**, 398 Broadway, New York 13, N. Y.

TRANSISTORIZED CB RADIO, *model 510*. 5-watt transceiver has 5 receiving and 5 transmit-



ting channels. Receiver tunes all 23 channels. Uses 18 transistors, 8 diodes. Dynamic push-to-talk microphone, adjustable squelch, automatic noise limiter with agc. Built-in power supply and rechargeable batteries.—**Cadre Industries Corp.**, 20 Valley St., Endicott, N. Y.

FM MUTIPLEX ADAPTER, *model 23911*. For use with any multiplex-ready FM tuner. All-

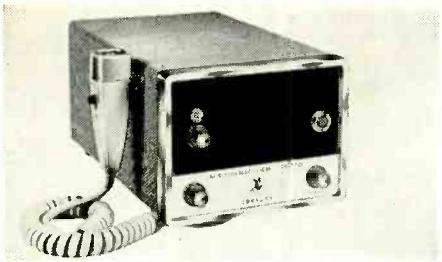


transistor unit can be plugged into 117-volt ac or convenience outlet on amplifier or tuner. Impedance-changing input stage, self-contained power supply. Cross-talk attenuation —30 to —35 db. Three SCA filters.—**Korting Recorder Sales Corp.**, Matthew Stuart & Co., Inc., 156 5th Ave., New York 10, N. Y.

FM ANTENNA, *Stereotron, model SF-8*. 8-element antenna with or without built-in nuvistor amplifier, *model AP-320*. Min gain of 26 db over

folded dipole, flat frequency response ±¼ db, 88 to 108 mc. 300-ohm Twin-Lead or 75-ohm coaxial cable.—**Winegard Co.**, Burlington, Iowa.

CB TRANSCEIVER, *Messenger Two*. 10-tube, crystal-controlled CB transceiver covers 10 channels. Illuminated channel indicator, rotating channel selector switch. Automatic volume control circuit, positive acting squelch control, universal mounting



bracket. 5⅝ x 7 x 11⅜ inches. Push-to-talk microphone, coiled cord, crystals for 1 channel. For 115 vac/6 vdc, 115 vac/12 vdc.—**E. F. Johnson Co.,** Waseca, Minn.

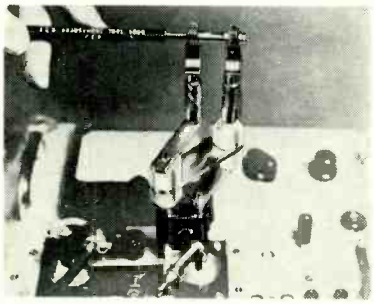
HIGH OUTPUT MICROPHONE, *Big Mike*. Transistorized, variable mike for mobile or base CB and amateur transceivers. Built-in transistor

amplifier with adjustable controls, squeeze-to-talk bar, magnetic hang-up. Optional permanent magnet allows unit to be hung on any metal surface. 4½ x 1½ in.—**Communications, Inc.,** 33 Danbury Rd., Wilton, Conn.

WALKIE-TALKIE, *model HE-66L*. Superhet CB transceiver provides exact frequency control

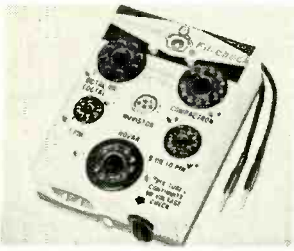
for receive and transmit channels. 4 transistors, 1 diode, 85-mw output, telescoping antenna. Push-to-talk and on-off volume controls. 6 penlight batteries.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

UNIVERSAL TEST FIXTURE, *model UTF-62*. For critical measurement of resistance, capacitance and Q factor. Spacing of banana plug meter input terminals can be varied. Adjustable arm



construction permits evaluation of ½ to 3½-inch components. 12 snap-clip and alligator-clip accessories allow for wide range of measurements. 2 nickel-plated brass sides insulated from each other at movable swing joints with self-lubricating plastic.—**JFD Electronics Corp.,** 6101 16th Ave., Brooklyn 4, N. Y.

FILAMENT CHECKER, *model FC 123*. For continuity speed testing of all tube filaments in-



cluding compactrons, novars, Nuvistor, 10-pin types. Test leads for CRT filament testing, continuity tests. ac or dc neon light indication voltage tests. TV cheater cord powers TV set to check power cord on set—**Sencore, Inc.,** 426 S. Westgate Dr., Addison, Ill.

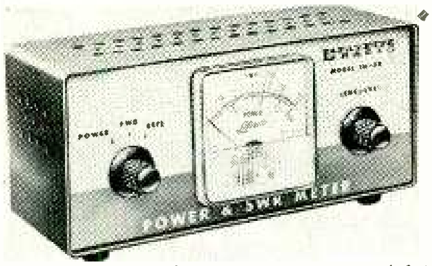
STYLUS PRESSURE GAUGE. Equal arm balance. Assortment of exact weights. Permits ac-

curate adjustment of stylus pressure of any pickup arm.—**Acoustic Research, Inc.,** 24 Thorndike St., Cambridge 41, Mass.

SELF-SERVICE TUBE TESTER, *model 203-LB*. Tests all tubes including Nuvistors, Novars, compactrons, 10-pin types, auto radio vibrators,

batteries, fuses and pilot lights. Cabinet has sliding drawers with tube dividers, drawer sheets for automatic inventory control, 63 phosphor-bronze beryllium sockets. Quick-flip tube chart lists 1200 tube types. Tester will accommodate new tubes as they appear.—**Mercury Electronics Corp.,** 111 Roosevelt Ave., Mineola, N. Y.

SWR BRIDGE/RF POWER METER, *model TM-58*. Gives accurate swr and direct power readings to 50 mc. May be inserted permanently into transmission line for swr and relative power monitoring. Indicates rf power to 15 watts; into built-in 52-ohm dummy load; reads relative forward pow-

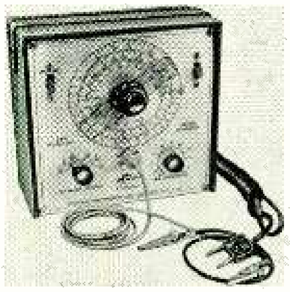


er to 1 kw. Gives direct swr measurements 1:1 to 4:1 with powers up to 1 kw. Full scale accuracy 10%.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

REGULATED POWER SUPPLY, *Kit model IP-20.* Delivers up to 1.5 amps, 9 to 50 volts, less than 150 μv ac ripple. Current ranges: 50 ma, 150 ma, 500 ma, 1.5 amps. Transistor series-type voltage regulator, Zener diode. Voltage control uses

tapped power transformer; adjustable current limiter automatically controls output on any current range.—**Heath Co.,** Benton Harbor, Mich.

RF SIGNAL GENERATOR, *model 502.* Wired or kit. 6 bands, 115 kc to 110 mc on fundamentals, up to 220 mc on second harmonic. Individual slug-tuned coils for each band. Colpitts rf oscillator, planetary drive tuning capacitor. 400-cycle internal modulation available. Rf accuracy

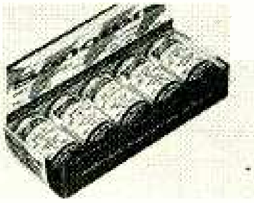


within 1½%. 2-color etched panel, provision for external modulation. Rf output lead, cathode follower output, rf attenuator. 6-⅝ x 6-⅝ x 4 inches —**Electronic Measurements Corp.,** 625 Broadway, New York, 12, N. Y.

DEGAUSSING COIL. *model DGC-100.* Features 10-foot line cord with line switch at the end

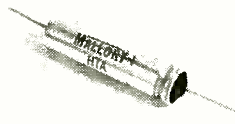
—no need to plug and unplug from ac line.—**Stancor Electronics, Inc.,** 3501 Addison St., Chicago 18, Ill.

DRY CELL BATTERIES. *Model SC-100,* 9-volt rectangular; *model SC-101,* 1½-volt penlite;



SC-102, 9-volt round. Premium electrolyte assures full capacity. Graphite-film process produces high output. In self-display cartons.—**Sonotone Corp.,** Elmsford, N. Y.

ALUMINUM ELECTROLYTICS, *type HTA* 30, 40, 50 and 60-volt ratings, values from 10 to 60 μf. Temperature range —55° to 125°C, without de-



rating. 3/8-inch diameter, 13/16 to 5/8-inch long.—**Mallory Capacitor Co.,** 34 S. Gray St., Indianapolis 6, Ind.

TUNING HEADS for radio and TV, to replace channel selectors and tuning dials on existing sets. Inserts cover most dial numbering systems;

rear socket fits with stems in varied sizes, replacing over 600 types of knobs.—**Colman Electronic Products,** P.O. Box 2965, 1017 N.E. 3rd Ave., Amarillo, Tex.

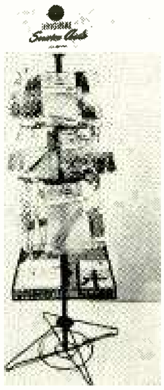
All specifications are from manufacturers' data

NEW BUSINESS GETTERS

NEW LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

DISPLAY RACK, *ETR-3257.* Holds 80 radio and TV service aids, occupies less than 2 square feet of floor space. Rotating hangers, basket for



reference manuals. Free to dealers who purchase 80 service aids—Dept. B, **General Electric Co.,** 3800 N. Milwaukee Ave., Chicago, Ill.

MICROPHONES, COMPONENTS, ACCESSORIES. 20-page *Catalog 62* contains photos and complete specs on about 40 models, including studio, general-purpose, controlled magnetic and crystal mikes, plus special-purpose types for amateur radio and language lab use. Shows manufacturer's line of cartridges, recording heads, accessories.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

ZENER DIODE LOCATOR. 24-page guidebook lists Zener devices by EIA and manufacturer's part numbers. Listings in numerical order show case type, power rating, nominal voltage range, specified test current. Specs for Zener devices include 250-mw, 400-mw, 750-mw, 1-watt, 3½- and 10-watt power dissipation ratings. **$1.00—International Rectifier Corp.,** 233 Kansas St., El Segundo, Calif.

MIKES, HI-FI, PA EQUIPMENT shown in 21-page *Catalog No. 150.* Contains illustrations and descriptions of about 60 mikes plus accessories; PA horns, drivers, speakers; hi-fi/stereo systems and enclosures, some in kit form. Many photos.—**Electro-Voice, Inc.,** Buchanan, Mich.

HOME STUDY COURSES in radio/electronics/TV offered in 4-page brochure. Also includes list of available service manuals for TV and radio. —**Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill.

ELECTRONIC EQUIPMENT offered in 284-page 1963 shopping guide, *Catalog 124.* Over 10,000 items include special closeout purchases of hi-fi-components, plus new products and lines. Large section features manufacturer's own hi-fi systems and components, kit and wired. Other items include receivers, transmitters, test equipment, transistor radios, phonographs, tape recorders, musical instruments, records and tapes, car radios, books, tools, cameras, educational toys, CB transceivers. —**Radio Shack Mail Order Headquarters,** 730 Commonwealth Ave., Boston 17, Mass.

FM STEREO INSTRUCTION RECORD. 7-inch plastic disc lets listener hear actual FM stereo broadcast "off the air". Gives complete explanation of technical specs, demonstration of what they mean and their effect on FM stereo reception.—**H. H. Scott, Inc.,** Dept. P, 111 Powdermill Rd., Maynard, Mass.

ELECTRONIC TRANSISTOR IGNITION explained in 4-page leaflet, with theory and wiring instructions for AEC-77 system. Graphs and photos show its advantages over conventional ignition.—**Automotive Electronics Co.,** 387 Park Ave. S., New York 16, N. Y.

TRANSFORMER AND COIL REPLACEMENTS for auto radios presented in 46-page *Catalog No. 501, 1962.* Lists 60 radio brands and manufacturers by model or chassis, cross-referenced to manufacturer and auto year. Separate cross-reference tables show proper replacement part.—**Stancor Electronics, Inc.,** 3501 Addison St., Chicago 18, Ill.

TELEMETRY ANTENNA SYSTEMS, *Catalog 300.* Photos, specs, complete details on manufacturer's line from large, remote-control multimode telemetry and command types to small special-purpose antennas.—**TACO, Technical Appliance Corp.,** Sherburne, N. Y.

SOUND IN FOCUS. 4-page illustrated brochure, explains sound-column PA installation. Tells what a sound column is, how it works, gives photos of sample installation. Specs on 8 models.—**GR Electronics Co.,** 447 MacQuesten Parkway N., Mount Vernon, N. Y.

SOLDERING EQUIPMENT. Single-sheet, hole-punched bulletins give full specs, including thermo/gram values, on soldering pencils/irons/guns. *Bulletins LM-62-10M, SG-62-10M, SM-62-10M and TM-62-10M.*—**Wall Mfg. Co.,** Grove City, Pa.

MICROMINIATURE & ELECTRONIC ASSEMBLY TOOLS. 24-page catalog presents tools and instruments for miniature assembly and microfine work. Features piers, tweezers, microscopes, taps, dies, high-speed drills. Many photos.—**Mini-Tool Technical Industries, Inc.,** 544 Grand Ave., Englewood, N. J.

CB/AMATEUR MIKE BROCHURE, *Bulletin No. 1066.* 4-page leaflet contains photos, specs and applications on 8 mobile and base station mikes, plus CB accessories.—**Turner Microphone Co.,** 909 17th St. N.E., Cedar Rapids, Iowa.

UHF TRANSMISSION EQUIPMENT offered in 4-page short-form catalog excerpt. Principles, applications, properties, suspension methods described in detail, with photos and specs of G-Line launchers and accessories.—**Surface Conduction Labs,** Regional Sales Office, PO Box 477, Montclair, N. J.

COMPONENTS CATALOG 200. 16-page book gives full data on controls, switches, ceramic capacitors, packaged circuits. Lists over 1,800 components, describes 15 kits. Contains control taper charts showing standard resistance and tapped resistance curves.—**Centralab,** Electronics Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis. END

NOW with TRANSISTOR POWER supply

MODEL 100 A TRANSCEIVER WITH NEW DYNAMIC MICROPHONE

EXTERNAL SPEAKER S/METER

CLIPPER/FILTER AMPLIFIER

INTERNATIONAL MODEL 100 A EXECUTIVE TRANSCEIVER

International's new Model 100 A is the latest in the outstanding line of Executive transceivers. The advanced design Executive features a *transistor power supply, new perforated metal cabinet,* and a *new rugged microphone* . . . all of which contribute to a more reliable mobile operation.

The Model 100 A . . . the finest of its kind, also features:
• Crystal filter for improved receiving • Twelve crystal controlled transmit positions • Two crystal controlled receive positions • Dual conversion superheterodyne receiver tuning 23 channels • Built-in calibration circuit • N R squelch • Provision for connecting external speaker and s/meter • Push-to-talk operation • Transistor power supply operates from 6/12 vdc or 115 vac

Model 100 A, complete with 1 transmit crystal, 1 receive crystal, and microphone $199.50

External Speaker and S/Meter

The perfect companion for the International Executive Model 100. Utilizes a high impedance vacuum tube volt meter circuit. Connects to socket on rear of transceiver. S/meter reads in three ranges. Brown cabinet, brown and silver panel matches Executive transceiver.

Complete with interconnecting cable $49.50

Executive Speech Clipper/Filter Amplifier

A microphone amplifier designed to increase average modulation . . . limits modulations peaks . . . filters audio frequencies above 2500 cycles. Permits arms-length microphone operation. Power requirements: 12 vac or 12 vdc.

Complete with interconnecting cable $36.50

12.6 VAC, 2 Ampere Power Unit

Base station power unit for Speech Clipper/Amplifier. Operates from 115 vac. Provides 12.6 vac at 2 amperes.

Complete with mounting chassis, power cord, fuse, switch $12.50

Citizens Band licensees with International equipped stations know the unquestioned superiority and advantages of Executive transceivers and their system engineered accessories.

See your authorized International dealer today.

INTERNATIONAL
CRYSTAL MANUFACTURING CO., INC.
18 NORTH LEE • OKLAHOMA CITY, OKLA.

TECHNICIANS' NEWS

150 Technicians Jam Color Meeting

Detroit, Mich.—A color service meeting, held at the Venetian Hall, was jammed by 150 service dealers and technicians. They were anxious to see the new RCA Mark VIII line chassis, and get into their new workshop sessions to see what type of repairs might be necessary on this set and how they could be handled. Jerry Ratz, area service representative for RCA, did a fine job in showing circuit changes and answering color service problems. The meeting can best be summed up by: "Wish there were more of them."

Eight Association Committees

Buffalo, N. Y.—TESA-New York has set up eight committees to handle important aspects of association business. They are the *Newspaper Committee,* which is responsible for the operation of a *TESA Vision* newspaper; *Publicity Committee,* responsible for all forms of publicity; *Public Relations Committee,* responsible for establishing good will between members, distributors and the general public; *Special Events Committee,* responsible for organizing and conducting special technical and business events, such as color clinics, lectures, etc., *NATESA Committee,* to handle all NATESA matters and act as delegate to the national association; *Membership Committee,* responsible for all matters pertaining to new memberships, as well as acquiring, contacting, screening and checking attendance at meetings of present members; *Lapsation Committee,* handling all matters pertaining to lapsed members, delinquent dues, etc., and lastly, the *Budget Committee,* to budget all moneys and operate the association on a prosperous financial basis.

Westinghouse Open House

Albany, N. Y.—TSA technicians attended an open house at the Inn Towne Motel, held by the Westinghouse Electric Corp. The display exhibited a large number of the company's appliances and TV sets. Servicing features of the TV line were stressed to those who attended. For instance, the console models contain a "tilt-down" chassis. With this arrangement, a technician can unfasten the upper mounting of the chassis and tilt the entire chassis downward until the back side of the printed-circuit board is exposed. John Doble, Westinghouse field representative, was present to answer any questions from the technicians.

Around Wisconsin

Racine.—Walter Beyer, president of this local group, played a tape recording of a speech on licensing at a recent regular business meeting. Members were urged to contribute to the licensing fund, and a very active discussion followed.

Green Bay.—The regular monthly meeting was held at the Wisconsin Public Service Building. All but two shops attended. Plans for the TESA Wisconsin Convention were discussed, and Harold Juelich reported that plans for the convention were progressing very well. Don Beno composed a letter to be sent to the Druggist Association, hoping to discourage the use of do-it-yourself tube testers. He pointed out that professionals should test tubes as well as fill prescriptions.

Sheboygan County.—A full report on the State Licensing Committee was given. Also shown at the meeting was a film from the Wisconsin Telephone Co. on communications. Members were urged to attend the State Convention, along with nonmember technicians. Fred Leonard states that no service dealer has a legitimate excuse for staying away.

Milwaukee.—Once again, Covic's Amerwood Hall was the scene of the regular meeting. Jill Wolff of the Telephone Co. presented an interesting and informing film strip and discussion on turning telephone inquiries into sales. The talk went into such matters as the importance of the manner in which you use your voice, having answers ready for objections and excuses, and learning when to close a conversation. A short movie titled "Overcoming Objections" followed the talk. END

"First service call I've ever had on Christmas day. Hope you can afford it."

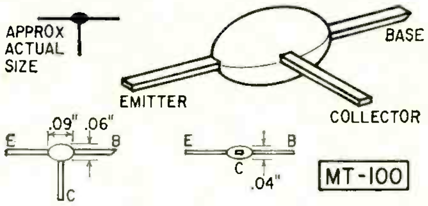
LOOKING?—you stand a better chance of finding what you want if you advertise in RADIO-ELECTRONICS Classified ads. See details at head of this column.

NEW SEMI CONDUCTORS & TUBES

WE START OFF WITH ONE OF THE TINIest transistors ever made. It measures only .09 x .06 x .04 inch. Then its on to a germanium audio transistor before we switch over to the tube side of this column. Here we find a full-wave power rectifier, a single-ended diode-pentode for TV, a sharp-cutoff pentode for TV, and a group of frame-grid pentodes for i.f. strips.

MT-100

An n-p-n silicon planar micro-transistor designed primarily for high-speed switching and high frequency amplifier service. The unit is useful in nanosecond switching circuits and hf and vhf tuned amplifiers.



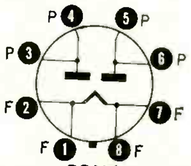
Electrical characteristics of the General-Instrument MT-100 are:

I_{CBO} (typical μa)	.004
I_{EBO} (typical μa)	.001
BV_{CBO} (min)	25
BV_{EBO} (min)	3
BV_{CER} (min)	20
h_{FE} (min)	20
P_{total} (max mw)	150

5DN4

A full-wave power rectifier, designed for reliable operation. It has double leads to each plate and filament, to reduce the current carried by each lead and eliminate hot spots. Its characteristics are similar to a 5V3. Maximum ratings for the Raytheon 5DN4 are:

V_{HTR}	5
I_{HTR} (amps)	3.3
V_P (inverse)	1,550
V_P (ac each plate)	550
I_P (steady state peak amps)	1.3
I_P (transient peak amps)	6
Tube voltage drop, when conducting at 350 ma (each plate)	47



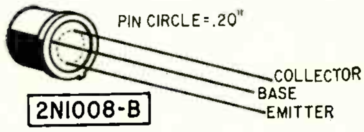
5DN4

Typical operating characteristics:

V_P (ac supply, each plate rms)	300	425
Input capacitance (μf)	40	40
Effective plate supply resistance (each plate, ohms)	24	56
Dc output current (ma)	380	350
Dc output voltage at filter input	285	430

2N1008-B

A germanium alloy high voltage p-n-p transistor designed for audio amplifier service and especially suited for use as single-ended audio drivers or in medium-speed switching applications.



The linear current gain characteristic of this transistor gives low distortion at the higher power levels.

Maximum ratings of the Bendix 2N1008-B are:

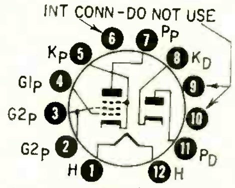
V_{CB}	60
V_{CE}	60
I_C (ma)	300
P_C (mw)	400

Electrical characteristics are:

h_{fe} (min)	40
(max)	120
h_{ie} (ohms)	200–800
f_{ab} (min mc)	0.5

6GA7

A single-ended diode-pentode on a 12-pin base. In one envelope, it combines a TV damper and beam pentode amplifier for horizontal deflection circuits. Combining the damper and amplifier in one envelope results in a more compact design and reduces the com-



6GA7

plexity of the wiring. Note that no top-cap connector is used for the output pentode.

Maximum design ratings for the Raytheon 6GA7 are:

Pentode Section	
V_P (boost and dc)	770
V_{G2}	220
P_P (watts)	15
P_{G2} (watts)	3.6
I_K (average ma)	150
I_K (peak ma)	500
V_P (peak positive)	6,500
(peak negative)	1,500
V_{G1} (peak negative)	330
R_{G1} (circuit megohms)	1
Diode	
V_P (peak inverse)	5,500
I_P (steady state ma)	325
I_P (dc, ma)	140
P_P (watts)	5

Characteristics of the pentode section in actual use are:

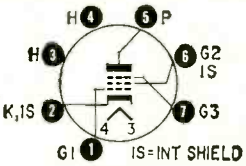
V_{G1}	—22.5
I_P (ma)	75
I_{G2} (ma)	2.4
μ (triode amplification factor)	4.1

GM (μmhos)	6,600
R_P (K ohms)	20

The only diode characteristic of interest is the 32-volt drop in the tube when it is conducting at 250 ma.

6HZ6

A sharp-cutoff pentode in a 7-pin miniature envelope, designed for use as a combined detector, limiter and audio voltage drive tube in locked-oscillator quadrature-grid FM sound detector service. The tube has two independent control grids (grid 1 and grid 3) a feature which provides great flexibility in circuit design. This tube also has a special shield associated with grid 2. This



6HZ6

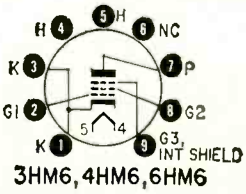
shield enables the tube to suppress parasitic oscillations which may be picked up in the tuners of some TV receivers.

Maximum ratings of the RCA 6HZ6 in FM sound detector service:

V_P	300
V_{G3} (pos value)	25
(neg value)	100
V_{G2}	300
V_{G1} (pos bias value)	0
(neg bias value)	50
P_P (watts)	1.7
G_3 input (watts)	0.1
G_2 input (watts for volts up to 150)	1

3HM6, 4HM6, 6HM6

A series of sharp-cutoff 9-pin miniature frame grid pentodes, designed for use in TV receiver i.f. amplifier stages. They feature very high transconductance and low interelectrode capacitance. The cathode has two terminals to increase input impedance at high frequencies. Grid 3 is connected to a separate pin for easy grounding. All three tubes are electrically identical, except for their heater ratings. The 3HM6 has a 3.15-volt 600-ma heater.



3HM6,4HM6,6HM6

The 4HM6 has a 4.2-volt 450-ma heater, while the 6HM6 has a 6.3-volt 300-ma heater.

Characteristics of the Westinghouse 'HM6 series in typical i.f. service are:

V_P	125
G_3 (connected to cathode at socket)	
G_2	125
R_K (bias ohms)	56
R_P (approx K ohms)	156
GM (μmhos)	15,000
I_P (ma)	13
I_{G2} (ma)	3.2

END

Technotes

Record Changer Hints

All record changers eventually develop turntable slippage, turntable-drive slippage, speed-shift cam problems and motor shaft binding at times.

Turntable slippage is usually caused by oil or grease. It can be eliminated by thoroughly cleaning all rubber tires, the inside of the turntable rim and the motor shaft pulleys. The turntable drive, idler and the inside of the turntable rim must always be clean and dry. Since the turntable idler is a sort of clutch, there must be some slippage. But, this clutch must not slip under 5 to 6 inch ounces of weight or records on the turntable. Adjust the idler assembly so it will not slip under 5 to 6 inch ounces. If it does slip, a full stack of records will cause wow or turntable slowdown.

The speed shift cam needs occasional lubrication—to enable it to do the proper job. It may also be so worn that it should be replaced. When it needs lubrication or is badly worn, improper changer speed results.

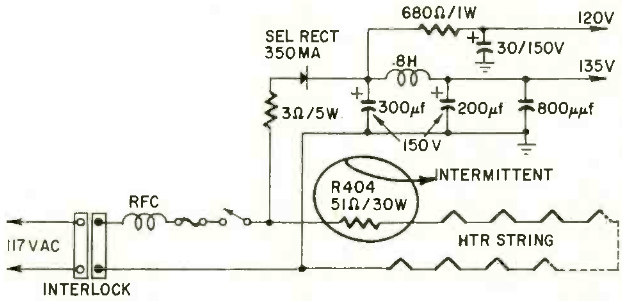
In a record changer that has seen a lot of use, motor bearings may have tightened up. To test for this remote trouble, set the idlers so they are not engaged. Now, turn the motor shaft with your fingers, giving it a good twist. It should revolve at least three or four times. If it makes less than one revolution, check the motor bearings.

Unless all of the above troubles are eliminated, no record will revolve at the desired speed and all records sound bad or unnatural.

One final job must be done before returning record players that have styli cartridges. Thoroughly clean the space between the styli and the cartridge shell. An accumulation of dust in this area could cause distortion.—*A. von Zook*

Hotpoint 14S202

When I checked this set, all the tube heaters were blinking on and off. A careful check of all tubes in the



circuit showed no defects. An ohmmeter check of other components revealed that R404 was opening intermittently. Once it was replaced, the blinking heaters stayed lit and the set worked.—*William Porter*

Buzz and Poor Sync

We recently encountered a TV set that lacked vertical sync, had a wide dark line on the screen, and a buzz in the sound. After checking all tubes in the set and finding them good, we noticed that the set was connected to a booster at the antenna. Checking the booster revealed a tube with a heater-to-cathode short. It was feeding 60-cycle hum directly into the tuner. The symptom gave the appearance of a heater-cathode short in the set's rf amplifier, and the customer took the wide black hum bar for the blanking bar. After replacing the defective tube, picture, sound and sync returned to normal.—*Walter H. Peter*

Motorola 902 Color Set

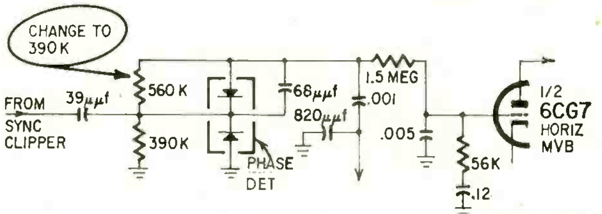
While attempting a "touchup" static convergence adjustment for the red gun, the knob on the magnet broke off, leaving the red dots displaced by about ¼ inch. A slight misconvergence can be tolerated in the blue or green raster, but not in the red.

Anticipating a long delay in obtaining a new magnet, I used plastic tape to strap a small magnet from an ion trap to the back of the red coils. Turning and moving the magnet about on the coil shield made possible excellent red static and dynamic convergence.

These sets are capable of almost perfect convergence to the edges of the picture tube if the electrolytics in the convergence circuits are in good condition.—*Arthur Kelley*

G-E M5 TV Chassis

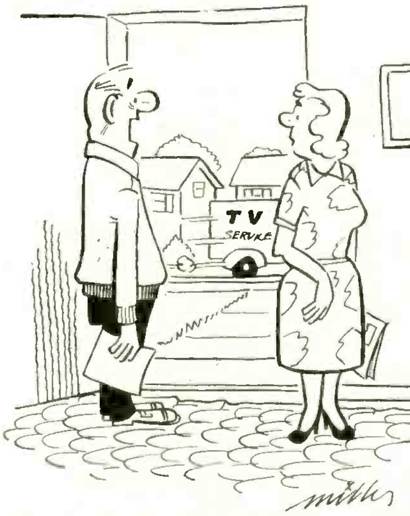
The picture curled at the top. Three other shops had worked on this set without correcting this condition. After about 10 hours' work, we found that the phase detector di-



odes had two resistors connected in parallel—560,000 and 390,000 ohms. We changed the 560,000-ohm resistor to 390,000 ohms and solved the problem.—*Roland Demers*

Transvision Series E

This set behaved in a fashion maddening to the viewer. Performance was normal until it was well warmed up (and the viewer well into a program). Then both sound and picture would slowly fade. Turning the set off to cool restored operation but only for a shorter interval. Since both sound and picture faded together, the tuner was suspect. The tubes checked OK. Physical manipulation of the 6U8 and its shield assembly finally provided the clue. When the tuner was wired, a very small gap had been left between the grid lead and a grounded point. As the tube and its shield got hot, expansion moved the socket pins and their associated components. This movement, though hardly perceptible, was enough to short the grid.—*Wm. B. Rasmussen* END



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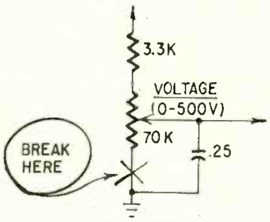
NOTEWORTHY CIRCUITS

Add Low-Voltage Test to Your R-C Bridge

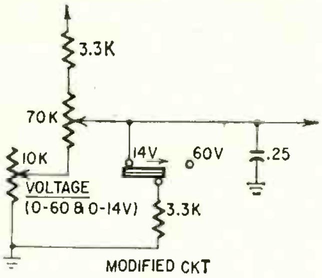
Like most instruments of its type, my EMC model 801 resistance-capacitance and comparator bridge tests capacitors for leakage at their normal working voltage. A potentiometer (Fig. 1), calibrated 0 to 500 volts, is set to the capacitors' voltage rating. However, you cannot adjust the voltage close



NORMAL CKT
Fig.1

enough to check the low-voltage capacitors used in transistor circuits.

Fig. 2 shows how I used a spst slide switch, a 10,000-ohm wirewound pot



MODIFIED CKT
Fig.2

and 3,300-ohm resistor to add 0–14- and 0–60-volt ranges to the instrument. (The same method can be used on other instruments by selecting suitable values for the pot and resistor.)

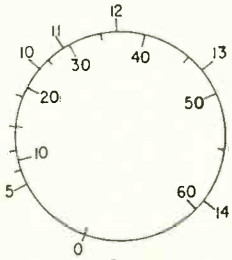


Fig.3

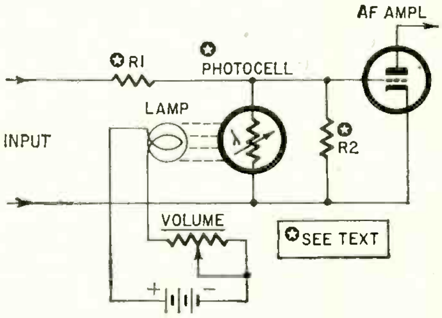
I mounted the pot directly below the model number on the panel and calibrated it as in Fig. 3. The switch is on the left edge of the panel about one-third the way up from the bottom.

When using, start with both pots in the zero position. Use the regular VOLTAGE control for tests up to 500 volts. The slide switch may be in either position. For tests on the 0–14- and 0–60-volt ranges, set the switch as required and use the 10,000-ohm pot. Leave the VOLTAGE control in the zero position.
—*L. F. Guzman Mendoza*

Remote Volume Control

An unusual method of controlling the gain of a PA amplifier from a remote point was described in *Popular Radio og Fjernsyn* (Copenhagen). The circuit is shown.

A photoresistor such as a cadmium



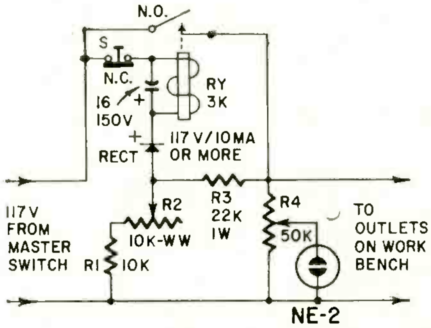
sulphide or cadmium selenide photocell is connected as a part of a voltage divider at the input to one of the amplifier stages. A small incandescent lamp is mounted close to the photocell and supplied from a battery and adjustable resistor located at any desired remote-control point. Turning up the light intensity decreases the photocell's resistance and the volume promptly decreases linearly.

The value of series resistor R1 and the resistive characteristics of the cell depend on the value of grid resistor R2. In the Danish circuit, R1 and R2 are 1 and 22 megohms, respectively. Photocell characteristics were not specified. CdS and CdSe cells (Clairex types) are available with resistances ranging from 1 megohm to 250 ohms with light intensity at 2 foot-candles. Select R1 and photocell to suit circuit impedance.

The Loadminder

Like many technicians and experimenters, I used to leave the workbench for the night and then return the next day to find occasionally that at least one piece of equipment was still turned on. My Loadminder (see diagram) has eliminated this problem. It is connected into the power line feeding the bench. When a test instrument is turned on or a soldering iron is plugged in, the Loadminder's indicator comes on and cannot be turned off until all loads have been turned off or disconnected.

Here is how it works: When the master switch is turned on, current flows through R1, R2, the rectifier, the relay coil and the normally closed pushbutton switch S. R2 is adjusted so that the current in this string is not enough to pull in the relay, but high enough to hold it in once the contacts are closed. When a load, say a vtvm, is turned on, the power supply of that instrument and resistor R3, the "starter resistor", form a second string in parallel with R1–R2.



Now there is enough current through the relay to pull in and close its contacts. When the relay operates, full line power appears at the output and the load proceeds to function in its normal manner. Also, there is now 117 volts across R4, which is adjusted so that the neon lamp now glows.

Assume now that S is depressed. This de-energizes the relay and opens the circuit to the load. As soon as S is released, however, the relay pulls in again. In other words, *as long as a load is connected to an outlet, the indicator light cannot be turned off*. Imagine that you have forgotten to turn off a tester or its pilot light is burned out. Then the Loadminder tells you: "Something is still *on!*"

I put all parts in a small box with the neon lamp and S mounted on top and screwed the whole works to the wall above the workbench. The relay is a surplus plate-circuit type with a coil resistance of around 3,000 ohms. It pulls in at 4.5 ma and holds in at 3 ma. The contacts are adequate to handle the normal bench load. With a different relay, you may have to experiment to find the optimum value for R3.

Adjustments: Turn R2 to maximum resistance and R4 to minimum for the neon lamp. Apply power to the input but do not connect a load to the output yet. Reduce R2 till the relay pulls in. Now adjust R4 until the neon lamp glows normally. Next increase R2 a small amount. Now depress and release S. If the relay still pulls in, increase R2 further. Try S again. Continue this till the relay no longer pulls in. You will still see a slight motion of the armature as S is released. This is all right as long as the contacts don't close. Now connect the smallest load on your bench, probably the vtvm, to the output. As you turn on the instrument, the relay should pull in and 117 volts should appear at the output. This completes the adjustments.—*H. Velme* END

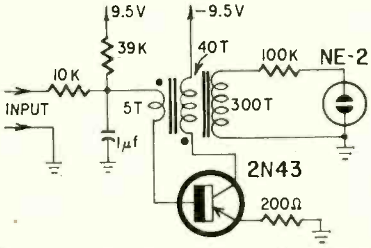
new PATENTS

Neon Indicator

Patent No. 3,012,237

William B. McCoy, Highland, N.Y. (Assigned to International Business Machines Corp., New York, N.Y.)

This neon indicator lights up when minus 3 volts is applied. It biases the transistor to conduction so it oscillates. The ac output is stepped up high enough to ignite the lamp.

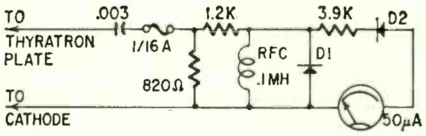


Thyratron Failure Detection

Patent No. 3,040,244

John E. Owens, Wilmington, Del. (Assigned to E. I. duPont deNemours & Co., Wilmington, Del.)

If a thyratron burns out during operation, the controlled equipment might be damaged. This inventor has discovered that, as the tube nears the end of useful life, it generates internal oscillations. For example, a 3C23 generates 200 kc. The circuit shown detects this signal. The choke is broadly resonant at 200 kc. D1 suppresses spikes of voltage often associated with thyratron circuitry, and D2 is a meter rectifier.



Tests show that the oscillation gets weaker during the first 1,000 hours of tube use, then becomes stronger. When the signal reaches a predetermined strength, the tube should be replaced.

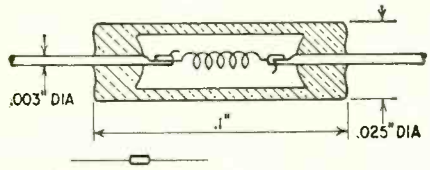
Microminiature Lamp

Patent No. 3,040,204

Donald J. Belknap, 302 Patterson Court, Takoma Park 12, Md. (May be manufactured and used by or for the US Government without payment of royalty)

This tiny lamp may be used as a probe or an indicator. It is so small that a single unit may be mounted at the end of a meter pointer.

Dimensions are shown in the diagram. The filament (held by hooked ends on the leads) may be 25 turns of tungsten wire .00025 inch in diameter wound on a .001-inch mandrel. The lamp consumes only 25 ma at 1 volt.



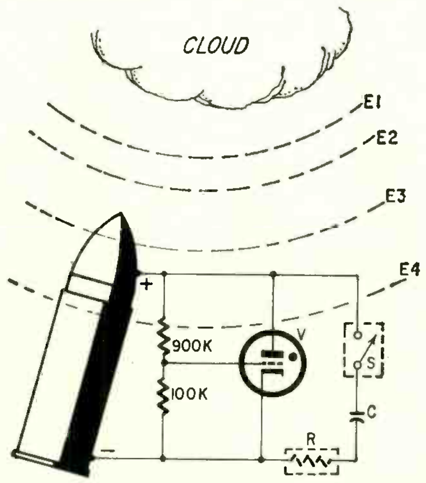
ACTUAL SIZE (APPROX)

Cloud Research

PATENT No. 3,038,154

V. K. Zworykin and G. C. Sziklai, Princeton, N. J. (Assigned to RCA)

This patent was applied for in 1948, but was delayed for reasons of military security. It describes a rocket used to explore clouds. The metal nose and rear case are insulated from each other. For clarity, the components inside the missile are drawn schematically *outside.*



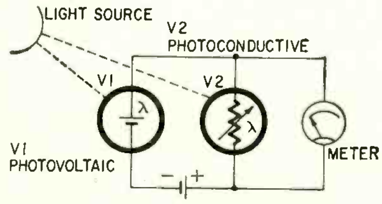
C is charged before launching, and S is closed on leaving the ground. The tube cannot fire because of its grid bias. However, when the rocket reaches a cloud where the potential difference is high enough to overcome the bias, the tube fires. Current through R (resistance wire) sets off an explosive charge to indicate the exact location of the rocket and charged cloud.

Exposure Meter

Patent No. 3,028,499

Robert A. Farrall, Beverly, Mass. (Assigned to General Electric Co.)

An exposure meter must respond to a very wide range of illumination. This requirement is normally met with *logarithmic* type meter energized by a photocell. This new method uses a *linear* meter (which is less expensive) and two photocells, one photovoltaic (V1) and the other photoconductive (V2).



The same light source energizes both cells. If the illumination increases, for example, V1 generates higher voltage but, since V2's resistance falls, there is only slightly greater output to the meter.

Such an arrangement may respond from 0.1 foot-candle to 1,000 foot-candles. Also, it provides temperature compensation. For example, high temperature causes more output from V1, but since it also lowers V2's resistance, the output remains nearly constant.

Close Regulation

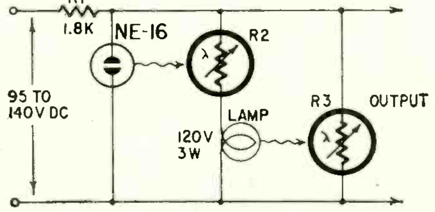
PATENT No. 3,040,241

Irwin Wunderman, Mountain View, Calif. (Assigned to Hewlett-Packard Co., Palo Alto, Calif.)

A neon lamp alone can regulate dc voltage, but here it does a far better job with the aid of an incandescent lamp and photoresistors (R2, R3). Over the input range shown, the output varies only 2 volts.

R2 is placed where light from the neon lamp falls on it. R3 is illuminated by the 3-watt lamp.

If, for any reason, the output tends to fall,



V1 dims slightly and RE's resistance increases. Lower current now flows through the 3-watt lamp and R3's resistance also increases. As a result of a smaller drop across R1, the output voltage returns to normal.

R2, R3 have a dark resistance of about 5 megohms. END

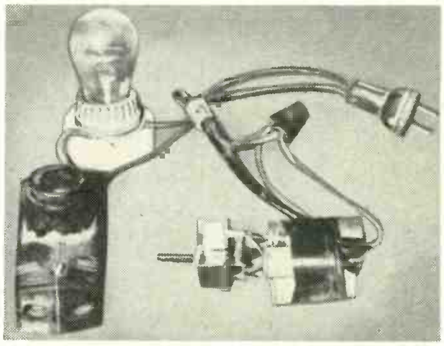
Change That Capacitance!

Here's a trick that I have been getting away with when in tight spots in building various types of R-C oscillators or networks. When I need a fixed-frequency oscillator and stock components just aren't the right value, I merely insert disc ceramic capacitors slightly higher in value than I calculate I need. Noting the operating frequency of my oscillator, I gayly start chopping at the capacitor with a pair of wire cutters, removing pieces of its body opposite the leads until enough of the dielectric and its associated plates has been removed to lower the capacitance to the correct value.

Granted, this method is a bit insane and against all teachings of electronic component manufacturers but nevertheless it works and is invaluable to the home experimenter who can't afford costly precision parts. One word of warning, however—temperature and long-term stability-wise, the altered components just don't stand up. Thus, in final designs it is advisable to replace the hacked-up components with ones of higher quality. This is especially true when extreme temperature ranges are to be encountered. Remember, too, that this technique works only on disc ceramic capacitors. Other types just can't be altered.—*George R. Wisner*

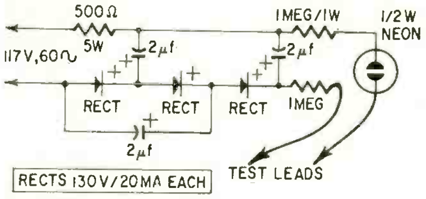
High-Voltage Leakage Tester

We use a simple radio rig to provide 450 volts dc for insulation leakage tests on appliance motors and controls. Half-



wave rectifiers for voltage tripling give 450 volts on open circuit. We use a 20-ma 130-volt rectifier stack. Polarity of the capacitors, if electrolytic, is important.

We use this rig feeding one side of a two-circuit receptacle, the other the series resistor for bench test leads. The small components are housed in a box 4 inches square for use at customers' homes, or they may be mounted on a test panel at the workbench, the box having a combination duplex receptacle and pilot-light cover. Be sure to include the



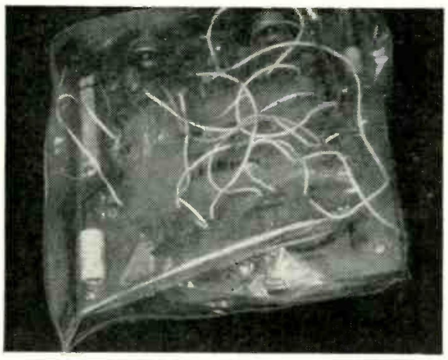
1-megohm resistors in the output leads, and be careful to enclose the equipment completely. Otherwise you can find yourself across a lethal 500 volts. —*Harry J. Miller*

Marking Tubes and Chassis

In servicing, I often find it helpful to mark or identify tubes and chassis points—B+, Video In, Sync Signal, etc. An invaluable aid for this is the use of pressure-sensitive tapes, which come on cards. Obtainable in various colors from electrical supply houses, they are precut to uniform size, inexpensive, easy to write on, clearly visible, and they make for small, neat identification.—*Jack J. Rothstein*

Dust Protection

The workbench of the electronics experimenter is the one place in the house most likely to be covered with dust, mainly because of the difficulty of trying to dust panels studded with knobs, switches, jacks, etc. Dust is particularly bad for electronic devices be-



cause of their many sensitive switch and relay contacts. One solution, especially useful for equipment used only occasionally, such as the printed-circuit breadboard outfit shown in the photograph, is to put the equipment in plastic bags, or at least to cover it with plastic sheets. Thus the instrument is always visible, easily accessible and, best of all, dust-free.—*Ronald S. Newbower* END

new BOOKS

BASIC INDUSTRIAL ELECTRONIC CONTROLS, by Jacob H. Ruiter, Jr. and R. Gordon Murphy. *Holt, Rinehart and Winston Inc., 383 Madison Ave., New York 17, N. Y. 6 x 9 in. 282 pp. Cloth, $8.50.*

This handy reference volume describes the way many types of transducers work. It also contains detailed information on indicators, recorders, controllers and actuators used in electronic control applications.

PROGRAMMING FOR DIGITAL COMPUTERS, by J. F. Davison. *Gordon and Breach, Science Publishers Inc., 150 5th Ave., New York 11, N. Y. 5½ x 8½ in. 175 pp. Cloth, $6.*

The prospective programmer will do well to read this book, which is simply an introduction to writing programs for digital computers.

HOW TO READ SCHEMATIC DIAGRAMS, by Donald E. Herrington. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 128 pp. $1.50.*

From simple component to complicated module, this book explains its function and how to recognize it in a complete diagram.

RADIO SERVICING MADE EASY, Vol's 1 and 2, by Leonard G. Lane. *Gernsback Library Inc. 154 W. 14 St., New York, N. Y. 5½ x 8½ in. 188 pp. ea., Paper, $3.85 ea., $7.20 set. Cloth, $9.95 set.*

A two-volume set, so complete that both the beginner and the full-time technician will find it useful.

ELECTROTECHNOLOGY, Parts 1 through 8, by D. L. Carr. *St. Martin's Press Inc., 175 Fifth Ave., New York 10, N. Y. 5½ x 8½ in. 695 pp. in all. Paper, $1.50 each part.*

An eight-part course in basic electronics. Part 1 covers direct current circuitry; part 2 electrochemistry and electromagnetism; part 3 magnetism, electromagnetism and electrostatics; part 4 alternating currents; part 5 more advanced ac theory; part 6 dc generators and motors; part 7 transformers and ac machinery; part 8 electronics and electrical illumination.

ABC's of SYNCHROS AND SERVOS, by Alan Andrews. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 96 pp. $1.95.*

With the aid of illustrations, this booklet begins with fundamental principles to explain how servos operate.

HANDBOOK OF SEMICONDUCTOR ELECTRONICS, Second edition, edited by Lloyd P. Hunter. *McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N. Y. 6½ x 9 in. 162 pp. Leather, $18.50.*

This enlarged and expanded volume is a practical manual that covers the physics, technology and circuit applications of transistors, diodes and photocells.

COMPUTER ARITHMETIC by Henry Jacobowitz. *John F. Rider Publisher Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 297 pp. $3.*

Refresher course in basic arithmetic operations of positional number systems.

MANAGEMENT AND THE COMPUTER OF THE FUTURE, edited by Martin Greenberger. *M. I. T.*

(*Continued on page 111*)

School Directory

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H. Gernsback

(Signature of editor, publisher, business manager, or owner)

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Joane Dodge

(My commission expires March 30, 1964)

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(Continued from page 108)

Press and John Wiley & Sons Inc., 440 Park Ave. So., New York 16, N. Y. 5½ x 8½ in. 340 pp. Cloth, $6.

How computers may affect traditional business management techniques.

RADIO NOISE OF TERRESTRIAL ORIGIN, edited by F. Horner. *American Elsevier Publishing Co. Inc. 52 Vanderbilt Ave., New York 17, N. Y. 6 x 9 in. 202 pp. Cloth, $8.75.*

Introductory papers and summaries of discussions on man-made and natural noise. Proceedings of Commission IV of the International Scientific Radio Union, in London, Sept. 1960.

SELECTED PAPERS ON NEW TECHNIQUES FOR ENERGY CONVERSION, edited by Sumner N. Levine. *Dover Publications Inc., 180 Varick St., New York 14, N.Y. 6 x 9 in. 444 pp. Paper, $2.85.*

A collection of 37 papers, covering thermoelectric, thermionic, photovoltaic and electrochemical devices used to convert other types of energy into electricity.

FUN WITH RADIO-CONTROLLED MODELS, by E. L. Safford. *Gernsback Library, Inc., 154 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 160 pp. Paper, $3.20.*

A clear and simple presentation, intended for the nontechnical hobbyist. It is expected that the experimenter will buy most of his electronic apparatus, but will build much of the mechanical control equipment.

ABC'S OF TAPE RECORDING, by Norman Crowhurst. *Howard W. Sams & Co. Inc., 1720 E. 38th St., Indianapolis 6, Ind. 5½ x 8½ in. 95 pp. $1.50.*

Practical book for the nontechnical man. Tells him how to buy, maintain and use his tape recorder in simple, practical and advanced applications. A few hookups for the advanced applications, in pictorial-diagram style.

HIGH FIDELITY SYSTEMS, A User's Guide, by Roy F. Allison. *Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass. 6 x 9 in. 93 pp. Paper, $1. Direct from publisher only.*

A book intended for the nontechnical man, to help him to select intelligently, to install and, to a certain extent, maintain his high-fidelity equipment.

REPAIRING TV REMOTE CONTROLS by Leon Cantor and Harry Horstmann. *John F. Rider Publisher Inc., 116 W. 14 St., New York, N.Y. 5½ x 8½ in. 122 pp. $2.50.*

Tells how to align and troubleshoot modern TV remote-control units. END

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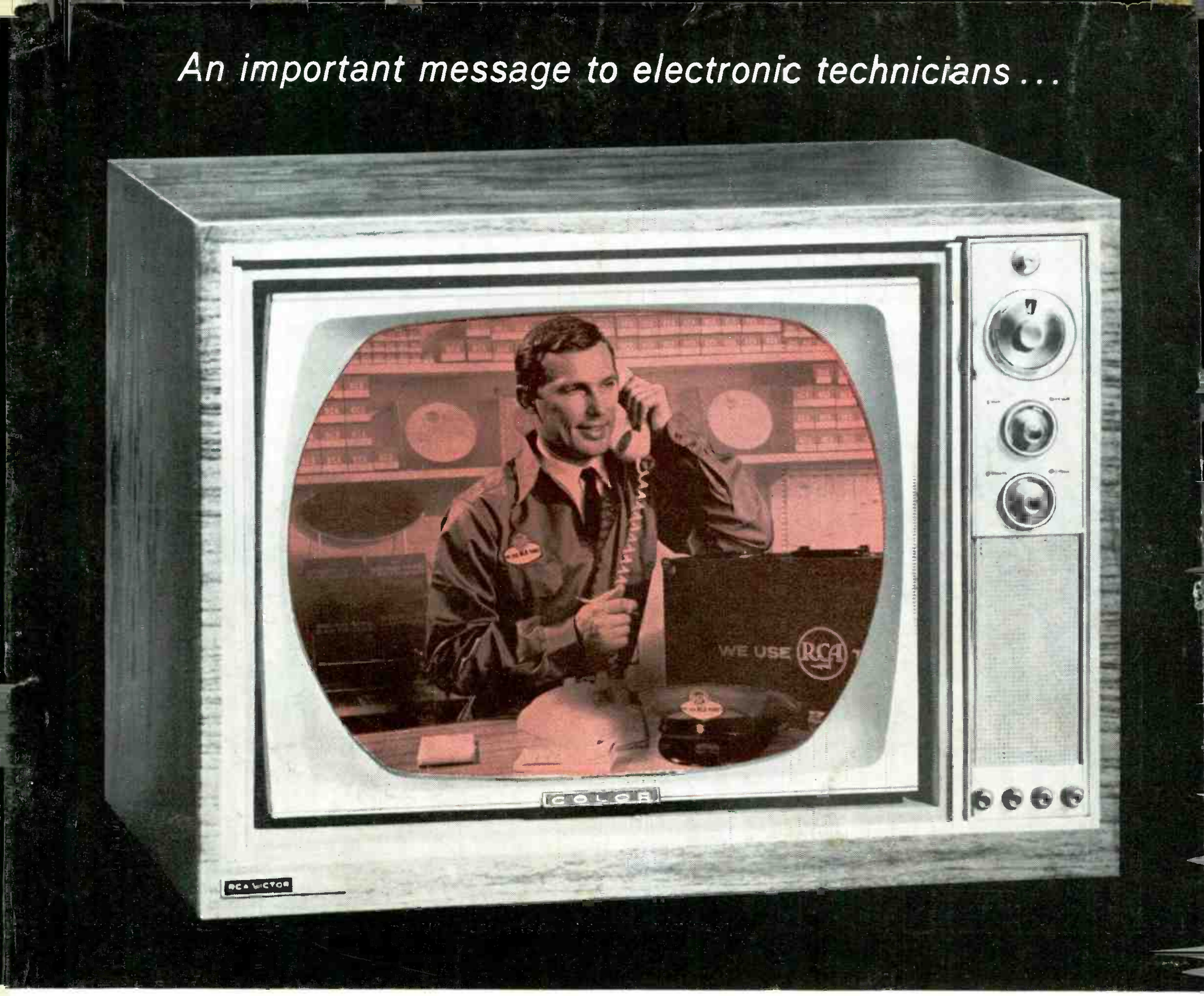

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