SEPTEMBER

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor-in-chief

what's inside TELSTAR

TELEVISION MONOCLE

See page 50

SIMPLE ELECTRONIC METAL LOCATOR

If you find buried treasure (or locate a submerged marine motor) this device pays for itself on its first day of use. Readily built—uses a standard transistor radio for its detector unit.

ALL-TRANSISTOR FM TUNER

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Next time you visit your distributor, look for the green and yellow box and ask about Ampliframe tubes for TV and other entertainment replacement applications. Amperex Electronic Corporation, 230 Duffy Avenue, Hicksville, L. I., N. Y.

In Canada: Philips Electron Devices Ltd., 116 Vanderhoof Ave., Toronto 17.

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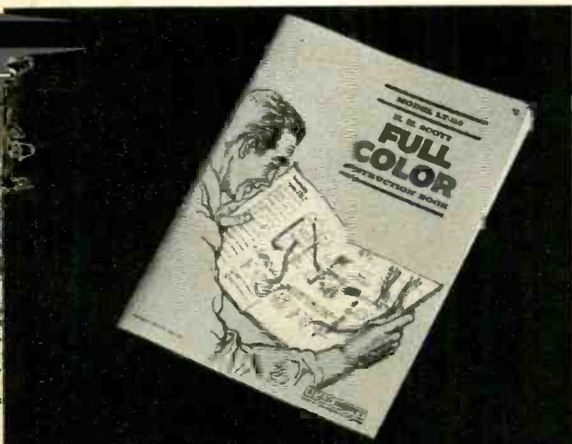
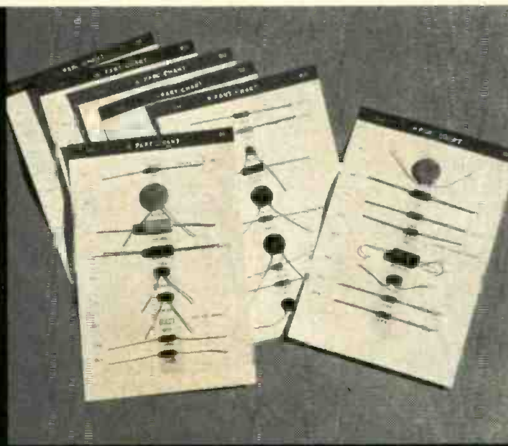
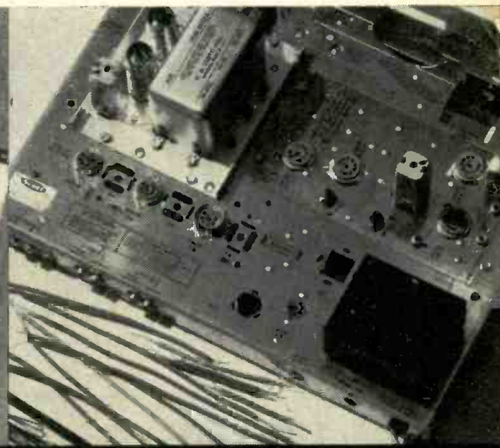
"Simplest to build..." and have "Engineering of the highest calibre" *



The exclusive Scott full color instruction book shows every part and every wire in natural color and in proper position. To make the instruction book even clearer, each of the full color illustrations shows only a few assembly steps. There are no oversized sheets to confuse you.



Each full color illustration is accompanied by its own Part Chart . . . another Scott exclusive. The actual parts described in the illustration are placed in the exact sequence in which they are used. You can't possibly make a mistake.



Much of the uninteresting mechanical assembly is completed when you open your Scott Kit-Pak. All the terminal strips and tube sockets are already permanently riveted to the chassis. To insure accuracy all wires are pre-cut and pre-stripped to proper length.

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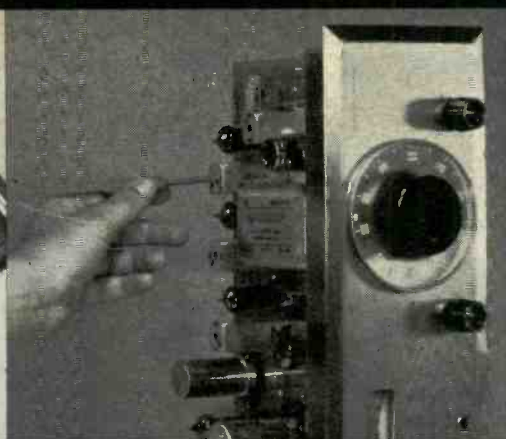

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*Audio — February 1961, Pages 54-56

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Radio-Electronics

SEPTEMBER 1962
VOL. XXXIII No. 9

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(Story on page 50)

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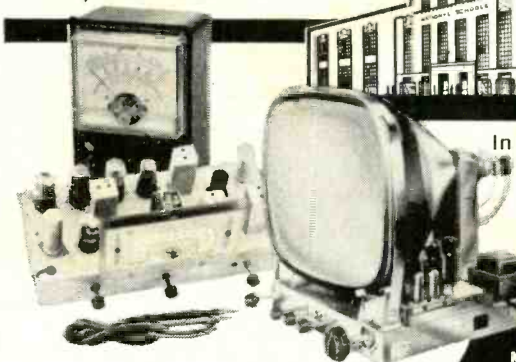

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News Briefs

Uhf on All TV's Now Law

President Kennedy has signed into law a bill that requires all manufacturers of television receivers to equip their sets with a uhf tuner. This will mean that all TV sets will be capable of receiving the uhf channels 14 through 82 as well as the vhf 2 through 13.

The bill gives the FCC authority to require that all sets sold across state lines be equipped for both vhf and uhf, and to set minimum performance specs for the uhf tuners. The commission says it will allow a reasonable transition period to give manufacturers time to get the necessary changes incorporated into their forthcoming sets.

New Art Form Uses 10-Track Tape

A combination of sound and light, electronically controlled, is being used to re-create the stirring scenes of the dawn of American liberty at Independence Hall in Philadelphia. Using some 64 loudspeakers and numerous banks of light, the "voices" of Washington, Jefferson, Franklin and Payne, as well as sounds representing meetings of the Assembly of the Province of Pennsylvania and the Continental Congress, are reproduced on various parts of the grounds and from the Assembly Chamber. Variations in illumination increase the dramatic effect. The whole production is on 10-track tape. Five of the tracks carry voice programs, four triggering and intensity controls for light and one triggers the sound. The equipment was developed by North American Philips

The "Sound and Light" production, under the name *Lumidrama*, opened on July 4, and it is expected that two performances will be given each night, seven nights a week, through October.

Used here for the first time in this country, the technique, known as "Son et Lumiere" has been used on several important buildings in Europe.

H-Bomb Communications Interruption Slight

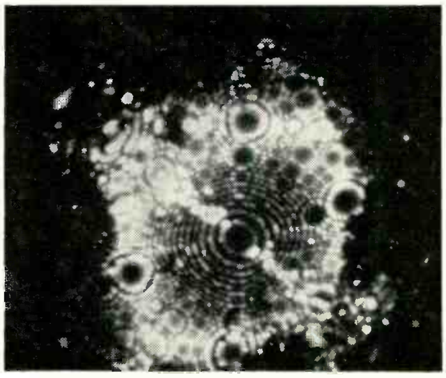
Despite a lot of talk to the contrary, the miles-high megaton H-bomb blast by the US in the skies over the Pacific blotted out radio reception for only a period of minutes. Scientists feared a long disruption caused by the explosion temporarily destroying the reflecting layer in the ionosphere that makes long distance communications over the miles of the Pacific possible.

Magnetometer Now Aids Archeological Research

A proton magnetometer (Radio-Electronics April, 1960, p. 38) has been used to locate ancient Sybaris, a city so wealthy that the word "sybarite" is still used to denote a person of extremely expensive and luxurious taste. Buried cities like Sybaris can be found with a magnetometer, because topsoil, garbage and even dungheaps are more magnetic than ordinary soil. So when a cellar, for example, has been filled with material washed from the surface, it can be detected by the magnetometer through several yards of material washed over it. Stone walls, which differ from the material around them, can also be detected. Empty spaces are immediately noted by the magnetometer. So are the magnetic metals, like iron or steel.

Electron Microscope Sees Individual Atoms

Magnification 5 to 10 times greater than that which can be obtained with standard electron micro-



scopes is obtained by the improved ion-emission microscope, now in operation at Columbia University. Each spot in the photograph is the image of one atom. The top of the emitter from which the ions are projected is a fine tungsten wire. The center of the tip can be seen as the solid dark spot surrounded by dark, concentric circles in the center of the photo. While the emission microscope is not new (Radio-Electronics, September 1951, page 43), this is the first one ever to be commercially produced.

Pay TV Experiment Begins in Hartford, Conn.

The world's first large-scale over-the-air pay-TV trial was initiated late in June over TV station WHCT, channel 18, Hartford, Conn. The system used was Zenith's Phonevision (Radio-Electronics, February 1951, "Box Office TV," Dorf; and February 1954, "Pay As You Go," Kamen). Some 300 homes have been wired, and subscribers are given the opportunity to view first-run movies for payment averaging $1 for a high-class show. Other viewers simply see a jittery picture which is actually four images displaced horizontally on the screen.

Engstrom Awarded EIA Medal

Dr. Elmer Engstrom, president of RCA, was given the Electronic Industries Association Medal of Honor for "distinguished service contributing to the advancement of the electronics industry." In presenting the medal, EIA president L. Berkley Davis pointed out that the appearance of an engineer-scientist like Dr. Engstrom as head of a large corporation, was something that could have happened "only recently."

Dr. Engstrom has been with RCA for some 32 years, working before that in the Radio Engineering Department of G-E. He organized RCA's Research Department and was especially active in the development of television. In 1943, he became director of general research when all of RCA's research activities were brought together at Princeton, N. J. He became executive vice president of research and engineering in 1954,

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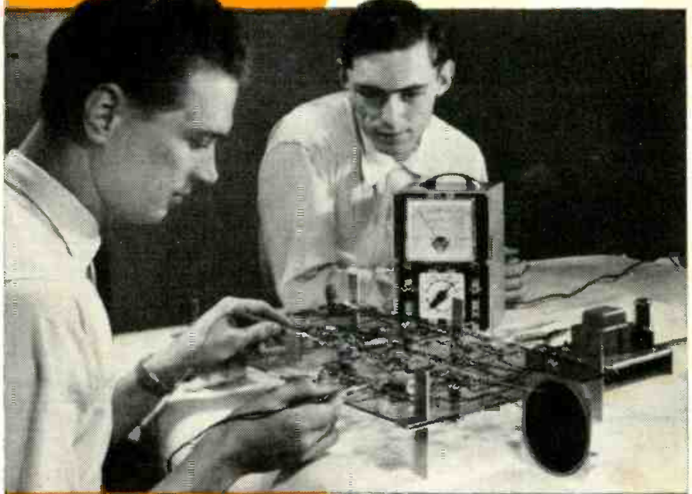

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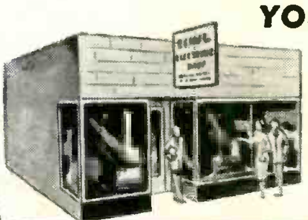

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senior executive vice president in 1955, and was elected president of RCA in 1961.

Dr. Engstrom was also a member of the two National Television Systems Committees established by EIA, and a member of the Radio Technical Planning Board. He holds honorary engineering degrees and awards from establishments as widely separated as the Royal Swedish Academy of Engineering Sciences, the University of Minnesota and the Republic of Italy.

TV Repairman Collects For Unusual Job Hazard

Television repairman T. R. McDonald, of Sacramento, Calif., was awarded $75 by the court for chicken pox picked up on the job. Repairman McDonald had sued a Sacramento customer who refused to pay him a bill of $165 which he claimed for medical expenses and lost time after he caught chicken pox from the 4-year-old daughter of the customer.

CALENDAR OF EVENTS

Western Electronic Show & Convention (Wescon), Aug. 21–24; Sports Arena, Los Angeles, Calif.

4th Conference on Maintainability of Electronics Equipment, Aug. 28–30; Boulder, Colo.

World's Fair of Music & Sound, Aug. 31–Sept. 9; McCormick Place, Chicago, Ill.

2nd International Symposium on Information Theory, Sept. 3–7; Brussels, Belgium.

National Symposium on Engineering Writing & Speech, Sept. 13–15; Mayflower Hotel, Washington, D. C.

11th Annual Industrial Electronics Symposium, Sept. 19–20; Hotel Sheraton, Chicago, Ill.

8th National Communications Symposium, Oct. 1–3; Hotel Utica & Municipal Auditorium, Utica, N.Y.

1962 N.Y. High Fidelity Music Show, Oct. 2–6; N.Y. Trade Show Bldg., New York, N.Y. RADIO-ELECTRONICS exhibit in Room 624.

ISA Instrument-Automation Conference & Exhibit, Oct. 15–18; New York Coliseum, New York, N.Y.

1962 Computer Applications Symposium, Oct. 24–25; Morrison Hotel, Chicago, Ill.

New Approaches to Safety Shields

General Electric recently announced their new "Lamilite" tube shielding—a thin, two-layer plastic face plate, bonded direct to the face of the tube. Introduced in the new G-E 16-inch portable, it will also be manufactured in sizes up to 23 inches. The inside layer of the Lamilite shield is an exceedingly tough material—the other layer, hard and scratch-resistant. Total thickness is about 1/32 inch. The new shield is anti-static, and should mean a considerable reduction in the weight of portable TV's that use it.

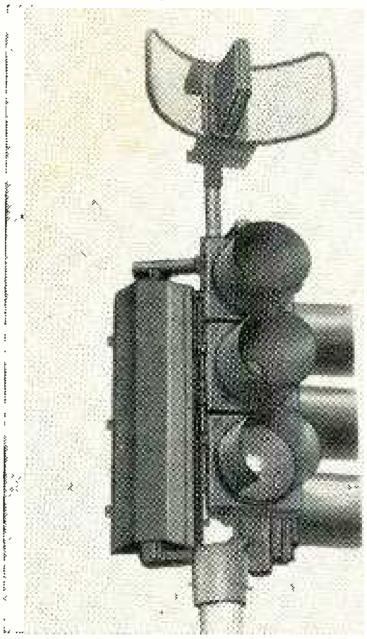
Almost at the same time, the Kimble Glass Co. announced final approval of the "Kimcode" tube, which uses a special face plate bound by two metal rims, and has a fiberglass cloth cemented around the funnel to prevent shattering in case of implosion. The Kimcode tube has no

safety glass as such. The face of the tube is the safety glass.

Pittsburgh Plate Glass also came out almost simultaneously with a new lightweight "Teleglas" for bonding to picture tubes. The new glass is somewhat less expensive, lighter and thinner than the older bonded implosion shield.

Autos Use Computers To Control Traffic

A new traffic control system being experimentally installed on Riverside Drive in New York City will permit traffic to control its own pattern. Radar antennas placed above the traffic lights will scan all approaching traffic. Information thus received is fed to computers at Traffic Department headquarters. These computers



select the best possible combinations of signals—progressive uptown, progressive downtown, short period on cross streets, etc.—then radio signals to each traffic light to adjust the cycle accordingly.

Not only will the new traffic control system speed traffic, but it is believed that the radio-control system is cheaper than the present interconnecting cable system.

Satellite Broadcasts Not for the Home

Space-satellite television broadcasts direct to the homes of peoples of the world, are not practical at this time, FCC Commissioner Craven told University of Washington's School of Communications.

"There are many problems to be solved," said Commissioner Craven, "before such a space-satellite broadcast system can be established on a permanent basis." Among the things the commissioner mentioned were the problems of language, time differences, technical difficulties in lifting and maintaining the high-powered transmitters required, economics, spectrum allocation standards and, most important, cost. He also pointed out that important events which people all over the world would wish to see do not occur too often. Space flights occur only occasionally, the Olympic Games once every 4 years, and British coronations even less frequently than that.

"Mixed-Up" Crooks Identified by Closed-Circuit TV

The uhf TV station, WUHF-TV, channel 31, operated by the FCC and New York City's Municipal Broadcasting System in cooperation, has been transmitting an experimental program which may well be a major weapon against crime. The transmission is a police lineup program. Suspected criminals, lined up for identification at police headquarters, are televised and the "program" broadcast to New York City's five boroughs. Thus, policeman at various points can see the lineup without traveling to headquarters. This results in a considerable saving of officers' travel time and the taxpayers' money, and results in the lineup being viewed by a greater number of police officers.

To protect the rights of the persons arrested, the broadcast is scrambled in such a manner that it cannot be received by any but the special TV receivers adapted to the purpose. The scrambling system, developed by Teleglobe Cosmotronics Corp., uses telephone lines to carry the scrambling signal, thus making it impossible for anyone to decode.

The "Scrambled Yeggs" program is expected to reduce crime by making it possible for a larger number of officers to identify wanted individuals, and by increasing their familiarity with the appearance of known criminals

Russians Plan Sputnik TV Relay

On the heels of an actual operating Telstar satellite launched successfully by the US, word comes from the Soviet Union of its intention to launch TV relay satellites of its own in the near future. The Russians say the Sputniks will be used instead of coaxial cable to link Moscow TV broadcasts with other parts of the country.

Brief Briefs

Patent No. 3,033,714 has been issued to the Sony Corp. for a semiconductor device called the "Esaki diode," or tunnel diode.

Univac III, new large-scale computer, uses several input and output channels to keep the high-speed main unit busy. An interleaving system makes it possible for the main unit to process the various programs simultaneously, feeding the results out in bits

Improved thin-film resistors are made by sputtering tantalum films on glass or ceramic bases in a partial nitrogen atmosphere, report Bell Lab scientists.

A hearing aid with automatic volume limiting is announced by Zenith. Called Controlled Dynamic Range (CDR) by the company, the instrument automatically protects the user from painful or uncomfortably loud sounds, permits hearing of words immediately after the sound, which otherwise would be lost in a "black-out period." It makes hearing better in noisy surroundings, while amplifying faint or muffled voices in a quiet environment.

FM radio's expansion does not extend to the passenger plan. The ban on FM radios on civilian aircraft has been extended for another year by the FAA. Reason: radiating FM receivers can interfere with the aircraft's electronic equipment.

Kits for color TV receivers are expected to be on the market this Fall. Two companies, Transvision and Conar, plan to produce such kits.

New electronic piano recently placed on the market by Wurlitzer is an all-transistor type that works off the line or with its own supply. A 36-volt battery makes it completely portable. The company suggests that it might be taken along on a picnic or to the beach!

Transistorized ignition will be optional on Ford Motor Co.'s trucks in 1963, if present plans are carried out. The new system is expected to increase spark plug life from 10,000 to 50,000 miles and point life to 100,000 miles.

A metal locator for detecting concealed weapons has been developed by Med Electronics, Alexandria, Va. The search coil is in a flat pad worn under the sleeve of the operator, so a suspect can be searched without even knowing he is an object of suspicion.

Two new gas optical masers, one using a mixture of neon and oxygen and one of argon and oxygen, have been announced by Bell Telephone Labs. In both these masers, the noble (inert) gas raises the oxygen to an excited state, from which it can be triggered to radiate infrared light at 8446 Angstroms. END

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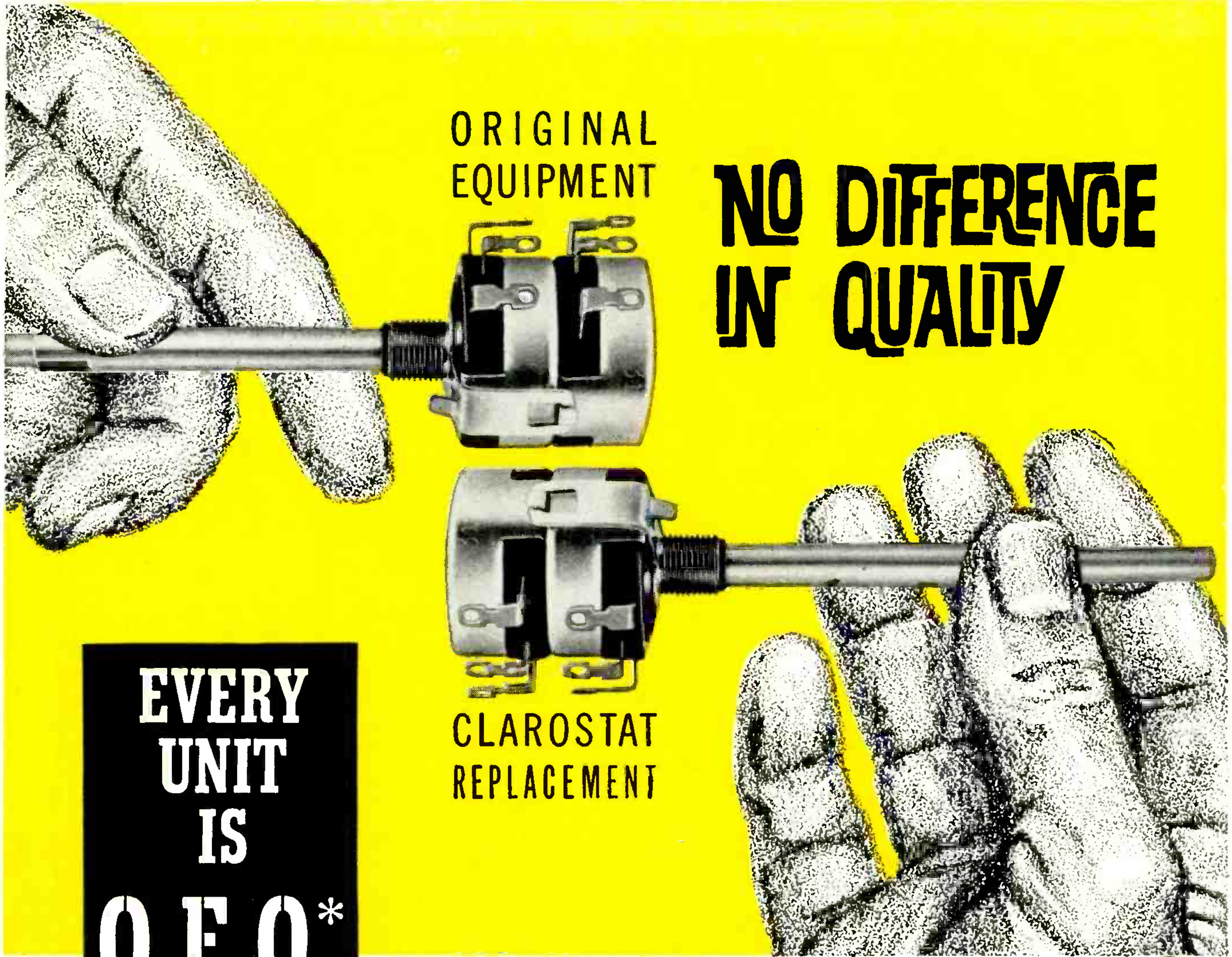

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Edward R. Barber, 907 S. Winnifred, Tacoma, Wash.	1st	20
M. A. Dill, Jr., 20 Cherry St., Gardiner, Maine	1st	12
Bernhard G. Fokken, Route 2, Canby, Minn.	1st	12
Kenneth F. Foltz, Broad St., Middletown, Md.	1st	12
James C. Greer, Mound City, Kansas	1st	12
Thomas J. Hoof, 216 S. Franklin St., Allentown, Pa.	1st	22
Clyde C. Morse, 7505 Sharronlee Dr., Mentor, Ohio	1st	12
Louis W. Pavek, 838 Page St., Berkeley 10, Calif.	1st	16
Wayne Winsauer, 2009 B St., Bellingham, Wash.	1st	12

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Correspondence

Patent Patient

Dear Editor:

Reading the July issue, I became most interested in the article "Our Patent Problem" by Ben Miessner. Since I live in Washington, D.C., I frequently rub elbows with Patent Office employees and hear personal comments that are dropped. One of the frequent things mentioned is the "modest salary" Mr. Miessner discusses. I agree that the men should have special training or schooling before coming on the job, but if they are to stay they must receive a salary equal to what they could get elsewhere.

About computer techniques. A group at the Patent Office is already doing research on devices to speed up office procedures.

I got a laugh from Mr. Miessner's way of saying the French patent system is no good and ours is just like it.

I was most impressed by the method the Germans have of issuing a patent that's free from legal prosecution. It is a national shame when the law permits outstanding inventors to be forced into poverty through legal prosecution.

THOMAS L. BARTHOLOMEW
Washington, D.C.

Error in "Servicing"

Dear Editor:

Horrible mistake I made in my article "Servicing CB Transistor Transceivers"! It's in Fig. 5 on page 50 of the April issue. Switch the connections to the B-minus line and the collector. The way the circuit is drawn, it's an oscillator, the neutralizing network appearing as positive feedback.

LEONARD E. GEISLER
Tokoyo, Japan

You're the Best

Dear Editor:

As a subscriber and reader of your fine magazine since it first started publication in the 1920's, let me congratulate you on doing such a fine job and keeping all of us informed on the vastly expanding electronics field. We are one of the leading color dealers and servicers in the Midwest (we have now sold over 400 color receivers and service everything with tubes and transistors in it), so you can see what a help your fine publication is. I have built several of your smaller instruments, many of which can't be bought anywhere. Probably best and most useful was the horizontal sweep analyzer (RADIO-ELECTRONICS, February 1961). I built it right after it was published and have used it almost every day since. I also appreciate your writeups on new test equipment.

CHESTER M. BENSON, W9IFB
Richmond's Television Center
Richmond, Ind.

You Don't Change the Temperature

Dear Editor:

In "Soldering Shortcuts" (page 84 of the June issue) you mention that hammering out solder will reduce its *melting temperature*.

I believe this statement is incorrect, since melting temperature is independent of the quantity of a material, being a molecular binding property. Rather, the thinner solder will conduct less heat away and allow a smaller portion to be melted. Thus the *amount* of heat required is less, but the *temperature* is the same.

GERARD LIETZ
Physics Department
University of Notre Dame
Notre Dame, Ind.

[Mr. Lietz is 100% correct. Thinning out the solder does make it easier to melt, but it certainly does not change the melting point.—*Editor*]

Pressure Pad and the Capstan

Dear Editor:

I purchased a capstanless tape recorder not too long ago—the type described on page 47 of your May issue. I have found it a reasonably good performer, with one exception—the pressure pad that holds the tape against the head applies a much greater pressure during playback than during record. This added friction upsets the playback quality somewhat. A little experimenting showed that, under normal conditions, no pressure is needed during playback to keep the tape against the head. So now I usually disable the pressure system during playback by inserting a wedge to keep it open.

STEPHEN A. KALLIS, JR.
Dunedin, Fla.

Author Replies

Dear Editor:

Mr. Jaski's vituperative comments in the June Correspondence column can hardly be classified as *constructive* criticism. I am quite sure that, to the average reader, the radiation meter article (February, page 39) was not construed to be a treatise on the physiological effects of radiation. For the sake of brevity, the chart correlating dosage and effect was quoted almost verbatim from an AEC report, and its context was such

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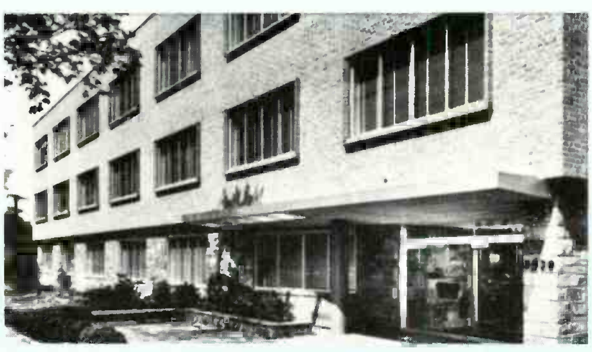

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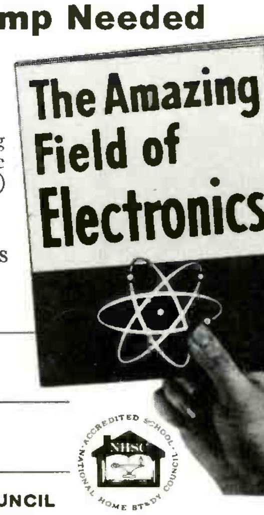

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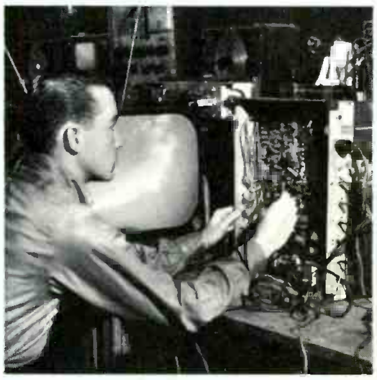

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that the reader would realize its use was confined to radioactive fallout primarily.

Besides all that, Mr. Jaski is dubious about the continued insulation resistance properties of the ceramic socket and proposes to use a mica-filled socket instead. He then brilliantly suggests that a notch be cut for pin 4. It seems to me that the nonexistent phenolic of a phenolic wafer socket prepared in this manner would have an insulation resistance fully as high as the nonexistent mica of Jaski's mica-filled socket. And a darn sight cheaper to boot.

ELLIOT A. MCCREADY
Colorado Springs, Colo.

Cut Electronic Ignition Cost

Dear Editor:

We were highly impressed with the ingenuity shown by Harry W. Lawson in overcoming the many practical problems encountered in "Putting Electronic Ignition in Your Car" (RADIO-ELECTRONICS, July). Also with Harry's polished penmanship.

There are two points worthy of mention, however, that can save your readers considerable expense:

1. The C5C silicon-controlled rectifier listed in the article is now available from any authorized G-E distributor at less than $25—a more than 50% price reduction.

2. The recently introduced 300-volt C15C—which we would recommend for this application—is obtainable from the same source for under $9.

D. R. GRAFHAM
General Electric
Application Engineering Center
Auburn, N. Y.

They're Not Interchangeable

Dear Editor:

We've bought about three dozen of the little tape recorders you mentioned on page 47 of your May issue, under a different label, that we take with us on trips. Believe me, the tapes *cannot* be interchanged between machines . . . unless one understands Japanese!!!

JEANN C. NIELSEN
Sales Promotion Manager
Triad Distributor Div.
Huntington, Ind.

Write Me a Letter

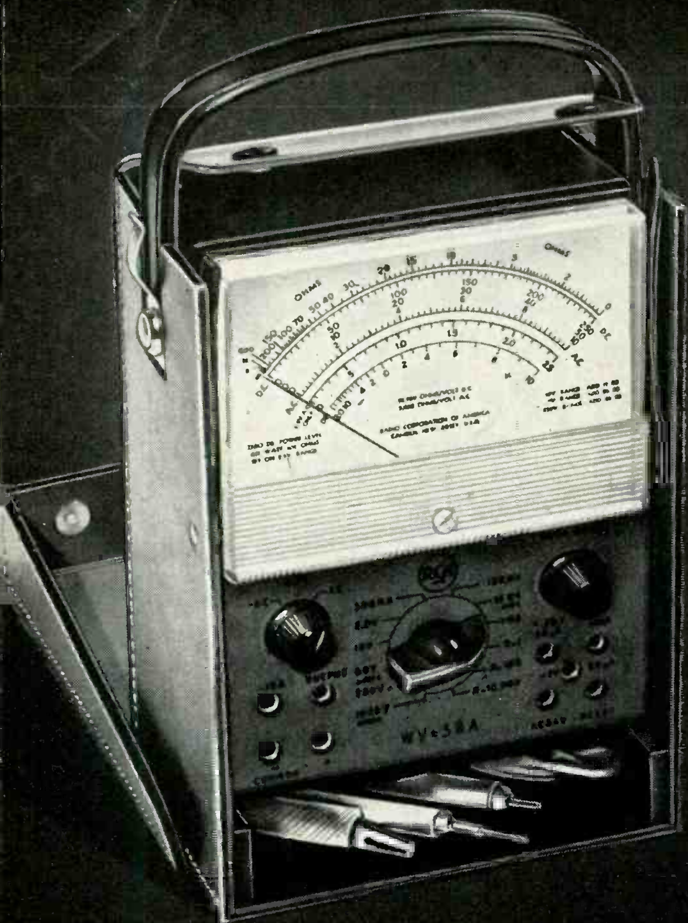
Dear Editor:

I am a reader of RADIO-ELECTRONICS in Japan and I run a radio-TV service business here. I am most eager to exchange letters with American technicians.

Would some electronic technician correspond with me?

TAICHI ISA
30 Okubo-cho Tanaka
Sakyo-ku
Kyoto
Japan

END



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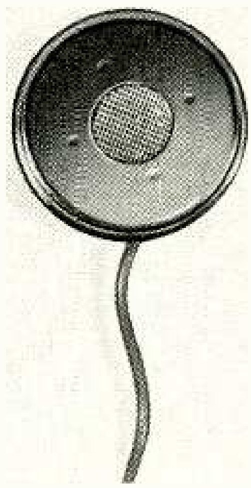

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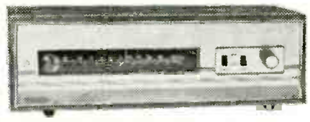

ST-26. FM TUNER/AMPLIFIER KIT. Low-cost combination hi-fi FM music system. Requires only the addition of external speaker (see L-3) to complete system. Pre-Built Front End fully adjusted and prealigned at factory. Kit: $54.95; Factory Wired, ready to operate: $69.95.

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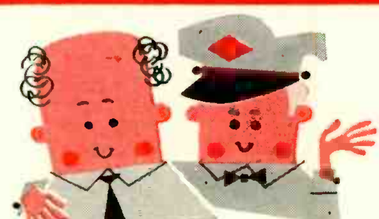

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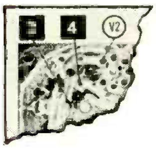

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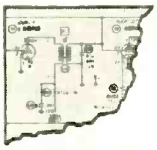
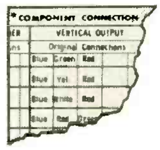


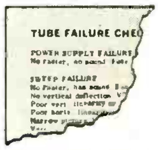
Famous Standard Notation Schematic saves valuable hours—always uniform, accurate, complete for every model.



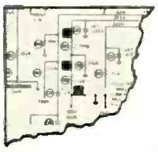
Exact Terminal Connections are indicated—no need for trial-and-error methods—a real time-saving feature.

Field Servicing Notes spell out locations of adjustments for speedy "in home" servicing. Saves time spent in hunting for hidden adjustments.

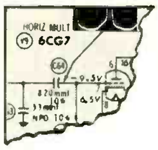
Tube Location Guide enables you to locate and replace proper tubes in seconds—a big time-saver on most repair jobs.



Tube Failure Check Charts spell out probable tubes responsible for failure—no need to waste time studying circuitry.

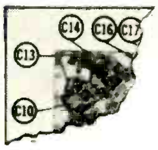


Clear Parts Symbols with values and associated information are shown plainly on the schematic—no time wasted in cross-reference "look-up."

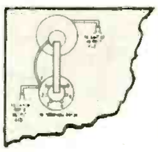


Waveform actual photos are shown on schematic for quick comparison of patterns on your scope. No time wasted in guesswork.

Unique Alignment System eliminates guessing; you get complete instructions with response curves, how to connect test equipment, proper adjustment sequence.



Full Photo Coverage of the actual equipment makes identification of all components and wiring easy—you can see everything.

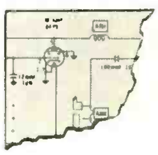


Terminal Identification saves you time; transformer and coil terminals quickly identified by color code or basing diagram shown on schematic.

Auto Radio Removal instructions show you step-by-step procedure for removal of even the most complicated models—a big time-saver.

Disassembly Instructions, step-by-step, help you remove difficult chassis, subchassis, and assemblies in minutes.

Dial Cord Stringing instructions save you up to an hour or more of time and headaches on a single job.



Alternate Tuner Data—separate schematics, alignment data and parts lists are provided—no time wasted interpreting various tuner versions.

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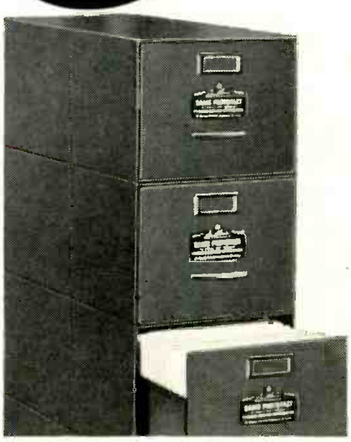

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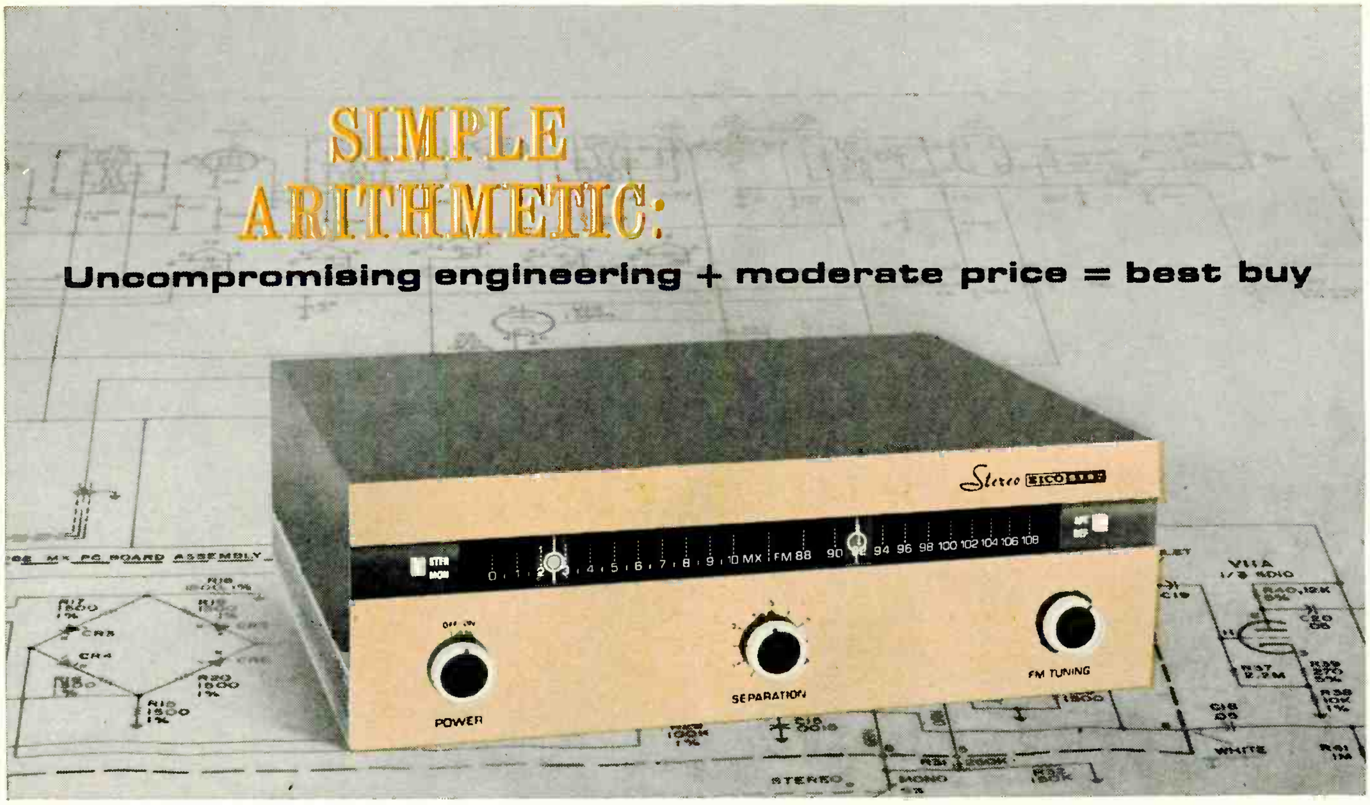


New Eico Stereo FM Multiplex Tuner ST 97

Semi-Kit **$99.95** Wired **$149.95** Includes Metal Cover AND FET

BUILDING THE SEMI-KIT:

The two most critical sections, the front end and 4 IF's through to the detector, are entirely pre-wired and pre-aligned for best performance on weak signals (fringe area reception).

For **the third most critical section**, the heart of the stereo demodulator, you simply mount and solder the components on a high quality circuit board. Pre-aligned coils eliminate all adjustments. The rest is non-critical and easily accomplished with the clearest pictorial drawings and most thorough-going step-by-step procedure in the industry.

THE CIRCUIT

the front end Consistent and reliable printed circuit. Ultra-sensitive, stable, and low-noise. Wide-band design. Rugged plated steel housing for protection and shielding. Meets FCC radiation requirements. Precise temperature-compensation for freedom from drift without AFC. AFC provided with defeat for convenience. Indirect gear drive is backlash-free and eliminates possibility of microphony.

the IF strip Four IF amplifier-limiter stages (all that will do any good) and an ultra-wide-band ratio detector, all pre-wired and pre-aligned. Designed with the utmost practicality so that the simplest alignment is also the alignment for highest sensitivity and practically lowest distortion. (Important to you if a service alignment is ever required.) Output is flat to the limit of the composite stereo signal frequency spectrum to eliminate any need for roll-off compensation in the stereo demodulator.

the stereo demodulator Ten stages for unequalled performance capabilities. EICO's brilliantly-engineered zero phase-shift, filterless detection circuit (patents pending) eliminates loss of separation due to phase-shift in the stereo sub-channel before recovery. Complete rejection of storecasting interference. Cathode follower driven, sharp cut-off 15kc low pass filters in each output channel.

THE OPERATION

Two slide-rule dials in a line: one, a station frequency dial with the famous EICO "eye-tronic"® tuning-eye travelling along it to indicate the exact center of each broadcast channel; the other a logging dial with an automatic stereo indicator lamp travelling along it in tandem with the tuning-eye to indicate when the station tuned in is broadcasting stereo.

THE LOOK

Massive extruded aluminum panel and side rails, exquisitely brushed and anodized pale gold, with baked epoxy brown, perforated steel cover.

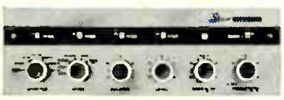
PERFORMANCE

Pre-production field tests brought back the report "Definitely a fringe-area stereo tuner," which is simply the meaning of our laboratory measurements. We know, for example, that full limiting is achieved at 10uV input signal, meaning that the low distortion and noise specifications (the full benefits of FM) will apply to all but the most distant and difficult-to-receive stations. The sharp selectivity you need when a tuner is that sensitive is here also (a strong local station and a low-power station 100 miles distant separated by only 0.4 mc, each had its own sharp tuning-in point on the dial). While signal levels as low as 2.5uV will produce phase-locking for full stereo separation, very strong local signals will produce no higher output from the FM detector than a 10uV signal and will not be degraded in quality by overloading the stereo demodulator. Distortion is very low, both in mono and stereo, so that the sound you hear has that sweetness, clarity, and freedom from grating harshness that results from absence of distortion. The stereo output signals are so clean that there is not a sign of the 19kc pilot carrier or the re-inserted 38kc sub-carrier visible on a scope presentation.

SPECIFICATIONS

Antenna Input: 300 ohms balanced. IHFM Usable Sensitivity: 3uV (30db quieting), 1.5uV for 20db quieting. Sensitivity for phase-locking (synchronization) in stereo: 2.5 uV. Full limiting sensitivity: 10uV. IF Bandwidth: 280kc at 6db points. Ratio Detector Bandwidth: 1 megacycle peak-to-peak separation. Audio Bandwidth at FM Detector: Flat to 53kc discounting pre-emphasis. IHFM Signal-to-Noise Ratio: −55db. IHFM Harmonic Distortion: 0.6%. Stereo Harmonic Distortion: less than 1.5%*. IHFM IM Distortion: 0.1%. Output Audio Frequency Response: ±1db 20cps-15kc. IHFM Capture Ratio: 3db. Channel Separation: 30db. Audio Output: 0.8 volt. Output Impedance: low impedance cathode followers. Controls: Power, Separation, FM Tuning, Stereo-Mono, AFC-Defeat. Tubes: 1-ECC85, 5-6AU6, 1-6AL5, 1-12AT7, 2-12AU7, 1-6D10 (triple triode), 1-DM70 (tuning-eye), 1-EZ80 rectifier, 6 signal diodes, 1 neon lamp. Power Source: 117V, 60cps; 60 watts drain; extractor post fuse. Size (HWD): 5⅛" x 15⅞" x 11⅜". Weight 17 lbs.

*Actual distortion meter reading of derived left or right channel output with a stereo FM signal fed to the antenna input terminals.



70-Watt Integrated Stereo Amplifier ST70
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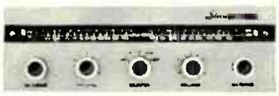
Includes Metal Cover

40-Watt Integrated Stereo Amplifier ST40
Kit: **$79.95** Wired: **$129.95**
Includes Metal Cover



FM-AM Stereo Tuner ST96
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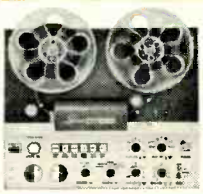
Includes Metal Cover and FET

FM Multiplex Autodaptor MX99 (Patent Pending)
Kit: **$39.95**
Wired: **$64.95**
Cover Optional $2.95



Transistorized Stereo/Mono 4-Track Tape Deck RP100
(Patents Pending)
Semikit: **$299.95**
Wired: **$399.95**
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LETHAL ENERGY BEAMS

. . . The "Death Ray" Is No Longer Science Fiction . . .

LAST March Gen. Curtis E. LeMay, Chief of Staff of the Air Force, lectured at Assumption College, Worcester, Mass. Long before that, it had become known that the Air Force was interested in developing super-power light beams to divert or destroy satellites in flight, or to explode at a great height incoming intercontinental ballistic missiles (ICBM's). LeMay spoke of these new lethal armaments as "beam-directed energy weapons." He did not elaborate.

The so-called "death rays" have had a long history in fact and fiction. They became an actuality in the 1890's when the great Nikola Tesla, in his historic high-frequency experiments in Colorado, used electric energy beams—without wires—over distances of several miles. He was the first to transmit electric power—wirelessly—over appreciable distances. In his *War of the Worlds* (1898), H. G. Wells had his earth-invading Martians use a lethal heat ray to keep human armies at bay. Hardly any science-fiction author could do without his pet death ray after the early 20's. These lethal rays were usually electric, such as "condensed lightning," à la Buck Rogers' ray guns, and many others.

The writer, in his article "Warfare of the Future," in *The Electrical Experimenter* for November 1915, was probably the first to speak of an atom ray. Here is a verbatim quote, 30 years before the actual atom bomb:

> Suppose that by that time our scientists have solved the puzzle of the atom and have succeeded in liberating its prodigious forces. Imagine that at that time one atom can be disintegrated at will, instantly into another, what will happen? The results will simply be overwhelmingly astounding and almost incomprehensible to our present mind. . . .
>
> Within a few hours the first atomic gun, popularly known as the "Radium Destroyer," has crossed the enemy's frontier. . . .
>
> A solid green "Radium-K" emanation ray bursts from the top of the Destroyer and hits the concreted steel trench. Our front cover gives but a faint idea of what happens. . . .
>
> Within five minutes the entire city (of 300,000 souls), houses, churches, bridges, parks and everything else have gone up in a titanic vapor cloud; only a vast crater in the ground where the thriving city once stood, remains. . . .

Prophetic fiction has a long record of metamorphosing into actualities in shorter and shorter time intervals. Thus, in the spring of 1961, Raytheon disclosed its new Amplitron tube, less than 6 inches in diameter, that produces over 1,000 kilowatts of radio-frequency power beams.*

In 1953, Sidney I. Brody, Commander (MC) US Navy, reported that "present-day Radar beams of a million watts or over become dangerous. . . . Rabbits exposed to a 3,000-watt field for 75 seconds were killed." †

As far back as the early '50's, the great power of radar beams was demonstrated:

> A spectacular illustration of the power output of radar equipment was conducted by Lockheed Aircraft Corp. Dry steel wool in the radar beam was ignited at a distance of 100 feet. At 70 feet an explosion was produced by aluminum chips in a gasoline-vapor–air mixture. Photoflash bulbs were fired at a distance of 323 feet. At 330 feet, audible and visible sparking was apparent when metallic chips were shaken in a paper bag. With high-power radar, these and other spectacular effects can be duplicated at even greater distances.§

Let us now investigate the most modern "beam-directed energy weapons" hinted at by General LeMay. It is known that both Americans and Russians are working feverishly on these new weapons, which may well prove to become our only effective future countermeasure to the ICBM's. Recently, Khrushchev even brashly boasted of a "fantastic new weapon." This probably will turn out to be General LeMay's "beam-directed energy weapon," or something very closely related to it.

Air Force and other technicians have recently experimented with the fabulous Maser (*m*icrowave *a*mplification by *s*timulated *e*mission of *r*adiation) and Laser (*l*ight *a*mplification by *s*timulated *e*mission of *r*adiation). A recent breakthrough in both can turn radio into light energy (or power), or light into radio energy.

In other experiments, a light (Laser) beam cut a steel razor blade in two. Last March, Raytheon scientists burned holes through stainless-steel sheets and burst a balloon 10 feet beyond. The Laser action lasted only 1/2,000 second. But that is only a micro-beginning. Because Laser beams are non-spreading and "tight," it became possible last May to project a series of beams onto the moon with comparatively small energy (2,000 Joules). This was comparable to the power of a 2,000,000 watt lamp.

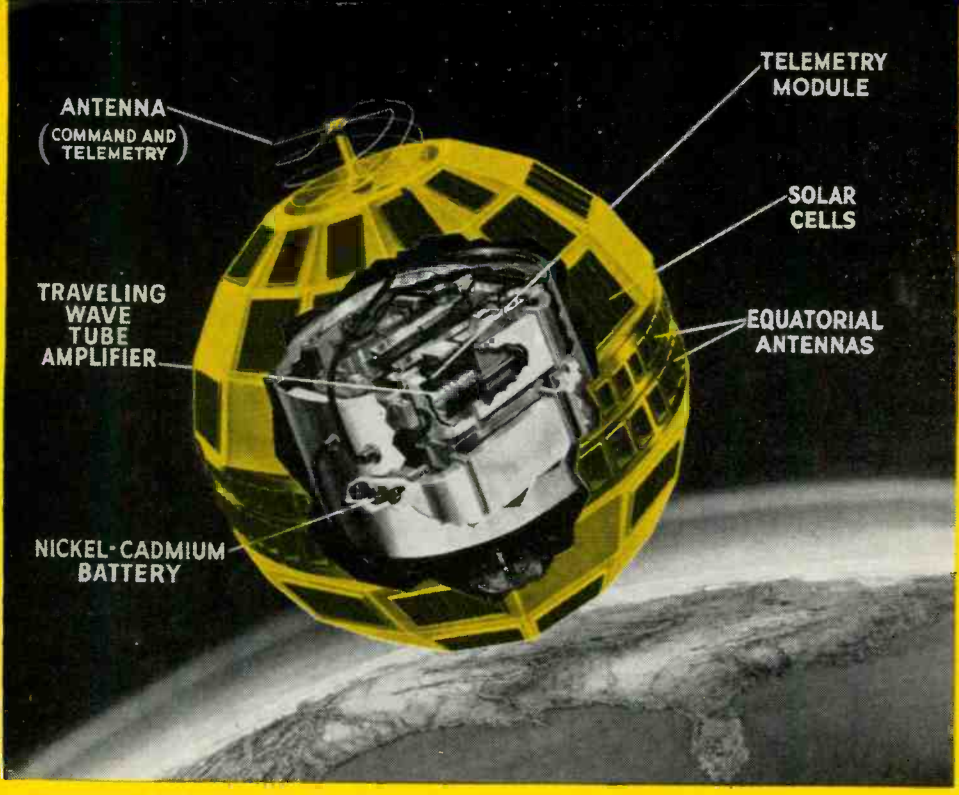
Moreover, the "tight" Laser beam spreads very little during its 236,000 mile trip, only about 1,000 miles on the surface of the moon. With ordinary light the beam would have spread over 25,000 miles!

Because the coherent Laser beam packs a tremendous amount of energy into a very small diameter, it delivers a vast concentrated power, *exactly* where you want it. It is as if you had a soda straw thousands of miles long, through which you pumped a vast amount of energy at the speed of light. Furthermore, you would lose very little power over the whole distance. Militarily it is an ideal weapon. Once it is fully developed, we can scrap our comparatively slow-moving—17,000 miles *an hour*—ICBM's, our Nikes and other present-day defense gear.

Laser- or Maser-beam weapons move with the speed of light—186,000 miles *a second*. When perfected, a Laser or Maser battery will make short shrift of incoming enemy ICBM's, which are 40,000 times slower than Laser or Maser beams. Laser or Maser batteries will locate the enemy missiles 600 to 800 miles up by radar, and explode the warheads in the vacuum of space, far above the earth's atmosphere. Damage to the defender will be minimal—even the fallout will probably be disseminated into new Van Allen belts, hundreds of miles above our vital—and vulnerable—atmosphere.

—H. G.

* "Radio Power," RADIO-ELECTRONICS, July 1961.
† "Lethal Radio Waves," RADIO-ELECTRONICS, August 1959.
§ "Radar Hazards," RADIO-ELECTRONICS, August 1953.



Telstar— Giant Step into the Future

By LARRY STECKLER
ASSOCIATE EDITOR

EIGHTY-SIX YEARS HAVE PASSED SINCE Alexander Graham Bell received his patent for that marvelous invention, the telephone. And right now, 600 miles over our heads, a man-made star, the Telstar satellite, is circling the earth once every 2 hours and 40 minutes. It is the first experimental link in a forthcoming chain of satellites which will one day give the world a net of transcontinental communications Alexander Graham Bell probably never dreamed possible.

Now only a few short days since its successful launch on July 10, 1962, successful transmission of TV programs from the US to Europe and from France and England to the US have already been completed. Also successful has been a test of trans-Atlantic satellite telephone calls. The TV programs were seen on TV screens across the US and Europe. Telstar definitely works.

TV or any other wide-band communications channel is normally restricted to vhf or higher. This is mandatory because of the required 3- to 6-mc bandwidth required. At lower frequencies, this much space is just not available. As soon as we go to vhf, however, we run into the "line-of-sight" problem. Radio signals at these frequencies go straight through the ionosphere and are not reflected to earth as are lower-frequency radio signals. This restricts TV to about a 50-mile range—the distance to the horizon as seen from the top of a TV tower. By the same token—extreme bandwidth—standard telephone cables are not satisfactory for TV either. The lines will not pass the entire signal without noticeably injuring its quality. With Telstar in the sky, we get a 600-mile-tall TV relay tower that has enough line of sight to cover a distance measured in thousands of miles, making intercontinental TV a practicality.

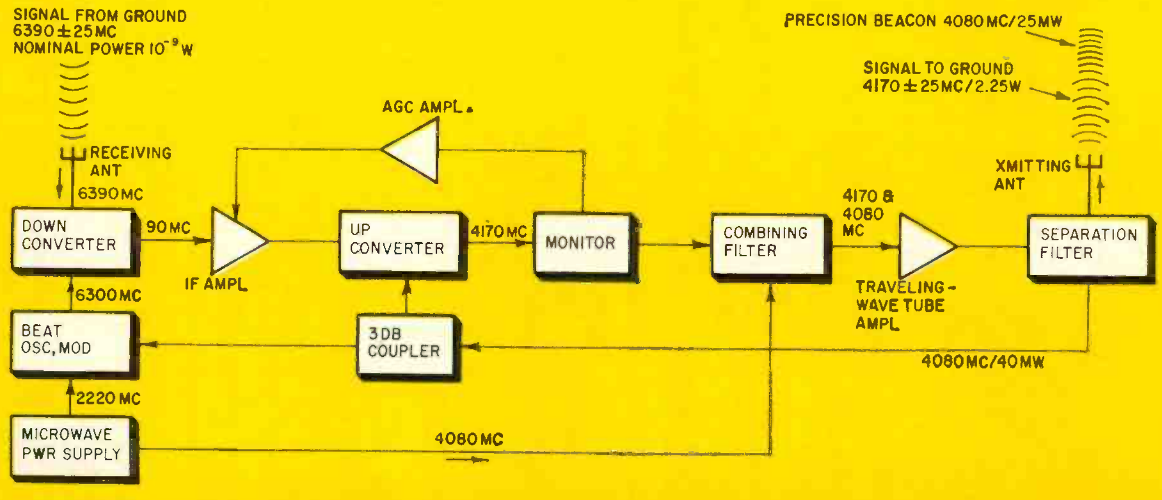
The particular frequency used was selected as the one that presented the fewest problems in the construction of the satellite.

Telstar's basic capability is to handle either one TV channel, 600 one-way simultaneous telephone conversations, or an equivalent bandwidth of facsimile or other radio-frequency transmission over a wide-band FM channel.

The system sounds simple. Telstar receives radio signals beamed at it from a station on the ground, amplifies them some 10 billion times, and immediately rebroadcasts them on another frequency to a ground station on another continent. Sounds simple, but it takes a heap of electronics packed into a comparatively tiny package to make it all possible.

Overall, the satellite appears spherical. Actually it has 72 flat faces, like facets cut on a diamond. It is 34½ inches in diameter and weighs 170 pounds. Two rows of antennas encircle Telstar's waist, like the equator encircles a globe of the earth. One set is for picking up signals beamed at the satellite, the other is for retransmitting these signals.

In the instrument package carefully tucked away in Telstar's center are 1 electron tube, 1,064 transistors and 1,464 diodes. Also, all the associated circuitry that goes with these components. Power is supplied by 3,600 solar cells distributed over the satellite's outer skin. These cells convert sunlight into electricity at a rate of 15 watts while Telstar is on the sunny side of the earth, but this is expected to drop to around 11 watts by the end of one year in orbit.



Block diagram of the Telstar broadband communications circuit.

The drop will be caused by radiation and tiny micrometeroroids reducing the efficiency of the cells.

Their output would drop much more rapidly if they had not been protected with a thin tough layer of synthetic sapphire.

The 15 watts delivered by the solar cells goes to charge 10 nickel-cadmium batteries. These batteries supply the power to Telstar's electronic circuits to keep them working.

The communications network

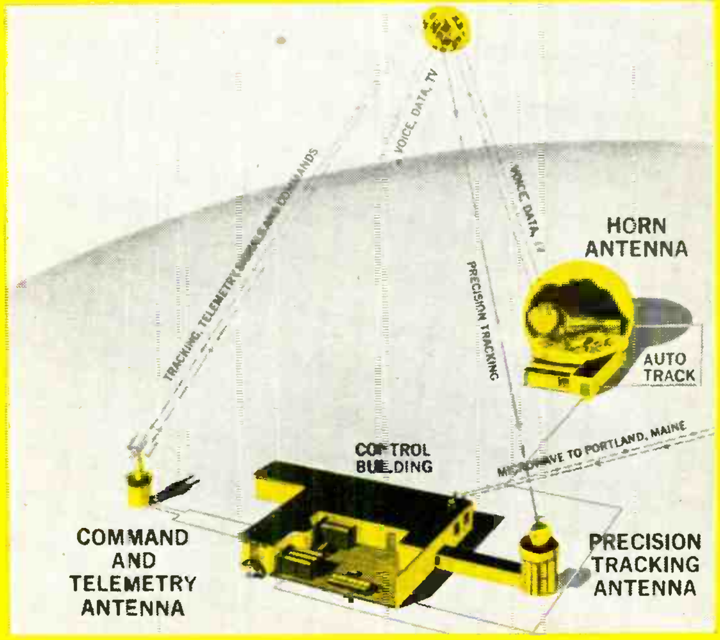
Ground stations send signals to Telstar on 6390 mc. Telstar retransmits them on a lower frequency—4170 mc. While the bandwidth is 50 mc for Telstar and 100 mc for the ground stations, effective bandwidth is only 3 or 4 mc. The rest of the space is taken up by tracking, telemetering and control signals.

Aboard the satellite, the incoming 6390-mc signal is mixed with the 6300-mc output of a crystal oscillator to produce a 90-mc i.f. signal. This is done to put the signal in a low enough freqency range so it can be easily handled by the transistor circuits. Fourteen germanium diffused-base transistors amplify the i.f. signal about 1,000,000 times. An automatic gain control holds the amplification within preset limits, so that no matter how strong a signal Telstar receives, its retransmitted signal has a strength of about 2¼ watts.

The amplified i.f. signal is then mixed with the output of another crystal-controlled oscillator to produce the 4170-mc signal the satellite transmits.

Just before transmission, the signal is fed to the only vacuum tube Telstar carries for final amplification. This special foot-long traveling-wave tube amplifies the broad-band signal an additional 5,000 times. The traveling-wave tube has a double purpose. Along with the communications signal, it transmits a single-frequency 4080-mc signal. This low-power transmission, a mere 1/200 watt, acts as a beacon for the tracking antennas and devices to home on.

Final adjustments are made in Bell Telephone Labs.



How satellite system works: Quad antenna on left picks up satellite beacon. Command is sent turning on communications gear. Precision tracking antenna picks up 4080-mc signal. As this antenna tracks, so does big horn. Horn transmits to satellite and it relays data over horizon to Europe.

Telemetering and control

Telstar is an experimental prototype and as such carries a number of research experiments. Among the 115 conditions checked are density and energies of free protons and electrons, effects of radiation on semiconductors, temperature of the electronic chassis, how much sunlight is hitting the satellites skin at various points, and currents and voltages on many of the electronic components.

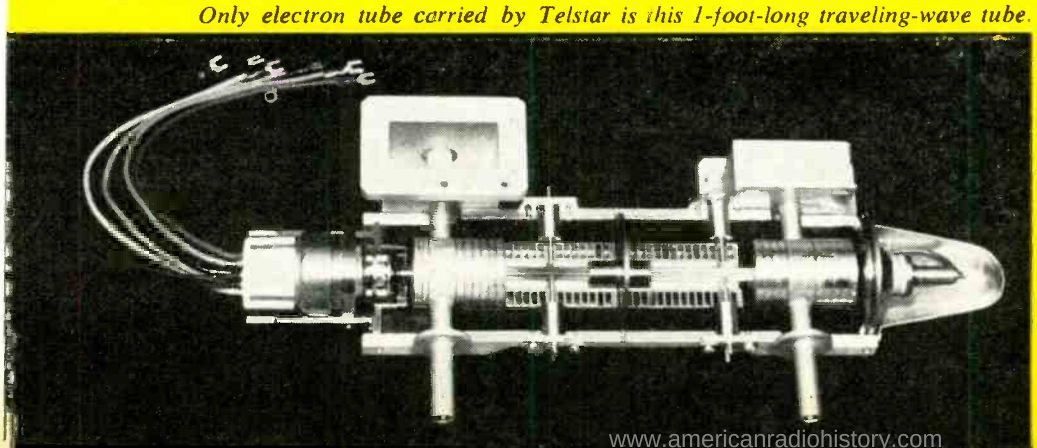
Getting these measurements to the ground station is the task of a separate 136-mc transmitter that has a ¼-watt output. It transmits constantly, and since it does, acts as a secondary beacon to help the ground stations track the satellite.

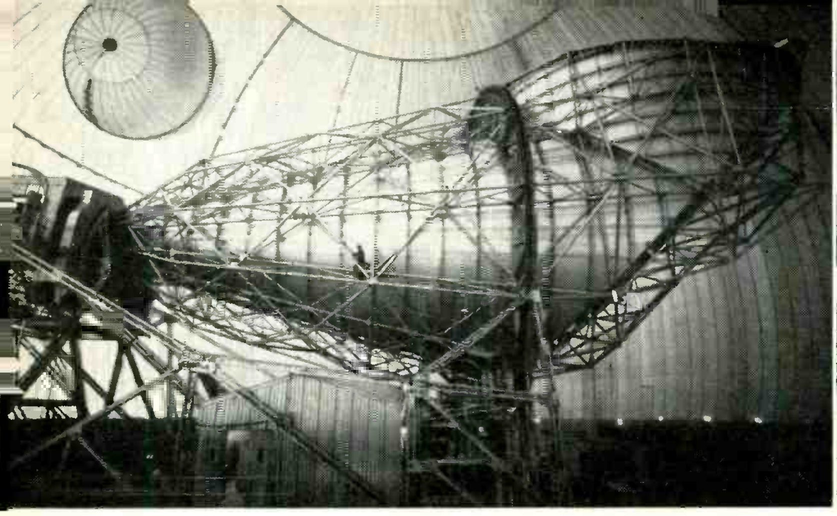
When a radio command (over still another circuit) is sent to the satellite from the ground, Telstar adds a group of coded telemetry signals to the 136-mc beacon. It continues sending this combination signal until it is told to stop. In each 1-minute period of transmission, every one of the 115 measurements is sent once.

Because of the need for constantly transmitting the 136-mc carrier to act as a beacon, an unusual modulation system is used to add the telemetry data. The telemetry pulses (PCM) frequency-modulate (FM) a 3-kc subcarrier, plus or minus 225 cycles. This signal is then used to amplitude-modulate (AM) the 136-mc carrier. This gives a total complex transmitted signal called a PCM-FM-AM transmission.

If all of the electronic systems aboard Telstar were operated simultaneously, they would draw current from the batteries faster than the solar cells can deliver it to the batteries, and in a short time the satellite would be silent. So to conserve power, the communications section of the satellite can be turned on and off by remote commands from the ground stations. This requires

Only electron tube carried by Telstar is this 1-foot-long traveling-wave tube.





Receiving end of communications link is this tremendous horn antenna.

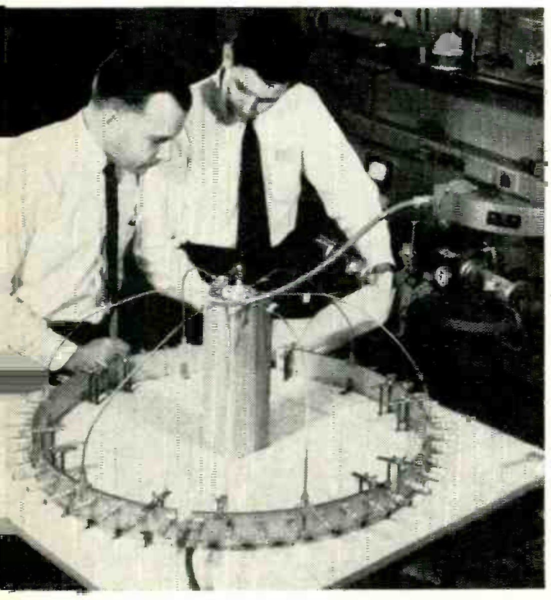
Control room at the Andover ground stations keeps careful track of operation. Consoles (foreground) track Telstar. Monitors (right) evaluate signal levels during transmit and receive tests to satellite.

still another radio channel.

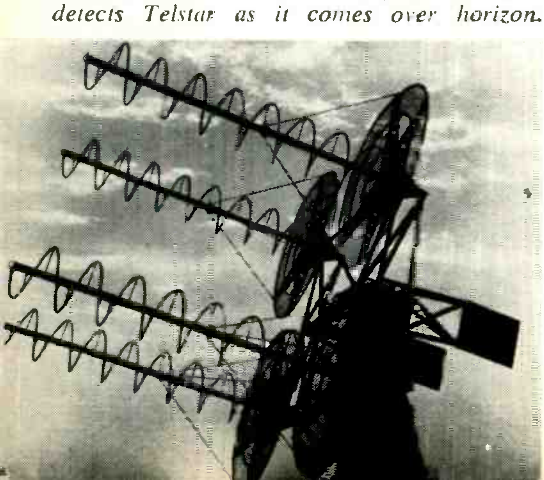
Telstar's command system is made up of two identical channels of equipment so if one should fail, the other will take over. There are two radio receivers set to pick up 120-mc commands and two decoders that change these commands into usable instructions. Of course, there are also the relays that actually do the work.

The control system can turn the traveling-wave tube on and off. Similarly it can switch on and off the various measurements being made inside the satellite, telemetry receivers and transmitters, and of course, the communications equipment. The last piece of gear aboard Telstar is an automatic cutoff device that turns off all satellite systems after two years. This makes the channels being used by Telstar available for other satellites.

This ring connects to one of the antenna belts around satellite.



Quad-spiral automatic tracking antenna first detects Telstar as it comes over horizon.



Down on the ground

Nestled in the middle of a ring of mountains near Andover, Me., is the United States' "Earth Station for Communicating by Satellites." It comprises two major buildings—a huge dome housing the tremendous horn antenna and, a quarter mile away, the control building where all the computers and major control equipment are located. This Earth Station is tied in to the US telephone network and is this country's end of the satellite link.

Inside the radome is the largest horn antenna ever built. Its opening has an area of 3,600 square feet and is designed to scoop up the billionth of watt from Telstar that is available to it. The entire antenna structure weighs about 340 tons, has an overall length of 177 feet and carries along with it two houses full of transmitter and receiver gear.

As Telstar rises above the horizon the ground station goes to work. A quad-helix (spiral) common-tracking antenna picks up Telstar's 136-mc beacon and locks in on the satellite. As it follows the satellite, the big horn acts as a slave and also starts tracking Telstar. This is handled by a bank of computers in the control building.

Once the tracking antenna has locked in, a 120-mc control signal is sent to Telstar to turn on its communications equipment and the 4080-mc precision tracking signal. As soon as Telstar responds by starting transmission, another tracking antenna, this one an 8-foot dish, tracks the satellite with even greater precision. Again as this antenna tracks, so does the big horn.

The horn itself takes care of final tracking accuracy, for, should the horn be off just a fraction to any side of the satellite signal, the 4080-mc tracking frequency is propagated in a slightly different manner through the waveguide connected to the throat of the horn. This produces an error signal that corrects the tracking. The system is called the vernier auto-track.

While the tremendous size of the receiving antenna makes it extremely sensitive, this alone is not enough. For even greater sensitivity, a maser receiver using a synthetic ruby crystal cooled by liquid helium to $-456°F$ is located in the throat of the horn.

To add to the sensitivity of the maser, a special frequency-modulation feedback circuit is also used. Developed in 1930, it acts as an automatic tuning device. It tunes a narrow-band receiver to the particular frequency being transmitted by Telstar at a particular instant, even though the signal can vary over a 25-mc wide band of frequencies. By doing this, background noise is drastically reduced because, instead of getting all the noise of a 25-mc wide channel, only the noise in the particular narrow band being received is picked up.

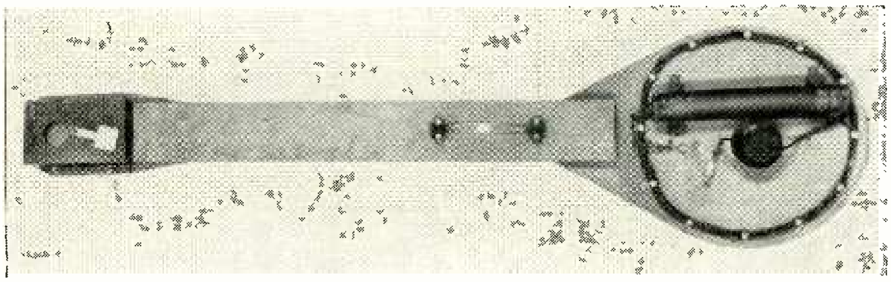
In this manner, communications continue as long as Telstar is above the horizon. Just before the satellite disappears over the horizon, a command signal is sent to turn off the communications gear and conserve power.

In future years, when a series of these satellites are in orbit, multiple antennas will be used at the ground station and before one satellite sets another will rise. The transmitted signal will be switched automatically from one to the other as necessary to ensure continuous communications.

The Telstar satellite was conceived, designed and built by the American Telephone and Telegraph Company as was the ground station at Andover, Maine. The firm also paid NASA for the cost of the rocket and launching from Cape Canaveral that put the satellite into orbit. While trans-Atlantic TV is not entirely new, this is its first practical application. On Feb. 8, 1928, John Baird sent the first TV picture from England to the US on 45 meters. Also, during the last sunspot maximum, there were reports of European TV signals crossing the Atlantic on 50 mc (RADIO-ELECTRONICS, September 1958, page 52). END

SIMPLIFIED METAL LOCATOR

Use your transistor radio to find buried treasure and other metal objects the easy way.



Complete metal locator mounted on carrying handle.

By B. F. MIESSNER

THIS METAL LOCATOR IS QUITE SIMPLE. It uses an rf magnetic-field transmitter and a conventional pocket-size transistor radio as the receiver. This keeps construction to a minimum.

The transmitter consists of a 12-inch diameter coil made up of seven turns of No. 14 insulated wire. The coil is shunted by a .0015-μf mica capacitor and connected in series with a 6 to 8-volt battery. A switch and an electric buzzer complete the unit.

The transmitter generates a very broad 550-kc signal and is suitable for searching for and locating metallic objects with dimensions of a few inches to a few feet. If you plan to look for larger objects at distances beyond a few feet, you could use a larger coil wound with heavier wire for more power and lower frequency. You would also have to modify your receiver and use a larger air-core shielded loop or a longer ferrite-core antenna.

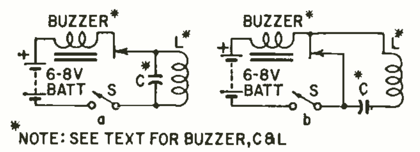


Fig. 1—Two transmitter circuits that can be used. One on left is preferable, as it gives best results.

There are two possible ways to wire the transmitter (Fig. 1). The circuit of Fig. 1-a is more effective. In operation the inductive (spark) voltage at the buzzer's contact charges the capacitor periodically and the capacitor discharges through the loop at the buzzer's audio-frequency rate. Since the loop and capacitor form a closed oscillator circuit with no antenna, there is little radiation of electrostatic fields. However, there is a magnetic rf field around the loop. This can be detected indoors to a distance of about 25 feet. The loop is electrostatically shielded by wrapping insulated wire around it (torroidally), spacing the turns about an inch apart. One end of this wire connects to one terminal of the coil and battery; the other end is left open.

The receiver is an eight-transistor set. I have used several sets with good results. However, wedge the antenna firmly in place to avoid slight movements which could upset the null-signal adjustment.

Transmitter and receiver are mounted on a wood frame—a 30-inch length of 2 x 4 with 1-inch thick boards at its ends as mounting bases (Fig. 2).

Receiver shielding

The receiver must also be shielded. My shield consists of a wooden cigar box, cut down to fit snugly around the receiver. It has a cellophane-tape-hinged lid, and a hooked clasp screwed to the side of the box makes receiver adjustments possible. The entire outer surface of the box is painted with a thick, water solution of (Acheson) colloidal graphite (Aquadag). After it dries, measure the resistance between opposite ends of the box. It should be between 500 and 1,000 ohms. If it is higher, apply additional coats, one at a time, until the proper resistance is reached.

This coating shields the receiver from stray electrostatic components from the transmitter, but allows the electromagnetic component through unhindered. Without it, you could not adjust for an inaudible null.

Cut a hole in the box over the receiver speaker so you can hear the tone —1½ inches in diameter is large enough. Solder a wire to the screw holding the clasp hook on the box. Connect the other end of this wire to the receiver chassis. Make sure it is long enough to

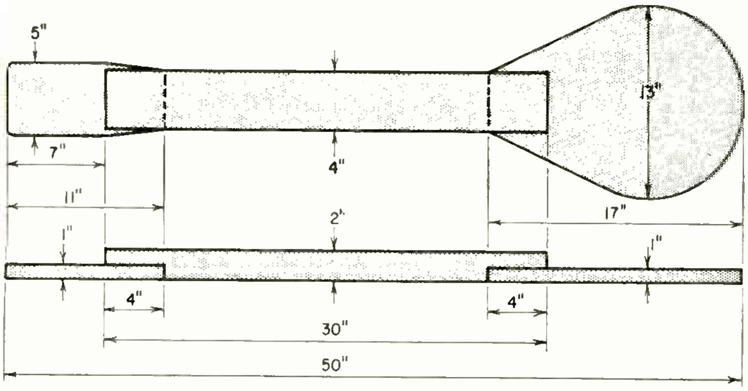


Fig. 2—Details of carrying platform construction.

allow you to remove the radio and replace batteries when necessary.

Mount on the box lid an aluminum or brass vane about .005-inch thick and 1 inch square with a ½-inch-wide arm, 2 inches long, extending from one side. At the free end of the arm, drill a hole for a small wood screw. Screw the arm down to the middle of the box lid near the speaker hole, and between two washers. Now the free end of the vane can be swiveled over the internal ferrite-core antenna for vernier adjustment of the signal null point, after the receiver box has been very carefully oriented for minimum signal strength in a locale known to be free of metal.

When the receiver is correctly oriented, hold the box firmly in that position, remove the receiver and fasten the box to the wood base with two small screws. You may have to raise one side or end of the box, or both, with thin wooden wedges, to get the necessarily critical orientation adjustments, particularly if either of the two base boards or the 2 x 4 between them has warped. Once oriented, the vernier vane should permit reducing the speaker's null tone to inaudibility in an outdoor location known to be free of metallic objects. This adjustment is very critical, so much so that it may be difficult to find, and a minute fraction of an inch of displacement will upset it.

Attach a nonmetallic carrying handle to the 2 x 4 at the longitudinal and lateral balance point when all components are finally mounted. A leather strap or a short length of rubber or soft plastic tubing does very well for this. The complete device weighs approximately 12 pounds, so make sure your carrying handle can support that weight.

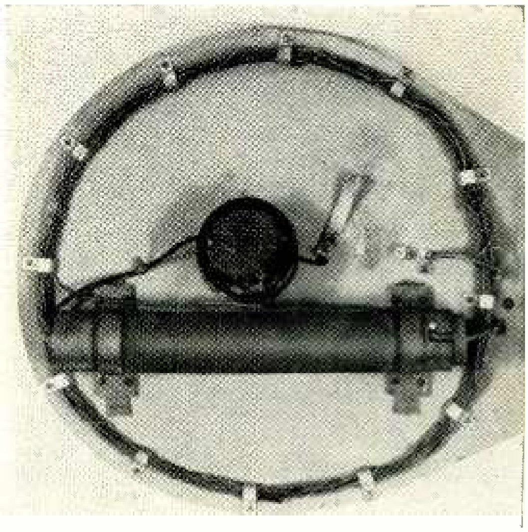
Four regular flashlight D-cells power the transmitter. They are enclosed end to end, in series, in an insulating tube. A wooden plug with a central contact element connected to the lead wire is held in place in one end by several radial brads. Another plug with a spring (like those in flashlights) and a lead wire was made for the other end. A wood screw in its side holds it in place. The assembly is fastened to the loop base, somewhat off center, with two leather straps, the ends of which are clamped down under thin wood plates.

Buzzer details

I used a buzzer made by the Ericcson Telephone Manufacturing Co. of Sweden. It may not be readily obtainable. Its pitch can be adjusted to 1 or 2 kc and its tone is clean and pure, unlike the ragged tones of household buzzers. If no such buzzer is procurable, an ordinary type with lower pitch must be substituted.

Since the direct, air-transmitted sound of the buzzer can blanket the very weak null-point reproduction by the radio receiver, it must be silenced as much as possible. Short of a thick-walled, massive, felt-lined metallic enclosure, with an equally stiff and massive airtight closure, such soundproofing can be difficult. And since such a massive metal container must be mounted within the transmitter loop on its wood base, its position couples it to the loop, with resulting induced currents which interfere with loop operation.

I used a small glass jelly jar (Fig. 3), stiffening its flat bottom with a ⅜-inch thick aluminum disc set in melted sealing wax. On top of this, for vibration isolation, I laid a ⅜-inch-thick disc of felt (rug padding). Around the inside wall of the jar I cemented another layer of ⅛-inch felt. The buzzer nests loosely in this felt-lined jar. The top tin lid was discarded. In its place I used another ⅜-inch-thick aluminum disc with a 1/16-inch wrapping of rubber tape as a side-wall gasket. When this disc was pressed tightly into the jar mouth, it sealed in the buzzer, airtight. Two lead-in holes were bored in the disc for connections to the buzzer. The wires were rubber-insulated with their rubber ends



Transmitter end of locator. Buzzer is in middle, battery holder alongside it, and transmitter coil around whole section.

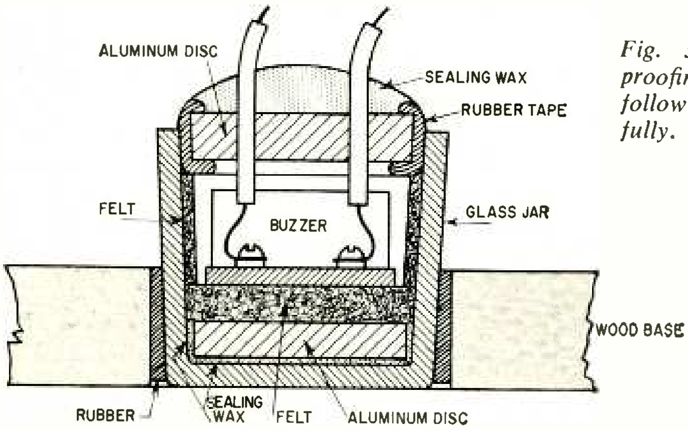
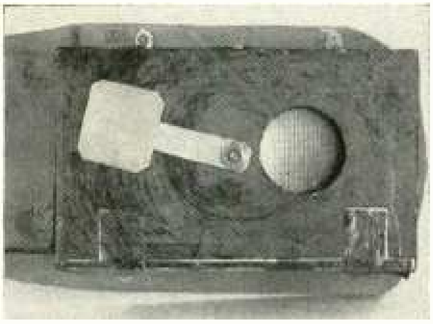


Fig. 3—Buzzer soundproofing is important, so follow this diagram carefully.

Receiver end of locator. Receiver box is open, showing transistor radio inside.



The closed receiver box, note the vane for nulling.

tapered so they could be pulled through the holes for an airtight fit.

In spite of all these precautions, some residual sound came from the buzzer. It was traced with a mechanical stethoscope to diaphragm action of the ⅜-inch-thick closure disc. driven by the internal air waves. I melted a ⅜-inch layer of sealing wax onto the disc and around the lead-in wires to stiffen and damp it. While this did not completely silence the internal buzzer, it did reduce the sound to a tolerable minimum.

The lower outside surface of the glass jar was then wrapped with 1/16 inch of rubber tape to fit into a hole bored in the center of the wood base and its loop, with the jar bottom flush with the bottom of the loop's base board.

The battery switch could, of course, be any type, but I made one with a ½-inch-wide strip of spring brass about 1/32 inch thick. A screw hole was bored in one end and the strip bent into a curved shape. Mounted between a washer and a top-side terminal lug with a screw on the loop board, its free end curves upward about ½ inch.

Over this free end was similarly mounted a doubly 90° bent, shorter strip of the same brass so that its free end overhung the free end of the other curved strip. By depressing the curved contact arm and swiveling it under the overhanging fixed contact strip, the battery circuit can be closed.

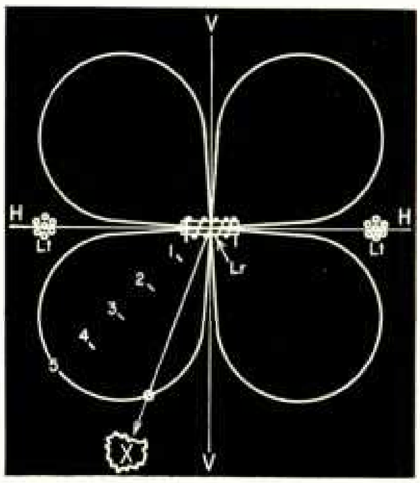


Fig. 4—Sensitivity pattern of metal locator. H–H is horizontal plane and V–V the vertical plane through transmitter loop (Lt–Lt).

For use in bad weather, the transmitter and the receiver may be protected with plastic food bags of appropriate size with their open ends tied around the 2 x 4.

For underwater use, watertight, preferably transparent, (acrylic plastic) enclosures are necessary. These should also be stiff enough to withstand the expected water pressure. Watertight switching controls and headphones instead of the receiver's speaker would be used. If towed along the sea's bottom by boat, only the lead-in wires for conventional headphones would be needed by an operator in the boat. That fully efficient underwater operation is possible, even in salt water, has been proved by enclosing the receiver in a waterproof plastic bag and immersing it in a plastic bucket full of salt water.

Operation

Between the transmitter and the receiver, and around both, are four very broad high-sensitivity radial lobes, separated by four very narrow low-sensitivity zones. The sharply defined zones lie in vertical and horizontal planes through the transmitter and receiver loops and somewhat beyond both.

The broad, high-sensitivity lobes extend diagonally upward and downward between the sharply defined low-sensitivity zones. If any plane section 90° to a straight line joining the transmitter and receiver loop centers is considered, the radial sensitivity curve will have the appearance of a more or less symmetrical four-leafed clover (Fig. 4). The sensitive areas around the device are centered around diagonal planes angled 45° to the horizontal and vertical planes. While either the transmitter or the receiver end is sensitive to external conductive objects, the receiver end is the more sensitive.

Since it is about twice as far from the carrying handle, this end of the device can more easily be swept about near the ground in a search area. In this searching operation, as the receiver is swung in a horizontal circle over the ground, first one of the diagonally downward sensitive lobes will pick up the object beneath it. Then there will be a sharply defined null-signal point. Finally, the other sensitive lobe will signal the object's presence. The sharply defined null-signal point indicates that the object is directly beneath the receiver or along a line through that point to the transmitter. Another sweep along a line at right angles to the first will pinpoint location.

Of course, sensitivity falls off with distance, and depends on the size and conductivity of the searched-for object, as well as on the perfection of the null-signal adjustment in a metal-free locale. For the latter, the signal must be well nigh inaudible.

Sensitivity is greatest near the receiver end, lower in the mid-area and medium near the transmitter end. You must think of the clover-leaf polar curve of sensitivity as a solid, having a thickness somewhat greater than the 3 feet of separation between transmitter and receiver loops, and that signal loudness, as measured from the center to any point on the curve of Fig. 4, is for a given object at a fixed distance from, say, the receiver loop as the object is moved in a circle around it in a verticle plane at 90° to a line joining the receiver and transmitter loop's centers.

Actually, the four lobes are not as symmetrical as shown. They are somewhat distorted by the transmitter's and receiver's metallic components. The receiver's tuning capacitor, for example, is immediately adjacent to one end of the ferrite antenna, and rf eddy currents induced in it by the transmitter's magnetic field are accompanied by a magnetic field which opposes the transmitter field near it. That end of the ferrite antenna is, therefore, less sensitive.

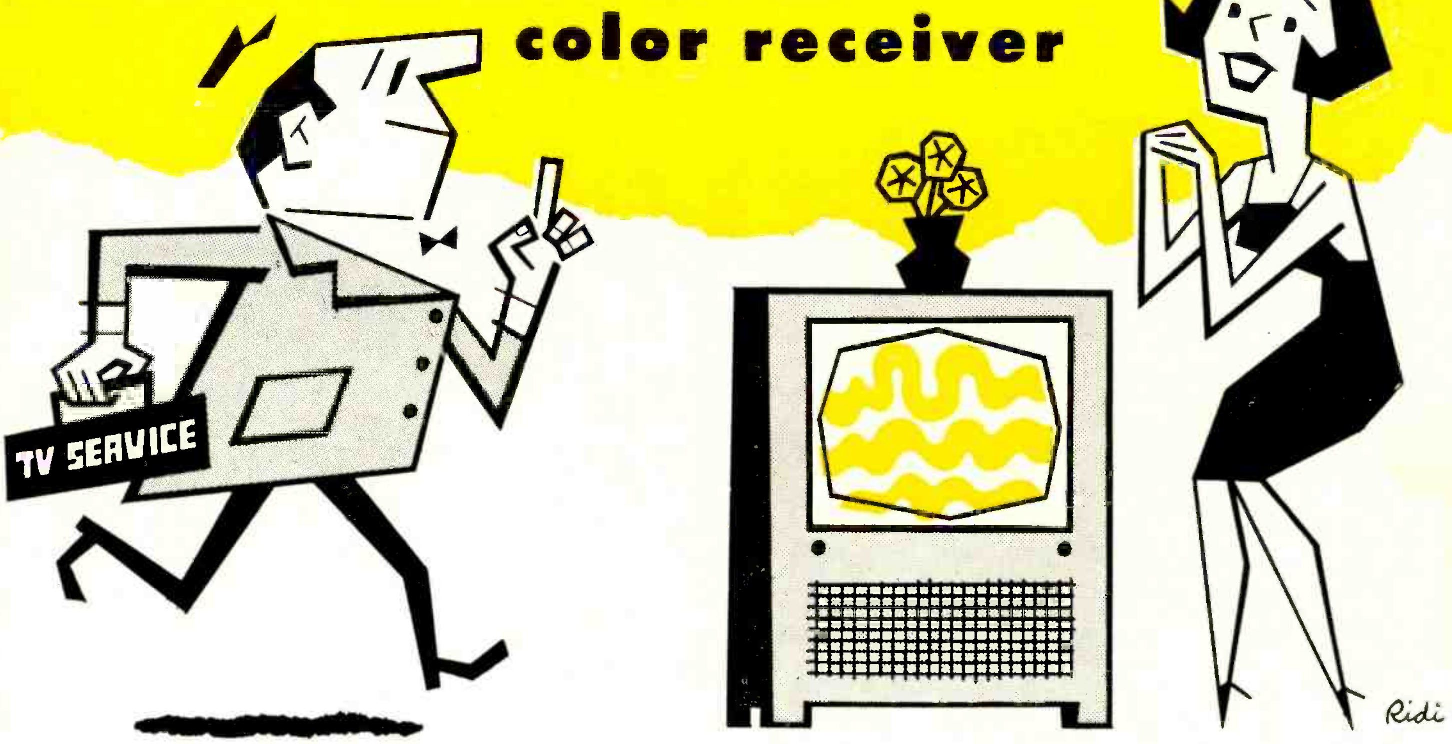
These electrically conductive components of the receiver, so closely adjacent to the antenna, act somewhat like ferromagnetic objects located near a ship's magnetic compass, and for which compensatory adjustments are made.

Detector sensitivity

Tests have shown that this device will detect and locate a galvanized iron bucket at about 3 feet, an insecticide spray can at about 1 foot, a cigarette lighter at a few inches. Lawn sprinkler-system pipes a foot underground can be found with the device several feet above ground. Larger objects can, of course, be located at greater distances. Water and electrical conduit pipes can be located inside walls, floors, etc. of a house. Nonconductive intervening objects have no effect upon it. Earth, rock, salt or fresh water over concealed metallic objects do not lessen the sensitivity.

Since the rf magnetic fields penetrate very little into solid conductive objects, these give little more signal indication than do thin sheets or shell-like objects. For example, the galvanized iron bucket will give about as much signal as a solid-metal object of like size. Objects having higher rf skin-effect conductivity are more readily detectable. Since ordinary iron objects have low magnetic permeability for rf magnetic fields, they are detected mainly by their electrical conductivity. But special ferromagnetic alloys, suitable for rf applications, are detectable, although they act oppositely from conductive materials in that they strengthen the transmitter's magnetic field in their vicinity whereas purely conductive, nonmagnetic objects weaken it. END

tube changing in the color receiver



As in black-and-white—you can fix 75% of your troubles by changing tubes

By ART MARGOLIS

RECENTLY I HAD TO HIRE A NEW OUTside technician. I was shocked to find that many experienced roadmen have never changed a tube in a color set. Often their instructions on previous color jobs had been to walk right out without touching the set.

Tube changing in a color TV takes care of at least 75% of troubles—just like black-and-white.

The only differences are the five odd new combination tubes that act as bandpass amplifier, color killer, burst keyer, burst amplifier, 3.58-mc oscillator, reactance tube, phase detector and demodulators. The tubes themselves are not new. 6CL6, 12AT7, 6AL5, 6AW8, 6AN8 are familiar numbers. You must learn what symptoms these tubes can cause. Then tube changing a color TV is no harder than B&W, only more colorful. Once you realize that these repairs are approached in the same way, the few extra symptoms and tubes are handled easily. These four recent case histories are par for the course.

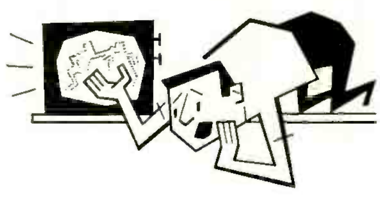
The case of the bored bartender

"How's that look Frank?" I called down from my perch behind the tavern's color TV. My old school chum who is a snappy but jovial bartender shot back, "I couldn't care less."

I understood his disenchantment and laughed in the dim bar 15 feet above the floor: "You'll care when I write up the bill."

Frank shrugged. When I had arrived at the bar a ½ hour before, a color program was just going on. (I time it that way on all color calls if possible.) But there wasn't any color in the picture, just ordinary black-and-white.

(I try to think of color as another element in a black-and-white picture. As I analyze symptoms, they are either conventional or a color type. Ordinary troubles get the same treatment I give any TV. Color troubles point me to the color circuits. The type of color trouble determines which color circuit I check out.)



"I couldn't care less!"

The symptom here at the bar was "no color". The black-and-white picture was good. Compatible color TV produces a color picture by putting together a black-and-white picture (Y-signal) and a color picture (color-difference signal). That way a black and white set can produce a picture during a color show by responding to the monochrome transmission. A color TV, with its extra few circuits and special picture tube, responds to both monochrome and color segments to produce a color picture.

In a color TV, during a black-and-white show, the color picture tube receives no special activation from the color circuits. The red, green and blue phosphers and add to produce black and white.

During a color show, the color circuits do activate the picture tube. Each color phospher is lighted up in accordance with the TV studio color camera and the colors add to produce a color picture.

In Frank's TV there was a color show but the color circuits were not actuating the picture tube. The first stage of the color circuits is an amplifier. It is simply amplifies the signal preparatory to color processing, similar to an i.f. If this tube dies, the rest of the color circuits don't receive any signal and the monochrome picture will continue.

It followed—the 6AW8 bandpass amplifier was out cold. I replaced it. The colors snapped in. That's when I called down to Frank. I crawled down from the the platform, and began writing up the bill. To further the idea I was going to charge him high, I began writing a lot of technical talk in the bill even though the charge was routine.

He picked up the bill and shook his head. He said dourly, "I don't know what I'm paying you for. I can't understand the bill and I can't see any difference in the picture."

I answered, "It's a blind item, buddy." You see, Frank never could distinguish one color from another.

COLOR TV TROUBLE CHART

When these symptoms appear, test the check-off tubes as first service move.

Possible Tubes	NO COLOR	WEAK COLOR	LOSS COLOR SYNC	COLORS COME AND GO	HUM BARS	MISSING or TINTED HUES	MISSING or TINTED RASERS
Bandpass Amplifier	X	X			X		
Color killer	X	X		X	X		
Burst keyer			X				
Burst amplifier			X				
3.58-mc oscillator	X		X			X	X
Reactance tube	X		X				
Phase detector	X		X				
Demodulator tubes					X	X	X
Tuner, i.f. & video amps	X	X			X		

The easy convergence cure

My kid cousin Pete is very upset about color TV. Since he's still logging experience on black-and-white sets, I haven't given him full rein on color. This overanxiety to work on color gets him in trouble—like the telephone call I received from him the other day. He was calling from a customer's house. "Art," he said excitedly, "I got a convergence job."

"You have?" I asked. The only ones Pete has performed were practice jobs when I taught him how. He never ran into a job on the street before.

There are three groups of color phosphor dots on the color CRT face to produce the elements of light—a green, blue and red. In the CRT electron gun, there are three guns: a green, blue and red. The green gun is aimed at the green phosphor, and the blue and red at their respective phosphors. Each gun must bull's-eye on its respective phosphor. When they do not, they impinge on the wrong color dot. Under those circumstances, they are "out of convergence".

I said to Pete, "Describe the symptoms."

He answered quickly, "There's a green border around all the figures during a black-and-white program. Makes you dizzy if you watch it for a while."

I said, "Go on."

He snorted, "That's enough."

I said emphatically, "How is the black-and-white picture?"

He hesitated in answering. "Well, now that you mention it, the people have pointed heads and there's a wee bit of width loss."

I said, "Before you touch convergence, fix the people. I'll hold on."

First rule of thumb before touching any convergence controls: have a perfectly linear and spread-out picture. This means replacing all weak sweep tubes, then making appropriate linearity adjustments.

Shortly, Pete spoke softly into the phone, "OK, exalted one, I put in a new 6AQ5 vertical output, 6CB5 horizontal output, 6AU4 damper and 5U4 rectifier. The picture spread out and the convergence problem is gone. I didn't have to touch a control."

I gloated a bit, "What would have happened if you went for the convergence controls first?"

Never to be out-talked, he retorted, "Then I'd have had a convergence job, like I wanted in the first place."

Mystery of the crystal-ball colors

Madame Terazzo tells fortunes in a restaurant on our main highway. She must do well, 'cause she owns a color TV. The last time I serviced her set, she intoned as I went in her door, "It occurred this afternoon as the thundershower ceased. A rainbow appeared in the sky and shimmering cascades of color began going through the picture."

I turned her TV on. She was right—a shimmering cascade of colors was flowing from top to bottom. In our language, she had lost color sync.

When you lose black-and-white sync, the picture flops all over. When you lose color sync, the picture remains in place but the colors shimmer all over.

After the color signal leaves the bandpass amplifiers, a portion of it is tapped off and sent to a circuit called the burst amplifier. Here, with the aid of a couple other circuits called burst keyer, reactance control, color phase detector and color oscillator, the colors are looked into place as the oscillator runs at its prescribed 3.58 mc.

When you lose color sync, though you still have color, it indicates that the oscillator is running but at the wrong frequency. Any of the aforementioned tube types could be at fault.

"It's trying to tell me something!"

I began replacing these tubes. As I changed the 6AN8 burst keyer, the running rainbow cleared into a color picture. The tube was defective.

Usually people are happy when you repair their TV's. Not so Madame Terazzo. As I placed the defective tube on top of her TV, she moaned, "It's only a bad tube. I thought the TV was trying to tell me something."

The cat and the colors

I walked into the house of a new color TV customer, went through routine introductions and began asking him about the troubles.

I asked, "What seems to be the trouble?"

He shrugged, "Red light, man."

I turned on the TV. A blue-and-white picture came on instead of a black-and-white or color picture. I asked, "Is the blue tinting the trouble?"

"Green light all the way, man." he smiled.

I tried to keep a straight face and figure out what in the world he was talking about. The picture was blue and stayed that way no matter what I turned.

I immediately began testing the demodulator tubes. After the color is amplified, part of it goes to the demodulator tubes. The ouput of the color sync also goes to the demodulator tubes.

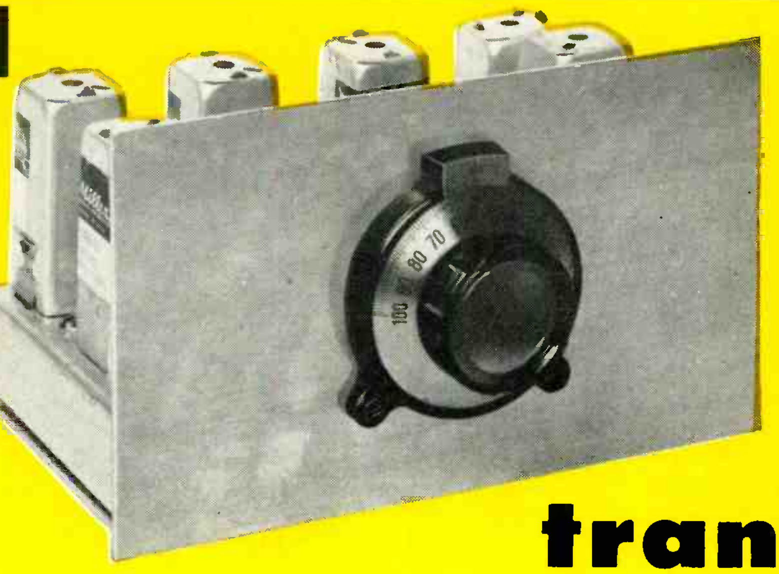
The demods have letters (G—Y), R — Y), (B — Y). The G, R and B stand for the primary colors and the Y for the black-and-white picture. In the tubes, the respective color signal is mixed with black and white. This mixture modulates the individual color guns. If one of the demods fails, that color gun will emit wide open, putting that tint onto the screen.

I tested the (B — Y) demodulator, a 12AT7. It was out cold. I replaced it and the blue tinting disappeared.

"Green light, man, green light," the cat yelled excitedly. I looked at the picture again. No green, it was perfect.

I began packing up and making small talk. I asked what he did for a living. Then I understood him. "I install traffic lights, man." END

Build this all-transistor FM tuner



9 transistors give excellent sensitivity and selectivity

By MARK H. GOODMAN, W6AKG

This nine-transistor FM tuner has a tuned rf stage for higher gain and lower noise. The local oscillator and mixer are each separate transistors for better stability. The i.f. strip has five stages tuned to 10.7 mc (the last two serve as limiters). Each i.f. transformer is double-tuned, which gives the unit a very high degree of selectivity. Afc compensates for changes in voltage or temperature.

As the transistors are quite stable, afc could be omitted. However, if the unit is to be used for recording "off the air" (especially long selections), afc is good to have.

About the circuit

The tuned rf stage (Fig. 1) is a common-emitter amplifier, using a 2N1742. While the high-frequency performance of a common-base amplifier is superior to that of a common-emitter, the latter will give considerably more gain. These transistors are all special high-frequency units with alpha cutoffs well above the frequencies used so common-emitter amplification is used throughout. Neutralization was not used in the rf stage; it was not necessary. Base-to-collector capacitance is very low in these units.

The local oscillator is a common-base stage. Feedback is from collector to emitter via a 5-μμf capacitor. It should be a high-quality ceramic, as it affects the oscillator's stability. The 5-50-μμf trimmer should also be a quality unit or the same dial settings will not hold for any length of time. Remove the built-in trimmer from across C1-c. It is replaced by C8.

Afc is fed to oscillator coil L4 via D1, a Varicap diode. This diode is connected to the collector of a 2N207 dc amplifier, so it will increase the plus-zero-minus voltage developed by the ratio detector.

The barrier between the diodes p-n junction is made to move (electronically, not physically) with different applied voltages. As it shifts, the capacitance between the junctions changes slightly. This means that this particular diode is a voltage-sensitive capacitor. Hence, if the station to which you are tuned drifts slightly, a correction voltage is applied to the diode, changing its capacitance and bringing your station back in tune.

The first three i.f. stages are voltage amplifiers. By the time the signal has reached the base of the fourth i.f. stage, the voltage swing is great enough to drive this stage to saturation. This also holds for the fifth i.f. By this method we get limiting. The output is a square wave, which is the output of any limiter. This "limiting by saturation" works very well with transistors, and has performed as well as four stages of limiting on conventional tube FM receivers.

I used a wide-band ratio detector

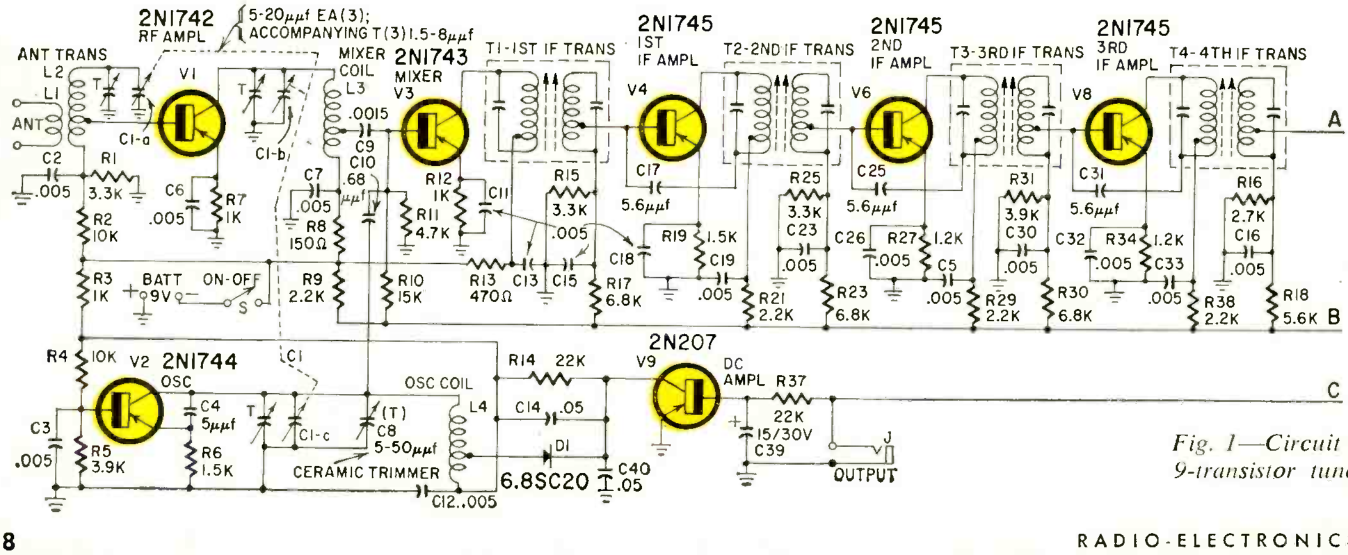


Fig. 1—Circuit of 9-transistor tuner.

and did not include any de-emphasis, as this depends upon the load impedance the tuner output sees. While a vacuum-tube amplifier has high enough input impedance to ignore, this is not true of a transistor amplifier. One value of de-emphasis would work with vacuum-tube but not with transistor amplifiers. Fig. 2 shows the circuit to use with vacuum-tube amplifiers. Also there should be no dc load or shunt from the output of the ratio detector to ground; this would short the afc voltage (weaken or destroy afc action). For a high-impedance amplifier, a coupling capacitor should be used—about 0.1 μf will work. If the output is to go to a transistor amplifier, use a coupling capacitor between 5 and 15 μf (miniature electrolytic, observing correct polarity).

Construction facts

The entire unit is constructed on a 5½ x 3½ x 1-inch aluminum chassis. The i.f. transformers and transistor sockets are laid out first, their positions marked, and the holes drilled. Drilling the holes for the i.f. cans will take some patience; they are small and tolerances slight. Use quality transistor sockets, especially for the front end. Also, when soldering to the socket pins, be sure to remember to remove the transistors. They are very delicate and easily damaged by excess heat. Although heat may not destroy them, it will ruin their performance.

Start with the detector stage, then wire up the last i.f. stage. Proceed backward one stage at a time. You can test each stage as it is wired in, if desired. After three or four stages have been wired, a steady hiss should be heard when you turn on the power.

The mixer, oscillator and rf transistors are located as close to the variable capacitor as possible. This helps keep leads short. The coils are located directly under these transistors, which makes leads extremely short (probably one reason for the exceptional sensitivity of the unit).

The front panel is a 6 x 3½ x 1/16-inch piece of aluminum.

The choice of dial (2-inch vernier) was based upon ease of operation, compactness (try to find a directly calibrated dial for this tuner), neat appearance, and ease of making up a logging scale for the stations desired (omitting undesired ones). The newspapers in your locality will give a list of the stations, so, with one known station, the others can be found easily. I made up a small chart and pasted it directly on the front panel. Furthermore, this dial has an 8-to-1 tuning ratio and there is no backlash.

You may notice that other than tuning there are no controls on the front panel. The unit is not in its final form (it will be a part of a larger system). The controls will be "remoted." For the time being, the 9-volt battery is taped to the rear of the front panel. I connect it when I want to use the set.

Sit back and listen

After the unit is completed, plug in all the transistors, except V1 and V2 (rf amplifier and oscillator). Having made sure there are no serious errors in the wiring, connect the battery and feed the output of the unit to a high-gain audio amplifier. Tune up the five i.f. stages with a signal generator tuned to 10.7 mc.

After this is done (peaking each stage from the last one to the first), loosely couple a 100-mc signal to the mixer base (use 10-$\mu\mu$f capacitors in series with the leads), and feed the output from another signal generator to the same base. Tune the latter signal source to 89.3 mc (giving a difference of 10.7 mc). Now adjust the mixer coil for maximum output by squeezing or compressing its turns to change its inductance. Remove the 89.3-mc generator and adjust the oscillator coil, again squeezing or compressing the turns (after plugging in the oscillator transistor) until the output from the 100-mc generator can be heard. The local os-

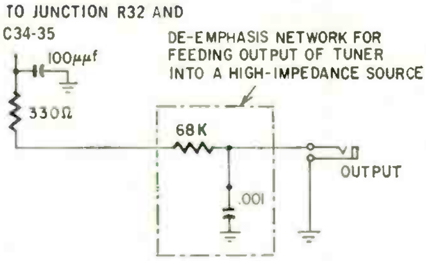


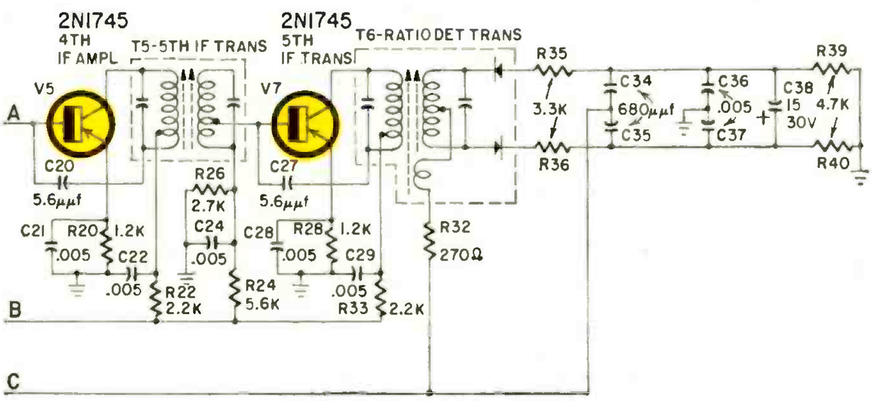
Fig. 2—Use this de-emphasis network if tuner feeds tube type amplifier.

cillator is now at 89.3 mc. If it is tuned to the high side, it will be on 110.7 mc instead of 89.3. Either is satisfactory.

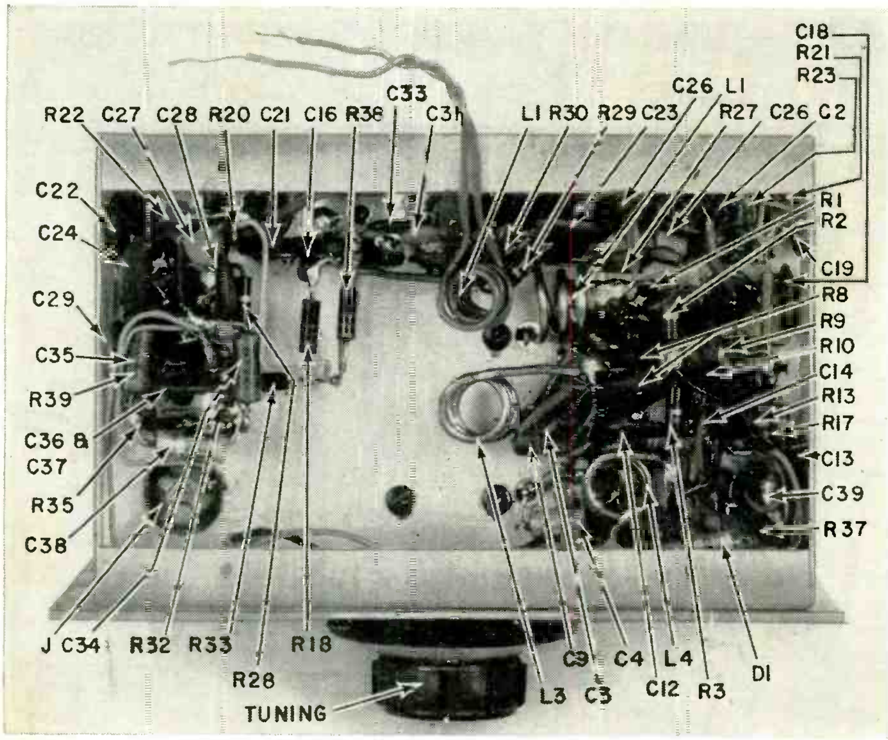
Now plug in the rf transistor and apply the 100-mc signal to its base via L1. Adjust the coupling between L1 and L2 for maximum output. You will have to experiment with this coil arrangement, as coupling may be critical. If there is not enough coupling, weak stations may be "hissy" or down in the noise. If there is overcoupling, local stations may cause cross-talk.

I had trouble with one FM station beating with the sound of TV channel 5, the net result being a 10.7-mc beat which could not be tuned out when I increased the coupling. I installed a wavetrap tuned to channel 5 sound in series with my lead-in, thus curing the trouble.

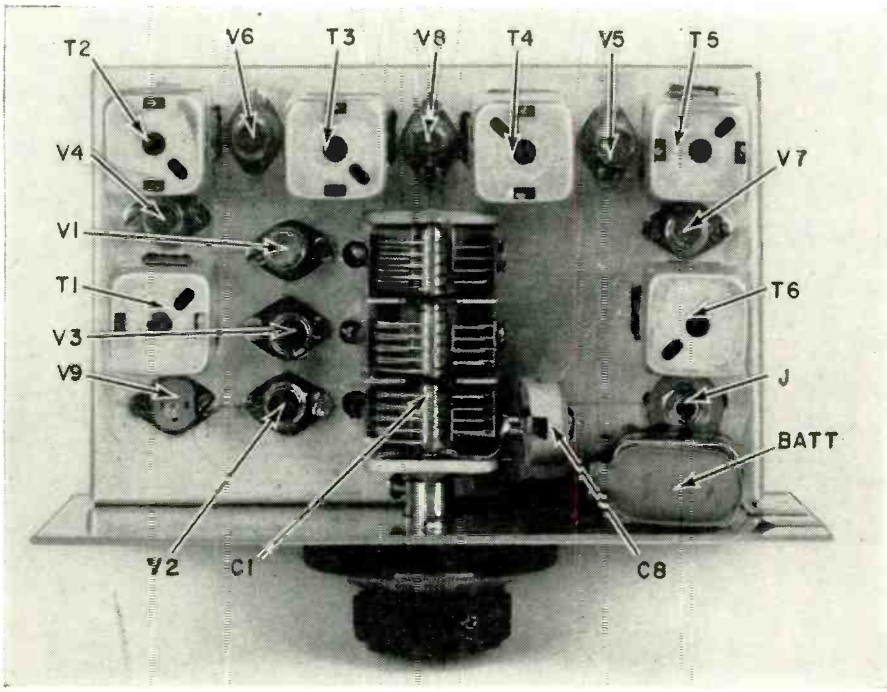
In strong-signal areas L1 can be dispensed with and L2 can be tapped one or two turns from ground and run to a lead 1 or 2 feet long.



R1, R15, R25, R35, R36—3,300 ohms
R2, R4—10,000 ohms
R3, R7, R12—1,000 ohms
R5, R31—3,900 ohms
R6, R19—1,500 ohms
R8—150 ohms
R9, R21, R22, R29, R33, R38—2,200 ohms
R10—15,000 ohms
R11, R39, R40—4,700 ohms
R13—470 ohms
R14, R37—22,000 ohms
R16, R26—2,700 ohms
R17, R23, R30—6,800 ohms
R18, R24—5,600 ohms
R20, R27, R28, R34—1,200 ohms
R32—270 ohms
All resistors ½-watt 10%
C1—subminiature variable capacitor, 3-gang, 5–20 $\mu\mu$f, each section; trimmer range, 1.5–8 $\mu\mu$f, each section (Miller 1460 or equivalent)
C2, C3, C6, C7, C11, C13, C15, C16, C18, C19, C21, C22, C23, C24, C26, C28, C29, C30, C32, C33, C36, C37—.005 μf, disc ceramic
C4—5 $\mu\mu$f, tubular ceramic
C8—5–50 $\mu\mu$f, ceramic padder
C9—.0015 μf, tubular ceramic
C10—0.68 $\mu\mu$f, ceramic
C14, C40—.05 μf, disc ceramic
C17, C20, C25, C27, C31—5.6 $\mu\mu$f, ceramic
C34, C35—680 $\mu\mu$f, tubular ceramic
C38, C39—15 μf, 30 volts, miniature electrolytic
BATT—9 volts
D1—Varicap (International Rectifier 6.8SC20 or equivalent)
J—phone jack
L1—2 turns hookup wire coupled to cold end of L2
L2—3¼ turns No. 12 bare copper wire, ½-inch inside diameter and ½ inch long. Tapped 1 turn from cold end.
L3—4 turns No. 12 bare copper, ½-inch inside diameter and ⅜ inch long. Tapped 1 turn from cold end.
L4—2½ turns No. 12 bare copper wire, ½-inch inside diameter, and ⅜ inch long. Tapped ¾ turn from cold end.
S—spst switch
T1, T2, T3—10.7-mc first i.f. transformer (Miller 1463-T1 or equivalent)
T4—10.7-mc second i.f. transformer (Miller 1463-T2, or equivalent)
T5—10.7-mc third i.f. transformer (Miller 1463-T3, or equivalent)
T6—ratio detector transformer (Miller 1465-TRD or equivalent) **don't forget to reverse the diodes in the can**
V1—2N1742
V2—2N1744
V3—2N1743
V4, V5, V6, V7, V8—2N1745
V9—2N207
Chassis, 5½ x 3½ x 1-inch aluminum
Panel, 6 x 3½ x 1/16-inch aluminum
Tuning knob (see text)
Miscellaneous hardware



Lead lengths are kept short and neat under the chassis.



Parts layout on the chassis top. V9 may be hard to see; it's quite a tiny thing.

The transistors are all made by Philco who referred me to a local distributor. The reader may have to contact Philco Co. in his area to find out where they may be obtained.

Tune in a station. If it jumps out of tune and cannot be tuned in again, afc polarity is wrong. Reverse it by reversing both diodes in the detector transformer (easily accessible from the top). Now, with a weak station tuned in, adjust the secondary of the ratio detector for clearest reception. This is done with the afc on.

While the afc cannot be turned off, its amplitude can be changed. As the circuit is now, afc is very strong. A variable resistor can be put in series with R37 (Fig. 3). This pot becomes the afc control. If desired, and if you can find the room, you can mount it on the back of the tuner.

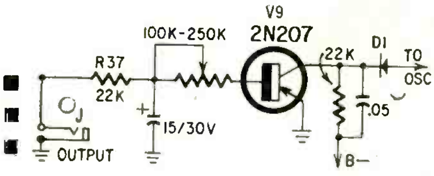


Fig. 3—Add a pot to give adjustable control of afc.

The tap on oscillator coil L4 is also important. If the coil is tapped too far from the cold end, there will be too much afc and the local oscillator may not oscillate. Tapping too low may give insufficient afc. Experiment for the best results.

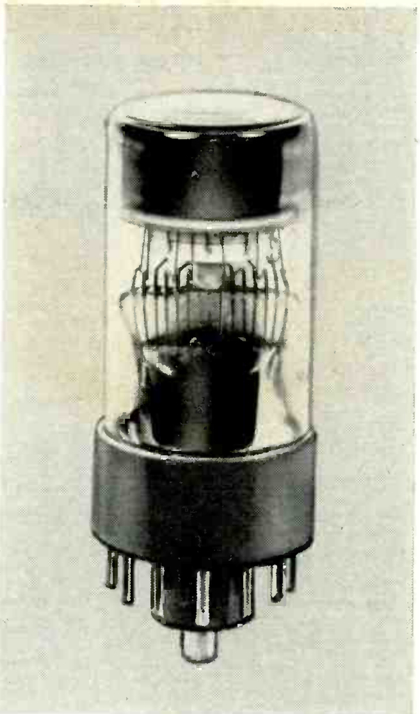
Although the receiver was built only a short time ago, it has already given a great deal of pleasure. It is wonderful to tune the unit and listen to the clean reproduction. The selectivity makes dxing a possibility, as weak stations can be separated from locals quite readily. The unit has been shown to be remarkably sensitive. Stations have been heard which were impossible before. Stations which the average FM tuner would either miss altogether or produce in the background under the babel of locals have been brought out in the clear.

Distant stations tune just like the locals, with stations up to 200 miles causing complete limiting (this with a folded dipole on the roof).

Transistors and FM seem to be here to stay. So, reach deep into your spare-parts box, roam the local radio stores, and dig in. Good luck! END

". . . and if you like Westerns . . ."

COUNTING WITH THE DEKATRON



By DELLROYE D. DARLING*

Automation was made possible largely by the introduction of automatic control circuits that take the place of human operators. Some "see", some "hear", some "feel". Some also count.

The Dekatron is a cathode-glow type of counter. It is a special cold-cathode tube that adds or subtracts according to the voltage pulses fed into it.

This timer is a basic "building-block" unit—several can be put together to make up a control which can count as high as the job requires. Each tube can count to 9, and then resets to 0. Two will count to 99, three to 999, and so forth. Each basic unit also has a count selector switch that causes the unit to supply an output signal when a predetermined count is reached.

A complete control also contains circuits for power supply, sensing equipment, and thyratrons and relays to operate the load when a count is reached. One popular use of this counter is shown in Fig. 1, where it is controlling the cutting of strip material into correct lengths.

This measurement operation is carried out by a measuring disc and a photocell arrangement. The disc rests against the moving strip of material, and rotates as the material passes under it. Holes in the disc allow light from a light source to reach the photocell a fixed number of times for each revolution. (If the disc is 1 foot in circumference and has three holes, three output pulses from the photocell will indicate 1 foot of material has passed by.)

Output pulses from the photocell are counted by the Dekatron counter, which has been set to a count that corresponds to the desired length of material. When the proper count is reached, the circuit to the flying shear closes, and the material is cut off.

This is just one of many possible applications for this control. Others include packaging, sequencing of automatic machines, etc.

The heart of this timer is the Dekatron tube. It is a cold-cathode gas-filled type that has 10 cathodes, arranged around the end or face of the tube. Between each two cathodes are two guides. These guides are actually cathodes too, but their purpose is to cause the ionized glow spot to jump from cathode to cathode in the correct sequence for counting.

We can trace the tube's operation by referring to Fig. 2. Suppose there is conduction between the common anode and cathode 0. A glow spot of ionized gas appears around this cathode. Although all the other cathodes are also negative with respect to the anode, only one cathode can conduct at a time. This happens because in a gas-filled tube the "arc-drop" potential that appears between cathode and anode when the tube is firing is lower than the potential required to fire the tube. In the Dekatron counter circuit, a resistance is placed in series with the anode. As long as any one cathode is conducting, the anode voltage is pulled down too low to allow any other cathode to fire.

The glow spot is transferred from cathode to cathode by applying negative-going pulses to the guides in proper sequence. If a negative pulse is applied to the guide 1 terminal, all the No. 1 guides become more negative than the cathodes. However, the glow spot jumps to the nearest guide, since it is closest to the area of ionized gas that surrounds the conducting cathode. This causes the spot to move one jump clockwise from cathode "zero." If the pulse is now removed from guide 1 and immediately applied to the No. 2 guides, the spot jumps to the nearest guide 2, the one just before cathode 1. When the pulse is removed from the guide 2 terminal, the spot transfers to the nearest cathode, in this case cathode 1. The tube has now reached the count of 1.

This same sequence of pulses must be followed for each successive count—first a negative pulse applied to the No. 1 guides, then removed and applied to the No. 2 guides, then again removed to allow the spot to appear on the next higher cathode. If the pulses are applied to the No. 2 guides first and then 1, the spot moves counterclockwise, and the tube subtracts.

Because these tubes require two pulses for each count, a simple pulse generator circuit is necessary. This circuit simply takes each incoming pulse and converts it to two negative-going pulses that are applied to the guides in proper order.

This pulse generator can be seen in Fig. 3, which shows the circuit of a two-decade counter with load-control thyratron, relay, count selector, power supply and other necessary circuitry.

At rest, V2-b conducts because there is a positive voltage on its grid. It develops a high value of voltage across the common-cathode resistor, which keeps V2-a cut off. When a positive pulse from the sensing circuit (photocell, etc.) arrives at V2-a's grid, the triode conducts. The voltage at V2-a's plate drops, causing a negative pulse to be coupled to the No. 1 guides through C2. This negative-going pulse is also sent to V2-b's grid through C1, and it

*Director of industrial electronic training, Radio-Electronic Television Schools, Detroit, Mich.

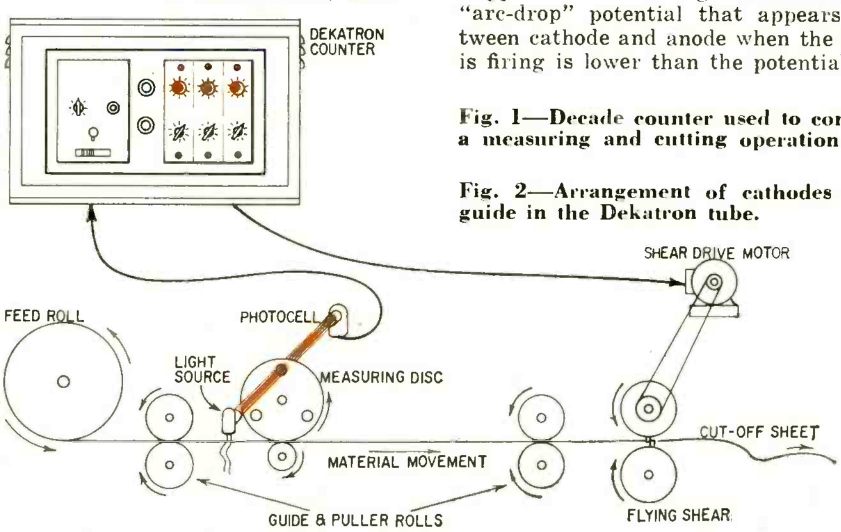


Fig. 1—Decade counter used to control a measuring and cutting operation.

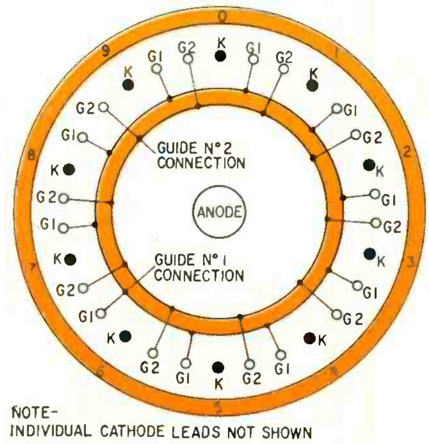
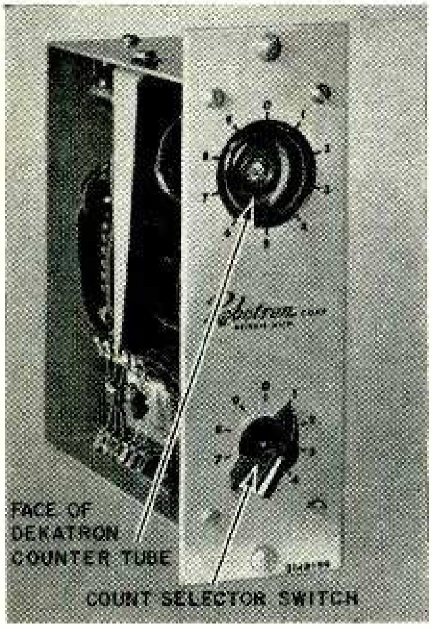
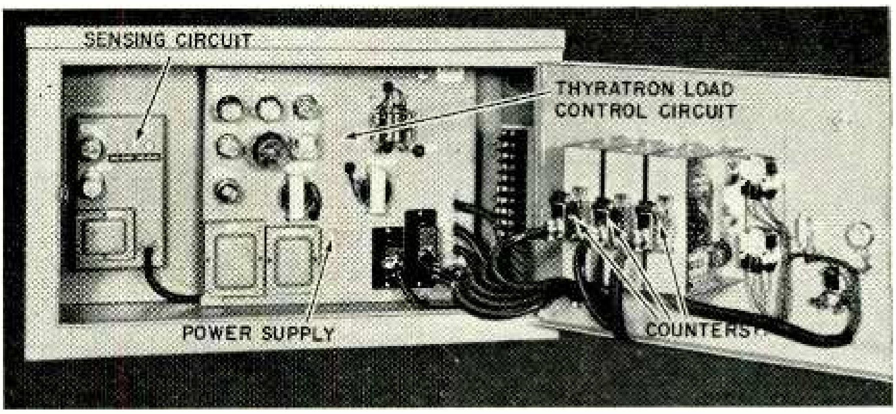


Fig. 2—Arrangement of cathodes and guide in the Dekatron tube.



A basic counter unit, the Robotron model 547B008.

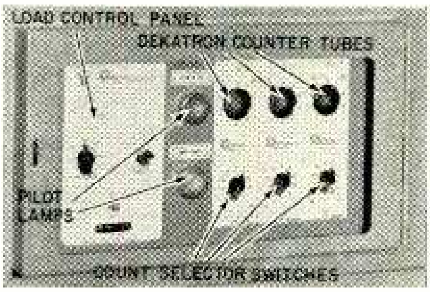


Interior of Robotron 3-stage counter with sensing and load-control circuits.

decreases conduction of that triode. When the sensing pulse is gone, and V2-a is conducting normally, V2-b's conduction increases momentarily, producing a negative pulse which is fed to the guide 2 connection on the Dekatron. The same things happen for each positive-going pulse the sensing circuit produces, causing the Dekatron to count those pulses.

Each cathode in the Dekatron has a resistor in series with it. There is a voltage drop across the resistor of the cathode that is conducting at the moment. The COUNT-SELECTOR switch selects the cathodes that must be conducting to get an output voltage.

Cathode voltage from the count selector is used as positive conducting bias for V6. This thyratron is normally blocked by a negative bias on its shielded grid. In this two-Dekatron counter, the bias



Three-unit counter can count to 999.

on V6 is made large enough so the combined voltages from one cathode of the "units" tube and one cathode of the "tens" tube are both necessary to make the thyratron fire.

The "tens" count circuit is identical to the "units" circuit, except that the pulses that trigger pulse generator V4 come from the 0 cathode of the units tube. Thus, each time the units tube counts 10, the 0 cathode conducts, causing the tens tube to count one 10.

When the preset count is reached, V6 fires, energizing the relay in its plate circuit, and closes the load circuit to operate the cutoff shear or whatever apparatus the counter is controlling.

If the control must count higher than 99, additional Dekatron units can be added, taking their trigger pulses from the 0 cathode of the previous Dekatron.

Service hints

Keeping these units working is not difficult if you understand the operation of the circuits involved. A scope is a big help, since correct Dekatron operation depends on the correct polarity and order of pulses applied to the guides. Incorrect counting is sometimes caused by a lack of "reset". This is done by a switch that opens the circuits for all cathodes except 0 in each tube. Naturally, if the control starts a count with the tubes not reset to zero, an incorrect count will cause the thyratron to fire. This reset is sometimes done automatically by tripping the switch with the load relay at the end of each count.

Like much other industrial equipment, these counting controls look pretty unfamiliar to most radio and television service technicians. However, remember that capacitors, resistors, tubes and so on operate on the same basic principles here as they do in any other electronic gear. Troubleshooting and service are still just a matter of logic, coupled with a knowledge of basic electronics. END

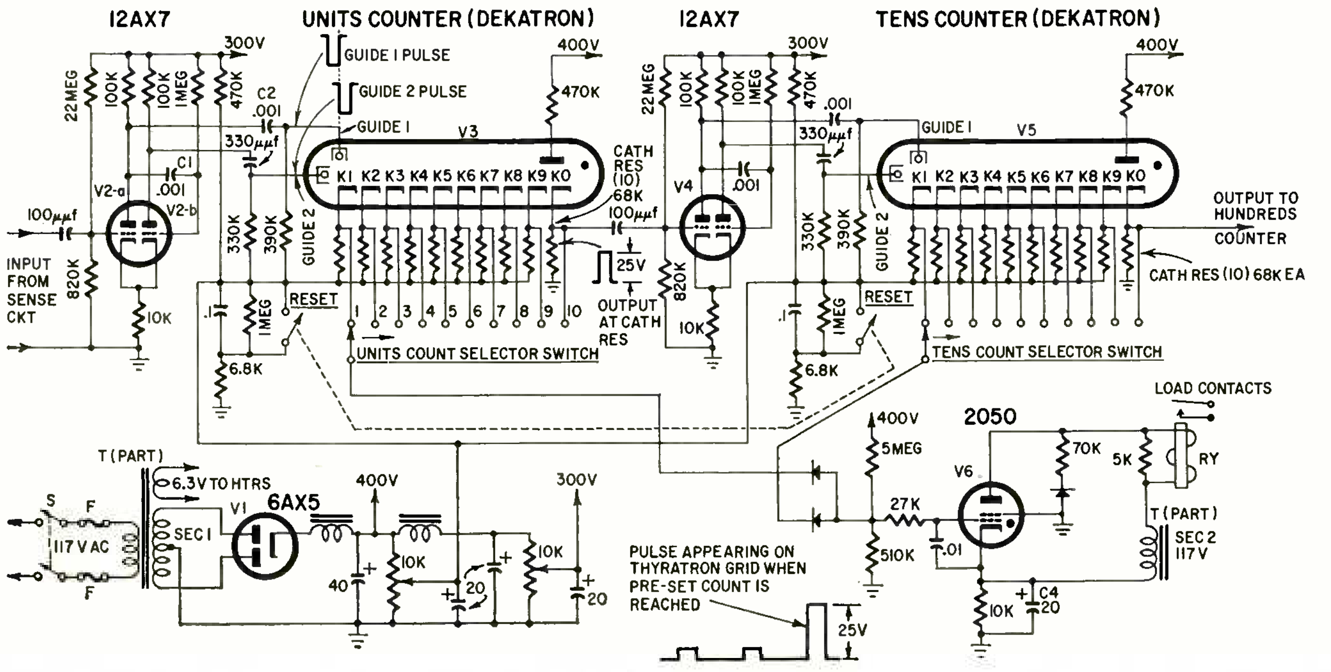


Fig. 3—Circuit of a two-stage counter.

measure atomic radiation

Part II—Ion-chamber meters and a G-M counter you can build

By CARL L. HENRY

Last month we discussed devices that read the absorbed dose rate of nuclear radiation. Undoubtedly such equipment is very useful, since it tells you exactly how much radiation you have absorbed. But surveying an area for radiation is slow and difficult work with such equipment. A much better approach is an actual survey meter that uses an ion chamber as the basis of its indication. Such instruments that cover ranges of from 0.1 to 500 roentgens are available at a reasonable price. (Both Lafayette Radio and Radio Shack list one in their catalogs.)

They are sensitive to atmospheric moisture and shock, and in general have low-reliability circuits. However, to balance these drawbacks, they are accurate, highly portable and easy to use. Ion chambers measure the *exposure dose rate*. They are normally calibrated in roentgens per hour. In other words, if you walked into an area and the meter indicated 500 roentgens, you could walk out again and the absorbed dose you received would be on the order of 10 roentgens had you been in the field for approximately 1 minute.

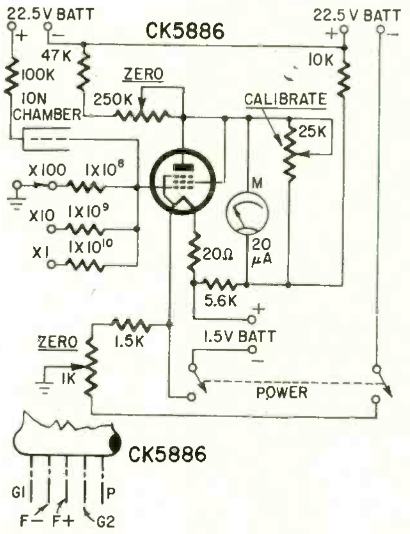
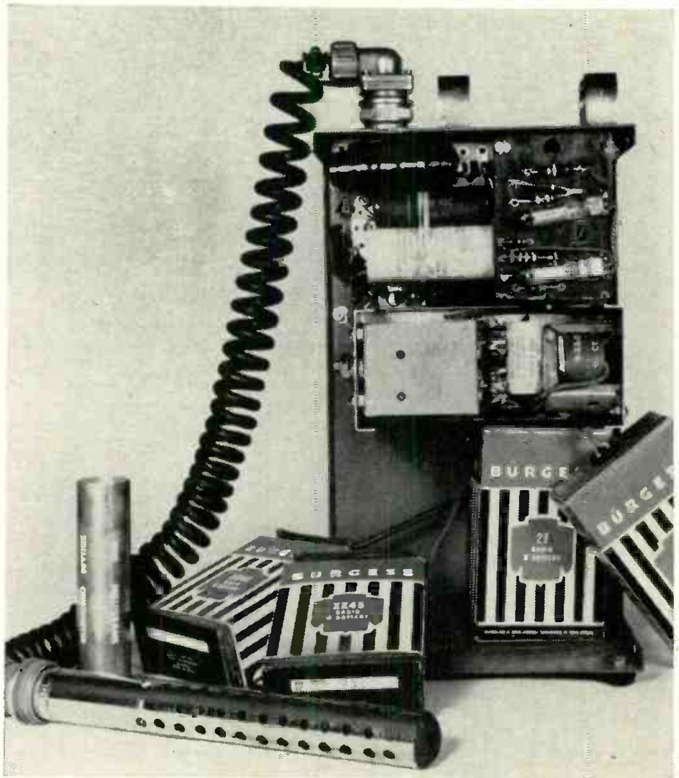


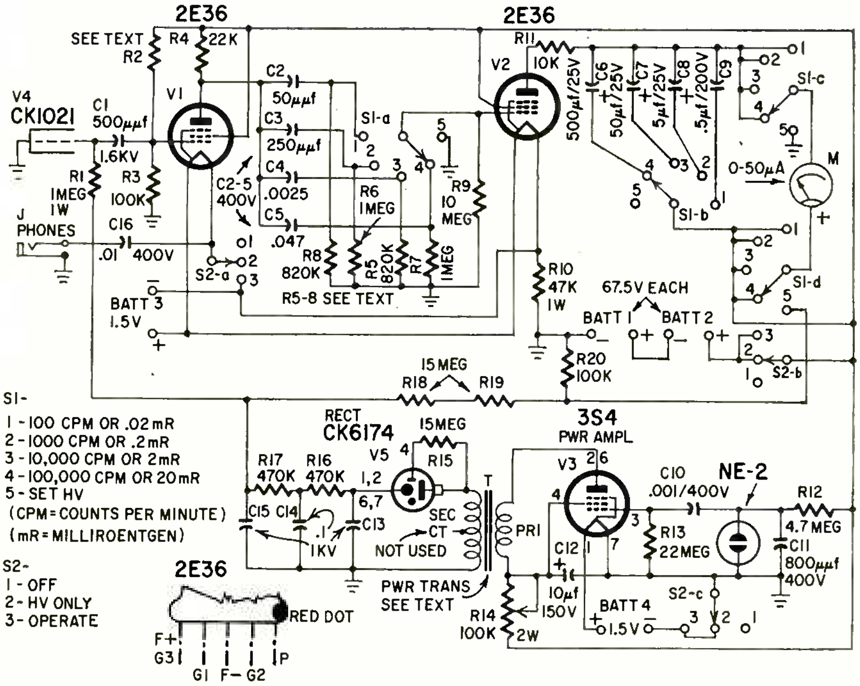
Fig. 5—Typical ion-chamber type radiation detector.

Fig. 5 is the schematic of a typical ion-chamber instrument. The measurement basis is a sealed chamber filled with gas or dry air. The chamber is "saturated" by a 22.5-volt battery, and any ions generated in the chamber are collected by the center electrode. The current from this chamber may be on the order of 10^{-10} to 10^{-11} amperes. Measuring such a small current accurately is a tough job. The 5886 electrometer tube is the only possible simple solution. The extremely high-impedance grid circuit accounts for the basic trouble with this type meter. Moisture has a great effect on the reading. The meter must be frequently balanced and corrected. In the past year I have repaired six of these instruments. In each case, the 5886 had to be replaced. This does not mean that the circuit is poorly designed—rather that the circuit is delicate, and when more reliability is designed in, cost increases appreciably.

Front-panel layout of precision Geiger counter.



Inside the Geiger counter.



R1—1 megohm, 1 watt, deposited carbon
R2—see text
R3—100,000 ohms
R4—22,000 ohms
R5, R8—820,000 ohms
R6, R7—1 megohm
R9—10 megohms
R10—47,000 ohms, 1 watt
R11—10,000 ohms
R12—4.7 megohms
R13—22 megohms
R14—pot, 100,000 ohms, 2 watts, linear taper
R15—15 megohms
R16, R17—470,000 ohms
R18, R19—15 megohms
R20—100,000 ohms
All resistors ½-watt 10% unless noted
C1—500 μμf, 1,600 volts, ceramic
C2—50 μμf, 400 volts, ceramic
C3—250 μμf, 400 volts, ceramic
C4—.0025 μf, 400 volts, ceramic
C5—.047 μf, 400 volts, paper
C6—500 μf, 25 volts, electrolytic
C7—50 μf, 25 volts, electrolytic
C8—5 μf, 25 volts, electrolytic
C9—0.5 μf, 200 volts, paper
C10—.001 μf, 400 volts, ceramic
C11—800 μμf, 400 volts, ceramic
C12—10 μf, 150 volts, electrolytic
C13, C14, C15—0.1 μf, 1,000 volts, paper
C16—.01 μf, 400 volts, ceramic
BATT 1, BATT 2—67.5 volts (NEDA 200)
BATT 3, BATT 4—1.5 volts (NEDA 11)
J—phone jack
M—microammeter, 0–50, (Lafayette TM-70 or equivalent)
S1—rotary switch, ceramic, 2-gang 4-pole 5-position
S2—rotary switch, 3-pole 3 position
T—any plate to push-pull grid audio interstage transformer
V1, V2—2E36
V3—3S4
V4—CK1021
V5—CK6174
Neon lamp, NE-2
Case, to suit
Miscellaneous hardware

Fig. 6—An accurate, battery-powered Geiger counter.

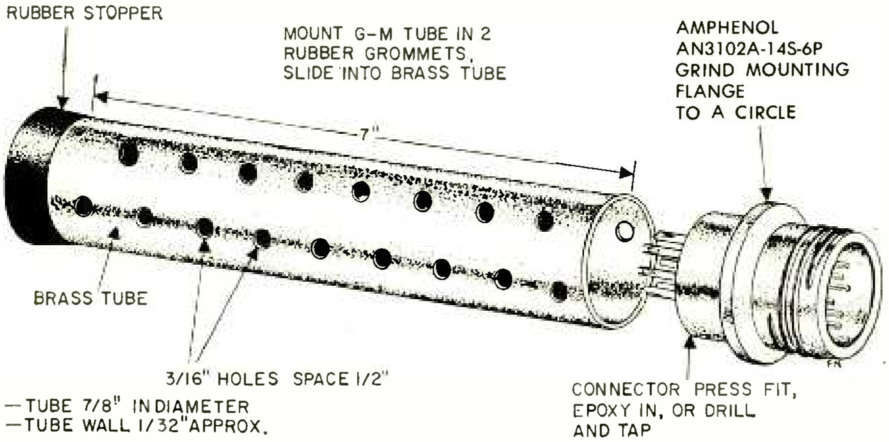


Fig. 7—Details of G-M tube housing.

Notwithstanding all these arguments, the ion chamber is the best high-level radiation surveying instrument now available. Servicing this type instrument is a problem. You *cannot* check the 5886 except by replacing it with a known good tube. You can make a careful check of batteries and circuit to discover any obvious defects. Be extremely careful when checking the meter, since it is usually very sensitive. One manufacturer markets an instrument with a 5-μa meter as the indicator. If there is no apparent trouble and the chamber appears sealed, your best bet is to substitute a good 5886.

At present, ion-chamber instruments are available that measure radiation from .01 milliroentgen to 10,000 Roentgen per hour. Although the present concern over fallout has served to drop prices on these instruments, they are still overpriced for the average person.

Pulse counting

So far in this article we have discussed methods of measuring the absorbed dose and the exposure dose rate, both methods being based directly on the ionization produced by the radiation being measured. Now we are going to discuss the third method of measuring radiation, pulse counting. All of us are familiar with Geiger-Muller counters. They work because gamma radiation excites the walls of the G-M tube, causing the gas within to be ionized by particles given out by the tube walls. Theoretically only 1% to 10% of the gamma radiation present is actually measured by a conventional G-M tube. Also, since the G-M tube measures particles or events, and the definition of a roentgen refers to the amount of ionization in a given volume of gas, the G-M tube cannot measure roentgens.

There is a way around this problem. If we pick a monochromatic radiation source (a source that radiates gamma radiation on one frequency) such as cobalt (60) or radium, and adjust the G-M counter to read correctly the proper roentgen value of the radiation, it will be correct on any other monochromatic source of similar strength. It will be accurate enough on other sources to give an approximate indication within 20% to 30%. Further inaccuracies are caused by particles that leave the source at different velocities (measured in electron volts, ev, or million electron volts, mev). The accuracy of a G-M counter is usually good enough for survey work, however.

In dealing with high-level radiation, such as in a radiography laboratory or with fallout from an atomic bomb blast, the G-M counter has a further big disadvantage. All G-M tubes have a dead time of from 80 to 300 microseconds. This "dead time" means that, as in all gas tubes, a certain length of time is required for the gas to deionize before it can begin another ionization period. With a dead time of 100 microseconds, any pulses occurring quicker than 100 microseconds apart will be lost. This limits the counting rate to 10,000 pulses per second, which roughly corresponds to 50 milliroentgens per hour. The bad thing about a G-M counter is that when the radiation field exceeds the maximum value, the G-M tube is continuously ionized, and the counter will go dead. There are several ways around this problem as we shall see shortly.

Home-built counter

Fig. 6 shows a precision home-built counter that is very accurate and stable. Fig. 7 shows details of the G-M tube mounting. The tube and instrument are connected with a 3-foot length of shielded two-conductor coil cord terminated in an Amphenol AN3106A-14S-6S connector. A matching connector is on the probe. The counter is rather elaborate. However, it has two advantages. The circuit is very reliable and basically very accurate. It *is* large and heavy, making it difficult to carry and use for any length of time.

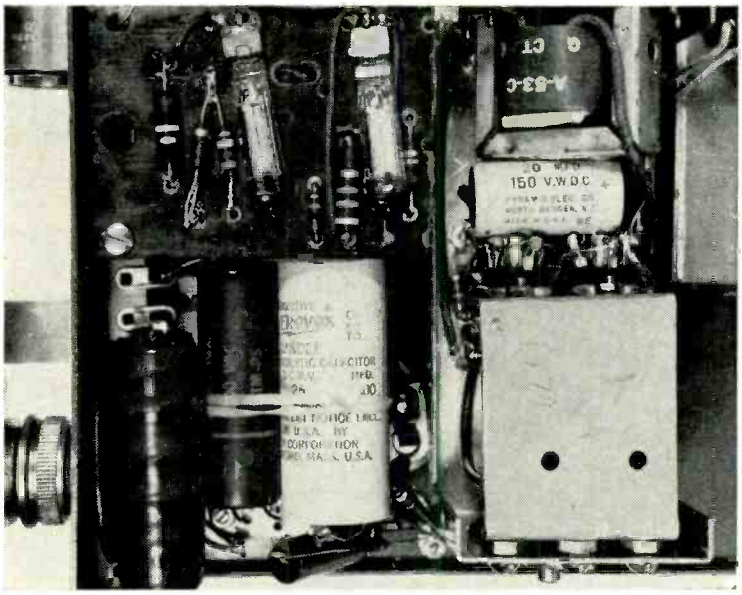
The instrument is built in two sections. The first is the high-voltage supply and the Geiger tube circuit. The high-voltage section is built in a separate small box between the counting-rate meter and the battery space. It consists of a neon-bulb oscillator that feeds a power amplifier. The amplifier output is stepped up by a plate-to-grid audio interstage transformer, and rectified by a cold-cathode rectifier tube. After filtering, the high voltage (variable from 600 to 1,100 volts) is applied through a limiting resistor to the Geiger tube. Pulses in the neighborhood of 1 volt peak to peak are obtained from the Geiger tube in normal operation.

The counting-rate meter comprises the second section of the circuit. Referring to Fig. 6, you can see that the counting-rate meter uses two tubes. The first is normally conducting and, due to common-cathode resistor R10, keeps the second tube, V2, biased off. When a pulse from the Geiger tube arrives at V1's grid, it cuts off this tube, V2 conducts and the meter indicates a count. Values for C6, C7, C8 and C9 are chosen to damp the meter properly by lengthening the pulse. Resistors R5, R6, R7, and R8 serve to calibrate each range of the meter. The counting-rate circuit can be calibrated with a pulse generator if you have one available. Using the values shown, your accuracy should be within 20%.

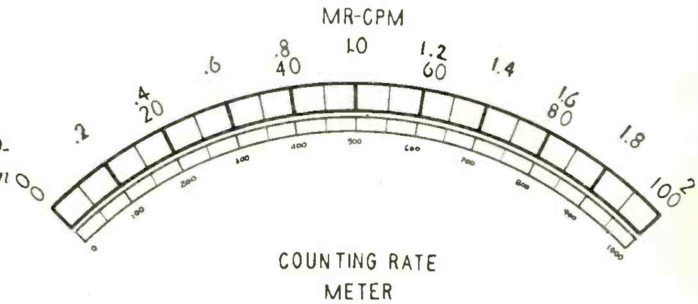
R2 determines the height of the negative pulse required to cut off V1. Normally, after construction is completed, you would turn on the instrument and have a potentiometer in place of R2. Vary the potentiometer until the meter reads background (about 40 to 60 counts per minute). Too much resistance here will cause V2 to draw a steady current and pin the meter. Too little resistance will prevent the radiation pulses from the G-M tube from cutting off V1. After determining the proper value for your meter, remove the potentiometer and replace it with a 5% fixed resistor.

Headphones or a small loudspeaker (with a matching transformer) can be plugged into J to give an audible indication of an increase in radiation.

If we keep in mind the limitations of the Geiger counter, it is very valuable in radiation survey work. It indicates beta as well as gamma radiation. It would be valuable inside a fallout shelter for checking radiation in food and water. Also the level of radiation outside the shelter could be approximated from inside. Most high-level survey instruments will not respond to low electron-volt or "soft" radiation. This radiation is lethal, and the G-M counter is the ideal instrument with which to measure it. Although the instrument cannot be calibrated in roentgens, an approximate calibration on cobalt 60 can be made.



A closer view of the inside of the Geiger counter.



Meter scale for the 0- to 50-μa meter used in the counter.

The counter can also be used to check a projection TV set for soft radiation.

As I said before, a G-M counter is usually limited to 50 milliroentgens before it goes dead. There are two ways of extending the range of these counters, however. The first is by operating the Geiger tube in its *proportional range*. On the home-built instrument described here, the usable proportional range is between 750 and 800 volts. The Geiger range starts at 850 volts. In the Geiger range, the radiation pulses are amplified by gas action in the tube itself. In the proportional range, this amplification does not exist. The pulses from the tube must be amplified about 100 times in proportional operation before they are large enough to operate the counting rate meter. By using such an amplifier, a high range of 500 milliroentgens can be established on the counter. The equivalent counts per minute would be approximately 2.5 million. Both C2 and C9 would have to be reduced.

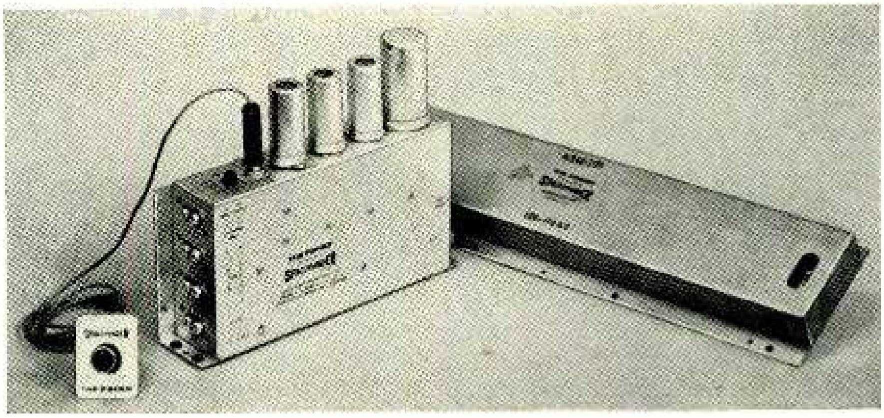
The second method of extending the range is by shielding the G-M tube with lead sheeting. The drawback in this is that different isotopes radiate particles and gamma rays at different strengths. An isotope of iridium, for instance, radiates on many wavelengths at several strengths. Lead shielding will apparently reduce the G-M counter reading since much of this radiation is stopped by the lead. A tube of lead ⅛ inch thick will reduce the reading by a factor of 20. When cobalt (60) is used in the same manner, the reading is reduced only by a factor of 0.9. Thus, two inches of lead would be required to reduce the reading by a factor of 100. In general, Geiger counters must be considered of little use in radiation areas above 50 milliroentgens. They are, however, ideal for low-level surveying.

A person working with radiation or concerned about possible fallout detection would have a good combination of detecting instruments in a dosimeter and a Geiger counter—the dosimeter to read the high-level radiation of absorbed dose, and the G-M counter to survey low-level areas or possible food contamination. Home-built ion-chamber instruments are not generally considered practical, since from the average person's standpoint, they cannot be calibrated and are useless. END

More on reverberation units

These delay line and mixer circuits are inserted at the preamp output

By ROBERT F. SCOTT
TECHNICAL EDITOR



Fisher's K-10 Spacexpander.

IN THE DECEMBER ISSUE WE DISCUSSED reverberation and saw how it can be created artificially with electromechanical delay lines. We also covered circuits of add-on units that connect across the speaker terminals of an audio system and include a separate amplifier and speaker to reproduce the delayed (reverberation) signal. Now, let's take a look at the delay-line and mixer circuits inserted in series with the signal path at a low-level point in an audio system. A portion of the signal voltage is tapped off, delayed and then mixed with the undelayed signal in a following stage.

Sargent-Rayment SR-202

The circuit of the SR-202 Reverbatron is shown in Fig. 1. This unit, designed for use with late-model Sargent-Rayment composite stereo amplifiers and FM tuner–amplifier combinations, is easily adapted to other high-quality audio systems. B-plus and heater voltages can be taken from power supply sockets on such amplifiers as the Acro, Marantz and McIntosh. The SR-900 power supply is recommended when the Reverbatron is used with amplifiers that do not have enough reserve power-supply capacity.

In systems consisting of preamplifiers and basic amplifiers on separate chassis, the SR-202 is connected between the preamp output and amplifier input. In composite preamp–amplifier systems, the reverb unit should be inserted in the circuit at a point where the signal is as high as possible, without being included in a feedback loop. Usually, this point is between the last pre-amp stage and the volume control.

The SR-202 has two controls. The SELECTOR determines the mode of operation. In the NORMAL position, the input and output jacks for each channel are tied together so the reverb circuits are removed from the amplifier chain. The REVERB position inserts reverberation into both channels. ECHO L switches the full delayed signal into the left channel. This develops a monophonic reverb sound that is delayed when compared to

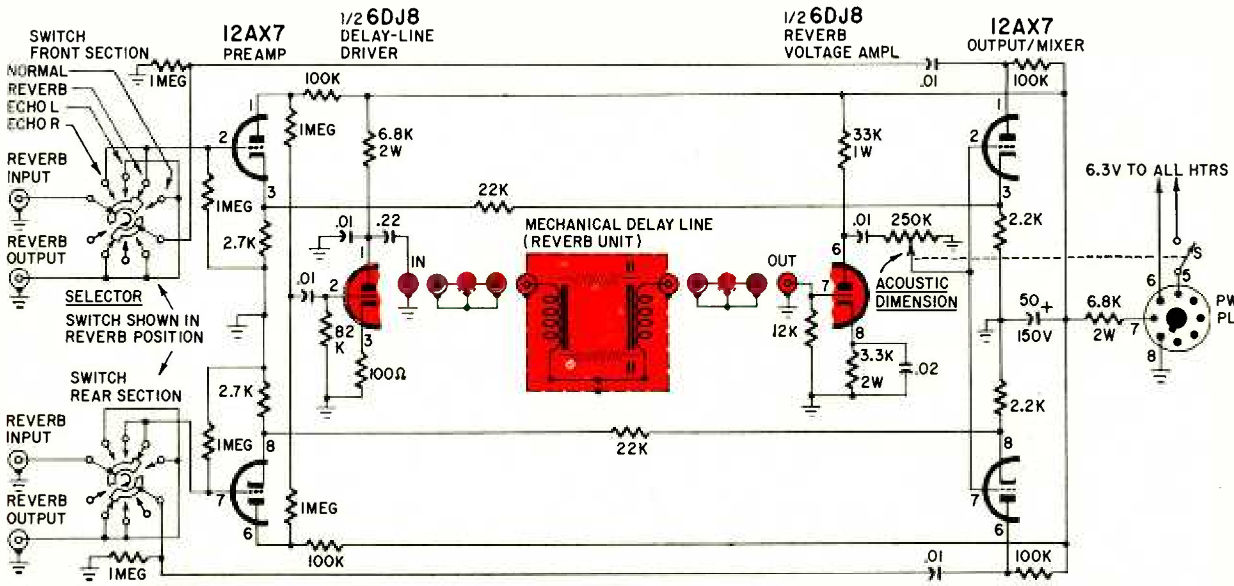


Fig. 1—Circuit of the SR-202 Reverbatron by Sargent-Rayment.

the right channel. This single-channel delay produces an echo effect when listening to stereo. In the ECHO R position the echo comes from the right side of the system. The ACOUSTIC DIMENSION control sets the amount of delayed signal fed to the output.

Stereo signals fed to the preamp grids appear in the plate and cathode circuits. The signals from the plates are fed through 1-megohm resistors and mixed (A + B) at the grid of the delay-line driver. This sum signal is delayed in the delay line and then fed from the reverb amplifier to the paralleled output grids through the ACOUSTIC DIMENSION control. The output tubes are operated as mixers. The signals from the preamp cathodes are fed to the output cathodes through 22,000-ohm decoupling resistors. The delayed signals at the output grids and the undelayed signals on the cathodes combine in the plate circuits to provide reverberation in each channel. Thus, we have a fixed amount of direct or undelayed signal fed straight through from the preamp to output through cathode coupling while a controllable amount of delayed sum signal is fed to the right and left channels.

Knight KN-701

This reverb unit (Fig. 2) is similar in circuitry and operation to the Reverbatron in Fig. 1 but does not include a function selector. Although it is basically a stereo unit, it can be used in a monophonic circuit by using only the A or B input and output jacks. It can be used without circuit modifications on any composite preamp–amplifier that has a front-panel TAPE MONITOR switch and in systems consisting of separate preamps and amplifiers. The only limitation is that the preamp or tape recording output jack must not deliver more than about 1.25 volts.

When the system has tape-monitor facilities, the leads from the TAPE RECORDING OUTPUT jacks are plugged into the input jacks on the KN-701 and leads from the output jacks are plugged into the TAPE MONITOR jacks. In composite amplifiers without tape-monitor facilities, the circuit can be modified as in Fig. 3 so the KN-701 can be inserted in series with the hot lead to the volume control. The conventional volume-control circuit (for one channel) is shown in Fig. 3-a. Fig. 3-b shows how phono jacks are inserted in series with the hot lead to the volume control. If the signal at the high end of the volume control exceeds 1.25 volts, connect the jacks between the arm of the control and the following stage as shown in dashed lines.

The KN-701 with tape recorders

Reverberation added to tape playback leaves the original tape unaffected. In this case, you simply play the tape through a system with reverberation added. You have two alternatives when adding reverberation while making a recording. The simplest is to use a separate mike preamp with the reverb unit in series with the high-level radio input jack on the recorder (Fig. 4).

The other alternative is to modify the wiring in the recorder so the reverb unit can be connected between the output of the mike preamp and the rest of the recording circuit. The dashed lines in Fig. 5 show how a dpdt switch and jacks (two for each channel in a stereo setup) can be added for connecting the KN-701.

Fisher K-10 Spacexpander

This is perhaps the most versatile of the add-on reverberation units that we have seen. It can be used in a number of ways in monophonic and two- and three-channel stereo hookups and can be used to convert a stereo system

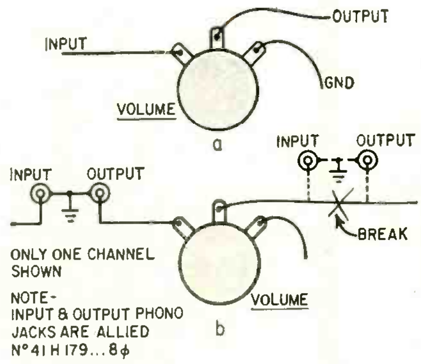


Fig. 3—Modifying the composite amplifier for use with the KN-701: a—conventional wiring of volume control (one channel): b—modification to use KN-701.

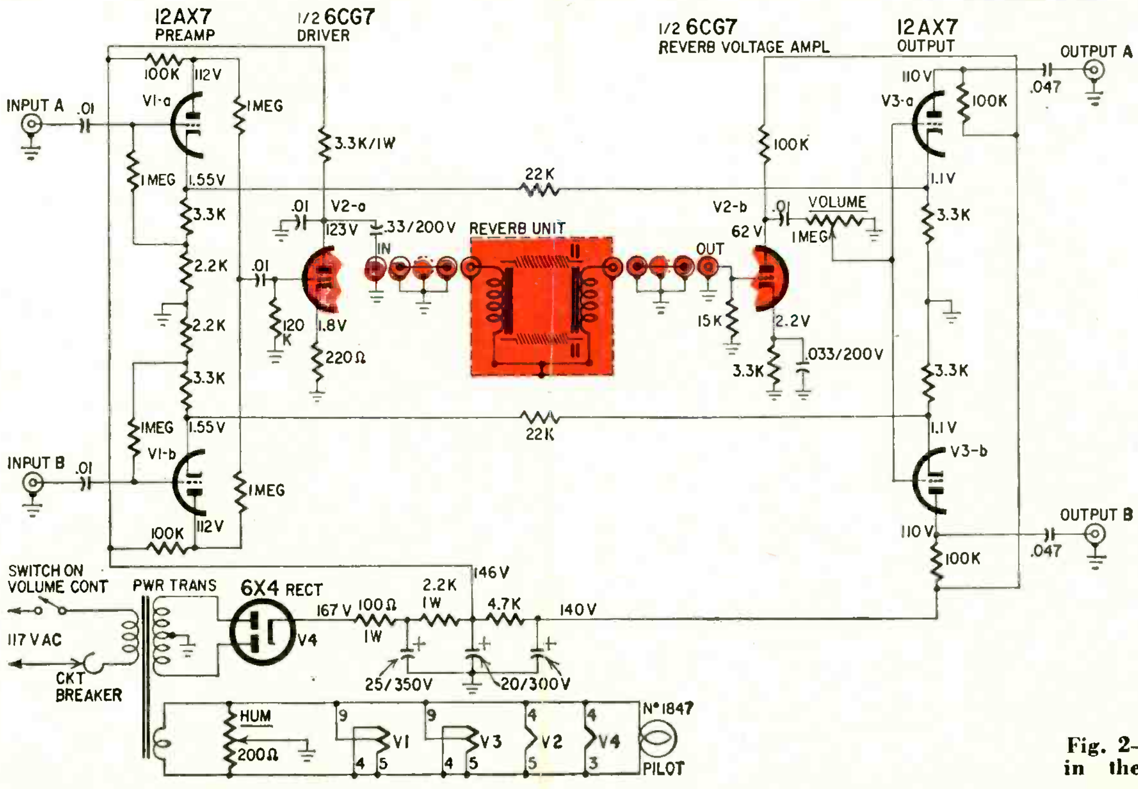


Fig. 2—There are 4 tubes in the Knight KN-701.

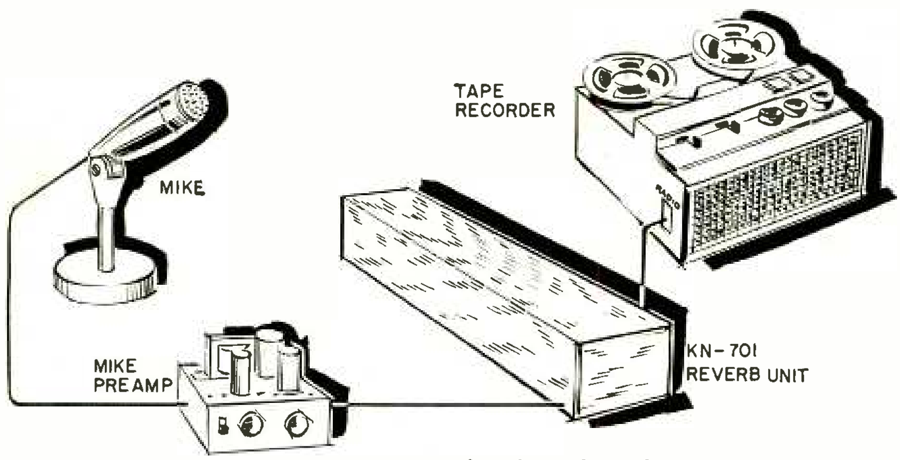


Fig. 4—Use a separate mike preamp with reverb unit in series with the high-level radio input jack on the recorder.

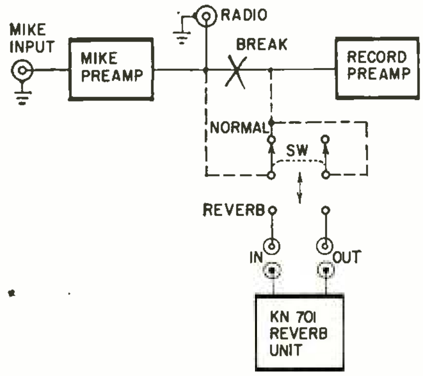


Fig. 5—An alternate is to modify the wiring in the recording preamp of the tape recorder and add a switch and extra jacks to allow for connecting the KN-701.

Fig. 6—The Fisher K-10 Spacexpander. The Spacexpander control plugs into the remote-control jack.

for three-channel operation.

Having zero circuit gain, this unit operates satisfactorily with voltage inputs ranging from 0.2 to 5 volts so it can be inserted at almost any convenient point in an amplifier chain. Input impedance is 250,000 and output impedance 2,000 ohms. Delay time is 33 milliseconds and maximum decay time is 2 seconds at 300 cycles.

The circuit is shown in Fig. 6. Signals from channels A and B are matrixed in R1, R2 and R3 to produce a sum signal on the grid of amplifier V1-a. Cathode follower V1-b is transformer-coupled to the input of the Hammond delay line. The time constants of coupling networks C1–R3 and C3–R7 roll off frequencies below 250 cycles. The output of the delay line goes to a two-stage amplifier (V2). The upper frequency response is restricted to around 6,000 cycles by a 12-db-per-octave low-pass filter between V2-a and V2-b and feedback from V2-b's plate to V2-a's cathode.

The SPACEXPANDER control that plugs into the plate circuit of V2-b varies the amount of reverberation signal applied to the grids of V3-a and V3-b. A part of the original signal from each channel is fed directly to the output grids through decoupling resistors R20 and R23. The MODE SELECTOR (S2) permits the K-10 reverb unit to be used for three types of operation.

In the NORMAL position the undelayed signal from each channel is mixed with the delayed A + B sum signal to provide reverberation in both outputs. (A monophonic signal in channel A or B produces a reverberated signal in the corresponding output.) The SPACEXPANDER control varies the amount of reverberation added from zero in the minimum position to a maximum of 50%.

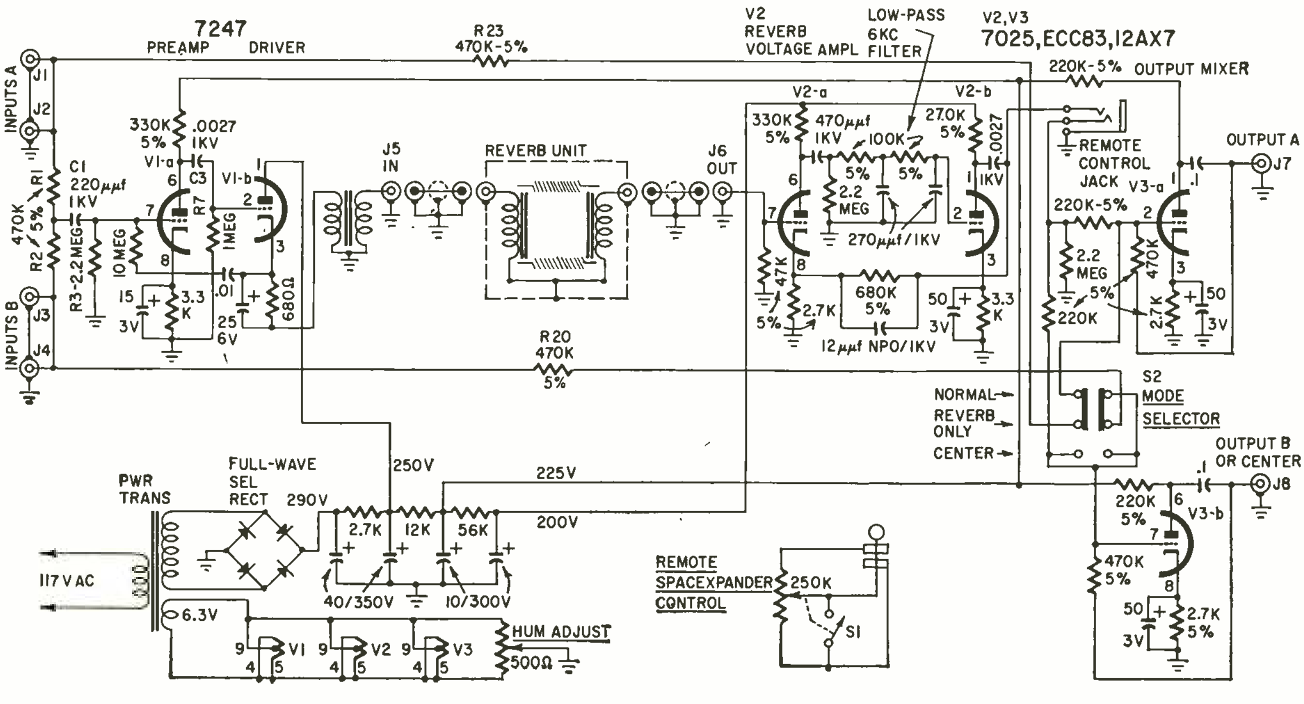
The REVERB ONLY and CENTER positions of S2 are used only for three-channel operation or for special recording effects. If the stereo setup includes a preamp or control amplifier with center-channel output, the K-10 can be connected as in Fig. 7 with the MODE SELECTOR in the REVERB ONLY position. In this case, reverberation is added only to the center channel. The signal is fed to one of the channel-A inputs, is delayed, then passed to the channel A output without being matrixed. The volume control on the center-channel power amplifier sets the lever of the delayed reverberation.

Another method of operating a three-channel system is to leave the switch in the NORMAL position. This adds a variable amount of reverberation to the center channel and provides an unreverberated center channel output when the SPACEXPANDER control is turned fully counterclockwise or its knob pulled out to close S1.

A stereo system that does not have center-channel output facilities can be converted to three-channel operation by using the setup in Fig. 8 and placing the MODE SELECTOR in the CENTER position. This method of operation provides a reverberated A + B signal at J8.

CBS reverberation unit

The delay line in this unit is a



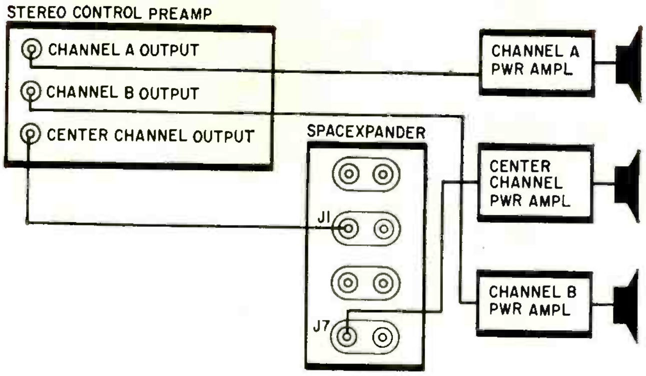


Fig. 7—Reverberated center channel with separate 3-channel preamp.

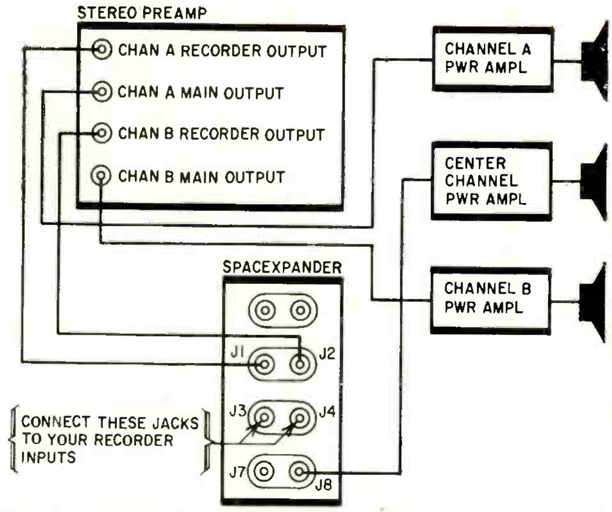


Fig. 8—Three-channel conversion with the Spacexpander.

CBS Electronics development. It consists of a single coil spring with barium titantate pickup transducers at each end and an electromagnetic driver vibrating the spring at a point about 30% in from the center (Fig. 9). Audio vibrations from this point reach the pickups at different times. Some of the mechanical signal energy reaching each pickup is reflected back to the other end and excites the other pickup. The pickup signals are combined with the original signal to produce reverberation.

The basic monaural circuit of the CBS Electronics RV1-3M reverberation unit is shown in Fig. 10. The signal is tapped off the audio system at a point where signal voltage is about 0.5. The amplified signal at the plate of V1-a is transformer-coupled to the input of the delay line. The delayed signal goes to the grid of V1-b through the REVERB GAIN control. When the control's arm is at the ground end, no delayed signal is fed to V1-b and only undelayed straight-through signal appears in the output. The straight-through signal is taken off the unbypassed screen grid of V1-a and fed to the cathode of V1-b through 100,000 ohms. Thus the mixer, V1-b, is a grounded-grid amplifier for the undelayed signal and a grounded-cathode amplifier for the delayed signal. The amount of reverberation is controlled by advancing the REVERB GAIN control. (CBS-designed audio equipment is now being manufactured and sold by Audiophonics, 95 Ranpoul St., Beverly, Mass.)

Installing reverb units

The reverberation units described in this article consist of the electronic circuitry (control unit) and the electromechanical delay line. The control unit is generally mounted in a convenient spot close to the controls of the rest of the system. The delay line must be mounted horizontally with the flanges in a vertical plane. It can be fastened to the back of the equipment cabinet, or any convenient spot within reach of the interconnecting cables. Just be sure to keep it as far as possible from the speakers or you will have trouble with acoustic feedback. END

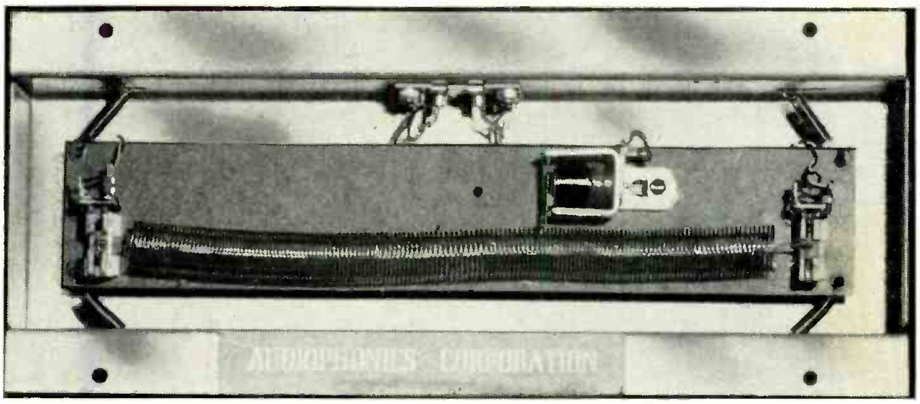


Fig. 9—The delay line used by CBS. It is now being handled by Audiophonics Corp.

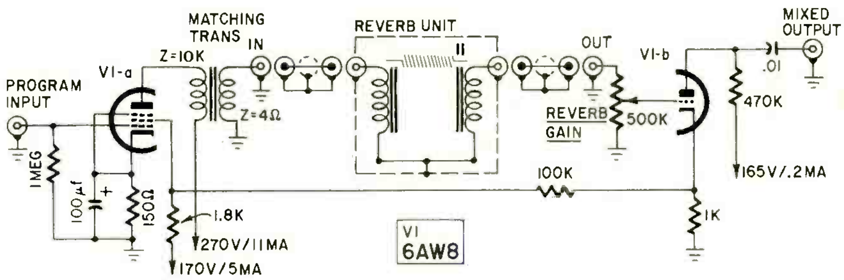
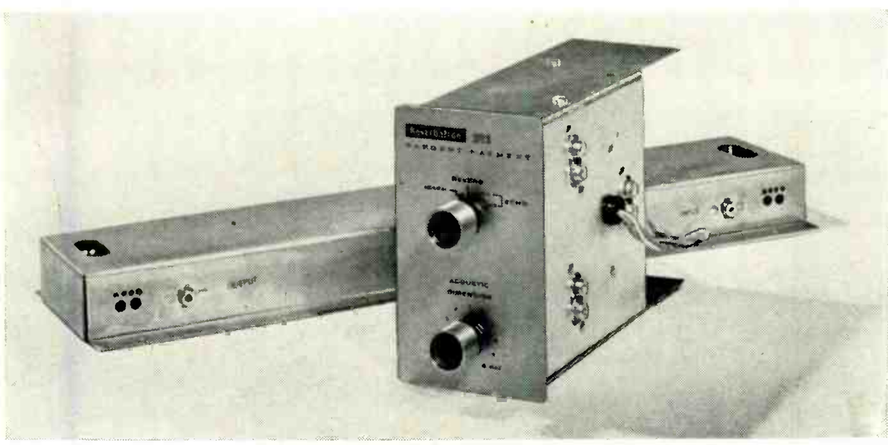


Fig. 10—This driver and mixer circuit is used in CBS reverberation unit.



Model SR-202 Reverbatron by Sargent-Rayment.

TV Monocle gives Extra Eye to wearer

This 30-ounce device gives the wearer "eyes in the back of his head" or even at far-distant points. *Electrocular* is an actual TV picture tube, worn on the head, with an eyepiece made of such material and so angled that the wearer can view the image on the television screen or look right through it at the scene beyond. The eyepiece is a dichroic (light-splitting) lens, set at an angle of 45° to the viewer's eye. This lens is at the end of a short tube, at the other end of which is another angled mirror which picks up the image from the face of the TV tube (the longer tube) and deflects it to the viewing lens at the side of the viewer's head.

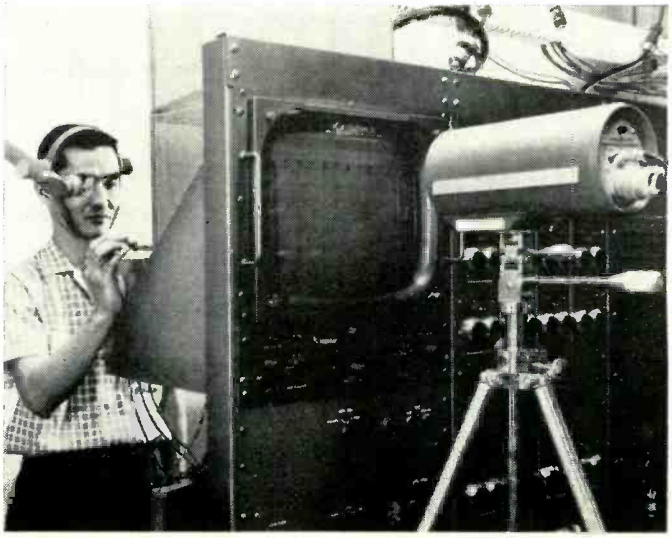
The TV tube itself is 7 inches long and 1⅜ inches outside diameter. It produces a much bigger picture than might be supposed, due to its closeness to the eye. The image has the standard 525 lines and the tube has 3,000 volts on its accelerating anode.

Only a few of the possible applications are shown here. At upper left, an airplane pilot is supposed to be viewing a picture of air traffic information televised to him from the ground while watching the instrument panel and carrying on his normal flying duties.

In the photo at lower right, adjustments are being made at the rear of a digital computer, while the TV camera is photographing the results on the display screen in front. (This would seem to open some interesting opportunities for the TV repair man.)

Lower left shows a possibly vital operation in airport control tower work, in which the problem of too many things to look at simultaneously is being solved with the help of the little head-mounted TV set. Without it, one would have to walk back to the fixed central display console for the information now transmitted to the Electrocular.

Electrocular can also be used in wartime. Officers on the bridge could view the board of a central information center many decks below, adding radar information to that being obtained with their own eyes. Operators and gunners on combat land vehicles could see a view of the field ahead as televised from a plane above, as well as their own eye-level view. In industry, workers could use Electrocular to keep instructions on wiring and installation of complex components directly ahead of the eye while working, making it unnecessary to turn away from the job to consult blueprints or printed instructions. A surgeon wearing an Electrocular could continuously scan data on the patient's pulse rate and breathing, without pausing in the operation. END



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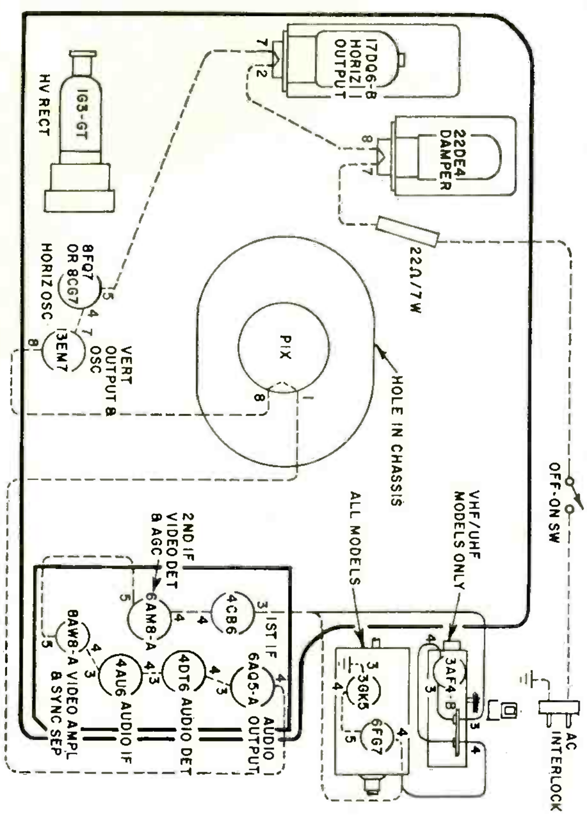
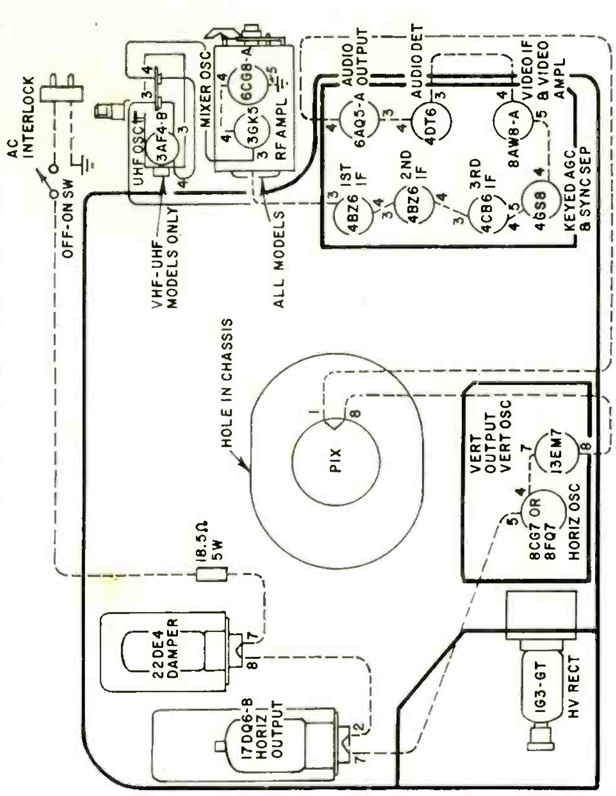


528 or 456.51780 thru .51799, .51820 thru .51829,
.51842 thru .51857, .51880 thru .51897



528 or 456.52230 thru .52237, .52402 thru .52419

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TRIM HERE AFTER FOLDING

Radio-Electronics

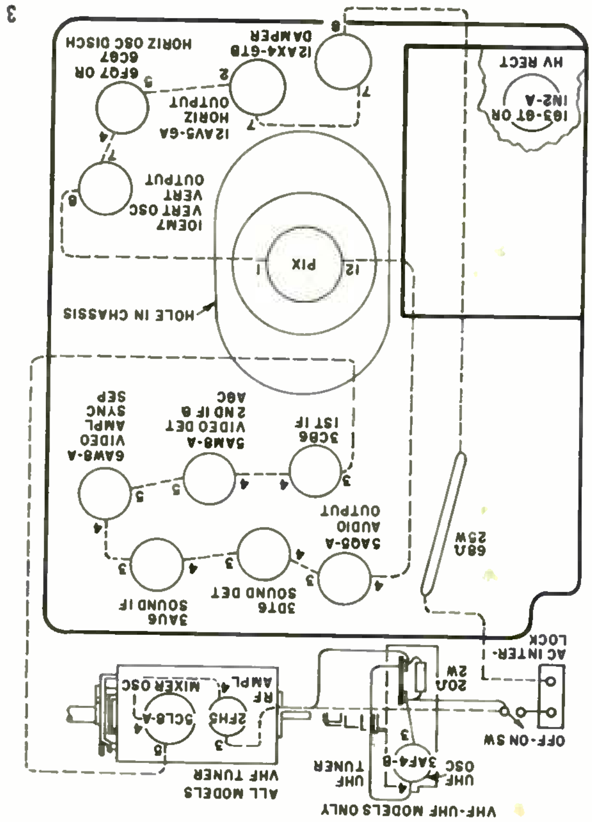
TUBE LAYOUTS IN TV SETS

Compiled by Larry Steckler, Associate Editor

SILVERTONE
1960—1962

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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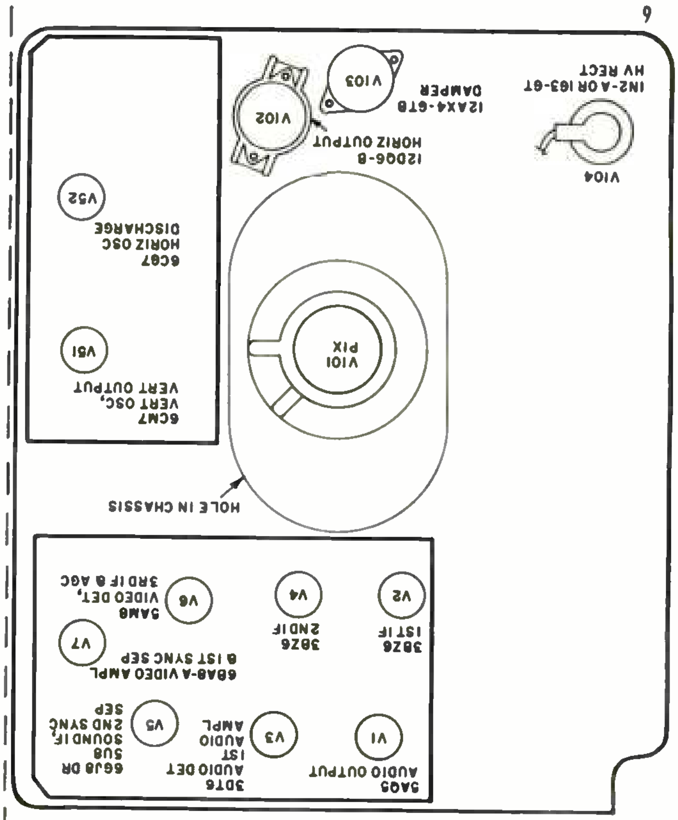

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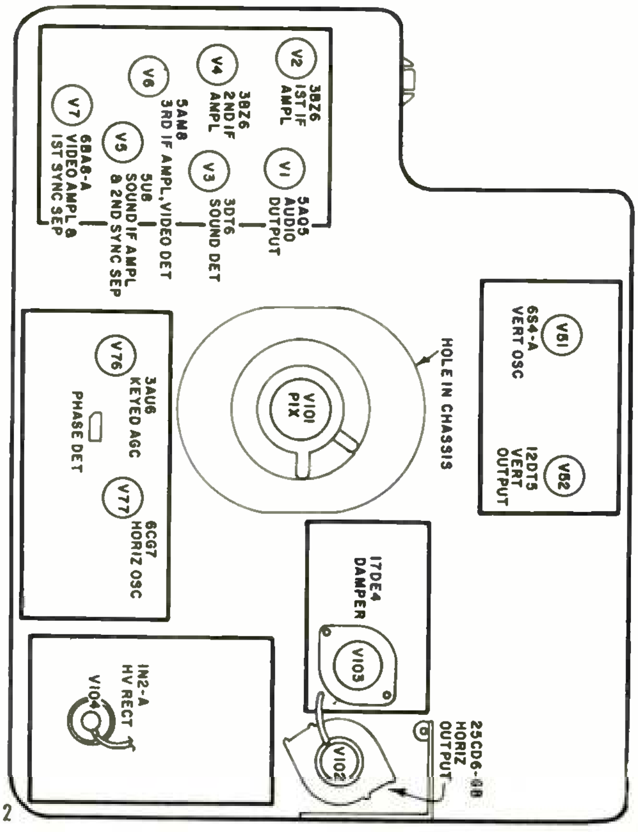

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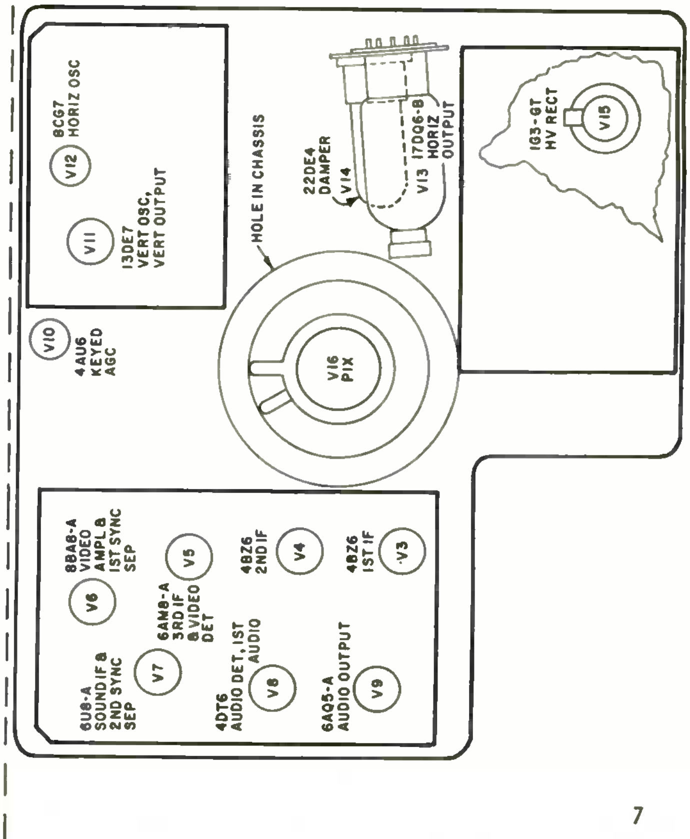
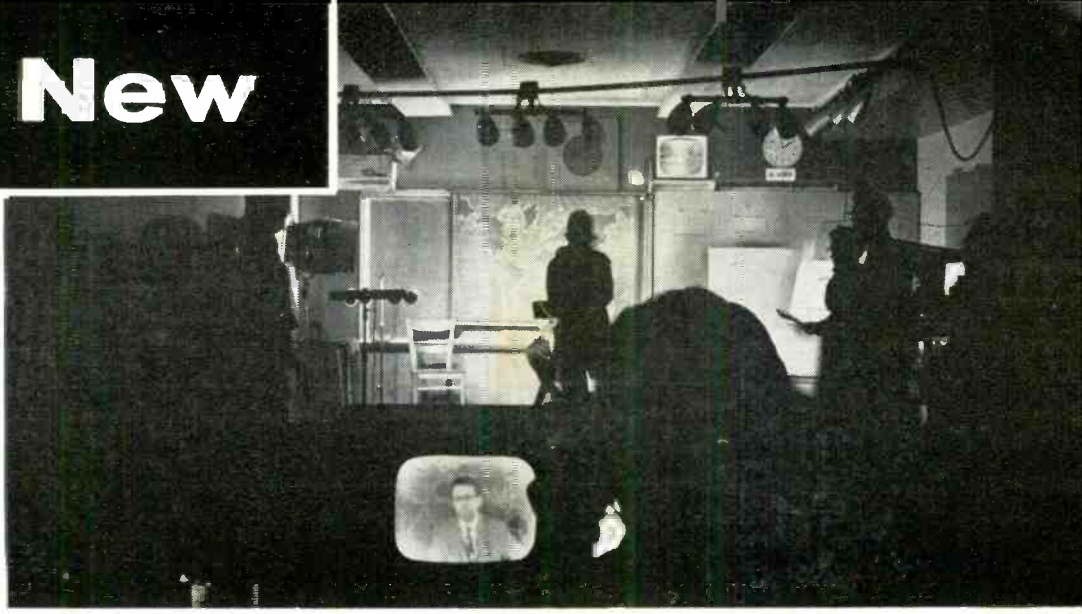
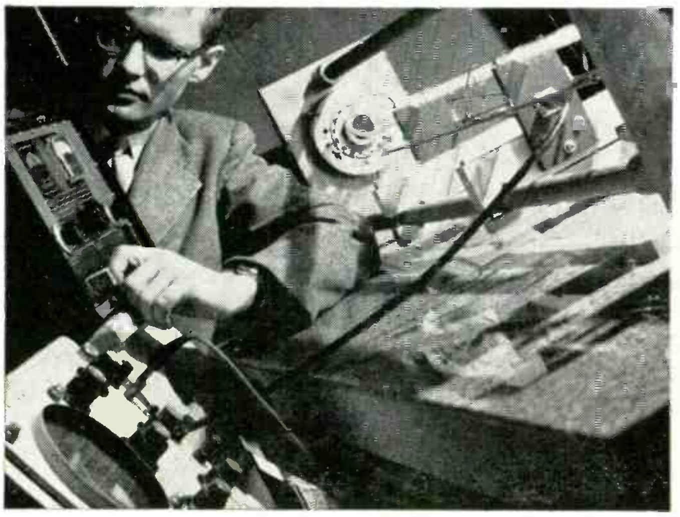


What's New

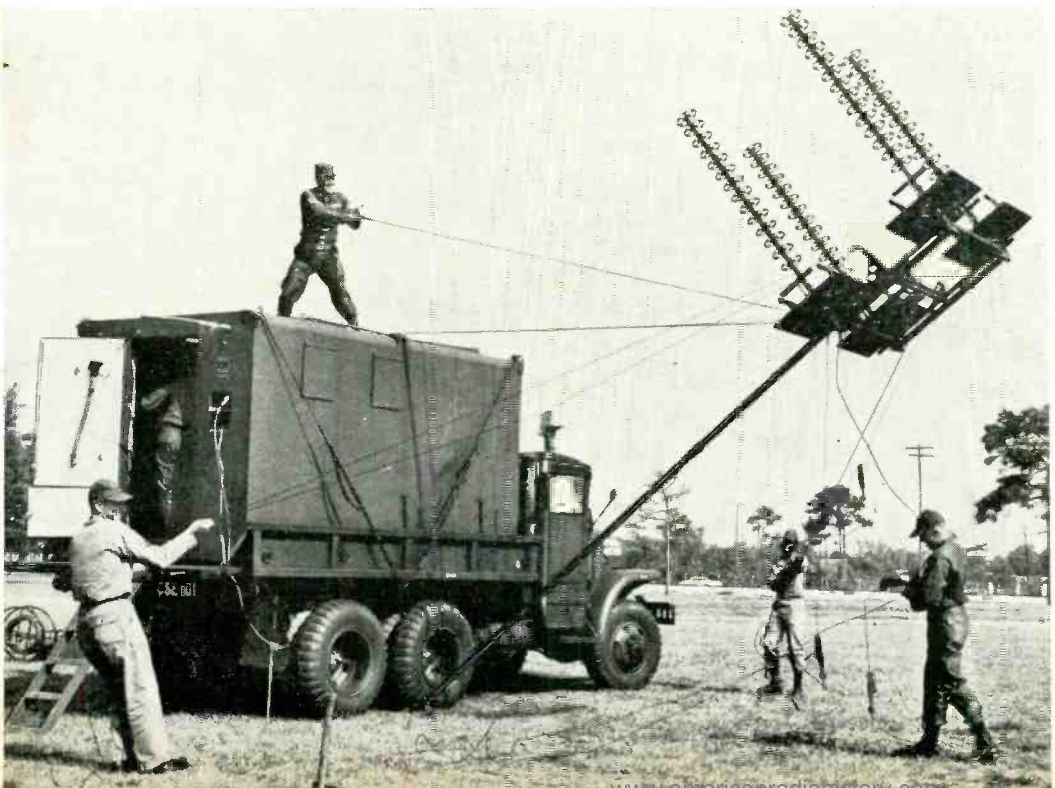


TV CLASSROOM originates closed-circuit TV lesson in Plainedge, N. Y., high school. Program can be transmitted on the air to other schools in the district over 2,000-mc system, forming an ETV net. System, developed by Adler Electronics, can be expanded to provide 10 channels simultaneously.

SPACE RADAR SYSTEM uses this helium-neon laser (the glowing tube at the right). The unit emits an intense narrow beam of infrared light. Sperry is now evaluating the new radar system, which is intended to give an accurate reading of target speed.



HYDROPHONE PREAMPLIFIERS use transistors and nuvistors for low-noise wide-band underwater amplification. They can operate at great depths for many years while transmitting precise acoustic data over miles of connecting cable. The preamps are made by Lockheed Electronics.



INSTANT RADIO STATION can be on the air minutes after its arrival in the field. Completely self-sufficient, it was developed by the National Company and is being used by the Air Force Systems Command in a Trans-European communications link.

There's more to calibrating the signal gen...

If you want your sig gen "on the nose," you have to do some things even before buying it!

By GEORGE D. PHILPOTT

THERE IS MORE TO CALIBRATING THE WELL designed marker or other signal generator than following step-by-step instructions given by the manufacturer, or even the more detailed information in my article in the August, 1961, issue of this magazine. Each generator presents its individual problems—has its own limitations and offers its special opportunities for better-than-average calibration. The know-how required to meet this challenge is one thing the manufacturer did not include with the instrument.

The first thing to be sure of when buying an rf signal generator—kit or assembled—is that it will satisfy *your* particular needs. Some signal generators are fine for tuning up a crystal set, others—once properly aligned—make excellent bench aids. But certain important features are found only in more expensive kits, or the higher-priced assembled sets.

Important features

Just about the most outstanding part any decent generator can have is an anti-backlash gear-drive tuning mechanism. The planetary-drive vernier is next best, but will not permit adding a calibration type knob for close reset accuracy. Without a precision dial-drive arrangement, it is virtually impossible to chart the instrument at those often-used frequencies. Close calibration is meaningless due to backlash or slippage.

Second is proper shielding. For an rf generator to be useful as a marker for TV work, it must supply accurate pips on the scope trace and the technician must be able to attenuate these marks low enough so they will not swamp the bandpass setup of the sweep generator. Poorly shielded rf generators often radiate enough energy with the attenuator set at zero to distort a normal bandpass pattern on the oscilloscope screen.

Features usually stressed by reliable and experienced kit manufacturers, such as voltage regulation, fully shielded copper-plated chassis and a line filter are also worth considering when selecting an rf signal generator.

For a constructor to expect and get pin-point accuracy, the finished instrument must be carefully and patiently calibrated. However, before attempting such a task, study the schematic furnished with the kit to determine the type of basic oscillator used (Hartley or Colpitts). The constructor should also familiarize himself with the tuning (L-C) network; coils, tuning capacitor and range-switch arrangement.

If an rf signal generator lacks the luxury of alignment trimmers, installing them is not too difficult. Ordinary mica trimmers are not recommended—temperature variations affect their capacitance. Centralab 822-EZ (1.5 to 7 $\mu\mu f$) ceramic dielectrics provide the necessary stability. Hammarlund MAC-10 (1.7 to 8.7 $\mu\mu f$) miniature variables make excellent high-frequency trimmers. Regardless of the type (air-spaced, or ceramic dielectric) mount them on the rear apron of the rf generator chassis, as close to the coils as possible, but available for adjusting through holes drilled in the instrument case.

With a Hartley oscillator circuit, trimmer rotors are grounded in a common configuration to avoid body-capacitance effects during alignment. Stators are connected individually (leads kept short as possible) to the terminals on the band switch that are connected to the individual range coils (grid ends). Fig. 1 is a schematic of a Hartley oscillator circuit, trimmers added, of a popular-brand instrument.

Fig. 2 is a Colpitts circuit split-stator type L-C network, showing a method of adding trimmers to compensate individual range bands. Since any trimmer capacitance added amounts to less than 10% of total circuit capacitance, the inherent stability of this particular oscillator will not be noticeably affected. A larger trimmer capacitor might upset the feed-back ratio of the circuit and cause instability. This is particularly true at the upper frequencies where close accuracy is important.

One other kit tip before going into the rather detailed explanation of instrument calibration: Some generators do not have a dc isolation capacitor in series with the output lead. Of course, at this point the question, "Why is such a component needed—rf voltages are ac and effectively travel through the capacitor?" is raised.

The answer: Most rf signal generators have a potentiometer, 250,000 ohms or less, connected as a voltage divider to fixed-resistance decade steps of the attenuator switch. If dc isolation is not provided, the first time the alligator clip on the rf cable accidentally touches a hot line in a receiver—smoke! And most of it coming from the signal generator. When that happens, examination usually discloses attenuator resistors split at the seams like dry logs, and the potentiometer, if positioned near ground of the resistance element, burned open. So, when an isolation capacitor is not part of the circuit or kit, install a .05-μf 600-volt tubular in the instrument in series with the rf output to the coax connector and avoid a discouraging mishap.

Fig. 1—Some form of Hartley circuit is used in many signal generators.

Fig. 2—Colpitts circuit, showing how trimmer capacitor is added.

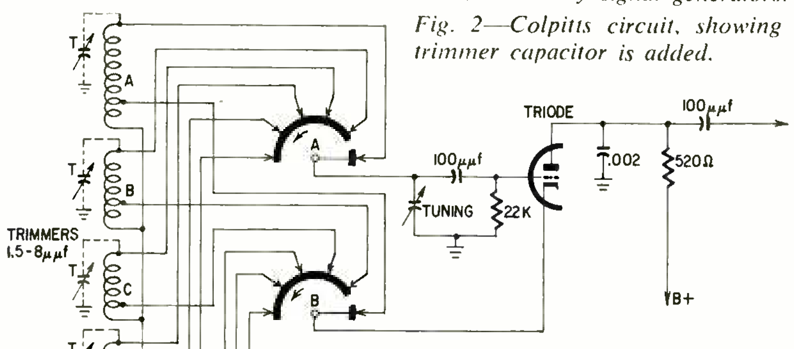


Fig. 1

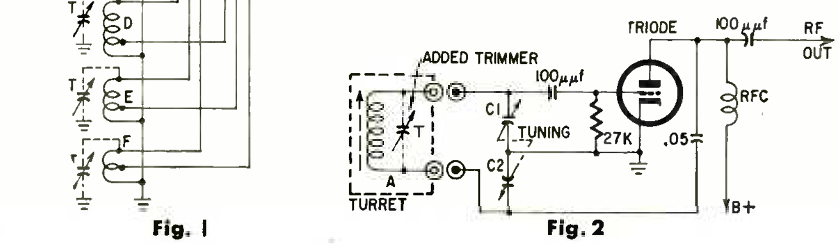


Fig. 2

Facts, figures and procedure:

Because harmonics are as useful during receiver alignment as fundamental frequencies, a brief review of harmonic interpretation may be helpful. As we know but sometimes forget, harmonics are always higher in frequency than a fundamental wave. They sometimes range to usable overtones 300 multiples higher than the fundamental.

Often confused with harmonic radiation are "beat signals," which are usually the difference frequency between two fundamental frequencies or their harmonics. Beat-frequency oscillations are the result of two fundamentals re-inforcing or canceling each other at wavelengths equal to the sum or difference frequencies between them. Beat frequencies also exist between harmonic frequencies or between a fundamental and a harmonic wave.

To emphasize the every-day practicability of using harmonics in ordinary electronic equipment, some FM receivers have been designed so the oscillator's second harmonic, rather than a higher-frequency fundamental, beats with the incoming FM signal to provide the 10–7-mc frequency for the receiver if's. This minimizes oscillation problems at higher frequencies. The radiation is reduced at frequencies that might otherwise cause serious TVI problems. And circuit stability is improved because rf leakage at a fundamental "lower" frequency in the oscillator circuit is reduced.

Therefore, harmonics are important and should be tentatively investigated and the results understood. In many instances, it is necessary to use harmonics to align an rf signal generator to often-used fundamentals, as, conversely, harmonics from the generator are often used for checking and alignment purposes. The highest band on more than one vhf signal generator (especially the older ones) is the harmonic of one of the lower bands.

In conclusion a few facts on rf signal generator alignment techniques in general: Each kit or factory-assembled instrument may be expected to present an individual problem of construction and alignment. Many variables are present, probably too numerous to be completely covered in any single article.

As the experienced technician knows, the job of receiver calibration is often one of patience and skill. The finesse required to align a radio or television receiver accurately comes with experience.

The task of a constructor attempting to align an instrument which will be used to align electronic equipment must be even more exacting. Experience will be a contributing factor to success.

Therefore, do not be discouraged easily. The instrument may need new trimmers to replace those worn out from adjustment during alignment, but this is unimportant. The important thing is experience—and it never fails to come to a man determined to re-align his future. END

SW PROPAGATION FORECAST

Aug. 15—Sept. 15 **By STANLEY LEINWOLL***

Mid-August to mid-September is the transition period from summer to fall propagation conditions. In September, the trend toward higher usable daytime frequencies begins, while nighttime frequencies begin to decrease.

Noise levels begin to drop significantly, making long-distance reception in the lower portions of the high-frequency spectrum possible with increasing regularity. In addition, sporadic-E propagation, which has been notable throughout the summer months, also trails off significantly in September.

The tables show optimum frequency in mc for propagation of shortwave signals between locations shown during indicated time periods.

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.

For example, a resident of Los Angeles would use the Western USA tables. At noon, PST, signals to and from the Far East would be optimum in the 14-mc band. A radio amateur would, therefore, be most likely to communicate in the 20-meter band, while the listener would first try the 15-mc international broadcast band, and follow this with the 11-mc band.

These tables are designed primarily as a guide; day to day variations in receiving conditions can be considerable. At certain hours, propagation over some paths given may be extremely difficult, or impossible. This will depend on the type of service, antenna characteristics, transmitter power, etc. The curves from which data in the tables are derived are based on an effective radiated power of 10 kw. These curves are representative for the paths given. They are valid from the center of one area to the center of another. Eastern USA-Western Europe data were taken from a Washington, D.C.-Bern, Switzerland, curve. In general, for locations in the northern area of your zone, frequencies will be somewhat lower. On circuits farther south, either transmitting or receiving, frequencies 1 or 2 mc higher than those given will be best.

EASTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	7	6	7	10	14	16	16	16	14	14	10	8
East Europe	7	6	7	10	14	14	14	14	14	10	10	8
Central America	12	10	10	17	20	20	20	20	20	17	13	13
South America	14	11	10	10	14	15	15	15	15	15	15	14
Near East	8	6	7	10	14	15	16	16	14	14	8	8
North Africa	8	6	7	8	14	15	16	16	15	14	10	9
South & Central Africa	10	8	8	13	14	15	16	18	14	10	10	6
Far East	10	8	7	7	10	10	10	10	13	15	15	13
Australia & New Zealand	10	10	10	8	10	10	10	12	13	15	15	15

CENTRAL US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	7	6	8	10	13	14	15	16	14	10	10	8
East Europe	8	8	8	10	14	14	15	15	10	9	9	9
Central America	13	11	10	13	20	20	20	20	20	20	15	13
South America	10	9	8	14	14	15	15	15	15	15	15	14
Near East	8	8	10	10	15	15	15	15	14	10	10	9
North Africa	8	6	7	10	14	14	15	16	15	14	10	8
South & Central Africa	10	9	10	14	14	14	14	15	14	10	10	10
Far East	10	8	7	7	10	10	10	14	14	15	16	15
Australia & New Zealand	10	10	8	8	10	10	10	14	14	16	16	16

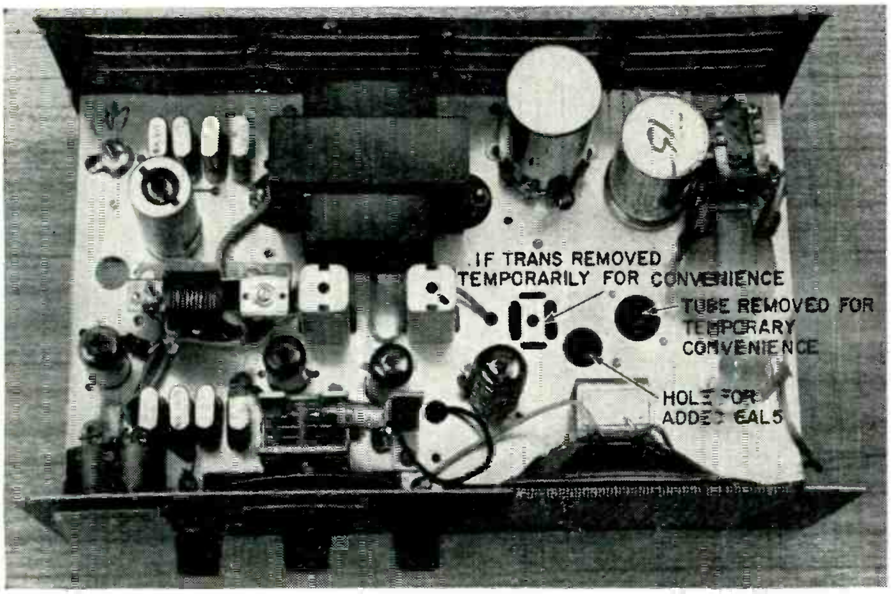
WESTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	8	7	7	10	13	14	14	16	14	10	10	10
East Europe	8	7	7	10	13	14	14	9	9	8	9	9
Central America	10	9	9	15	19	19	20	20	20	18	14	12
South America	10	8	7	13	15	15	15	15	15	15	15	13
North Africa	8	6	7	9	15	14	14	14	13	10	10	10
South & Central Africa	8	6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

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

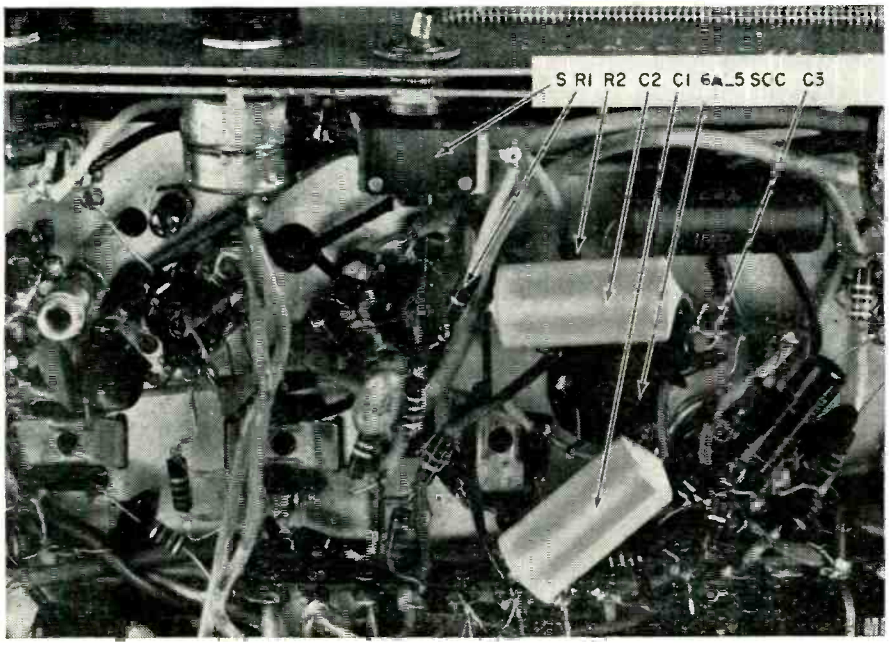
noise limiter for the HE-20A

By ROBERT L. PURDY

Quiet that CB receiver



Top-chassis view of the transceiver shows the last i.f. transformer removed and a new hole punched for the 6AL5. You don't have to remove the transformer, but you can do a neater job with it out of the way. It is reinstalled later.



Underchassis view shows the added circuitry in place.

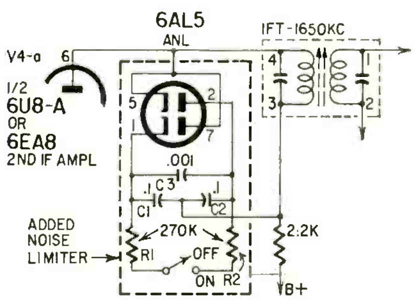
ADDING ONE TUBE, THREE CAPACITATORS, two resistors and a switch improves the performance of the Lafayette HE-20A, a popular CB unit. The Bishop i.f. noise-limiting circuit you'll be installing will take no more than 2 or 3 hours of your time and will pay dividends of hours of clearer listening.

Most noise-limiting circuits operate on the basis that noise, auto-ignition noise in particular, is a high-amplitude short-duration pulse. If the set is cut off during the pulse, the ear cannot detect the loss of signal, except for a slight drop in volume, and the noise is not heard at all.

The schematic shows the hookup. The added twin-diode 6AL5 is used as a full-wave shunt type diode limiter and is connected at the primary of the last i.f. transformer in the HE-20A. Heater voltage is taken off pin 3 of the power input receptacle through a 22-ohm 2-watt resistor. The plate resistance of the 6U8-A/6EA8 and the .001-μf capacitor determine the charging rate of the circuit. Bias is determined by the .001-μf capacitor and the resistors in series with it. Opening the switch disables the limited when desired.

The amount of clipping tolerable can be determined experimentally by varying the value of the 270,000-ohm resistors. Increasing their value will increase the clipping. Of course, strong nearby signals will be distorted the most, but you can switch off the limiter when receiving these stations. Where the limiter really goes to work is on weak or distant signals, and often, a signal can be copied that would otherwise be unintelligible.

While the photos show this circuit added to a particular transceiver it should also work well with other CB transceivers and amateur and short-wave receivers. END



Circuit of the noise limiter as added to the HE 20A.

TRAFFIC JAM ahead on SHORT WAVES

Fewer sunspots and more short-wave stations spell trouble for communications men.

By STANLEY LEINWOLL*

THE RELIABILITY OF THE HIGH-FREQUENCY radio spectrum for long-distance communication is in serious jeopardy. A combination of expanded frequency usage and decreasing spectrum space is increasing interference rapidly in the bands between 3 and 30 mc. Within the next several years, unless remedial action is taken, interference levels will increase fourfold over those that existed several years ago.

Man and nature appear to be conspiring to bring about this deterioration of conditions in the short-wave bands. During the past decade, use of the high-frequency spectrum for international broadcasting has doubled. During the same period, the number of radio amateurs has increased from approximately 90,000 to about a quarter of a million. Use by the military and commercial interests has increased comparably. In the meantime, sunspot activity, which has a direct bearing on the range of frequencies the ionosphere will reflect, has been decreasing steadily toward the low point of the 11-year sunspot cycle.

High-frequency radio signals are propagated over long distances via the ionosphere, a region of ionized gases at a height of from 50 to 250 miles above the surface of the earth. Radio waves striking the ionosphere are reflected and returned to earth the way a mirror reflects light.

The range of frequencies the ionosphere will reflect depends on the intensity of ultraviolet radiation from the sun. The capability of the ionosphere to reflect radio waves, therefore, varies diurnally, from season to season, and geographically, these variations depending upon the relative positions of the earth and the sun.

In addition to these variations, the intensity of ultraviolet light reaching the ionosphere varies over a much longer period. This change is directly related to the number of sunspots on the surface of the sun.

Sunspots are large disturbances on the solar disc. They appear as black spots and are surrounded by whirling masses of hot gas. Although the nature and origin of sunspots are not clearly understood, it is known that they are one of the sources of ultraviolet radiation from the sun.

Sunspots were first recorded by the Chinese more than 2,000 years ago, but it wasn't until the seventeenth century that Galileo started to make records of the sunspots he observed through his telescope. It was another 200 years before Hendrick Schwabe discovered the sunspot cycle. He had observed the sun on every clear day for close to 20 years, and found that the number of sunspots varied over a wide range. During some years he found the sun virtually covered with spots. During other years scarcely a spot was to be seen. He observed that these changes occurred in a regular manner.

Fig. 1 shows how sunspot activity has varied over the last 100 years. The number of years for a complete cycle —from minimum to maximum and back to minimum again—averages a little over 11 years, and for this reason is called the 11-year sunspot cycle. Over the past 200 years the length of sunspot cycles has varied from 9 to 14 years, the average about 11.1 years.

Influence on the ionosphere

Because the level of solar activity is in constant flux, ultraviolet radiation from the sun is also changing constantly. As a result, the 11-year sunspot cycle is probably the most important factor influencing the way the ionosphere affects long-distance high-frequency radio communication.

Fig. 2 shows a comparison between sunspot number and average noontime critical frequency in the vicinity of Washington, D. C., for the past 20 years. The critical frequency is the highest frequency for which an echo is received when a pulse of radio energy is sent straight up. Since a direct relationship exists between the critical fre-

*Radio frequency and propagation manager, Radio Free Europe.

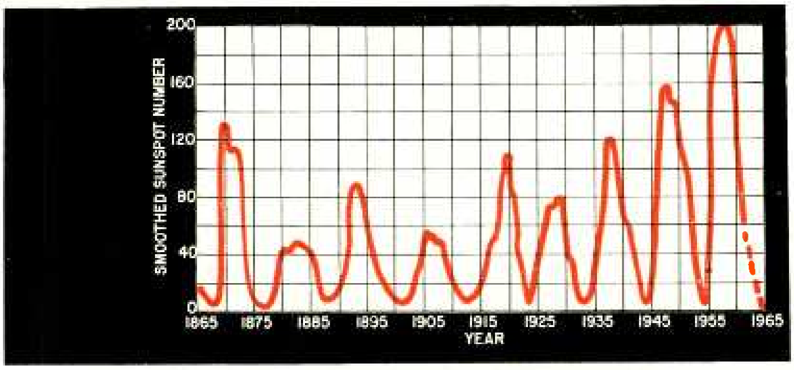


Fig. 1—Variations in solar cycles during past 100 years (dashed line projection to next minimum).

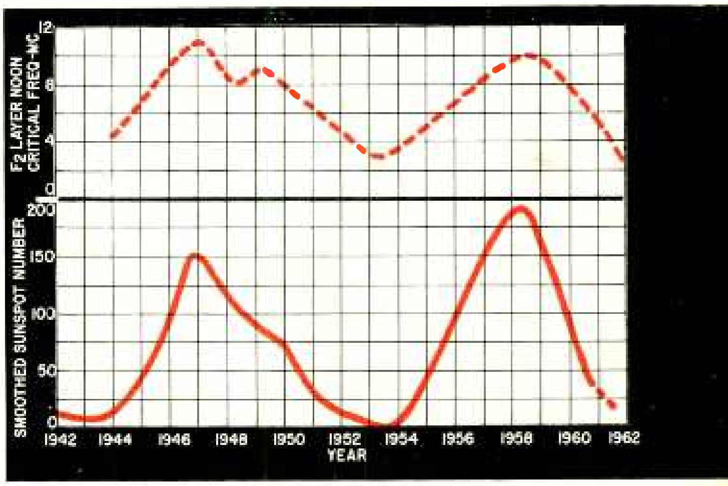


Fig. 2—Average noontime F2-layer critical frequency at Washington, D. C., 1942–62.

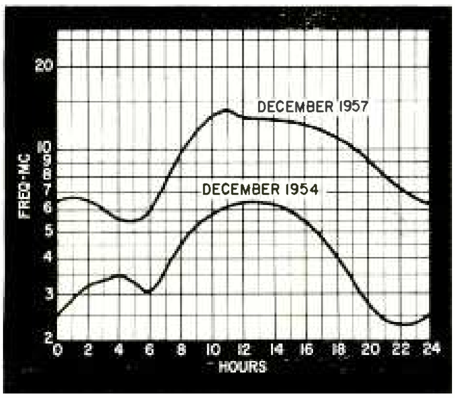


Fig. 3—Daily variation in F2-layer critical frequency at Washington, D. C., at sunspot maximum (December 1957) and minimum (December 1954) conditions.

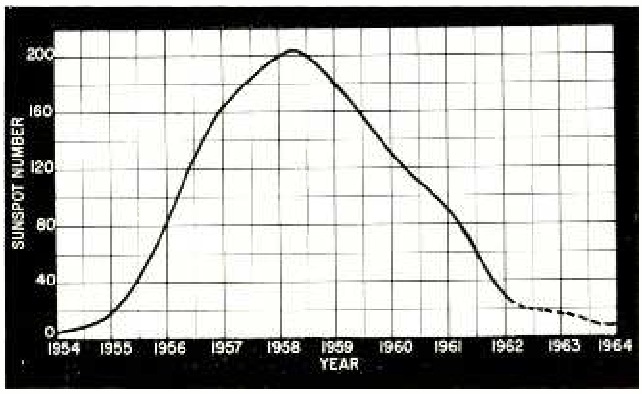


Fig. 4 — Current sunspot cycle and projection (dashed lines) for the next 2 years. Next minimum will probably occur sometime in 1964.

quency and the range of frequencies the ionosphere can reflect over long-distance circuits, the importance of variations in sunspot activity is further highlighted.

From 1957 through 1959 more sunspots appeared on the sun than ever before recorded. As a result, the range of frequencies the ionosphere could reflect was greater than had ever been observed, and conditions in the 10-, 11-, 13-, 15- and 16-meter bands were the best in the history of radio.

Fig. 3 shows variations in F-layer critical frequencies at Washington, D. C., in December during sunspot maximum and minimum conditions. Note that during maximum conditions the noontime critical frequency is nearly twice the minimum value. During nighttime hours the variation from high to low sunspot activity is not as influential on critical frequencies as during the day, although it certainly is significant.

Since 1958, the number of spots on the sun has been declining steadily. As a result, conditions in the bands that were best during sunspot maximum have been deteriorating. The 11-meter band is now "dead" and, except for occasional openings, will remain that way for many years to come. With sunspot activity expected to continue moving downward (Fig. 4) for the next several years, conditions in the higher bands will continue to worsen. Although there will be an improvement in the lower bands—49, 75, and 90 meters—the loss in spectrum space in the higher bands will be considerably greater than any corresponding gain in the lower bands because more spectrum space will be lost at the upper end than will be gained at the lower. Also, low-frequency bands double as local broadcasts in tropical areas. During minimums, these local signals travel to the US and cause additional interference.

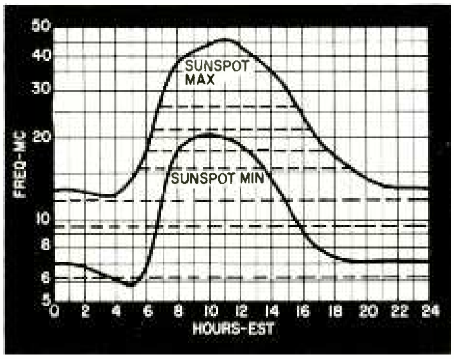


Fig. 5—Maximum usable frequency curve for circuit between New York City and London, England, during the winter season, sunspot maximum and minimum conditions. Bands allocated to international broadcasting are shown by broken horizontal lines. Area between the curves shows loss of useful spectrum space between periods of maximum and minmum solar activity.

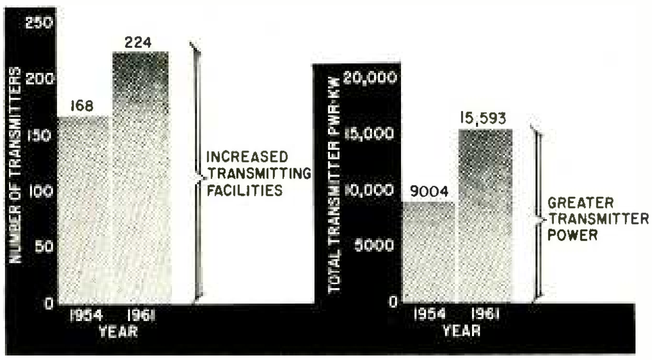


Fig. 6 — Changes in total number of transmitters in operation and total transmitter power in European area since last sunspot minimum in 1954. Number of transmitters has increased by 33% and total power by 73%.

Fig. 5 shows how changes in sunspot activity affects a particular circuit. The New York City—London, England, path is a good example. During the winter months of sunspot minimum, significant portions of the 9-, 11-, 15-, 17-, 21- and 26-mc international broadcast bands fall below the maximum frequencies usable during sunspot maximum.

Since 1954, when the last sunspot minimum occurred, international broadcasting has grown rapidly. In the European area, which was already heavily saturated with competitive broadcasts in 1954, the number of transmitters as well as total transmitter power has increased significantly, as shown on Fig. 6. This increasing trend shows no sign of abating. Additional transmitters mean more competition for available channels and higher power means increased interference from co- and adjacent-channel signals.

The situation becomes ever more serious when we consider Africa where many of the new and developing countries are rapidly adding high-power transmitters, most of which will be in direct competition with European allocations.

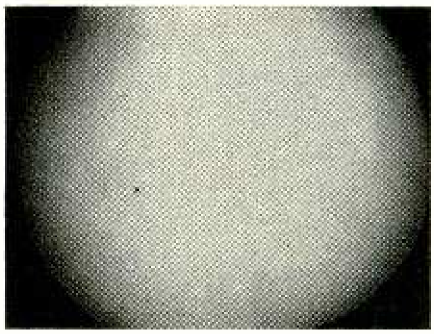
To make matters even worse for the listener or the radio amateur, there is the ever present problem of Communist jamming. It is estimated that since 1954 over 1,000 jammers have been added to an already massive system which is now estimated to consist of over 2,000 transmitters.

These jammers, operating against the broadcasts of the Free World, add to the problem, not only by directly causing interference, but also by forcing the broadcasters to transmit the same programs on many frequencies simultaneously in an effort to get their message through. Note that the western administrations do not jam.

Possible solutions

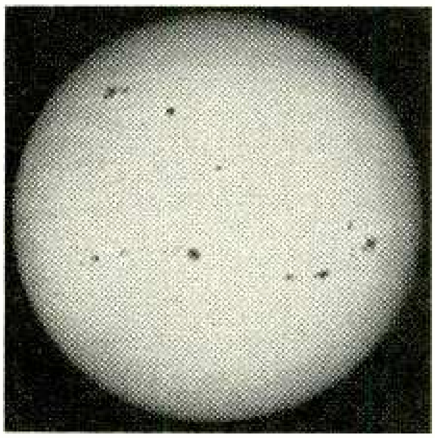
In painting this rather grim picture we do not mean to imply that chaos in the high-frequency bands is inevitable, nor that engineers and broadcast technicians are not fully aware of the growing threat to short-wave communications.

Great strides in the field of spectrum conservation on a national as well as an international level have been made. Scientific research is constantly seeking



J. H. Nelson, RCA Communications

During a sunspot minimum the solar disc has an almost perfectly clear surface.



US Navy

Multiple black blotches appear on the sun's surface during maximum sunspot conditions.

new means of using the ionosphere and ionospheric phenomena more efficiently and significant improvements in equipment design, as well as anticipated breakthroughs in the field of space communications, offer considerable hope. (See the author's article "Sporadic-E Opens New Horizons," RADIO-ELECTRONICS, October, 1961).

In the field of equipment design, interference has been effectively reduced by improvements in frequency and band width control, the reduction of spurious and harmonic radiation and advances in antenna design. Advances in the fields of information theory, noise filtering and compression and modulation techniques enable more information per kilocycle to be transmitted than ever before.

Some progress has been made by the International Telecommunications Union, working under the United Nations. Last fall, an 11-member panel of experts met in Geneva and made recommendations for alleviating congestion in the high-frequency bands, including replacement of double-sideband transmission systems in the fixed bands with single-sideband, use of directional antenna systems on all long-distance short-wave fixed and broadcast services, reduction of the number of frequencies used simultaneously for high-frequency broadcasting, and transfer of relatively short-range internal broadcast services to the medium-wave or vhf portions of the radio spectrum.

Communications satellites which can provide multi-channel systems in the microwave region are being developed. Such systems would be able to handle levels of communication traffic many times the present levels in the entire short-wave spectrum.

Another approach to solving the problem involves expanding multi-channel long-distance transmission cables such as the trans-Atlantic cables now in operation. The California–Hawaii cable could be extended to the Far East, new cables to Latin America could be laid and eventually US cables could be linked with other systems such as the world-wide British Commonwealth system now being constructed.

Finally, expanding vhf and microwave systems such as those being used in Western Europe would do much to alleviate congestion in the hf bands. Plans for linking the entire Western Hemisphere through such a system were discussed at an international conference held in Mexico City last year, and even the possibility of linking it with Europe and Asia is under serious consideration.

The use of frequencies in the vhf, uhf and microwave ranges, expanded cable facilities, and space communications systems would do much to free desperately needed spectrum space for services which can only utilize the hf bands. Once military and commercial interests were assured of an adequate number of channels outside the short-wave bands, spectrum space for international broadcasting and radio amateurs could be expanded to meet the needs of these rapidly growing services.

Other techniques to maximize efficient use of the hf spectrum are under investigation by those of us engaged in international broadcasting. These include sporadic-E propagation, use of backscatter techniques to determine whether a particular frequency is being heard with sufficient strength in the reception area, use of optimum radiation angles by employing vertically slewable antenna systems in conjunction with backscatter equipment to determine optimum propagation modes and, finally, paralleling transmitters to conserve spectrum space and increase transmitted power.

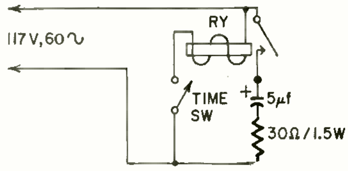
Radio amateurs also have been doing their part. Increased use of directional antenna systems and SSB equipment, as well as round-robins in which a group of amateurs use a single channel to communicate among themselves, has helped conserve precious spectrum space.

Despite the measures that have been taken to alleviate growing congestion in the short-wave bands, interference levels continue to rise at an alarming rate. We believe that one of the greatest challenges of the 60's will be the solution of the problem of radio spectrum conservation. The problem has been thought out and many possible solutions exist. If we are to avoid communications chaos in the next 5 years, we must take action. We have the tools, but they must be used. END

What's Your EQ?

Industrial Problem

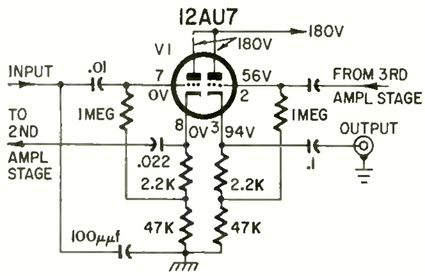
This one actually happened to me. The diagram shows part of a sequencing circuit. When the relay operated, the resistor dissipated excessive power—more than 10 times its 1.5-watt rating. The capacitor, resistor and line voltage were all checked and found OK. Meters



were connected to measure the current through and the voltage across the 30-ohm resistor. These read close to the expected values of 2.20 ma and 6.6 volts. What explains the excessive heating?—*David T. Smith.*

Audio Service Stinker

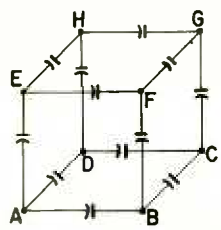
A Healthkit WA-P2 preamp came in with the complaint of lower than normal gain. Measurements showed no voltage on pins 7 and 8 of V1 (see schematic). All resistors and capacitors



tested (and were later proved) OK; all voltages on other elements in the preamplifier were within tolerances; the tube was good. What was wrong?—*Eric Leslie*

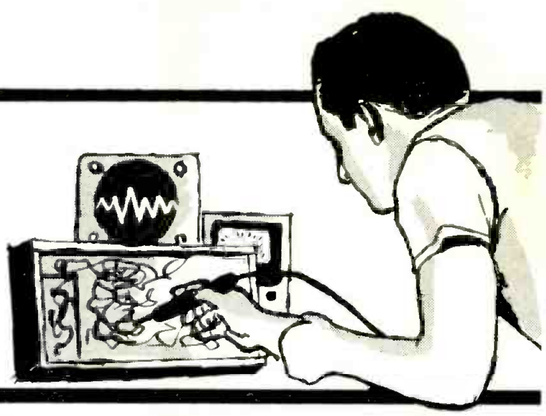
Capacitive Cube

As shown, 12 capacitors are connected in a cubical framework. Each has a capacitance of 5 µf. Determine



the equivalent capacitance between opposite corners of the network—say between A and G.—*Yak Chiang Yuen* END

for answers, see page 83.



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.

ABOUT THE MOST INFORMATIVE SINGLE test measurement, aside from the B-plus voltage, that can be made when you have high-voltage trouble in a TV set is the boost voltage. If it is OK, the trouble can be pinned down to the high-voltage rectifier or its associated circuitry in almost all cases.

Why? Because the horizontal-output-tube-flyback-yoke-damper combination operates in exactly the same way that the final amplifier stage in a radio transmitter does. It is a high-frequency power output stage working into a tuned load. In a radio transmitter, if the final amplifier tube, power supply and plate tank are OK, but the load—the antenna circuit—is mistuned or defective, circuit constants are upset through the whole final amplifier circuit. This is caused by the unloading of the power amplifier. Plate current drops far below normal and the voltage rises.

The yoke-damper-tube circuit is exactly like this. It forms a tuned circuit resonant around 50-70 kc, depending upon the flyback time constant used by the designer.

If this circuit is OK, the boost voltage will be normal, because the load is still resonant at the proper frequency. Off-value capacitors, shorts between turns in the yoke, lowering the Q, in fact anything that would detune the output load of the flyback, is going to affect the boost voltage. Almost always the efficiency of the circuit will be so far off that the boost will disappear, and we'll measure only the normal B-plus voltage on the damper plate and cathode.

However, and this is the more important application of this test, if boost is normal or almost so, we can say with a good chance of being right that the flyback-yoke-damper tube combination is OK. Our trouble will probably be found in incorrect CRT voltages, a dead high-voltage rectifier, low drive to the horizontal output and troubles of that nature. However, since there is boost, almost the correct amount, our flyback and yoke have a chance of being good. These components, of course, are the most difficult to test without special equipment, and most often suspect.

Therefore, when we find a TV set with almost enough boost but narrow raster, low brightness and similar symptoms, check the other operating constants. For the next most informative test, I believe the horizontal output tube's plate current would win. If it is low, either the B-plus or the tube is weak. If it's too high, either the drive is weak or the coupling capacitor is leaky, screen-grid voltage too low, horizontal linearity control set in the wrong place, and so on.

Like the radio transmitter, the horizontal linearity coil (if any) is a good indicator of conditions in the load circuit. If you can't find a dip in the plate current when adjusting this coil, either the drive signal is off frequency or the load is mistuned—a part which could affect the time constant has failed. This can be checked easily—the first with a scope, by comparison with the horizontal frequency of the video; the second with an ohmmeter and capacitance tester.

Intermittent blue flashes

One of my customers complains of intermittent blue flashes on her color TV. Sound and video still OK, but screen goes blue. I figured that the red or green amplifiers or demodulators were going out and changed them. No help.—T. A., New York, N. Y.

Change the *blue* amplifier. What happens in a black-and-white set if the video amplifier goes out? The screen stays *lit up!* In other words, the video signal *extinguishes* a bright raster to make a picture. Same in color TV. With a white raster, we've got all three guns conducting full steam. So, to make a picture, the amplifiers (demods, etc.) have to *extinguish* the three guns.

If you have trouble in the blue and it can't pass a signal, what's going to happen? It will be unable to cut off the blue gun, and the raster will turn blue. This is due to the blue gun running wide-open all the time. In the sets using X and Y demodulation, if the X demod goes out, you get no red. If the Y demod goes, no blue.

Yoke adjustments and purity

I can't get the purity right on the rim of a color tube, on this one set. I've tried all the ring adjustments but I still get contamination all around the rim.—W. L., Butler, Mo.

This sounds like rim-magnet trouble, if the set is one of the older models, or yoke adjustment on any of them. If you'll use a microscope on the dots, you'll see that the purity ring magnets move the dots at the center of the screen around in a circle (Fig. 1) while the yoke adjustment (forward and back on

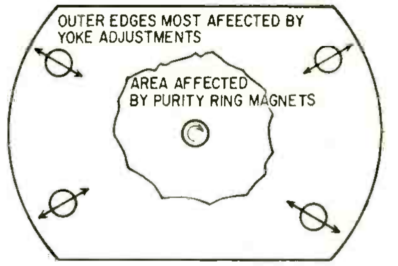


Fig. 1—Central area of color CRT is affected by ring magnets on neck of tube. Dots move in a circular pattern. At outer edges of tube dots move toward and away from center of screen. All edges move simultaneously.

the neck of the tube) causes *radial* movement.

So, follow the purity-setup adjustment procedure given in the manual for that particular set, although it's about the same for all of them. Roughly converge some white dots in the center of the screen, then set the purity rings for best *center* purity. (Red screen, blue and green screen controls turned off.) Now, slide the yoke back and forth along the neck until you get the best *edge* purity. You may have to reset the rings slightly. Keep at it until you get a pure red. Rim magnets, if any, should be fully retracted.

Centering is the problem

I'm having trouble getting the picture on a Radio Craftsmen C-201 far enough to the right. If I set the horizontal oscillator far enough to move the picture, it's unstable.—T. D., Worcester, Mass.

DON'T use the horizontal hold for a picture-positioning control! This always results in instability. Set the horizontal oscillator for the most stable position, then move the picture with the positioning magnets on the back of the yoke. If there aren't any on this set, in-

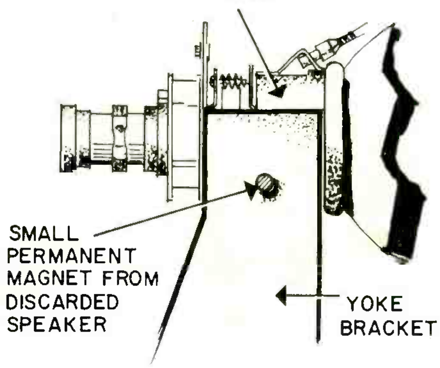


Fig. 2—If there are no centering magnets and you want to move the picture, try sticking a small magnet somewhere around the yoke. Move it around till you find the right spot, then cement it in place.

stall them. You can pick them up at supply houses.

Another dodge for doing this is to stick the little round magnet from a junked PM speaker somewhere on the yoke bracket (Fig. 2). You can move it around until you find a place where the picture moves in the right direction. When you find it, put a dab of speaker cement under it and leave it there, permanently.

Sweep gen query

The sweep control on my sweep generator is calibrated from 1 to 10. The manual says it can be swept from 0 to 15 mc. How can I tell what the actual amount of frequency range is? —M. M., Quebec, Canada

The best way to do this, and the way recommended by most test instrument manufacturers, is with an accurate marker signals.

For example, if you want to know how much your sweep generator is covering, connect a demodulator probe from your scope to the output of the sweep generator, displaying a pattern on the screen. Then insert markers (Fig. 3). By checking the marker-generator dial reading when the marker is at A, B and C, you can tell about where you are.

Fig. 4 shows a curve you might get while hooking up a scope and sweep generator to align a video if strip, for example. By placing the marker alternately at A, B and C, you can locate the various frequencies on this curve. Incidentally, if this were a real if strip, your sweep would be set far too narrow. You're not covering enough of the range of the if, as the trace does not return to the baseline at the left.

Fig. 5 shows a sweep generator with the sweep set wide enough to cover all of the actual bandpass of the stage (s) being aligned. (It makes no difference what frequency this sweep is, you'll do the actual identification of frequencies with the markers.) In this case, A indicates the lower limit of the bandpass, B approximately the center, and C the upper limit. To use actual figures, if this were a typical 40-mc if strip, B would be 44.15 mc, near the peak; A would be 41.25 mc, and C would be 47.25 mc. To get the correct figures for the if response curve on a TV set, consult the service data for that set.

Emergency correction magnets

I'm having trouble getting the purity right on a color set with a glass 21CYP22-A. This set has no rim magnets or other means of making this adjustment. I've degaussed it, and run yoke and ring adjustments several times, but I've still got a couple of tiny areas of contamination near the edge.—P. R., Jersey City, N.J.

If you've tried everything else, and it seems you have, try getting some small pieces of the rubber-covered PM magnet strip used to seal refrigerator doors. You can get this at appliance dealers, etc. Cut off very small pieces of this, and stick them on the bell of the tube, or near the rim, or wherever they're needed. You can adjust the magnetic field by cutting the strip to different lengths. A drop of speaker cement will hold them in place after you find the right adjustment.

Unstable sync

When I adjust the horizontal drive control in a DuMont 340, the sync becomes unstable if I set the control to remove the drive line. Sometimes the raster collapses momentarily.—J. H., Grand Forks, N.D.

This trouble probaly lies in the drive control itself. A dirty contact on the slider, or a burnt spot on the control has caused some trouble like this

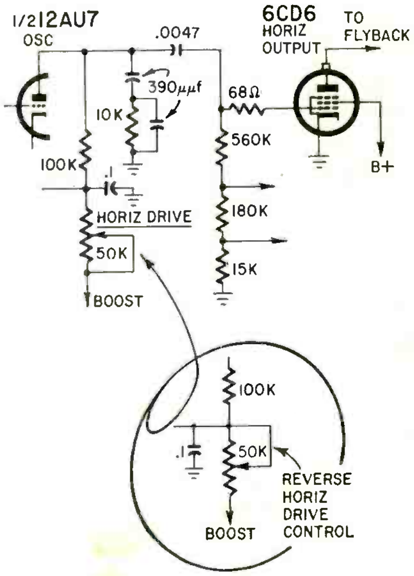


Fig. 6—Horizontal drive control circuit in DuMont 340. When replacing control, reverse connections as shown in inset.

in the past. When you replace the control, reverse it, as shown in the box in Fig. 6. Some factory technicians claim that this gives better life to such controls. The current flows from brass to carbon instead of from carbon to brass.

Use a vtvm and set the dc grid voltage on the 6CD6 to about —65. This will check the action of the drive control, too. This voltage should rise and fall smoothly if the control is not damaged. END

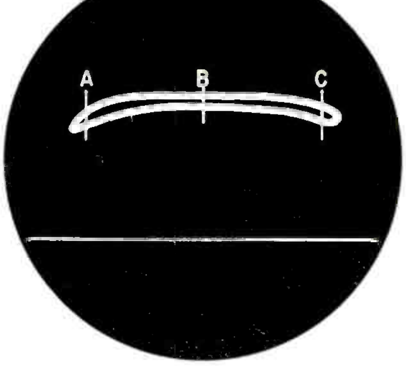


Fig. 3—You'll get this scope pattern if you use a demodulator probe connected to the output of your sweep generator.

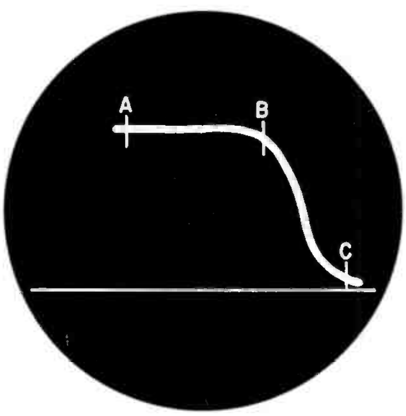


Fig. 4—You might get this curve when aligning an if strip. Note that it isn't complete. The left end doesn't come back down to the base line. This indicates that more sweep width is needed.

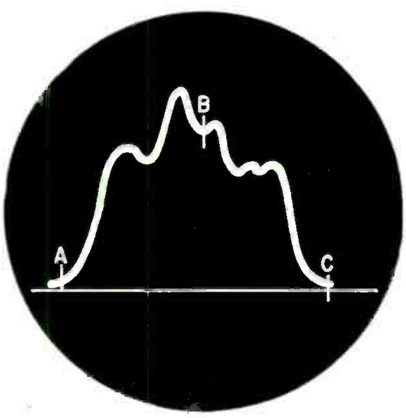


Fig. 5—Scope pattern when sweep width is great enough to cover all of the bandpass of the stages being aligned.

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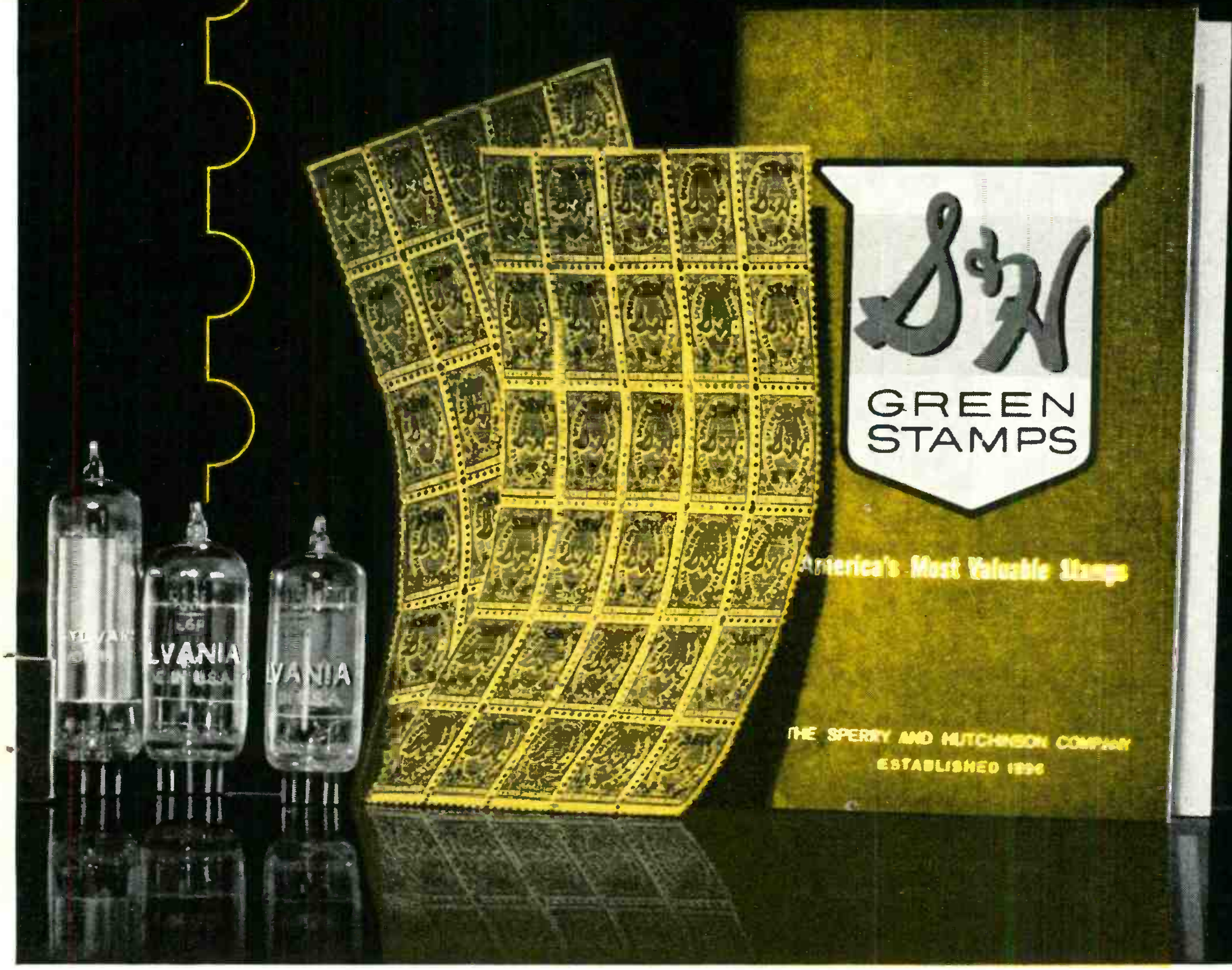

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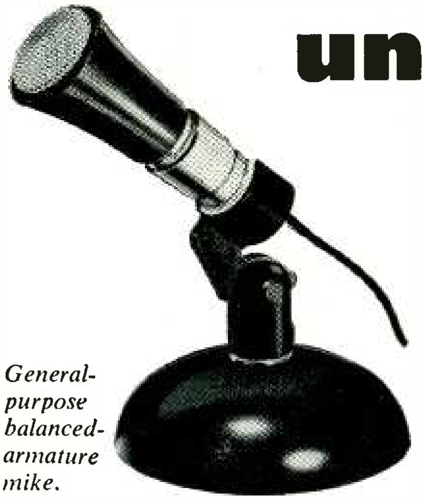
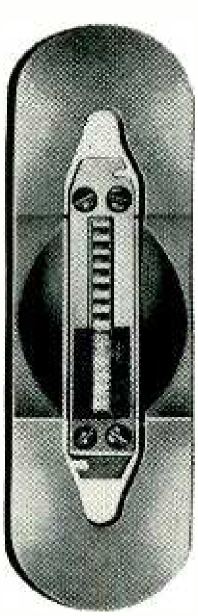


General-purpose balanced-armature mike.

Shure



Modern ribbon-mike cartridge with precisely formed ribbon visible in center.

Part II — Fundamentals of microphone selection

By ROBERT W. CARR*

LAST TIME WE SURVEYED THE MANY types of microphones available, split them into groups and discussed their operation, advantages and disadvantages. This time we'll go a step further and talk about some of the more important aspects of selecting a microphone for a particular job.

Over the years, particular mikes have been associated with particular duties. But a glance over the characteristics of the various types shows a lot of overlapping. Modern technology has put most of the common types on an equal footing, particularly from the viewpoint of frequency response and directivity. However, other factors may prevent you from using any microphone for any job.

Many microphones have a frequency response that might seem questionable for general use. However, in particular applications, this seemingly unsuitable characteristic can be very desirable indeed. The classic example is the microphone used for mobile communications. Here wide frequency response is definitely not wanted. Instead, we use a mike with a limited frequency response designed for high speech intelligibility.

Impedance

While this property has been mentioned with the microphone characteristics, its importance when selecting a microphone has not been emphasized. Space does not permit a detailed explanation, but it should not be left without at least a few general observations:

1. The ultimate impedance of a microphone line should always match the input impedance of the system in which the microphone is used.

*Manager of Microphone Development, Shure Brothers Inc., 222 Hartrey, Evanston, Ill.

Lavalier mike for TV.

University

2. As a general rule, low-impedance microphones should be used if cables are longer than 20-25 feet.
3. Where high-impedance microphones are to be used with long cables, or where a variable-impedance microphone is available but the amplifier is high-impedance only, most firms offer transformers to match the mike to the line.

Directional microphones

Our ears and our brain combine to form a truly remarkable computer system which allows us to hear—to interpret sound for communication, to evaluate, to enjoy sound, to measure and compare. But even more remarkable, this combination lets us select exactly what we want to hear out of a welter of other voices or sounds. As microphones were refined, it became apparent that, while the microphone system could be made to *hear* very well indeed, it did not have the ability to *listen*. One of the more common examples of this distinction is found in the use of home tape recorders. Many of us are familiar with the experience of recording the voices of friends in the living room and, upon playback, hearing various remarks on the marvelous sensitivity of the system. "That machine is wonderful. You can hear everything that's going on in the kitchen." Unfortunately, this sensitivity to extraneous sounds only means that the machine's ability to hear is much more acute than its ability to listen.

The closest substitute for this far-from-understood property of our nervous system has proved to be the directional microphone. While it cannot choose the sounds which it wishes to hear, it can choose the direction from which it will hear and be made to favor sounds coming from one or two directions and discriminate against those coming from others. This substitute for listening has been successful enough to permit the directional microphone to become the basic tool in PA systems, recording and radio and television broadcasting.

Directional microphones can be divided into two principal categories:

1. **Unidirectional** (Cardioid, supercardioid)

As its name implies, a unidirectional microphone picks up sounds mainly from one direction and discriminates against those coming from elsewhere. This property allows pointing the microphone at the desired source of sound so that other sounds in the locale are effectively reduced in level.

This characteristic is very familiar in PA applications for the reduction of background noise, and also of the annoying acoustical hazard known as feed-

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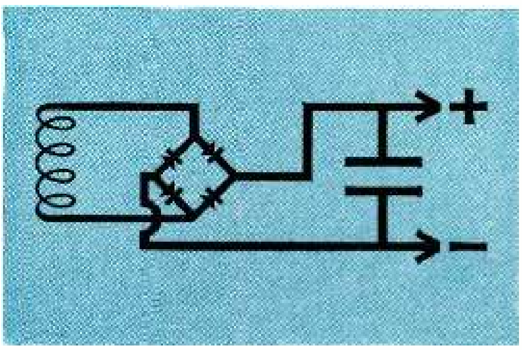
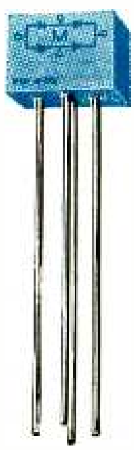
Hints on Reducing Hum . . .





In high fidelity sound systems . . . and in many kinds of commercial and industrial electronic equipment . . . reduction of 60-cycle hum is one of the toughest problems that a technician has to tackle. Most hum comes from 60-cycle voltage sneaking into the signal circuit. There are, of course, many well-known precautions that should be observed . . . using shielded or coax cable between major components, keeping cables short especially in the low-level portion of the system, making sure connectors are tight. Here are some other thoughts that may be useful.

Power supplies in sound systems . . . hi-fi or commercial . . . generally operate at higher temperatures than those encountered in radio or TV. So it pays to be particular about filter capacitors. It pays to use electrolytics rated at 85° C. Those rated at only 65° C start to run into trouble. Then too, because of the added heat, the vent construction is important. In other words, "How good is the seal?" Our tip is to always use Mallory FP-WP electrolytics . . . voltage ratings are conservative and dependable . . . they have excellent stability at high temperature . . . and they all have *etched cathode* construction. This latter is extremely important in avoiding hum. We covered the reasons in a previous TIP (remember?).

Here's another source of hum . . . filament circuits. Many of the highest quality sound systems use a DC filament supply in the preamplifier. It's easy to add this refinement to any system. All you'll need is a Mallory FW-50 "packaged" silicon rectifier circuit. It's encapsulated in a tiny plastic block and takes up very little space. Simply connect the FW-50 to the circuit, add a WP-042 electrolytic and filament hum disappears permanently. If you want more specific information, write and ask us.

Another tip: call on your Mallory Franchised Distributor for prompt service, at sensible prices, on Mallory capacitors, switches, silicon rectifiers, controls, and batteries . . . and for any other parts you may need.

back.† Since the speakers are generally located somewhere other than the performer's side of the microphone, unidirectional microphones tend to prevent this disturbance by reducing the volume of the signal as it re-enters the system.

In the recording and broadcasting fields, the unidirectional microphone is commonly used for separating various parts of a group or various sections of a stage, and reducing overall noise pickup—the sounds of working crews, audience noises, etc.

Unidirectional microphones are available in a wide range of prices and in such generic types as crystal, ceramic, dynamic, condenser and ribbon.

2. **Bidirectional** (cosine)

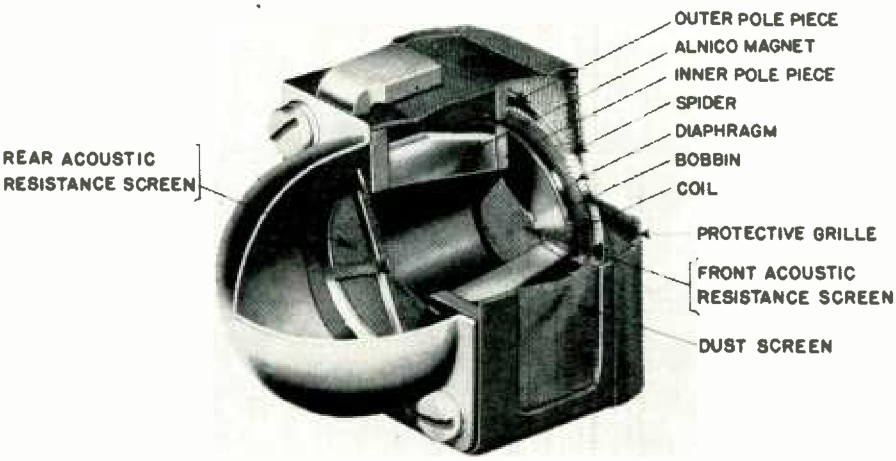
This microphone type is aptly named—it accepts sound mainly from two directions. Sounds produced in the plane perpendicular to the axis of the desired sounds will be reduced just as sound is reduced at the rear of the unidirectional microphone.

Turner

This ceramic mike is excellent for PA, paging and general-purpose use.

Surprisingly enough, the ability to reduce overall noise is exactly the same as with the unidirectional microphone. Also, the bidirectional microphone is actually more directional in its area of pickup than the conventional unidirectional.

The unique properties of this type of microphone have made it an invaluable tool in some PA applications: for example, in a situation where the loudspeakers are located at the sides of, or above, the stage. Its properties have also been very useful in the field of recording and broadcasting for overall background noise reduction and for good isolation with a performer or group working in each pickup area.



Shure

Internal view shows complexity of high-quality unidirectional element.

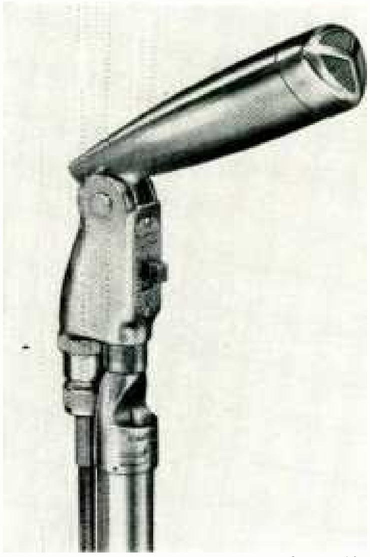
The bidirectional microphone is primarily available in the ribbon type, although some capacitor microphones have provision for bidirectional use.

The detailed comparison between the nondirectional (omnidirectional) microphone and directional types (represented by the pick-up pattern charts and table of properties) may help to visualize better the effect of directional microphones.

Another general characteristic of directional microphones is the tendency to increased low-frequency response as the performer works closer to the microphone, particularly at distances under 2 feet. As a performer draws very near the mike, the effect is quite noticeable. Although this effect is sometimes considered useful in imparting a manly voice quality, it is more often considered undesirable and the resulting sound is classified as "boomy". To minimize this, some microphones (particularly in the higher price ranges) are equipped with a control commonly known as a "Voice-Music" switch. In the "Voice" position, the lower frequencies are rolled-off so the resulting response for very close usage is approximately the same as the normal low-frequency response. For clarity, such a control might be more appropriately named a "near-far" switch.

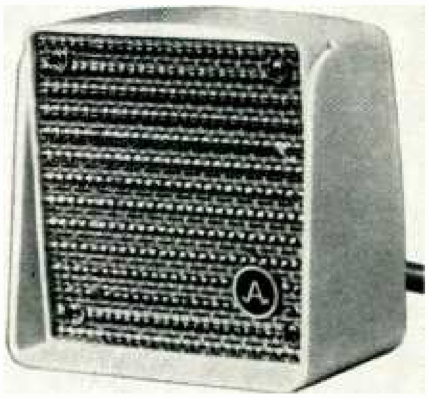
Before leaving the subject of directional microphones, let us consider briefly some special-purpose types available.

One such is a special case of the unidirectional microphone, featuring a more highly directive pickup pattern than any of the examples previously described. At least two basic forms of this type are available: with higher directivity occurring primarily at higher frequencies, or with a highly directional characteristic essentially uniform over the entire frequency range. These microphones fill a definite need, especially in situations involving unusually high background noise. Some limitations in costs, size and performance characteristics, however, prevent their classification as generally useful.



Electro-Voice

Nondirectional dynamic unit for PA, recording and communications.

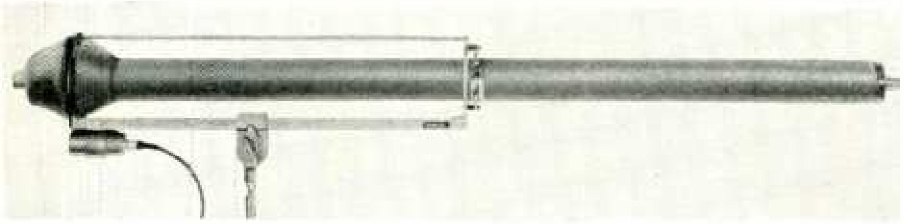


Astatic

General-purpose ceramic mike.

Another interesting and helpful type is the noise-reducing (differential) class. These microphones favor nearby

†This disturbance occurs when sound picked up by the microphone is amplified, radiated from the speakers and somehow returned to the microphone to be reamplified and redistributed until the resulting oscillation grows to a point where it completely dominates the sound system.



Electro-Voice
Highly directional dynamic mike for professional applications.

Turner
Dynamic unit is ideal for mobile communications.

Phantom view of cardioid dynamic modular mike. Clear plastic shell is used here to show shock mounting on which the inner metal case floats.

University

sounds, although they may be no louder than the surrounding noise. This type has found the most acceptance for use in military, commercial and private aircraft. Several types are commercially available, including carbon, dynamic and balanced armature.

Choosing a microphone

If the discussion of microphone types and properties has so far seemed confusing, it is due partly to the fact that there is such a great variety. To bring some order out of the confusion, the following approach is suggested as a guide to decision.

A. *Know what you expect the microphone to do*
   This point may sound very basic, but it is a key to selecting a microphone. Facts and premises are necessary to the solution of a problem, and a useful tool in collecting and assorting facts is the inquiring mind. Here are some questions which should be asked and answered in making a satisfactory choice:
   1. What are the conditions of use? For example, is feedback likely to be a problem? Will there be a noticeable amount of background noise? What is the amplifier input? Is the amplifier near to or far from the microphone? Is the performer likely to work close to the microphone? Is the location indoors or outdoors? Is the microphone likely to receive substantial abuse?
   2. What response characteristic is desired?
      Does the application require extreme fidelity of reproduction? Does it require optimum speech intelligibility? Is the application specialized (amateur radio, vehicular or marine communication system)? Can some response be sacrificed to achieve another more desirable characteristic, etc.
   3. What price should I pay?
      This question should be both last and least. In most cases, the microphone is a small part of the cost of the system in which it is used, but it is basic to the performance of the entire system. A representative question which should be asked is, "Can I afford *not* to buy the microphone which I feel will do the job?"

B. *Know what is available*
   Having read this far, you now have some idea of the types and combinations available. Manufacturers' literature will define specifications, prices and special features for each of these types and combinations, and makers will be glad to supply information about specific applications: Your local distributor will indicate what microphones are available to give the desired combination of features.

C. *Make the choice*
   We define the sum of 2 and 2 as 4, and 3 is obviously not enough while 5 is more than required. The same reasoning applies to the final selection of a microphone for a certain application. An inadequate choice has a poor chance for satisfactory performance. However, overbuying may be, not only economically unwise, but, in some applications, detrimental to the final result desired.

An understanding of what the microphone should do and which microphones are available to meet the particular requirement will provide a high degree of assurance for a wise and successful choice. END

DIRECTIONAL PROPERTIES

Property	*Omnidirectional*	*Cardioid*	*Super-cardioid*	*Cosine*
Unidirectional effect[1]	0	17 db	23 db	0
Front-to-back reduction (on axis)[2]	0	infinite (theoretical)	12 db	0
Random energy efficiency[3]	0	9.6 db	11.4 db	9.6 db
Distance factor[4]	0	1.7	1.8	1.7
Pickup angle[5]				
3 db down	360°	132°	114°	90°
6 db down	360°	180°	156°	120°

1. Pickup reduction of back half compared to front half. Useful in auditorium work for determining reduction of reverberant feedback or audience noise.
2. Pickup reduction at 180° compared to 0°. Used in conjunction with polar response shape gives indication of how microphone may be used for separation.
3. Reduction in pickup of overall ambient noise. Compared to omnidirectional. Indicates ability to discriminate against surrounding noise, especially in a studio or a reverberant room.
4. Increase in performer-to-microphone distance over omnidirectional due to directional properties (for same ambient noise and reverberation pickup.) Indicates possible advantage in performer freedom or group arrangement by using directional types when omnidirectional would just get by.
5. Included angle around microphone front for 3 or 6 db down at ends. Used for determining group size or performer movement practical for a certain microphone, or for estimating separation properties.

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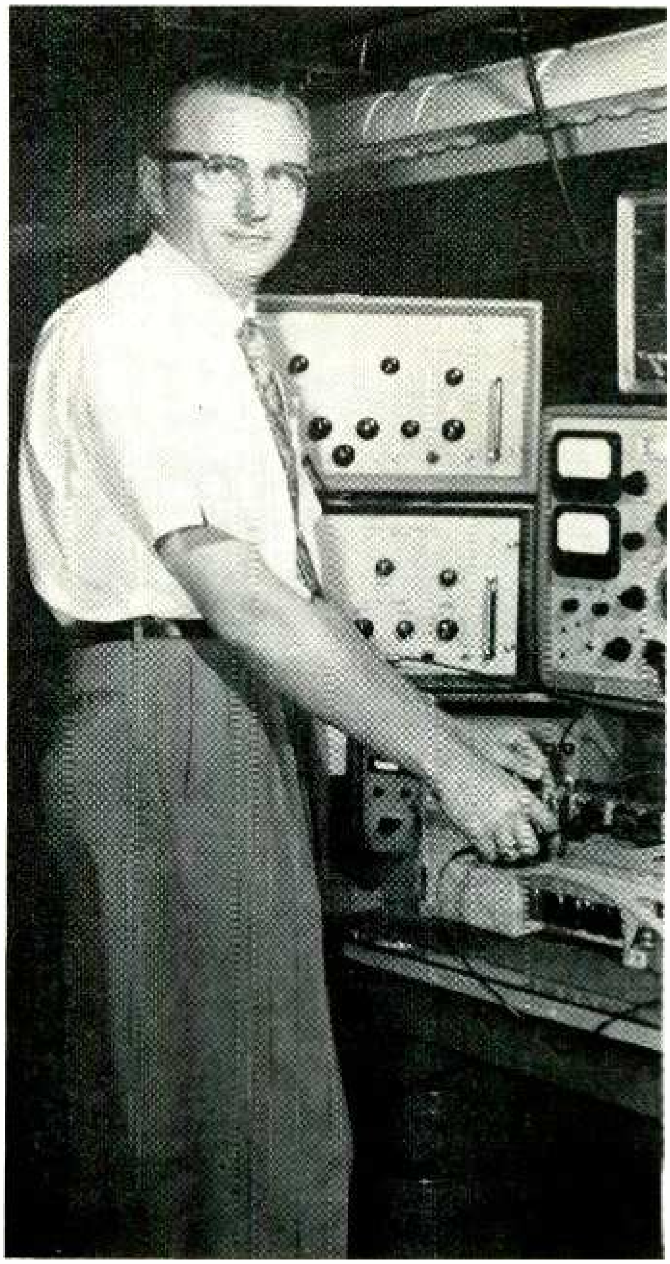

ELECTRONICS KNOWLEDGE YOU CAN USE. *CREI Home Study preparation gives R. S. Conway the technical background to deal with Engineers as Supervisor, Electronic Test Dept., Wilcox Electric Co.*

LET'S LOOK AT THE FACTS. There's something wonderful about understanding how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, *but only to qualified men.* In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

ADVANCED TECHNICAL KNOWLEDGE IS THE KEY to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

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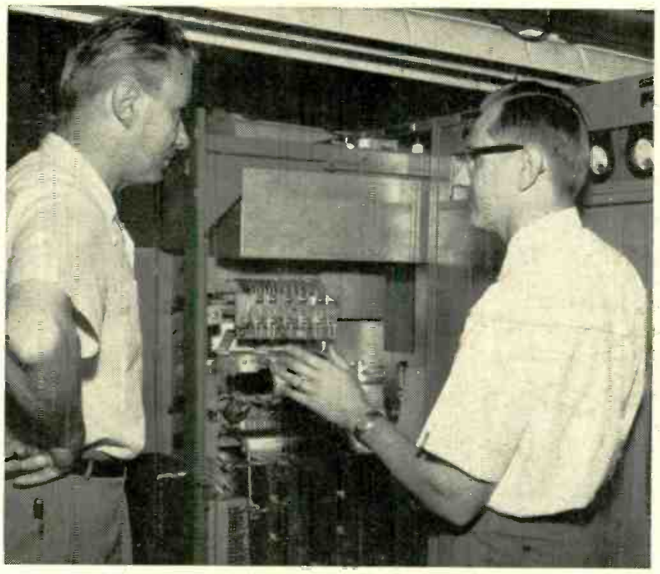

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#25

Win-Tronics model 825. It makes fast work of TV agc trouble.

AGC analyzer and TV-FM sweep gen

Paco model G-32. A compact TV and FM sweep generator with a built-in marker adder.

By ROBERT F. SCOTT
TECHNICAL EDITOR

NEW TEST INSTRUMENTS ARE CONSTANTly being developed and older basic types modified to speed up and improve the technician's service techniques. Surprisingly often, he is unaware of the latest developments in equipment and servicing procedures and does not realize how they can save him time and money. This article describes the circuitry and application of the Winston model 825 dynamic agc analyzer and the Paco G-32 TV and FM sweep generator and marker adder.

The agc analyzer

The agc system can be considered the heart of a TV receiver. When it is defective or improperly adjusted, it can produce trouble symptoms that lead the unwary service technician into spending needless hours checking the tuner, sync, video, sound and if sections of the set.

Some of the more common symptoms that may be caused by agc defects are: Poor vertical sync on strong signals. Tearing at the edges of the picture or strong signals. Sync on video buzz often accompanied by a dark picture. Poor response to weak signals. Negative picture. Picture contrast poor and washed out or gray on strong signals.

Since a defective agc system can simulate troubles in other parts of a TV set, it is good practice always to check the agc circuit first when the defect is not obvious. The busy technician will find that the Win-Tronix model 825 analyzer speeds agc servicing by combining the various tests and special equipment into one convenient instrument. You can run through the four tests that may be required to pin point an agc defect in about the time required to round up the bias box, vtvm and rf generator required to perform equivalent tests.

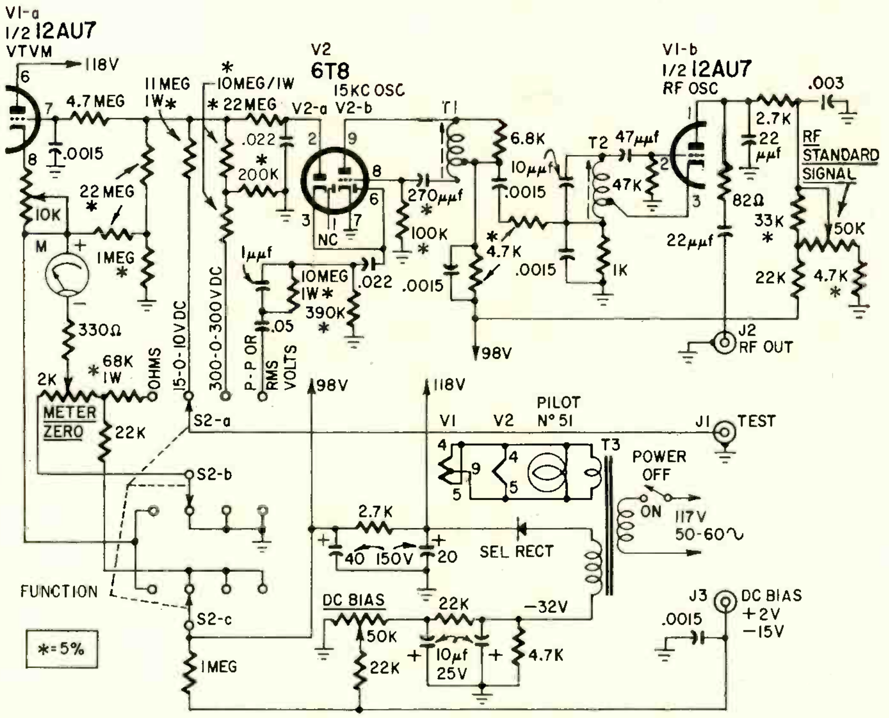

Fig. 1—Circuit of Win-Tronics Dynamic agc circuit analyzer.

The circuit of the 825 is shown in Fig. 1. The analyzer consists of four sections: an rf signal generator to feed a test signal into the set's front end; a bias box for agc substitution and clamping; an ohmmeter for checking the agc system for shorts and continuity, and a vtvm for measuring agc bias, keying-pulse amplitude and dc voltages up to 300.

Circuit analysis

The rf oscillator (V1-b) provides a wide range of rf signal voltages needed to check agc operation at various signal levels. The rf attenuator (RF STANDARD SIGNAL control) varies the output from 0 to 500,000 microvolts. The generator is pretuned to channel 2 but can be retuned to channels 3 or 4 to provide the vacant channel needed when checking agc performance on weak signals.

V2-b, a 15-kc blocking oscillator, modulates V1-b and provides a keying or gating pulse for keyed agc circuits.

V1-a is a zero-center dc vtvm with 15-0-10 and 300-0-300-volt ranges for agc monitoring and general dc circuit testing. When FUNCTION selector S2 is turned to P-P OR RMS VOLTS, peak-to-peak detector V2-a is switched in so the meter reads 800 volts peak to peak for checking keyer pulse amplitude, or 250 volts rms for general ac measurements.

With the switch in the OHMS position, the 825 becomes an ohmmeter with a range of 0 to 10 megohms for checking agc circuits for leakage, shorts and opens.

Using the analyzer

Once you've used the 825 a few times, you can check out agc circuits in a TV chassis about as fast as you can move the test prods from one point to another and read the meter. Our first step is to monitor the agc test point or source while switching the set between strong and weak channels. We check the picture for tearing, overloading and poor sync on strong signals, and snow and washed-out pictures on weak signals. If any of these symptoms are seen, we run the bias test lead to the agc line and try to correct the trouble with the DC BIAS control. If external bias corrects the difficulty, the trouble is in the agc circuit. We then move the voltmeter test lead along the agc line, checking agc voltage at each stage.

Our next step is to disconnect the bias supply, pull the line plug on the receiver and discharge the first agc filter capacitor. Next, we switch the FUNCTION selector to OHMS and connect the meter test leads between ground and the agc test point or source. The meter's AGC CONTINUITY scale shows whether the agc line is shorted or open. Generally, the minimum resistance to ground is around 50,000 ohms. If the line is shorted or open, we check the resistance of each component in the agc circuit.

The P-P OR RMS position is used when checking keyed agc circuits. Tune in a picture and use the voltmeter to measure the pulses on the agc keyer plate. Normal peak-to-peak voltage is approximately twice the dc voltage on the keyer screen grid. The pulses generally run from 300 to 500 volts peak to peak.

If pulse amplitude is normal, we switch to the 300-0-300-volt range. The meter should show a small negative voltage. If the plate is positive, we check for a shorted or leaky coupling capacitor between the keyer plate and a winding on the flyback transformer. As a final step, we use the 300-volt range to compare the keyer's cathode and screen-grid voltages with those listed in the set manufacturer's service data.

Our clean-up operation is to use the 825's rf generator to test agc operation for a wide range of signals. We use the voltmeter's 15-0-10 range to monitor the agc voltage at the source or test point. Then, with the rf generator feeding the set's antenna terminals, we set the rf attenuator to the center of its range and adjust the set's horizontal hold control to sync with the 15-kc modulation in the pattern. Varying the rf attenuator through its range shows the agc action for all signal levels. When the system is working properly, agc voltage rises rapidly as the attenuator is turned through its LOW, sector, starts to level off in the MEDIUM sector and saturates and levels off in the HIGH sector of the control.

Paco sweep generator

Like most present-day FM-TV sweep generators, the Paco G-32 is designed around the Increductor— a variable-frequency saturable inductor. The basic Increductor consists of a two-part toroidal magnetic-core assembly with control and signal windings. The control winding is wound as two coils on the legs of a U-shaped laminated core. The signal windings—used as the coils in a Colpitts oscillator—are wound on ferrite cores fastened across the open end of the U.

When current passes through the control winding, it varies the magnetic flux of the assembly and decreases the permeability of the ferrite cores in the signal coils. This reduces the inductance of the signal coils and increases the oscillator frequency.

The basic oscillator using the Increductor is shown in Fig. 2. The control winding and its core are shown at right angles to the signal winding and its core to indicate zero magnetic coupling and complete freedom from transformer action between the two sets of

(Continued on page 78)

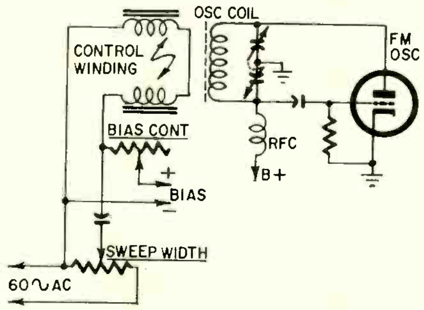

Fig. 2—Basic Increductor circuit.

G-E SEPT TUNE-UP SPECTAC

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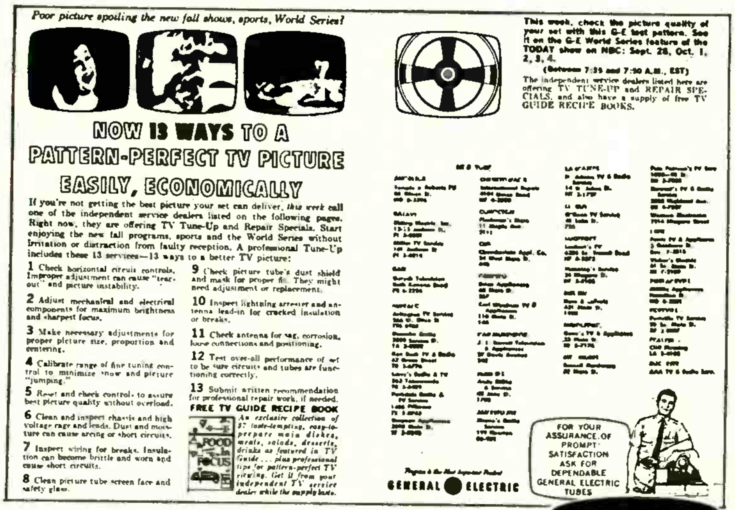

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This week, check the picture quality of your set with this G-E test pattern. See it on the G-E World Series feature of the TODAY show on NBC: Sept. 28, Oct. 1, 2, 3, 4.

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The independent service dealers listed here are offering TV TUNE-UP and REPAIR SPECIALS, and also have a supply of free TV GUIDE RECIPE BOOKS.

NOW 13 WAYS TO A PATTERN-PERFECT TV PICTURE EASILY, ECONOMICALLY

If you're not getting the best picture your set can deliver, *this week* call one of the independent service dealers listed on the following pages. Right now, they are offering TV Tune-Up and Repair Specials. Start enjoying the new fall programs, sports and the World Series without irritation or distraction from faulty reception. A professional Tune-Up includes these 13 services—13 ways to a better TV picture:

1 Check horizontal circuit controls. Improper adjustment can cause "tear-out" and picture instability.

2 Adjust mechanical and electrical components for maximum brightness and sharpest focus.

3 Make necessary adjustments for proper picture size, proportion and centering.

4 Calibrate range of fine tuning control to minimize snow and picture "jumping."

5 Reset and check controls to assure best picture quality without overload.

6 Clean and inspect chassis and high voltage cage and leads. Dust and moisture can cause arcing or short circuits.

7 Inspect wiring for breaks. Insulation can become brittle and worn and cause short circuits.

8 Clean picture tube screen face and safety glass.

9 Check picture tube's dust shield and mask for proper fit. They might need adjustment or replacement.

10 Inspect lightning arrester and antenna lead-in for cracked insulation or breaks.

11 Check antenna for sag, corrosion, loose connections and positioning.

12 Test over-all performance of set to be sure circuits and tubes are functioning correctly.

13 Submit written recommendation for professional repair work, if needed.

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Joe Garagiola hosts sports personalities on this timely show. **Mel Allen,** with unique "Test Pattern Commercial," sells immediate need for your service to your customers through your local station. Starts Sept. 10.

These commercials direct viewers to your name, address and phone number in your local TV Guide.

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TV GUIDE

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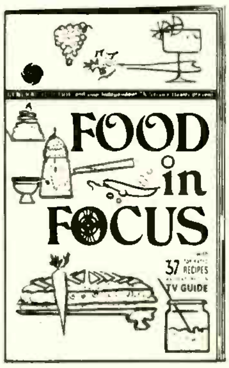

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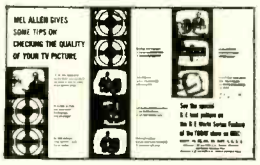

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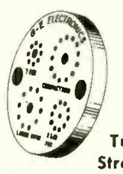

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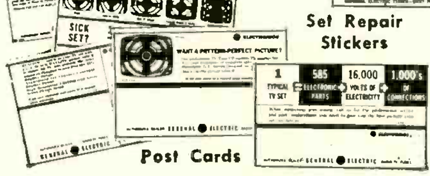

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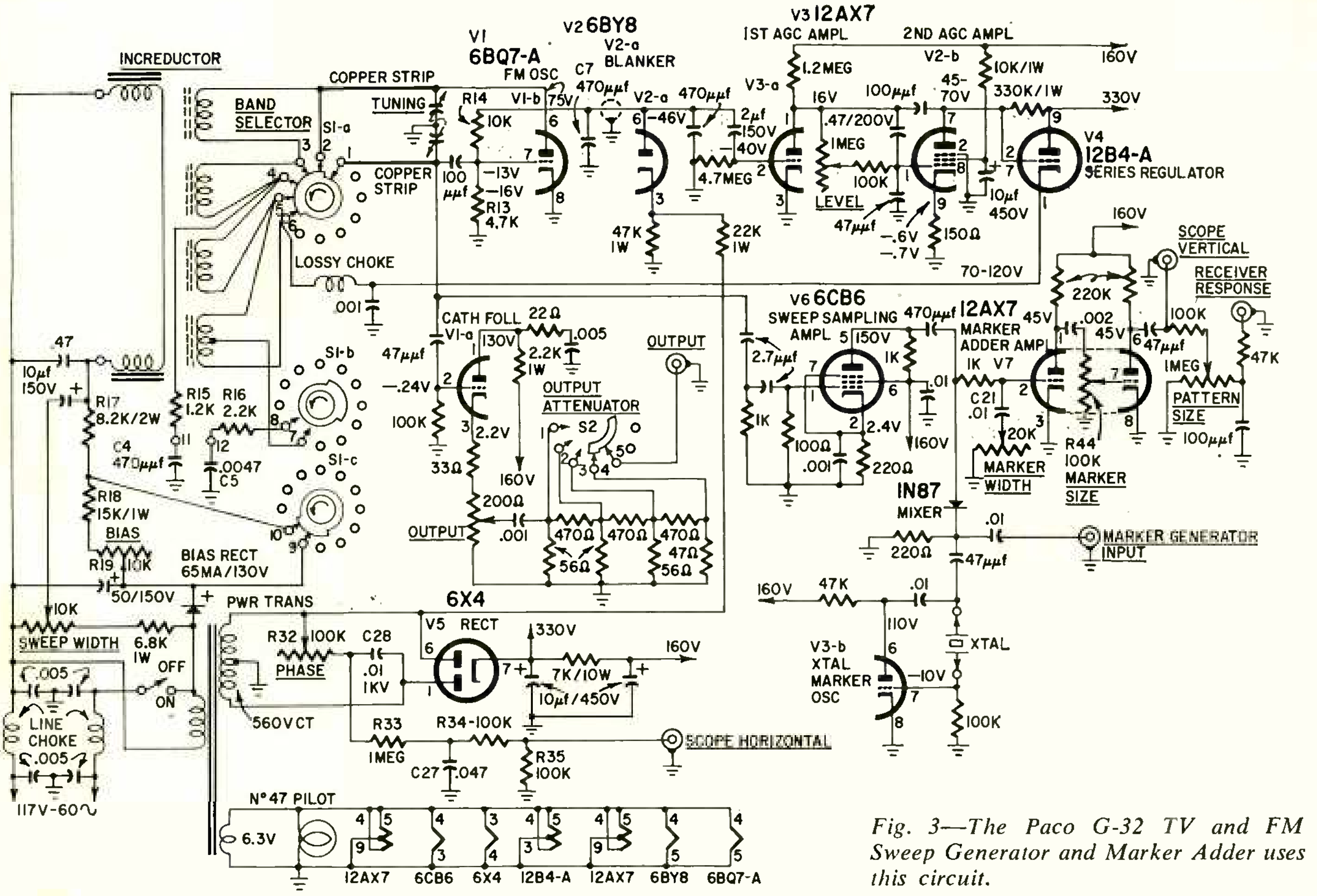


Fig. 3—The Paco G-32 TV and FM Sweep Generator and Marker Adder uses this circuit.

(Continued from page 75)

windings. The lowest signal frequency occurs with the tuning capacitor fully meshed and no current flow in the control coil. The highest is reached at the point where the core saturates. When ac or varying dc is applied to the control winding, the signal winding's inductance decreases in relation to the current. Thus, the oscillator's frequency can be swept by varying the current in the control winding.

The dc bias voltage applied to the control winding is adjusted so the center frequency of the sweep corresponds to the frequency setting of the tuning dial. Thus, when ac is superimposed on the bias, the oscillator frequency swings above and below the frequency indicated on the dials. The sweep width is determined by the ac voltage applied to the control winding.

The G-32 circuit

The sweep generator's tuning ranges are 3 to 7, 6 to 14, 13 to 33, 35 to 85 and 80 to 213 mc on fundamentals. Sweep width is continuously variable and ranges from zero to 3 mc on the lowest band to 30 mc on the highest. A marker-adder circuit superimposes marker frequencies on the receiver's response curve so the markers are not affected by its tuning characteristics.

The schematic of the G-32 is shown in Fig. 3. V1 is a 6BQ7-A twin triode FM oscillator and cathode follower. The FM oscillator (V1-b) uses a five-band Increductor covering from 3 to 213 mc. The signal coils are connected in series across the tuning capacitor on the lowest range. As we switch to higher ranges, coils are progressively shorted out until the inductance on the highest range consists of two copper strips and the switch.

On the lowest range, a tapped coil is switched into the circuit. The tap is grounded for rf through R16 and C5. This rf ground improves the performance of a Colpitts oscillator at low frequencies. This rf network and R15-C4 eliminate unwanted phase shift that occurs when the inductance of the signal windings is varied at a 60-cycle rate.

The dc bias for the control winding is obtained from a small selenium rectifier operating off the power line. Bias current is adjusted so the resting frequency is midway between the frequencies obtained with zero bias and saturation current. On band E (80-213 mc) bias current is limited by R18. On the other bands it is determined by R17, R18 and the setting of R19. The SWEEP WIDTH control sets the amount of 60-cycle ac fed to the control winding.

V1-a is a cathode follower feeding the 50-ohm output network consisting of variable and step attenuators. The signals are tapped off the arm of the OUTPUT control and fed to the output terminal through a 20-db-per-step OUTPUT ATTENUATOR.

The oscillator is disabled during the negative half of the 60-cycle sweep to blank out the return trace and provide a base line for the response curve. This is done by simultaneously driving the oscillator grid highly negative and reducing the plate voltage. The oscillator grid is direct-coupled to the blanker plate through isolating network R14-C7. The blanker cathode is connected to a voltage divider across half the secondary on the power transformer. When its cathode is positive with respect to the plate, blanker V2-a is cut off and V1-b develops normal operating bias across its 4,700-ohm grid resistor (R13).

As the blanker cathode swings negative, the diode conducts and develops a negative voltage across R14 and R13. The drop across R13 is sufficient to cut off the oscillator.

The negative pulse at V2-a's plate is capacitance-coupled to the two-stage agc amplifier. The amplified negative pulse appears at the plate of the second agc amplifier (V2-b) and the grid of V4.

V4 is a series type voltage regulator supplying B-plus voltage to the oscillator plate. The negative pulse from the agc amplifier biases V4 to cutoff and removes plate voltage from the oscillator. Thus, the oscillator is cut off

during the retrace period by the simultaneous interruption of plate voltage and application of high negative grid bias.

Rf output is held constant across the swept range by the agc amplifier. Negative operating grid bias varies directly as the rf output. If the oscillator output drops, its grid bias drops and produces a positive pulse that is amplified and fed to V4. Then V4's internal resistance drops and increases the oscillator supply voltage until the rf output returns to a predetermined level.

On the other hand, when oscillator output rises, a negative pulse is fed to the series regulator to increase its internal resistance and reduce oscillator plate voltage. The LEVEL control is set for maximum output with minimum amplitude variations across all bands.

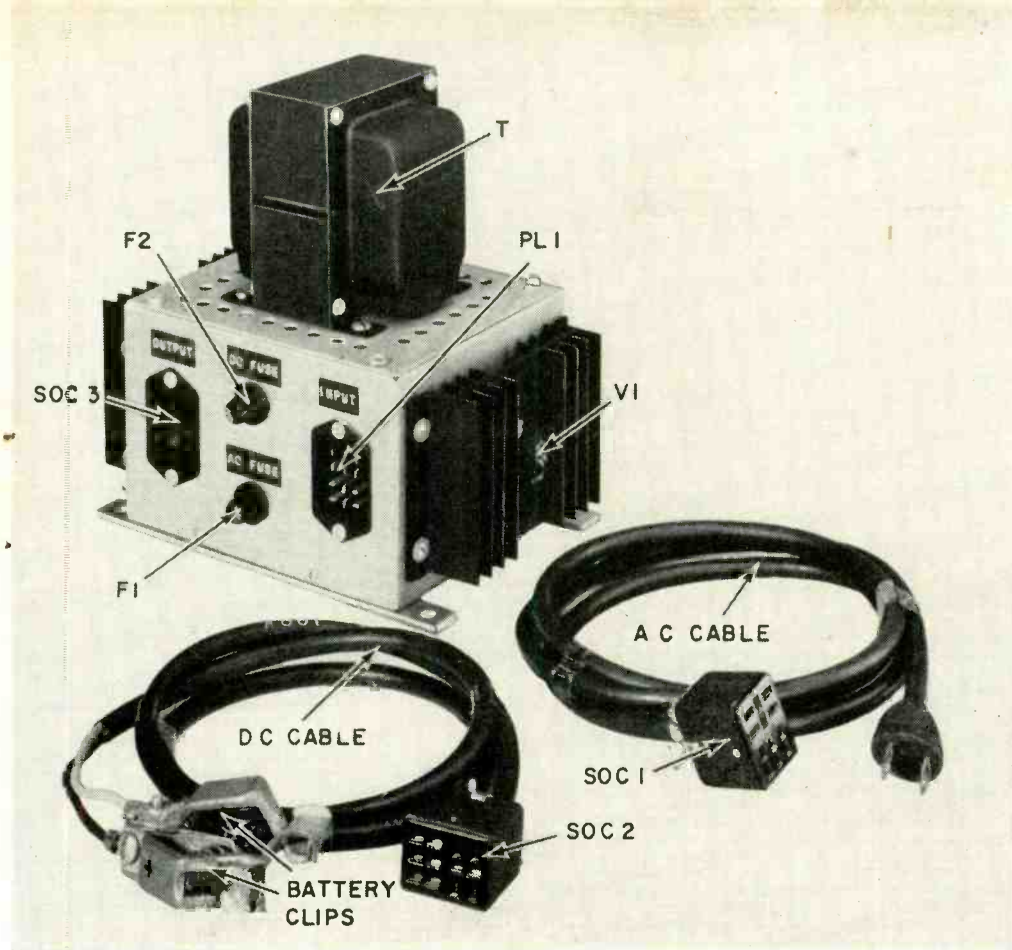
The G-32 has a built-in crystal-controlled marker generator and a marker-adder circuit. A part of the FM oscillator output is tapped off and fed to the grid of sweep-sampling and amplifier V6. This stage amplifies the sweep sample and isolates the sweep oscillator from marker oscillator V3-b.

The marker oscillator is a Pierce type for generating crystal-controlled marker frequencies. A 4.5-mc crystal is supplied. The crystal socket is on the front panel between the MARKER WIDTH and MARKER SIZE controls. An external signal generator can be connected to the marker input jack to provide variable marker and calibration pips on the response curve.

The outputs of the sampling amplifier and marker generator are heterodyned in the 1N87 crystal mixer to develop beats that are amplified by V7 and superimposed on the receiver's response curve as markers. The width of the markers is controlled by varying the time constant of the filter consisting of C21 and the MARKER WIDTH control.

The amplitude of the marker is varied by R44 connected as a gain control between the halves of V7. The amplitude of the receiver's response curve on the scope can be varied with the PATTERN SIZE control.

The 60-cycle sweep voltages applied to the scope and the FM oscillator must be pure sine waves exactly in phase to insure a linear display. The sweep voltage for the Increductor is taken off the ac line. The deflection voltage for the scope is taken off the power transformer secondary through a variable phase-shift network (R32-C28) and a filter network (R33-C27-R34-R35). The PHASE control permits the operator to bring scope and Increductor sweep voltages into phase and compensate for phase shift in the transformer, Increductor and other circuit elements. The filter network reduces distortion and provides the scope with a pure sine wave. END



Line ac or 12 volts dc, your mobile radio keeps right on working

With the increased use of mobile electronic equipment, especially for CB radio, need for a compact, easily transported power supply has increased. We have designed a unit that permits the use of mobile equipment with either a 12-volt dc power source or the home-side 117-volt ac power line.

While some available equipment contains a power supply that will work with both power sources, most electronic gear is built to operate from only one. Therefore, we felt that a moderate-price, portable power supply with a high power output, would have many applications. CB, amateur and other fixed-station radio operators, as well as PA technicians could find it useful.

Such a unit is described in this article. Starting with a specially designed transformer, the Stancor P-8195, we built a transistor power supply that weighs less than 8 lb (Fig. 1). It consists of the P-8195 transformer mounted on top of a 6 x 5 x 4-inch chassis with all other components, except transistors and heat sinks, under the chassis. The entire unit, including transformer and heat sinks, measures 8 x 8½ x 5 inches.

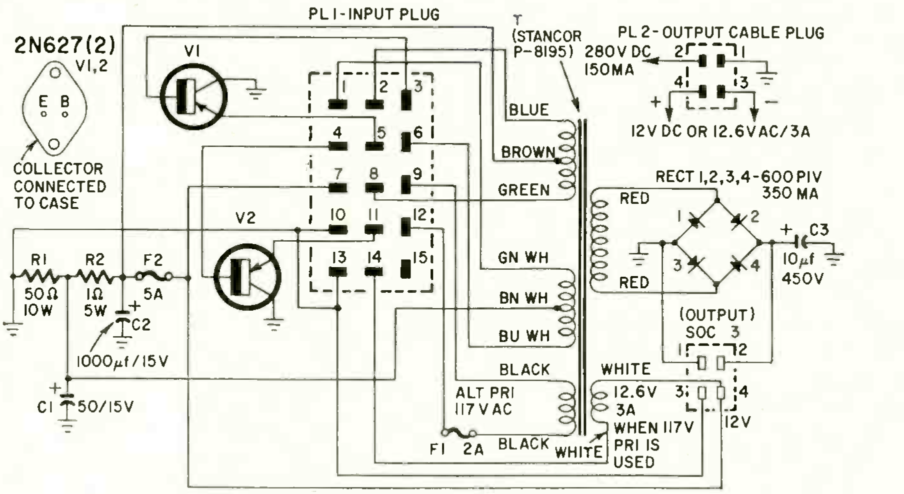
Transverter powers Mobile Gear

By OLIVER WILLIAMS and EDMUND P. KELLY, Jr.*

The unit packs a tremendous amount of power for its size. It will handle any equipment with power requirements up to 280 volts dc, at 150 ma. This means it will cover the majority of mobile audio and rf applications. All popular tube types, such as 6AQ5, 12AQ5, 6V6, 12V6GT, 12BY7, 5763, as well as any other tubes whose power requirements are 280 volts dc at 150 ma or less, can be handled.

The transverter is intended to provide excellent service under rugged conditions. It could be made at a somewhat lower cost by eliminating some of its features. However, we felt this would be false economy, since mobile equipment

*Stancor Electronics, Inc.



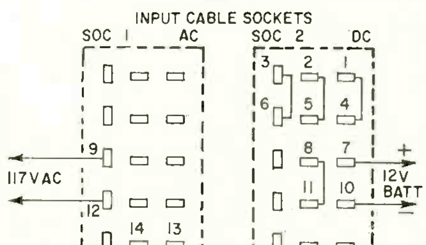


Fig. 1—Circuit of the 2-transistor transverter.

R1—50 ohms, 10 watts
R2—1 ohm, 5 watts
C1—50 µf, 15 volts, electrolytic
C2—1,000 µf, 15 volts, electrolytic
C3—10 µf, 450 volts, electrolytic
F1—2 amp fuse (type AGC or 3AG)
F2—5 amp fuse (type AGC or 3AG)
PL 1—15-contact plug (Cinch-Jones P-315-DB or equivalent)
PL 2—4-contact plug (Cinch-Jones P-304-CCT or equivalent)
RECT 1, 2, 3, 4—600 PIV, 350 ma
SOC 1, SOC 2—15-contact socket to match PL 1 (Cinch-Jones S-315-CCT or equivalent)
SOC 3—4-contact socket to match PL 2 (Cinch-Jones S-304-DB or equivalent)
T—transverter transformer: primaries; 12 volts dc; 117 volts ac, 60 cycles; secondaries; 280 volts dc, 150 ma; 12.6 volts ac, 3 amps (Stancor P-8195)
V1, V2—2N627
Fuseholders (Littlefuse 342001 or equivalent) (2)
Terminal board (Cinch-Jones X-1401C or equivalent)
Heat sinks (Motorola MS-10 or equivalent) (2)
Aluminum bars, 7½ x ½ x ⅛-inch (2)
Aluminum bar, ⅜ inch square (see text)
Chassis box, 6 x 5 x 4 inches
Battery clips (2)
Miscellaneous hardware

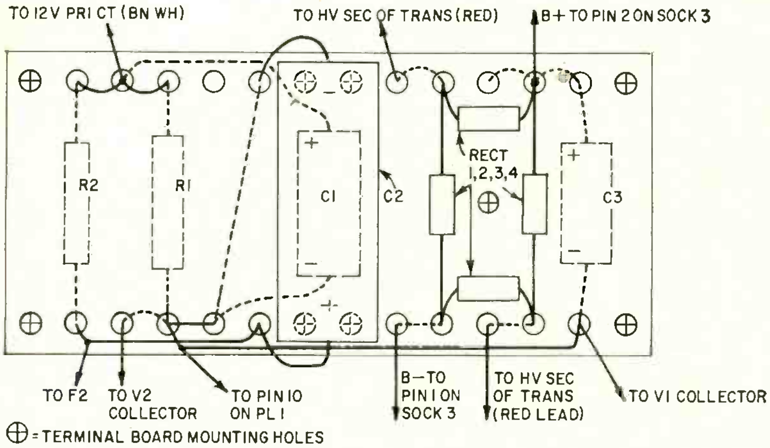
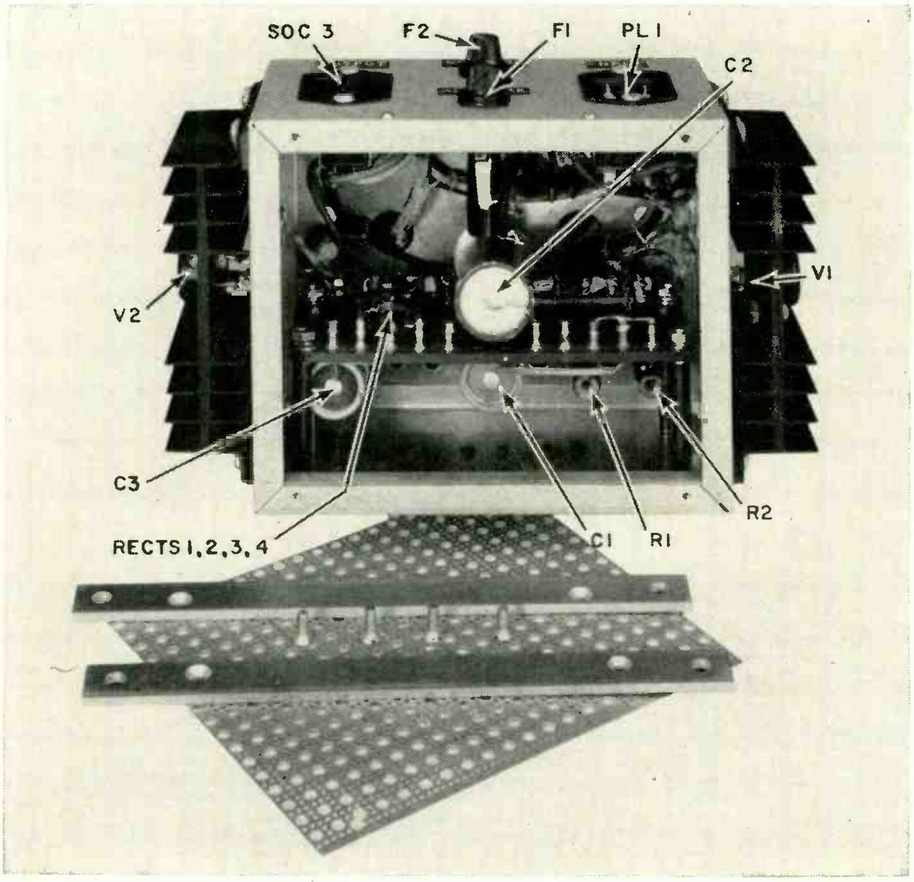


Fig. 2—Details of parts layout on the chassis board. Parts shown dashed are under the board.

must work under severe operating conditions.

All smaller components are fastened to a separate mounting board (Fig. 2). This keeps the components securely anchored so they will not work loose or be damaged by vibration from movement of the vehicle. It also permits mounting all components vertically for best ventilation and cooling. In addition, this technique eliminates the need for insulating most of the component leads.

Another important feature of the unit is the input plug. When the supply is used with 117 volts ac, the transistors must be out of circuit. Otherwise they will be burned out. While an on-off switch or simple rotary switch could do this, the safety of the transistors would depend upon the operator remembering to throw the switch. With the plug and socket arrangement we use, the operator must automatically disconnect the transistors from the circuit when he plugs the 117-volt line cord into the transverter. Conversely, the transistors are reconnected when the 12-volt line cord is plugged into the input socket. If the wrong socket is inserted, no connection is made, and the circuit cannot be damaged.



A look inside the chassis box. The perforated bottom plate and heavy bar supports are also shown.

Construction notes

Ventilation is very important. For this reason, holes are drilled around the transformer in the chassis top. It is important that the base of the power supply be raised from the mounting surface to permit free flow of air through the unit. We used two aluminum bars, each 1/8 inch thick by 7½ inches long to lift the chassis away from the mounting surface and to provide a means of fastening the unit in place. This technique can be modified to suit your particular installation problem but the chassis must be raised from the mounting surface to permit adequate ventilation. The unit is self-ventilating since the normal heat of the transformer creates enough of an updraft to pull the air through the metal chassis.

Aluminum bar stock, 3/8 inch square, is available from many hardware stores. A length was bolted to the bottom of the chassis to provide additional strength and to support the mounting bars. If desired, use the same square stock for the mounting bars. The perforated metal bottom plate is not essential. However, some sort of protective device for the chassis base is advisable, particularly if the unit will be moved frequently.

Construction is extremely simple. Wiring should take about an hour. The largest amount of time will be spent drilling the chassis.

The terminal-board layout is shown in Fig. 2. It is fastened to the chassis with 6-32 by 2⅛-inch round-head machine screws with 1⅝-inch spacers made of metal tubing slipped over them. Put washers on each side of the terminal-board mounting holes and a lockwasher under the nut. Lockwashers must be used with every bolt in the unit to keep them from loosening due to vibration. Drill a hole between the two smaller capacitors for attaching the capacitor clamps. Make sure they are installed before the diodes are soldered in position.

Insulate the heat sinks from the chassis. Insulated strips can be easily obtained by sawing lengths of the terminal mounting board. Use fiber washers under the head and at the nut end of the bolts, fastening the sink to the chassis. Be sure to drill holes large enough to keep the bolts from touching the chassis. Make the hole for the transistor leads on the side of the chassis about an inch in diameter to provide enough clearance for the transistor terminals.

All leads in 12-volt dc circuits should be No. 16 wire. No. 8 or 10 wire should be used for the battery cable. The 117-volt ac wiring may be No. 18. It is not necessary to cable any of the wiring although it does make for a neat appearance. END

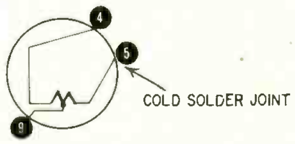
What's Your EQ? Solutions

Industrial Problem

The relay contacts were chattering at 120 cycles, and making contact at instances when the supply voltage was away from zero. This produced short pulses of extremely high peak current. These peaks were not measured on the meter, because of their short duration, but contributed to the total power, which was more truthfully indicated by the resistor than by the more sophisticated instruments.

Audio Service Stinker

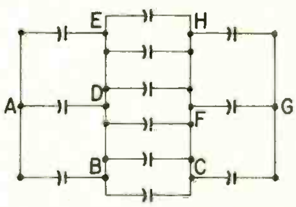
Since the WA-P2 preamplifier has a 6-volt heater supply, the heaters for the two triode sections are in parallel (pins 4-5-9). There was a cold solder



joint on pin 5, with the result that the heater in that triode section did not light.

Capacitive Cube

Junctions B, D and E are all at the same potential, as are F, C and H. Hence the network can be redrawn as shown. We now have, in effect, three capacitors, one of 15 μf, one of 30 μf



and another 15 μf, in series, calculating the total capacitance by the easiest formula to use in this case:

$$\frac{1}{C} = \frac{1}{15} + \frac{1}{30} + \frac{1}{15}, \text{ we}$$

find that $C = \frac{30}{5}$, or 6 μf

"Doesn't look too bad."

new PATENTS

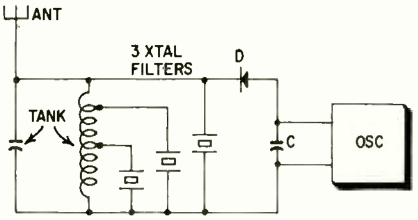
Responder Circuit

Patent No. 3,018,475

Robert A. Kleist, Sunnyvale, and Clarence S. Jones, Los Altos, Calif. (Assigned to General Precision, Inc., Binghamton, N.Y.)

The circuit forms part of a system containing one interrogator and several responders. An interrogator (not shown) radios a signal to the responder which instantly returns a coded signal. Each responder sends a different signal so it may be used to identify each car in a train, for example. The interrogator simply moves past a train of box cars, each containing a responder.

The interrogator signal may be a 200-kc carrier with a number of audio sidebands. It is tuned



in by the tank and detected by D. The dc output energizes a transistor oscillator, and the sidebands appear across C. Each responder contains a different set of piezo crystals which absorb certain sidebands.

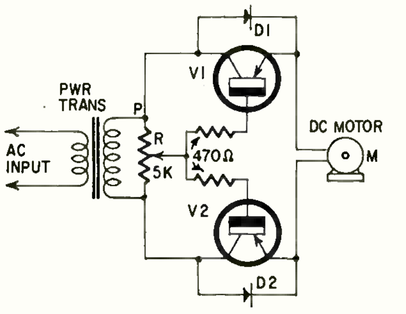
The responder carrier (which has a different frequency from the interrogator) is now modulated by the audio sidebands which remain across C. This signal is reradiated to the interrogator. Since each responder is equipped with a different set of crystals, it transmits a signal different from that of the other responders.

Dc Motor Control

Patent No. 3,022,454

Edwin G. Mills, Dallas, Tex. (Assigned to Texas Instruments, Inc., Dallas, Tex.)

This circuit is suitable for energizing small dc motors from the ac line. When point P is positive, D1 shorts out V1. D2 blocks so V2 conducts.



When point P is negative, V2 is shorted out while V1 conducts.

If R is center-tapped, equal and opposite currents flow into the motor M during one complete cycle and it does not rotate. If R is adjusted at a higher point, higher current will flow through V1 (during its active period) than through V2 during the next half-cycle. The further one sets R from center tap, the faster the motor will turn. To reverse it, R is set below center tap.

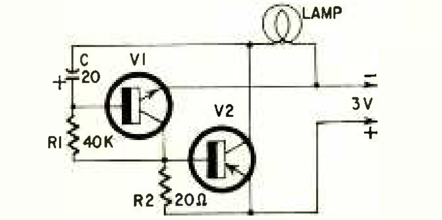
Lamp Flasher

Patent No. 3,018,473

George H. Rodgers, Elsinore, Calif. (Assigned to Marco Industries, Anaheim, Calif.)

Intially, C is uncharged, so there is no potential difference between V1's emitter and base. This transistor blocks. V2 also blocks because there is no forward bias.

C begins to charge and V1's base goes positive until V1 conducts. Its current flows through



R2 and generated forward bias for V2, which also conducts. The lamp lights because it is now across the battery through V2.

C begins to discharge through V1 and V2. V1's base goes more negative until the transistor blocks. V2 must also block because the drop across R2 has disappeared. The lamp is extinguished and C is discharged, completing a cycle.

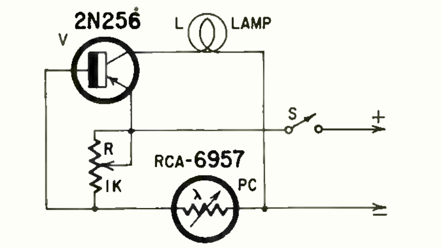
Warning Light

Patent No. 3,026,498

Edward G. Galliers, Brooklyn, N. Y.

This device is mounted at the rear of an automobile to warn trailing drivers to keep their distance. Photocell PC forms part of a voltage divider for V's base. R is adjusted to block V when no light falls on the photocell.

When the cell is illuminated by headlights,



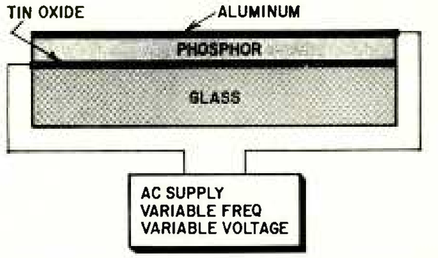
its resistance falls and the base goes more negative. V conducts and lamp L lights. This illuminates a signal that warns the tailgating driver to "keep distance". The photocell may be mounted on the car about 22 inches above the road. Amplifier and lights may be in a box considerably higher. One side of the box is a glass plate with the words printed on it, facing rearward.

Two-Time Electroluminescence

Patent No. 2,972,694

William A. Thornton, Jr., Cranford, N.J. (Assigned to Westinghouse Electric Corp., E. Pittsburgh, Pa.)

The life of a luminescent cell may be extended by energizing it first by low voltage at high frequency, then, when its useful life under these conditions is ended, by high voltage at low frequency. For example, 60 volts at 20 kc may be



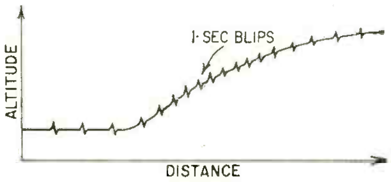
applied first. When the cell becomes exhausted, about 165 volts at 80 cycles may be applied, and the cell will work for an additional period.

The explanation is that only certain portions of the phosphor crystals deteriorate under the first mode of excitation. The remaining portions are then ready to give light. END

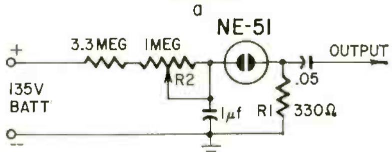
NOTEWORTHY CIRCUITS

New Use for Neon Oscillator

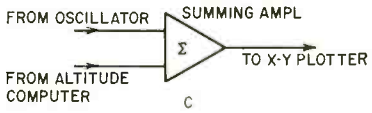
Here is a new application for the old familier neon oscillator circuit. A Pace X–Y plotter was being used with a small analog computer to record ground distance vs altitude for a traveling aircraft under simulated conditions. A simultaneous plot of the aircraft's velocity was also required. If 1-second marker blips could be superimposed on the distance trace, the interval between blips would show the velocity and how it would change (*a*).



a



b



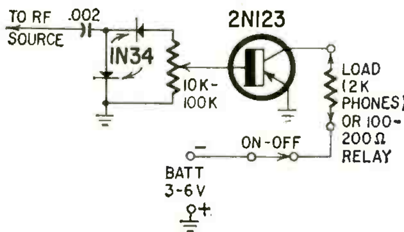
c

A simple neon blinker circuit was constructed (*b*), with the output pulse taken from R1. R2 sets the firing rate of the NE-51 to 1 pulse per second.

The resulting pulse is coupled to the plotter by adding it to the voltage used to represent altitude. One of the Philbrick summing amplifiers (*c*) on the computer served this function.—*Joseph E. Kroeger*

Amplified RF Relay

This circuit has proved its usefulness in the ham shack and on the hobby bench. Parts and layout are not critical. You can use any convenient rf diodes. The transistor shown was used because



it was available. The basic circuit consists of a half-wave voltage doubler biasing a transistor into conduction, thus producing a "no signal, no go" circuit.

The potentiometer is an input level control to prevent strong rf signals from overbiasing the transistor. It also contributes to more stable operation by providing a dc ground path when no signal is being received.

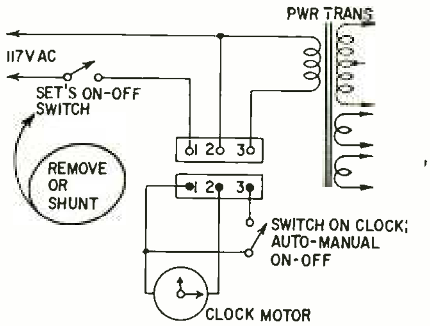
Although the basic relay/amplifier is untuned, connecting the probe across a tuned circuit converts it to a tuned rf relay, trf receiver. When connected to the last i.f. stage in a broadcast receiver, it becomes a Conalrad monitor. Many other uses for this instrument will no doubt occur to the experimenter.

The voltage-doubler portion alone is well worth the time required to assemble it. It makes an excellent demodulating probe for headphones or a multimeter.—*Claude C. Russell*

Clock Timer for Your TV

Clock radios have been around for quite some time. Now clock TV's are also appearing. The clock will turn the set off or on at some preset hour. You can add such a system to your TV.

Pick up a basic clock timer. (They're sold by Lafayette Radio, Allied Radio and several other mail-order houses.) Insert it into the ac line circuit of your TV receiver, as shown in the diagram.



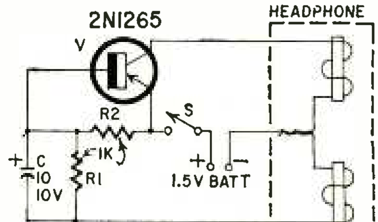
The matching plugs and jacks are a convenience. If you wish, you can wire the clock permanently in place and avoid them. Remove the set's on-off switch as it is replaced by the on-off-manual-automatic switch on the clock.

Now set the clock for, say, 6 pm and tune your TV to the station you'll be wanting to watch, and it will turn itself on at the proper hour. And when you're ready for bed, but want to watch a show till you drop off, set it to turn the set off in, say, 30 minutes. If you're asleep, the set goes off without any problems. And you don't get up in the morning to face a set that was running all night.—*Warren Roy*

Earphone Oscillator

Just a few years ago it was impossible to construct a complete code practice oscillator inside a conventional headphone. Now it is easy with subminiature components and a 2N1265 or equivalent audio transistor. I used the headphone coils as the inductor in a Hartley oscillator (see diagram). The phone is a low-impedance type with a dc resistance of 30 to 40 ohms.

Remove the cap and diaphragm and locate the twisted leads connecting



the two coils. (In most phones this connection is between the coils at the bottom of the case.) Drill a 5/64-inch hole near the twisted connection. Push these wires into the hole along with a thin piece of tinned wire. Solder the case and wires together with enough solder to fill the hole. The third wire goes to one side of the battery. In a nonmetallic case, solder the wires together and anchor to the case with a drop of cement. A switch or key can be made from the leaves of a discarded relay and bolted to the side of the case.

Try to fit all parts into the case before you begin wiring. If you can't find a dry cell small enough, cut down a size AAA cell. Don't cut directly through the cell. Cut around it so the center carbon rod is untouched. Nip off the extending rod with nippers and add a flexible lead for the positive terminal. Dip the cut end in molten wax several times. (If the cell is weak because of an accidental short while cutting, give it a boost by connecting a size-D cell across it for a few minutes.)

The audio frequency depends largely on the values of R1 and C. Vary for the most pleasing tone. If you need more volume for group practice, simply place the oscillator close to a radio tuned to a dead spot on the lower end of the broadcast band.—*Martin H. Patrick*.

[A standard key provides better keying practice. Why not replace the switch with a tiny jack such as Lafayette Radio's MS-833?—*Editor*] END

"Picture's been flopping for three months."

TECHNICIANS' NEWS

Cable TV A Threat? ? ? ?

Indianapolis, Ind.—According to the *Hoosier Test Probe*, it is. Here are some quotes from the front page of a recent issue. The decision, you'll have to make for yourself.

"Once established [the cable TV system] with a majority of the townspeople dependent on the cable, rates can go higher, new set sales could be accommodated over a 5- or 6-year period at only slightly higher monthly charges, and service can be monopolized in the biggest captive service setup ever envisioned. . . .

"In our neighboring state of Illinois, where they have had the cable in some areas for approximately a year, service technicians are reported to be starving to death. Many are said to have gone out of business.

"Are cable company people doing the service work? The companies say no, but the surviving servicers and distributors say yes. One lady interviewed replied she was instructed by the man hooking up her home on the cable to call him for any service needed, whether it was for the antenna system or her set. When asked about her previous regular technician, she replied, 'Oh, we don't call him anymore.' "

Welcome!!!

Sioux City, Iowa—Sooland TESA is now in business representing local service operators. The group is not limited to Sioux City, but takes in all territory within a 30-mile radius. Sooland will meet the first Tuesday of each month. President of the new association is Millard Perry; vice president, Walter Freeman; secretary-treasurer, Bill Lawson.

Check Cashing

Seattle, Wash.—King County Prosecutor warns all merchants to be extremely careful about cashing checks for visitors from out of town. Merchants (and this means TV techs, too) should require the best of identification before cashing even small checks, and visitors should be referred to banks for cashing.

Driver's licenses, Social Security cards and membership cards are not the best means of identification. The best would be an official card bearing the person's thumbprint and photograph. And even this would not solve the problem of returning a visitor to appear in court once he returned to his home state.

The best advice is not to cash or accept checks unless you know the person well enough to loan him the amount of money represented by the check.—TSA Service News.

State Conference

Richland, Wash.—More than 100 members of the Washington State Electronics Council met at the Desert Inn Hotel for their annual convention. Among the highlights was a discussion of problems which have confronted the service industry and steps that have been taken to ease them.

State Senator Mike McCormick pointed out that any attempts toward licensing must follow the course of any other proposed legislation and that with proper consideration for the protocol of the proposals greater progress may be made.

Possible cooperation between West Coast groups was also discussed. Keith Kirstein pointed out that many problems encountered in California are similar to those facing the Washington association. Group insurance was also on the agenda.

Wrapup of the very successful meeting came with elections. The list of new officers is headed by Ansel V. Heckman, chairman. Harold Hart, vice chairman, and Bob Mansfield, secretary-treasurer.

Lum Elected President

Sacramento, Calif.—The new officers list for the Sacramento chapter of the California State Electronics Association is headed by Diamond Lum, president. Other officers elected by the group are Edward R. Nelson, vice president, and Robert H. Schuetzle, treasurer. Directors elected this year are Victor H. Manley, outgoing president; Joseph Rodrigues and Floyd Marshall.

13,800,000 Radios Not Working

Washington, D. C.—There's a lot of work awaiting the electronic technician. The Bureau of the Census has revealed that, out of 97,900,000 portable radios, floor models, table models, clock radios, radio phonographs, radio-TV combinations, etc. in the United States, 13,800,000 sets are not in working order. Now if there was only some way to get those receivers into the shop. . . .

CSEA Fights Phony Advertising

California—In an effort to stop "phony" TV service advertising in the Yellow Pages, the California State Electronics Association has requested a hearing with the Public Utilities Commission. As part of its "Operation Cleanup," the group is trying to put an end to "no fix, no pay," "24-hour service" and multiple-ad layouts appearing in the phone book. CSEA met with the Pacific Telephone Co. who agreed to accept no further ads claiming 24-hour service unless positive proof were offered to support this claim. CSEA complained of one service company with seven quarter-page ads on one double page under five names with seven answering services.

Technicians Best Salesmen

Columbus, Ga.—"My TV technicians are better than a salesman on the sales floor." These are the words of Curt H. Drady, advertising manager of Seban TV. To ensure technicians selling sets, Seben has a bonus plan under which a cash bonus is paid to technician salesmen who meet a predetermined sales quota.

Drady went on to say, "From past repair calls my technicians have gained the confidence of the customer. If the customer needs extensive repairs on an old TV, the technician can advise that in the long run it would be cheaper to junk the old set and buy a new one."

[This is something we've known and advocated in our editorial pages for years. The technician is the best salesmen of TV sets, TV accessories and other electronic devices.—*Editor*]

They're Looking Under Rocks

Brooklyn, N. Y.—The newly formed Brooklyn Radio & Television Service Guild is being investigated by the New York State Attorney General's office, according to *Home Furnishings Daily*. Members of the guild were alleged to have posted a series of signs in their windows indicating prices of service. The rates are alleged to be largely similar.

The president of the Guild, Charles Edward, expressed the groups willingness to talk to the Attorney General about the complaints and stated that there is no specific program on prices. He said that members set their own prices based on overhead and several other factors. END

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An outstanding performer of proven design. Only its price is modest. Features 25 watt power output on each stereo channel —50 watts monophonic. Has complete stereo facilities including a separation control which customizes sound to your room; clutch type Volume/Balance control and separate Bass and Treble controls. Response: 15-40,000 cps ± .5 db (at normal listening levels). Housed in a distinctive 2-tone metal case with legs.

No Down Payment **99.50**

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59.50 No Down Payment

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Enjoy the enhanced beauty of FM stereophonic sound (known as Multiplex) and FM monophonic broadcasts too with this new FM tuner from Lafayette. Quality engineering features include a tuned RF stage provided by a 3-gang tuning condenser, ratio detector with dual tuned limiters, 2 microvolts of sensitivity for 20db of quieting and full fidelity frequency response, 20-20,000 ± 2db at less than 1% distortion. 10 tubes plus 4 diodes. Complete with tuning meter. Handsome two-tone metal cabinet will grace any decor.

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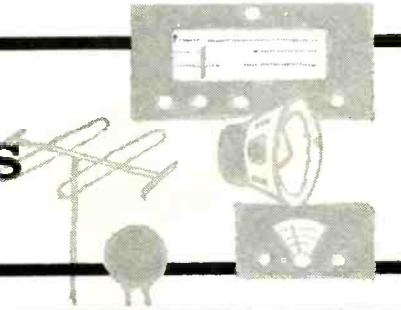


CLASS-D CB TRANSCEIVER, *model HE-20B.* 5-watt input crystal-controlled transmitter operates on any 8 channels. Operating channel chosen by front-panel control. Superhet receiver section has 8 crystal-controlled receive positions, tunable over all 23 channels, sensitivity 1 μv.

Squelch circuit, series gate noise limiter. S-meter. Matched crystals for channel 9, push-to-talk ceramic mike with mounting bracket and built-in 115-volt ac/12-vdc power supply.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

TRANSISTORIZED CB RADIO, *Commaire ED-276.* 6 channels, one plug-in crystal socket on front panel. Double-conversion superhet receiver;

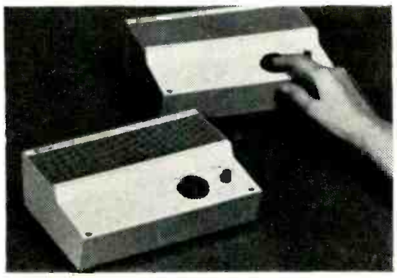
squelch and rf gain in single control; 3-stage agc. 22 transistors, 8 diodes, 3 tubes.—**Vocaline Co. of America, Inc.,** Old Saybrook, Conn.

SSB MOBILE TRANSMITTER, *model HX-20.* Hermetically sealed crystal bandpass filter, crystal-controlled dual-conversion heterodyne circuitry, automatic level control, automatic voice-operated transmit-receive switching. Doubles as

fixed-station transmitter. Complete bandswitching, 80- through 10-meter bands. Output frequency heterodyned from temperature-stable vfo operated from 5.0 to 5.5 mc.—**Heath Co.,** Benton Harbor, Mich.

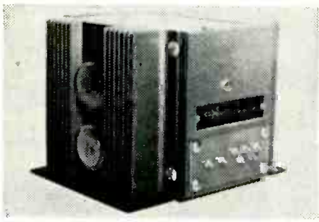
CB ANTENNA, *model HE-57WX.* 48-in. continuously loaded glass fiber whip, for auto cowl or rear deck mounting. Substitutes for ¼-wave whip

and base-loaded types. Special rocker support for 8-point grounding. Fits 15/16 to 1¼-in. mounting hole.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.



WIRELESS INTERCOM KIT, *catalog No. 83 Y 991.* Portable, transistorized, 2-station unit plugs into any ac outlet or dc power source. Press-to-talk button on each station may be locked on for use as monitor or baby-sitter. Additional stations, *catalog No. 83 Y 992.*—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

DC-AC INVERTER. 117 volts ac at 2.5 amps and 400 cycles, from 12-volt battery source. Heat radiation fins on sides of chassis let transistors operate at lower temperature. 4 transistors; regulator pack on special order. Power supplies avail-

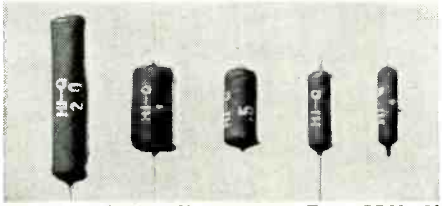


able for specific voltage regulation, ac-dc rectification with specified ripple factors. Input 6 to 32 volts dc, ambient temperature range —35° to +55°C. Voltage output to 300 volt/amps, mean efficiency 87%.—**SunAir Electronics, Inc.,** 3101 S.W. 3rd Ave., Fort Lauderdale, Fla.

ELECTRONIC IGNITION SYSTEM *model T Transfire.* For 6- or 12-volt negative-ground cars. All parts needed to convert standard ignition

system into transistorized electronic system.—**W. F. Palmer Electronics Labs Inc.,** Carlisle, Mass.

CEROL CERAMIC CAPACITORS. Tinned copper axial leads, weldable alloy leads available. Series resistance 0.20 ohm, maximum at 8 to 10



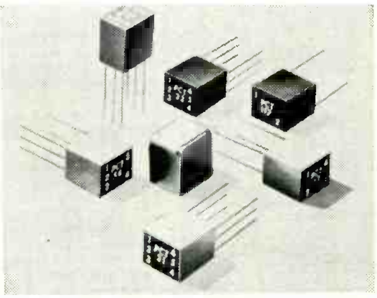
mc; power factor 2% maximum. *Type CR89, 50 vdc,* 0.1-2 μf. *Type CR91, 200 vdc,* 0.1-2 μf.—**Aerovox,** 740 Belleville St., New Bedford, Mass.

POLYSTYRENE CAPACITORS, *type PE.* 0.1 inch thick. Capacitance range .001 to .01 μf, higher values on special order. Tolerance range ±5% to ±.0025%. Solderable, weldable leads; internal lead attachment welded to capacitor insert. Voltage rating 100 vdc, insulation resistance 10^{12} ohms minimum at 25°C. Dissipation factor .02% maximum at 25°C. Long-term stability ±0.1% under all operating conditions.—**Arco Electronics, Inc.** Community Drive, Great Neck, N Y.

TRI-POWER SELENIUM RECTIFIERS. Triple-amperage selenium cells with true diffusion type p-n junction. Custom fabricated for new design or replacement for any selenium stack now

in use.—**Electro-Standards Labs, Inc.,** 387 N. W. So. River Drive, Miami 36, Fla.

MINIATURE TRANSISTOR TRANSFORMERS, *Polychromatrans.* 22 color-coded plug-ins include input, interstage, driver, output, isolation transformers and chokes. Each 0.410 x 0.310 x

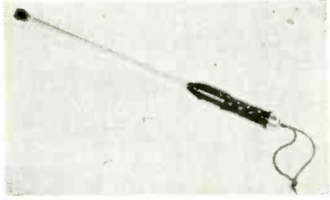


0.465 inch. Line includes 4 chokes, 3 each input, interstage and driver transformer and 2 isolation and 7 outputs.—**Stancor Electronics, Inc.,** 3501 Addison St., Chicago 18, Ill.

MINIATURE RHEOSTAT, *R-12½-watt.* For standard and special requirements. Variations in shafts, bushings, customer taper windings, etc.,

may be specified.—**Tru-Ohm Products,** 3426 W. Diversey Ave., Chicago 47, Ill.

TRANSISTOR SHOCK ROD for self-defense. 10-oz., 29-inch aluminum cane delivers harmless jolt into wild animals or vicious persons.



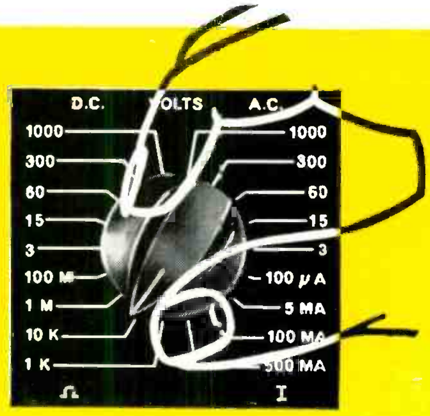
Two C-cell flashlight batteries bring tiny current to 4.000 volts. Fingertip control.—**Freeman Electric Co.,** Freeman, Mo.

EMERGENCY SIREN/AMPLIFIER, *Vanguard I.* Transistorized. pushbutton, self-contained, mobile. Standard, warbling siren wail; manual siren tone; PA operation; Civil Defense alert signal; radio relay operation. Amplifier response 400-10,000 cycles. Rated siren output 50 watts; mike

and radio 30 watts. Noise level 30 db below rated output; output impedance 16 ohms. Power requirements 12.4-14.0. vdc. Operating current drain: PA—3 amps; siren—5 amps. Quiescent current drain 150 ma.—**University Loudspeakers, Inc.,** 80 S. Kensico Ave., White Plains, N. Y.

VHF CHANNEL TRAPS, for any channel from 2 to 13. Approximately 35-db attenuation on

See Only the Scale You Want... in the Exact Range You Want



just set the range switch

and the correct scale appears

AUTOMATICALLY

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V O MATIC 360

WITH BURN-OUT PROOF METER

AUTOMATIC VOLT-OHM MILLIAMMETER

Greatly simplifies your VOM use. Individual full-size scale for each range—and only one scale visible at any one time, automatically. Once you set the range switch, it is impossible to read the wrong scale. Reading in the range you want is amazingly easy—and direct. No reading difficulties, no multiplying, no errors.

Sensitivity 20,000 ohms per volt DC; 5000 ohms per volt AC. **Accuracy** ±3% DC; ±5% AC; (full scale). DC Volts in 6 ranges 0-6000. **AC Volts** in 6 ranges 0-6000. **AF** (Output) in 4 ranges 0-300 volts. **DC Current** in 5 ranges 0-10 amps. **Resistance** in 4 ranges 0-100 megohms. Supplemental ranges also provided on external overlay meter scales. Meter protected against extreme overload and burn-out. Polarity reversing switch. Automatic ohms-adjust control. Mirrored scale. Complete with 1½-volt and 9-volt batteries, test leads, and easy-viewing stand. Net, **$59.95**

DYNAMATIC 375

AUTOMATIC VACUUM-TUBE VOLTMETER

Once you set the range switch, you automatically see only the scale you want and read the exact answer directly. Saves time, eliminates calculation, avoids errors. Individual full-size direct-reading scale for each range. Simplifies true reading of peak-to-peak voltages of complex wave forms in video, sync and deflection circuits, pulse circuits, radar systems, etc. Includes DC current ranges, too.

Accuracy ±3% full scale AC and DC. **Sensitive** 100 microampere meter movement. **DC Volts** in 7 ranges 0-1500. **AC Volts** (rms) in 7 ranges 0-1500. **AC Volts** (peak-to-peak) in 7 ranges 0-1500. **DC Current** in 3 ranges 0-500 ma. **Ohms** in 7 ranges 0-1000 megohms. Utilizes single DA-AC ohms probe and anti-parallax mirror. Swivel stand converts to carry-handle. Includes 1½ volt battery. Operates on 117 volts 50-60 cycle AC. Net, **$89.95**

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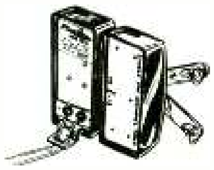
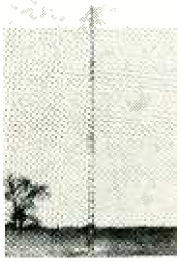
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

any interfering TV or FM station. All-vhf-channel amplifier then boosts signals from other stations. Piggy-back mounted on amplifier and at-



tached directly to antenna terminals by solid aluminum bus bars for direct feeding into trap.—**JFD Electronics Corp.**, 6101 16th Ave., Brooklyn 4, N. Y.

CRANK-UP TOWER, *No. 6.* 18, 26, 37 and 54 feet. Winch and cable lifts sections with ease.

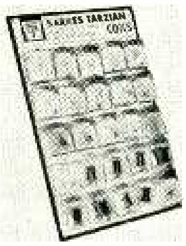


Hot-dipped galvanized.—**Rohn Mfg. Co.**, PO Box 2000, Peoria, Ill.

LOW-BAND YAGIS. *Series Y-104* (illus) 10 element, twin-driven design. range 43-88 mc.

Series Y-81, 50–66 mc; *series Y-101*, 66–112 mc.—**Taco,** Sherburne, N. Y.

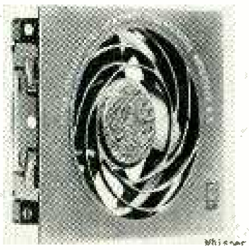
ANTENNA INPUT COILS for exact replacement. Individually packaged in polyethylene containers, arranged on display board. Shipped pre-



assembled for immediate display.—**Sarkes Tarzian, Inc.,** 415 N. College, Bloomington, Ind.

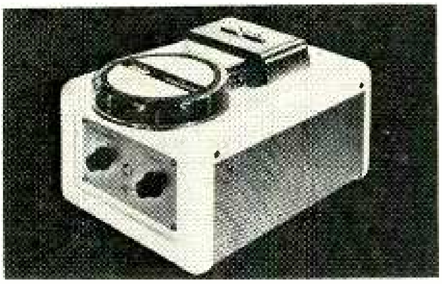
PATCH CORDS. *Model XJ-180*, for Revere and Wollensack tape recorders. RCA phone pin plug on one end, standard short extension jack on other, 15-foot 2-conductor, white, shielded cable. *Model XM-120,* for Webcor tape recorders. 3-conductor phone plug, internal resistor on one end, phono plug on other, 10-foot shielded cable.—**Robins Industries Corp.,** 36-27 Prince St., Flushing 54, N. Y.

WHISPER FAN. For hi-fi and TV home equipment. Moves 60 cubic feet of air per minute, works on 117 volts 60 cycles, draws 7 watts. Built-



in venturi block. 1½ in. deep x 4-11/16 in. square. Screws or mounting clips, plus decorative grille, available as accessories. Noise level indescernible at 2 feet.—**Rotron Mfg. Co., Inc.,** Woodstock, N. Y.

TAPE PLAYER, *Jetstar P-200.* Transistorized, 8-watt amplifier, wide-range 4 x 6-inch oval speaker. Continuous-play plastic tape cartridge, snap-on loading. Dual-track head, 2-track monaural playback at 3¾ ips. Response 50 to 10,000 cycles.

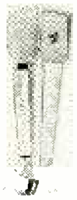


Hum and noise 45 db below rated output, wow and flutter 0.4%. Sensitivity 2.7-mv input for full power output.—**OrrTronics Div.** J. Herbert Orr Enterprises, 714 Wesley St., Opelika, Ala.

SUBMINIATURE MIKES for dictation machines, tape recorders, CB equipment, paging systems, transmitters, hearing aids. *Pen model AC-61* (*illus.*): Response 300-4,000 cycles, impedance

200 or 2,000 ohms. Output level —60 db. Shielded cord supplied in any length. *Lapel model AC-23*: Impedance 2,000 ohms, allows for matching to transistor circuits. May be used in base of ear as phone pickup.—**Telephone Dynamics Corp.,** Sunrise Highway, Baldwin, N. Y.

INDUSTRIAL MICROPHONE, *model #551.* Heavy-duty sealed dynamic mike withstands rain, corrosive atmosphere, blasting. High or low im-

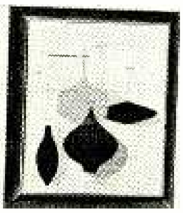


pedance, shielded transformer, leaf type switch, coiled cables.—**The Astatic Corp,** 250 Harbor St., Conneaut, Ohio.

WEATHERPROOF SPEAKER, *model SPF-2.* Flange mounting, bell-opening screen. Power 25 watts at voice frequencies impedance 8 ohms,

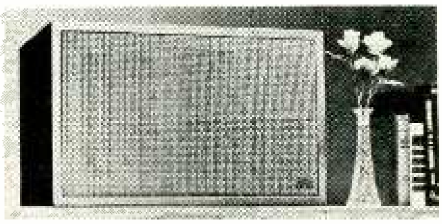
response 300-10,000 cycles.—**Atlas Sound Div.,** American Trading & Production Corp., 1419-51 39th St., Brooklyn 18, N. Y.

PICTURE SPEAKER, *model 2024.* 20 x 24 x 4-in enclosure, 6- or 8-in speaker, or cutout for speaker. For wall-hanging, singly or in pairs, or as extension units. Other models in various sizes



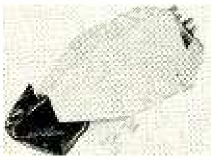
and designs. Speaker specs: 10 watts, response 30–16,000 cycles, voice-coil inmpedance 8 ohms.—**SPECO,** Components Specialties, Inc., 9 Kees Pl., Merrick, N. Y.

BOOKSHELF SPEAKER SYSTEM, *Senior II.* 12-inch Ultra-Linear Response woofer, 3½-inch tweeter with rigid diaphragm. Sphericon Super Tweeter radiates highs to 40,000 cycles, ±2 db to 22,000 cycles. Impedance 8 or 16 ohms; response



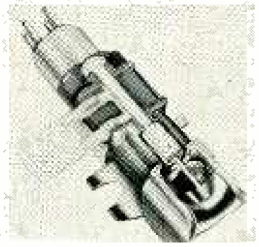
30 to 22,000 cycles; power-handling capacity 30 watts integrated program material. Optimum performance with 10-watt amplifier. 25 x 15⅝ x 12⅛ in.—**University Loudspeakers,** 80 S. Kensico Ave., White Plains, N. Y.

STEREO CARTRIDGE. *model U38IAT,* for automatic turntables. Response ±2 db, 20–20,000 cycles. Channel separation 35 db; output 10 μv per channel; tracking force 2–5 grams; impedance



47,000–100,000 ohms. Complete mu-metal shielding. 14 grams, mounting centers 7/16 to ½ in.—**Pickering & Co.,** Sunnyside Blvd, Plainview, N. Y.

STEREO CERAMIC CARTRIDGE, *model 916TA.* Response 20-15,000 cycles, ±3 db. Output voltage 0.42 mv; compliance 4.0×10^{-6} cm/dyne;



tracking pressure 3-5 grams for professional arms, 4-6 grams for changers. Sapphire tips or diamond sapphire stylus combo.—**Sonotone Corp.,** Elmsford, N. Y.

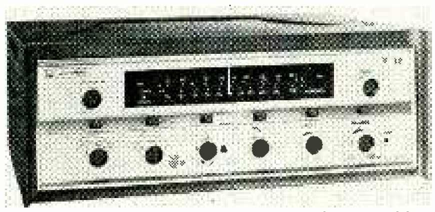
TRANSISTOR STEREO AMP, *model AAW-21.* 35 watts per channel (50 watts/channel by IHFM standards); 13 to 25,000 cycles ±1 db. 28 transistors, 10 diodes. Harmonic distortion at rated output: 1% at 20 cycles, 0.5% at 1 kc, 2.0% at 20 kc. Intermodulation distortion at rated output 1%, 60 and 6,000 cycles, signal mixed 4:1. Hum and noise: tape head 40 db below rated output; mag phono, 45 db below rated output. Channel separation 40 db at 20 kc, 55 db at 1 kc, 50 db at 20 cycles. Input sensitivity (35-watt output per channel, 8-ohm load): tape head 2 mv, mag phono 3 mv, tuner 0.25 volt, FM stereo 0.25 volt. Input

impedance: tape head 60,000 ohms; mag phono 30,000 ohms; tuner 100,000 ohms; FM stereo 100,000 ohms. Transformerless output circuit, multiple feedback loops. All controls on front panel. 6-position dual concentric input selector for mixing tape recording inputs; 5-position mode selector, dual concentric volume, base, treble controls. Touch-operated on/off switch. *Kit model AA-21*: 5 circuit boards, preamp circuits in 6 epoxy-covered modules containing 70 resistors and capacitors, factory-wired and sealed.—**Heath Co.,** Benton Harbor, Mich.

STEREO TAPE DECK, *model 6-44.* Record/playback 3-speed, 4-track. FM-MX filter input, free position switch, automatic microswitch tape stop, pushbutton control, individual recording controls, stop-start pause control. Equipped for sound-on-sound, echo effects, track adding, direct monitor and remote control. Erase head selectivity erases 1 or 2 tracks. Response at 7½ ips, 30-20,000 cycles; 3¾ ips, 30-15,000; 1⅞ ips, 50-7,000. Flutter and wow 0.1% rms at 7½ ips; 0.2% rms at

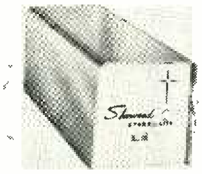
3¾ ips; 0.25% rms at 1⅞ ips. Signal-to-noise ratio 55 db. *Model 6-22* with 2 track heads.—**Tandberg of America, Inc.,** 8 Third Ave., Pelham, N. Y.

FM-AM STEREO RECEIVER, *model RP60.* Stereo-minder lights when stereo is broadcast; front-panel outlets for stereo headphones. Fre-



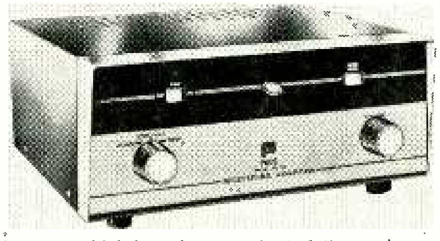
quency response ±1db 20–20,000 cycles; combined output power rating 60 watts.—**Bogen-Presto Div.,** Siegler Corp., PO Box 500, Paramus, N. J.

STEREO-LITE, *model SL-1 stereo multiplex adapter,* for FM tuners. Identifies FM stations broadcasting stereo. Sensitivity (varied with rear control): 100 mv FM stereo composite signal, 10-mv 19-kc pilot. Sensing selectivity: stereo pilot



down to 4 db below noise. No discernible drift. Two paralleled jacks for FM tuner input and MX adapter output. 6C10 compactron. 2 diodes, silicon rectifier. Power consumption 8 watts, 115-125 volts, 50-60 cycles.—**Sherwood Electronic Labs., Inc.,** 4300 N. California Ave., Chicago 18, Ill.

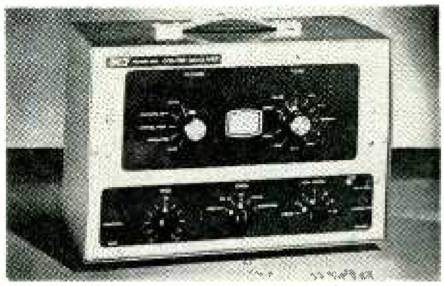
MULTIPLEX ADAPTER, *model MX100.* For most FM tuners, wide-and narrow-band, having tape recorder or multiplex output. Separation 28 db; output level 1.5 volt; distortion less than 1% third-harmonic; response ±1 db, 15 cycles to 15



kc. Dual high-impedance cathode-follower inputs, switch-selected, one for wide-band, one for narrow-band turners. Left and right stereo outputs.—**Paco Electronics Co., Inc.,** 70-31 84th St., Glendale 27, N. Y.

PRINTED CIRCUIT KITS. *Standard model SE-21P* makes 45-square-inch board. *Photo-etch model PE 31P* makes 45-square inch board by photographic method. *Etched model DE-41P* makes 72 square inches, contains assortment of dots, lines, fillets and terminations. *Engineering etch model EE-51P* makes over 3 square feet single- and double-clad board, photosensitized and unsensitized, for single-board or short-run production quantities. Supplied with phenolic board; epoxy glass board available.—**MiniPrint Electronics Co., Inc.,** 256 1st Ave., Carmel, Ind.

COLOR ANALYST, model 850. Provides dot patterns, crosshatch, vertical and horizontal lines, burst signal, individual colors one at a time on instrument panel and color TV set. Window viewer on front panel shows technician what he should see on TV screen. Produces colors R — Y, B — Y, I, Q, burst, yellow, red, magenta, blue, cyan, green. Automatically deconverges white dot into color dot trio, deconverges white horizontal or vertical

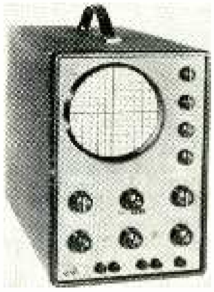


line into red, green, blue parallel lines. Front-panel gun killer; video output jack and video level control give positive and negative video information. Crystal-controlled 4.5-mc sound signal for easy receiver tuning and sound trap adjustments. Switch-selected rf signals, factory-tuned for channels 3, 4 and 5.—**B & K Div.,** Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago 13, Ill.

MIGHTY MITE TUBE TESTER, *model TC-114.* Stickproof D'Arsonval meter; large setup tube chart inside removable cover. Tests all tubes including new G-E compactrons, RCA nuvistors and

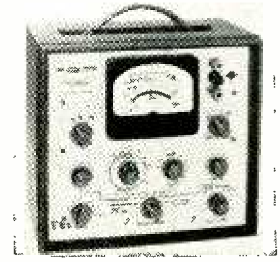
Novars, Sylvania 10-pin types—**Sencore, Inc.,** 426 S. Westgate Dr., Addison, Ill.

5-INCH SCOPE, *model 427.* Intensity, focus, astigmatism controls on front panel. Direct connection to vertical deflection plates without removing shorting links or wires. Vertical amplifier: direct-coupled, push-pull throughout. Flat from dc to 500 kc, —6 db at 1 mc. Sensitivity 10 mv p-p or 3.5 mv rms per cm. Direct or capacitive input coupling; fine attenuator, 4-position frequency-compensated coarse attenuator. 100-mv p-p



square wave injected at one calibration voltage input position. Horizontal amp: flat from 2 cycles to 450 kc. Sensitivity 0.5 v p-p or 0.18 v rms per cm. Sweep circuit: Recurrent sweeps 10 cycles to 100 kc in 4 overlapping ranges.—**Eico Electronic Instrument Co., Inc.,** 33-00 Northern Blvd., Long Island City 1, N. Y.

BETA IN-CIRCUIT TRANSISTOR TESTER, *model 1890 RD.* Power requirements: 22.5 volt battery, two 4.5-volt batteries, supplied with tester. Test signal: frequency 1,000-cycle sine wave; amplitude 5 μa, nominal, at CAL SET. Electrode voltages: V_{CE} 0-4.5 in 4 ranges; V_{CB} 1.5-4.5 in 3 ranges. Meter scales: I_C 0-1 ma to 0-100 ma in 3 ranges; I_{CBO} 0-50 μa to 0-5 ma in 3 ranges. Beta measured 0-400 in 4 stages. Full-scale accuracy ±5% for circuit impedance above

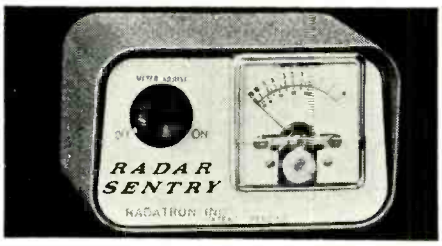


25 ohms on 0-100 range. Meter protected against burnout.—**RD Instruments,** Div. Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.

VOLT-OHM-MILLIAMMETER, *model 310-C.* Fully enclosed lever-range switch; 20,000 ohms per volt dc; 15,000 ohms per volt ac. Polarity reversal switch for dc measurements. Removable

test prod fits top of tester; manufacturer's *model 10* adapter attachable to tester for quick-testing all line loads. Self-shielded. 2¾ x 4¼ x 1-5/16 in. —**Triplett Electrical Instrument Co.,** Harmon Rd., Bluffton, Ohio.

RADAR SENTRY FIELD-STRENGTH METER. 13-oz transistorized microwave receiver covers 1,000 mc in L-band to 11,000 mc in X-band. Audible warning of radiation. Checks leakage from wave joints on microwave transmitters.

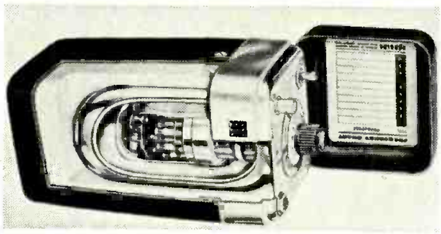


Makes antenna gain test; measures antenna patterns, waveguide connection leakage, etc. Checks adjustment of radar-frequency diathermy machines. With or without calibrated meter.—**Radatron, Inc.,** 232 Zimmerman St., North Tonawanda, N. Y.

TRANSISTOR TESTER KIT, *model TR-115K.* Kit form of model TR115 with improved meter design and one fewer switch. Checks leak-

age, beta current gain, shorts, opens. Beta read direct or on good-bad scale.—**Sencore, Inc.,** 426 S. Westgate Drive, Addison, Ill.

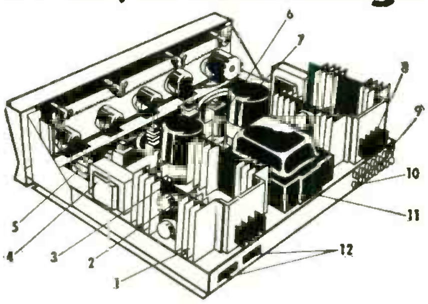
PORTABLE FREQUENCY STANDARD, *model SC-101.* For aligning 2-way radio networks, including transmitters, relay stations, receivers or transceivers. Works on 10 preselected frequencies within 10-mc to 480-mc range at tempera-



tures —22°F to +104°F. Zero-beat indication. 10 oven-controlled quartz crystals, harmonic genera-

(*Continued on page 106*)

Full Power, Wide-Range Sound As You Have Never Heard It



1. Eight germanium power output transistors mounted on four finned heat sinks. 2. Output circuit breakers. 3. Two power amplifier circuit boards containing four transistors and six diodes. 4. Two driver transformers. 5. Two preamplifier circuit boards containing six epoxy-sealed component modules and ten transistors. 6. Two germanium driver transistors plus four electronic filter transistors. 7. Two 3,000 mfd filter condensers and four power supply diodes. 8. Two output terminal boards. 9. Stereo input jacks. 10. Tape recorder output jacks. 11. Power transformer. 12. AC power outlets. All primary and secondary controls accessible at front panel area!

SPECIFICATIONS—Power output per channel: (Heath rating), 35 watts/8 ohm load—26 watts/16 ohm load—18 watts/4 ohm load: (IHFM music power output): 50 watts/8 ohm load—34 watts/16 ohm load—25 watts/4 ohm load @ 0.7% THD, 1 KC). **Power response:** ±1 db from 13 cps to 25 kc @ rated output; ±3 db from 8 cps to 40 kc @ rated output. **Harmonic distortion (at rated output):** Less than 1% @ 20 cps, 0.5% @ 1 kc, 2.0% @ 20 kc. **Intermodulation distortion (at rated output):** Less than 1%, 60 & 6,000 cps signal mixed 4:1. **Hum and noise:** Tapehead, 40 db below rated output; Mag phono, 45 db below rated output; Aux. inputs, 60 db below rated output; Tape monitor, 70 db below rated output. **Channel separation:** 40 db min. @ 20 kc, 55 db min. @ 1 kc, 50 db min. @ 20 cps. **Input sensitivity:** (For 35 watts output per channel, 8-ohm load) Tapehead, 2 mv; Mag. phono, 3 mv; Tuner, .25 v; FM Stereo, .25 v; Aux., .25 v; Tape Monitor, .90v. **Input impedance:** Tapehead, 60 K ohm; Mag. phono, 30 K ohm; Tuner, 100 K ohm; FM Stereo; 100 K ohm; Aux., 100 K ohm; Tape Monitor, 47 K ohm. **Outputs:** 4, 8, & 16 ohm and low impedance tape recorder outputs. **Controls:** 5-pos. Selector (dual-concentric). 5-pos. Mode switch, dual-concentric Volume, Bass & Treble controls, Tape monitor sw., Loudness sw., Phase sw., Input level controls (all inputs except Tape Head & Tape Monitor inputs), Push-Push on/off switch. **Semiconductor complement:** 28 Transistors, 10 diodes. **Power requirements:** 105-125 volts, 50-60 cycles AC. 35 watts idling, no signal; 200 watts, full power out, @ 120 volts with no load on AC receptacles. **Power outlets:** 2 AC receptacles, 1 switched, 1 unswitched. **Dimensions:** 15¼" W x 5" H x 14" D.

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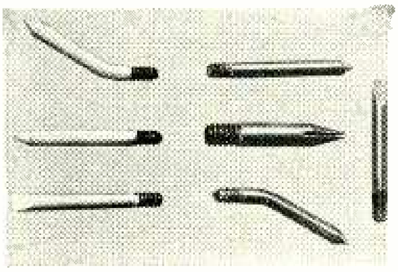
(Continued from page 103)

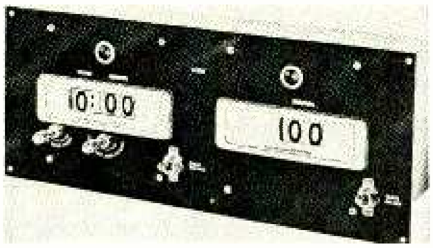
tor, crystal mixer, audio amplifier assembled in temperature-controlled vacuum flask.—**Stancor Electronics Inc.,** 3501 W. Addison, Chicago 18, Ill.

SOLDERING TIPLETS. Pretinned. Threads chemically treated with anti-seize compound to prevent binding and freezing. Use with mfr's tips.



Regular and iron-clad models, including conical, bent conical and chisel shapes. Pretinned desoldering tiplet available.—**SIDCO,** P.O. Box 137, Wyncote, Pa.

ELAPSED-TIME DIGITAL COMPUTER, *Tymeter.* Automatically calculates and registers elapsed time in hours, 10 minutes, minutes and seconds. Second-by-second digital readout, ⅝-in.



digits on 30- and 60-second, 12-hour; 5/16-in. digits 24-hour. Front panel mount, desk or bench use. Digits resettable individually.—**Tymeter Electronics,** Pennwood Numecron Co., 7249 Frankstown Ave., Pittsburgh 8, Pa.

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.

2-WAY RADIO SERVICE FORM, *No. 51.* Triplicate, one-time carbon service order for billing and service records. Spaces provided for: technical charactristics, measurements etc. for transmitter and receiver (may be shown before and after repair), materials used, description of labor and adjustments, origin or service authorization, technicians time.—**Oelrich Publications,** 4308 Milwaukee Ave., Chicago 41, Ill.

RADIO/TV DATA. 48-page list covers available radio diagrams from 1926 to present; TV diagrams 1950 to present—**Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill.

MORE THAN 250 KITS pictured and described in *Catalog Supplement 80/04.* Includes stereo and hi-fi, marine equipment, amateur radio equipment, test instruments, miscellaneous electronic products.—**Heath Co.,** Benton Harbor, Mich.

TELEVISION IN EDUCATION. 28-page illustrated booklet describes uses of educational TV. Explains how open- and closed-circuit TV is transmitted and received. Gives equipment requirements, installation plans.—**Sylvania Commercial Electronics,** 730 3rd Ave., New York 17, N. Y.

POWER EQUIPMENT, *Bulletin 4-100.* 6-page illustrated folder gives complete specs and dimensions for 31 silicon battery chargers delivering 24, 50 or 130 volts output, operating from single- or 3-phase ac inputs; 4 constant current chargers; 6 end-cell chargers.—I. E. Shemeld, **Raytheon Co.,** Utility and Communications Power Equipt. Dept., Hooksett Plant, Manchester, N. H.

CONTACT PRINTING WITH PANELESCENT EL DEVICES. 3-page illustrated leaflet outlines printing processes, describes 5 electroluminescent devices.—**Sylvania Electric Products Inc.,** 1100 Main St., Buffalo 9, N. Y.

CRYSTAL CATALOG, *No. 962.* Covers CB, amateur, low-frequency, pressure, miniature, barrel, hermetically sealed, military, radio-control and special use crystals and sockets. New additions are low-frequency crystals using CT, DT, GT, SL and 5°X cuts, frequencies 80–1,000 kc. Circuit diagrams, description of crystal manufacturing process.—**Texas Crystals,** 1000 Crystals Drive, Fort Myers, Fla.

POCKET-SIZE WIRE GUIDE. 6 x 4-in. reference table gives following specs on different gage copper wire: standard AWG size; diameter per gage (inches and mils); cross-section measurement per gage (circular mils and square inches); ohms per 1,000 ft.; pounds per 1,000 ft.; ft. per pound.—**Hudson Wire Co.,** Ossining Div., Ossining, N. Y.

RELAYS AND SOLENOIDS described in 4-page *Bulletin No. GC 100A.* Data on molded-plastic insulated general-purpose relay, new economy relay for contact wipe and high contact pressure, plus new stepping relay.—**Artisan Electronics Corp.,** 171 Ridgedale Ave., Morristown, N. J.

HI-FI/STEREO COMPONENTS, *series 3000.* 6-page illustrated foldup contains features and specs on tuners, amplifiers and integrated receivers, including stereo FM.—**Eric Electronics Corp.,** 1823 Colorado Ave., Santa Monica, Calif.

SEMICONDUCTORS, new and standard types, in revised 15-page catalog. Specs of new universal communications transistors made by PADT (Post Alloy Diffusion) process, with description of manufacturing technique. Lists germanium p-n-p and n-p-n audio, computer, switching and vhf transistors, germanium and silicon diodes. Use letterhead.—**Amperex Electronic Corp.,** Advertising Dept., 230 Duffy Ave., Hicksville, N. Y.

SUBMINIATURE CAPACITORS detailed in 8-page *Catalog M-1.* Charts, graphs give properties and sizes of caps made to order with any of manufacturer's 13 ceramic bodies in various types of construction. Stock capacitor line also described. Request on company letterhead.—**Mucon Corp.,** 9 St. Francis St., Newark 5, N. J.

HI-FI LOUDSPEAKERS, for stereo and mono, shown in *Catalog 165-G.* 24 pages include general hi-fi/stereo information, pix and description of manufacturer's many speakers, enclosures, speaker systems, components, headphones, outdoor equipment, speaker kits.—**Jensen Mfg. Co.,** Technical Service Dept., 6601 S. Laramie Ave., Chicago 38, Ill.

SEMICONDUCTOR PRODUCT GUIDE. 12 pages of data on full line of silicon and germanium transistors, silicon rectifiers, special computer diodes, tunnel diodes and varactor diodes. Application chart.—**RCA Semiconductor and Materials Div.,** Commercial Engineering, Somerville, N. J.

PUBLIC ADDRESS LOUDSPEAKERS, 12-page booklet. Photos, specs, application data on drivers, trumpets, paging-talkback speakers, sound columns and hi-fi speakers for PA use.

Your 1962 Guide to Component Stereo Hi Fi, 20 pages. Describes components and speaker systems. Tells how to choose components, compares components to consoles. Speaker-expansion charts for do-it-yourselfers.—**University Loudspeakers,** 80 S. Kensico Ave., White Plains, N. Y.

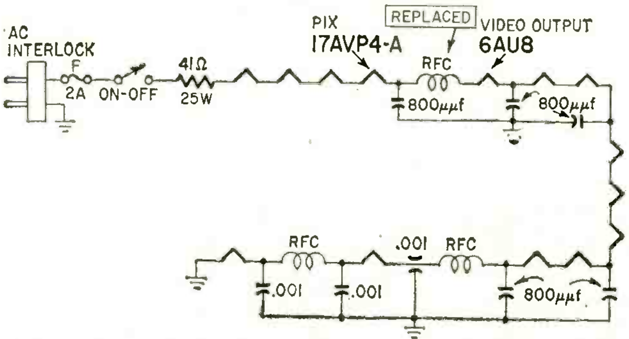
THREE TUBE LISTS. *Characteristics of Sylvania Cathode Ray Tubes* lists approximately 500 industrial and military tubes, plus TV picture tubes. Gives phosphor characteristics, basing diagrams, installation instructions. **15¢.** *Picture Tube Comparison Chart* lists approximately 350 types, including bonded-shield, color and check tubes. Basing diagrams, data for heater, face body and focus. Identical information in pocket-sized *Sylvania Television Tube Selector Guide.*—**Sylvania Electric Products Inc.,** 1100 Main St., Buffalo 9, N. Y.

BRITISH ELECTRONIC VALVE INDUSTRY, a 48-page booklet that classifies 48 types of tubes and other devices, giving names of British manufacturers. 800-word history of British semiconductor devices.—V.A.S.C.A., Secretary, B.V.A., Mappin House, 156 Oxford St., London W.1, England. END

Technotes

G-E 17T026

Complaint of intermittent loss of picture and sound appeared due to an intermittent or open heater as all tubes would darken each time the set acted up. Any slight jarring, removing tubes for testing, using an ohmmeter to trace the open or other test would temporarily heal the intermittent



and the set would play for weeks at a time before acting up again. Often the customer would get the set going by just flicking the off–on switch to make and break the circuit. After making several repeat visits, replacing the filament choke between the picture tube and video output tube heaters cured the trouble.—*George P. Oberto*

Steelman Transitape and Airline 7111-M Recorders

Complaint: Rewind fails to work or work properly.

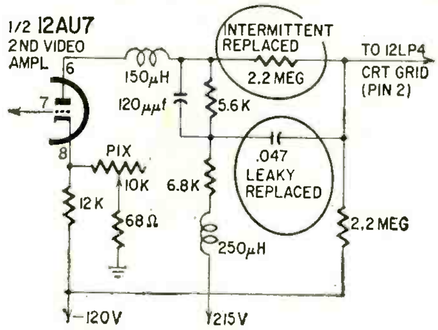
The rewind pulley turns when the slide bar brings the rewind yoke assembly up against the side of the flywheel. The rubber rewind belt is then friction-coupled to the flywheel and turns.

Use carbon tet or some other cleaner on the belt and the flywheel edge. Do not slosh the cleaner as some oil is necessary in the bearings. If the belt is worn, replace with Steelman part No. 930023. If the pulley hangs up, a new spring may be needed. Use part No. 678041. This is a fine spring and its tension is critical. If it is mangled by mishandling, the rewind action will never be correct.

If the rewind belt continually jumps from the pulley, a new design pulley should be installed. The new pulley has a riveted flange or a wider groove. The part number is 830140.—*Max Alth*

RCA T-120

This set had the usual symptoms of a defective picture tube, resulting in a weak intermittent picture accompanied by varying degrees of brightness. Tests indicated a short inside the picture tube plus weak emission. After replacing the



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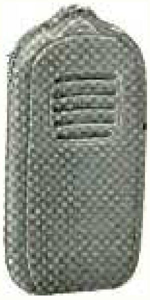
$200.00 HEARING AID (as shown)—YOUR PRICE . . . $2.00



We Scooped the Market on 15000 of these HEARING AIDS from one of the Leading Manufacturers (name withheld) who switched to the Transistor Type.

Each HEARING AID INSTRUMENT is a Complete AUDIO AMPLIFIER and includes—a CRYSTAL MICROPHONE, 3 SUB-MINIATURE TUBES and a Superb Beige Phenolic CABINET.

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5" x 2½" x 1"—Shipping Weight 1 lb.

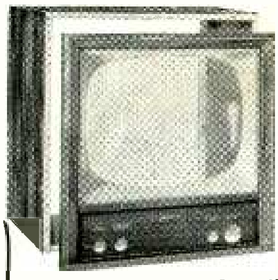
Complete as illustrated—Including a detailed informative SCHEMATIC DIAGRAM (less Earphone and Battery) **$2.00**

Sold without limit or reserve! Order as many as you want! Rush your order!

CUSTOM-BUILT ANDREA TV CHASSIS 23"—110° Complete Ready to Operate

Including Westinghouse PICTURE TUBE & FRONT PANEL **$227.50**

Brochure on Request



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Comparable to the type that Top Mfrs. use on high priced TV sets. CABINET KIT with 90% of the job done, includes—

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And EASY-TO-FOLLOW ASSEMBLY INSTRUCTIONS

Front, Top and Sides supplied in a beautiful Piano Finish ● Knob panel undrilled ● For matching Mask specify type or number of CRT used. Same price—Mahogany, Walnut or Blond. (Shipping weight 36 lbs.)

21" CABINET KIT 26"H, 25"W, 22"D **$26.97**

23" TV CABINET KIT . . $28.47 — 21" or 23" FRONT SECTION for flush to wall mounting...... $19.45 — 24" or 27" FRONT SECTION for flush to wall mounting...... $24.97

TUBULAR CONDENSERS—85°C TOP QUALITY—Equally as good for Radio or TV work

.0047-400v, .01-400v, .015-400v, .02-400v, .047-400v, .001-600v, .005-600v, .01-600v, .015-600v........ 5¢ ea.
.1-400v, .25-400v, .47-400v, .02-600v, .047-600v, .1-600v, .25-600v, .47-600v, .001-1000v........ 8¢ ea.
.0047-1000v, .01-1000v, .035-1000v, .047-1000v, .001-1600v, .007-1600v, .01-1600, .02-1600v........ 14¢ ea.

PACKAGE DEAL #1 — 52 TUBULAR CONDENSERS (2 of each) . . $3.00

ELECTROLYTIC CONDENSERS—85°C

1-50v, 1-150v, 2-450v, 25-50v, 4-150v........ 16¢ ea.
10-150v, 20-150v, 40-150v, 50/30-150v, 10-450v, 20-450v, 30-450v, 40-450v, 80-400v........ 34¢ ea.

PACKAGE DEAL #2 — 14 ELECTROLYTIC CONDENSERS (1 of each) . . $3.00

CARBON RESISTORS — Regular factory stock in Stackpole, Speer, IRC, etc.

½ WATT 10%, 10, 22, 39, 47, 68, 100, 120, 150, 270, 330, 390, 470, 560, 680, 820 1k Ω........ 3¢ ea.
½ WATT 10% 1800, 2200, 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k Ω........ 3¢ ea.
½ WATT 10% 27k, 33k, 39k, 47k, 56k, 68k, 82k, 100k, 120k, 150k, 180k, 220k, 270k, 330k Ω........ 3¢ ea.
½ WATT 10% 390k, 470k, 560k, 680k, 820k, Ω 1, 1.2, 1.5, 2.2, 4.7, 6.8, 10, 15 MEG Ω........ 3¢ ea.

1 WATT 10% 3.3, 10, 39, 68, 82, 100, 120, 150, 270, 330, 390, 470, 560, 680, 820, 1k, 1800 Ω........ 4¢ ea.
1 WATT 10% 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k, 27k, 33k, 39k Ω........ 4¢ ea.
1 WATT 10% 47k, 68k, 82k, 100k, 150k, 220k, 470k, 560k, 680k Ω 1, 2.2, 2.7 meg Ω........ 4¢ ea.

2 WATT 10% 18, 22, 47, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820 Ω........ 5¢ ea.
2 WATT 10% 1k, 1500, 1800, 2200, 2700, 3300, 3900, 4700, 6800, 8200, 10k, 15k, 18k, 22k Ω........ 5¢ ea.
2 WATT 10% 27k, 33k, 39k, 47k, 68k, 100k, 150k, 220k, 270k, 330k, 470k, 680k Ω 1, 10 meg Ω........ 5¢ ea.

PACKAGE DEAL #3 — 200 CARBON RESISTORS (½ w—2 ea.) (1 & 2w—1 ea.) . . $6.00

WIREWOUND RESISTORS

5-10w, 7-10w, 10-10w, 15-10w, 20-10w, 28-10w, 36-10w........ 12¢ ea.
40-10w, 50-10w, 56-10w, 60-10w, 70-10w, 85-10w, 100-10w, 150-10w, 180-10w, 200-10w,........ 12¢ ea.
250-10w, 350-5w, 470-10w, 560-10w, 650-10w, 680-10w, 820-5w, 1k-10w, 1500-5w, 2k-10w........ 12¢ ea.
2500-10w, 3k-10w, 5k-10w, 6k-10w, 7k-10w, 8k-10w, 9k-10w, 10k-10w, 15k-10w, 20k-10w........ 12¢ ea.

PACKAGE DEAL #4 — 37 WIREWOUND RESISTORS (1 of each) . . $3.40

CERAMIC CONDENSERS

1, 2, 3, 5, 6, 10, 20, 22, 25, 30, 33, 47, 50, 56, 68, 75 mmf........ 4¢ ea.
82, 100, 150, 220, 250, 270, 330, 470, 1k, 1200, 1500, 2k, 3300, 3900, 5k, 6800, 10k mmf........ 4¢ ea.

PACKAGE DEAL #5 — 66 CERAMIC CONDENSERS (2 of each) . . $1.90

MICA CONDENSERS

5, 22, 25, 50, 60, 65, 68, 75, 80, 100, 120, 150, 220, 270, 330 mmf........ 4¢ ea.
350, 470, 510, 560, 680, 820, 1k, 1500, 2k, 2500, 3300, 3900, 4700, 6k, 6800, 8k, 10k mmf........ 4¢ ea.

PACKAGE DEAL #6 — 64 MICA CONDENSERS (2 of each) . . $1.90

★ To order any PACKAGE DEAL, simply mention Package Number

$150,000 SALE

OVERSTOCK INVENTORY

"ONE DOLLAR" buys

As much as $15 worth — Everything Brand New and sold to you with a money back guarantee.

DEDUCT 10% ON ANY ORDER OF $10 OR OVER

(ON THESE DOLLAR BUYS)

Plus a FREE SURPRISE PACKAGE

- ☐ 1 — RADIO PARTS "JACKPOT" handy assortment $1
- ☐ 6 — TRANSISTOR BATTERIES 9v, same as #216 $1
- ☐ 2 — SILICON RECTIFIERS 750ma, 400piv........ $1
- ☐ 3 — ASST. TV DEFLECTION YOKES popular types $1
- ☐ 10 — ELECTRO. CONDENSERS 100/100/10-75v... $1
- ☐ 10 — ELECTRO. CONDENSERS 450/100/100-16v $1
- ☐ 10 — ELECTROLYTIC CONDENSERS 50-200v........ $1
- ☐ 10 — ELECTROLYTIC CONDENSERS 50-150v........ $1
- ☐ 100 — GOODALL CONDENSERS .015-600v........ $1
- ☐ 10 — SPRAGUE CONDENSERS 100/25-50v........ $1
- ☐ 10 — FILTER CHOKE TRANS. 75Ω, 1 hy, 100ma $1
- ☐ 1 — HEARING AID AMP. incl. Tubes & Mike, as is $1
- ☐ 6 — I.F. COILS 456kc latest small type........ $1
- ☐ 25 — ASST. TV COILS all types, value over $25.... $1
- ☐ 1 — $15.00 "TELEVISION PARTS JACKPOT"........ $1
- ☐ 1 — 90° FLYBACK TRANSFORMER w/diagram.... $1
- ☐ 1 — 70° FLYBACK TRANSFORMER w/diagram.... $1
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- ☐ 50 — TV PEAKING COILS standard assortment........ $1
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- ☐ 40 — ASST. TV KNOBS, ESCUTCHEONS, etc........ $1
- ☐ 10 — 21" TV MASKS standard gray........ $1
- ☐ 1 — TV SAFETY GLASS 18" x 22½"........ $1
- ☐ 1 — $10 INDOOR TV ANTENNA hi-gain 3 section $1
- ☐ 100' — TWIN LEAD-IN WIRE 300Ω heavy duty.... $1
- ☐ 10 — ASST. STANDARD TUNER UHF STRIPS........ $1
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- ☐ 2 — ELECTROLYTIC COND. 40/40/10-450v........ $1
- ☐ 6 — TV 6' CHEATER CORDS with both plugs........ $1
- ☐ 10 — PICTURE TUBE SOCKETS wired 20" leads.... $1
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- ☐ 4 — RATIO DETECTOR COILS 4.5mc or 10.7mc.... $1
- ☐ 7 — ASST. TV ELECTROLYTIC CONDENSERS........ $1
- ☐ 6 — TV ALIGNMENT TOOLS choice tools........ $1
- ☐ 3 — SYLVANIA 35W4 TUBES factory cartons........ $1
- ☐ 10 — RCA 12L8 TUBES........ $1
- ☐ 5 — SYLVANIA IU4 TUBES also serves as IT4...... $1
- ☐ 10 — ASSORTED TUBES Radio, TV, Industrial...... $1
- ☐ 30 — ASST. PILOT LIGHTS 44, 46, 47, 51, etc..... $1
- ☐ 20 — PILOT LIGHT SOCKETS bayonet, wired........ $1
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- ☐ 300 — ASST. ½ W RESISTORS short leads........ $1
- ☐ 50 — ASST. MOLDED CONDENSERS short leads.. $1
- ☐ 20 — ASST. WIREWOUND RESISTORS 10w........ $1
- ☐ 100 — ASST. ½ WATT RESISTORS some 5%........ $1
- ☐ 70 — ASST. 1 WATT RESISTORS some 5%........ $1
- ☐ 35 — ASST. 2 WATT RESISTORS some 5%........ $1
- ☐ 100 — ASST. CERAMIC COND. Some 5%........ $1
- ☐ 100 — MICA CONDENSERS 1000 mmf........ $1
- ☐ 60 — ASST. MICA CONDENSERS some 5%........ $1
- ☐ 50 — ASST. MICA TRIMMER CONDENSERS........ $1
- ☐ 60 — ASSORTED TUBULAR CONDENSERS........ $1
- ☐ 25 — TUBULAR CONDENSERS .047-600v........ $1
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- ☐ 1 — 5½" PM SPEAKER 1.47 oz. Alnico magnet.... $1
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- ☐ 10 — ASST. VOLUME CONTROLS less switch........ $1
- ☐ 5 — ASST. VOLUME CONTROLS with switch........ $1
- ☐ 100 — ACORN KNOBS ½ diameter, push-on........ $1
- ☐ 50 — ASST. RADIO KNOBS screw and push-on...... $1
- ☐ 30 — POINTER KNOBS with set screw........ $1
- ☐ 60 — ASSORTED SOCKETS all types........ $1
- ☐ 50 — ASST. TERMINAL STRIPS 1, 2, 3 and 4 lug.... $1
- ☐ 100 — ASST. RUBBER GROMMETS best sizes........ $1
- ☐ 50 — ANTENNA TERMINAL STRIPS........ $1
- ☐ 10 — 6' ELECTRIC LINE CORDS with plug........ $1
- ☐ 5 — 50' SPOOLS HOOK-UP WIRE asst. colors...... $1
- ☐ 50 — STRIPS ASST. SPAGHETTI best sizes........ $1
- ☐ 1 — LB. ROSIN CORE SOLDER 40/60........ $1
- ☐ 100 — RUBBER FEET for cabinets best sizes........ $1
- ☐ 500 — SELF TAPPING SCREWS #6, 7 and 8........ $1
- ☐ 10 — ASST. LUCITE CASES handy for parts........ $1
- ☐ 1000 — ASST. HDWRE screws, nuts, rivets, etc..... $1

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

TELEPHONE COrtland 7-2359

tube, the picture was very good and all other circuits performed well.

Several weeks later I got a callback—the set was giving the same trouble and the new tube was bad. A quick check showed a varying bias voltage on pin 2 of the picture tube—a positive voltage when the picture was bright to a negative voltage when the picture was too dark. In either case, the brightness control had little effect in restoring the picture to normal.

The cure was to replace an intermittent 2.2-megohm resistor and a .047-μf capacitor which was leaky intermittently. The old picture tube was later tried in another set to prove a point and, lo and behold! the same intermittent condition as we started with!—*George P. Oberto*

Philco T-75 Radio

One trouble occurs rather frequently in these models, especially if the i.f.'s are adjusted too vigorously—an open coil in the 1st i.f. transformer. Unfortunately, there is no way to measure the entire winding with an ohmmeter and breaks at X or Y (Fig. 1) will not affect the transistor voltages, but the signal will drop to virtually nothing.

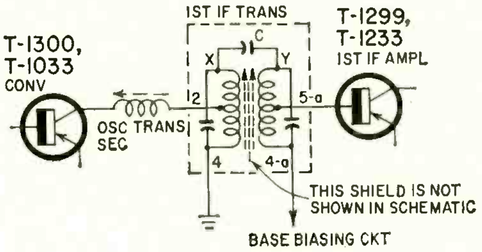


Fig.1

The circuit is an unusual one, employing bandpass coupling. Even though the transformer seems to be inductively coupled on the schematic, there is actually a shield between the coils (*the coils are in separate cans*) and the only coupling is through C. Only terminals 2, 4, 4-A and 5-A are available as test points.

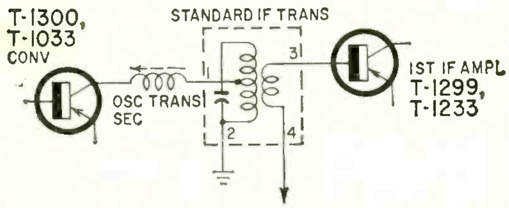
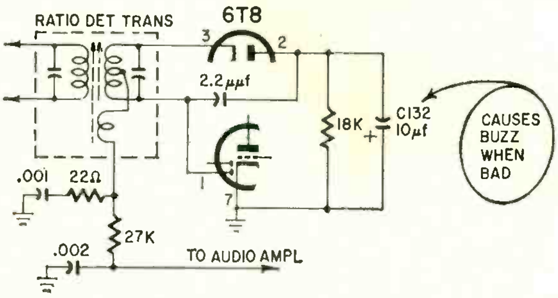


Fig.2

If the special dual transformer is not available, a conventional one may be used by connecting it as shown in Fig. 2.—*Wayne Lemons*

Crosley Chassis 321

When there is a strong buzz in the audio on this and similar chassis, and it can't be corrected by adjusting the ratio detector slug, check C132, a 10-μf electrolytic. This



unit has been found defective in such a large proportion of shop jobs that it has become a practice to replace all original ones in each set that is worked on.—*Charles B. Randall* END

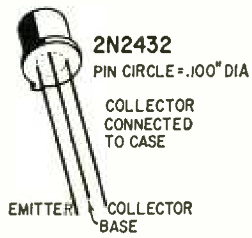
NEW TUBES and SEMI-CONDUCTORS

IF THE TREND CONTINUES WE'LL change the name of this column to New Semiconductors and Tubes. Although this month there is one vacuum tube and one special CRT in the list, semiconductors dominate again.

Some of the more interesting items are an epitaxial planar silicon transistor, a couple of nanosecond diodes, a pentode-diode tube combination, and a special storage-type CRT.

2N2432

An n-p-n diffused epitaxial planar silicon transistor specifically intended



for low-level high-speed chopper applications.

Maximum ratings of the Texas Instruments 2N2432 at 25°C are:

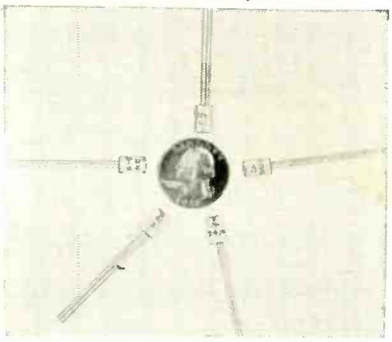
V_{CB}		30
V_{CEO}		30
V_{EB}		15
V_{EO}		15
I_C	(ma)	100
P_{total}	(mw)	300
	(at 25°C free air temp)	
	(at 25°C case temp)	

"Universal" audio transistors

A series of five germanium alloy transistors designed for radio and industrial applications. All five types (2N2428, 2N2429, 2N2430, 2N2431 and AC132) have extremely flat beta characteristics and uniformly high beta over the entire operating current range.

The 2N2428 is a high-gain p-n-p unit with a beta range of 80-170. The 2N2429 is similar to the 2N2428 but has a higher beta range (130-300). These two units are intended for use as preamps, drivers, and low-wattage output stages. The 2N2430 is an n-p-n transistor with a beta range of 65-190.

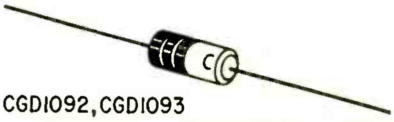
It is also available as the AC127 in matched pairs and as AC132 in p-n-p/n-p-n complementary pair. The last



type, the 2N2431, is a p-n-p medium-power unit that can handle up to 2-watts power output per pair. They are intended for use in class A and B audio output stages. All these transistors are made by Amperex.

CGD1092, CGD1093

Two nanosecond gold-bonded germanium diodes for high-speed computing circuits.



CGD1092,CGD1093

Maximum ratings of these Clevite units at 25°C are:

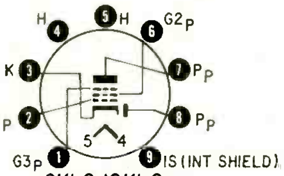
	CGD1092	*CGD1093*
V_R (continuous inverse operating voltage	15	10
I_F (continuous dc forward current, ma)	80	50
i_F (surge current for 1 second, ma)	300	150
P_{ave} (average power dissipation, mw)	80	80

Switching characteristics at 25°C are:

t_{rr} (reverse recovery time, nsec)	8	3
V_{peak} (forward recovery voltage)	1.5	2.5
C (capacitance $\mu\mu$f)	1.5	2

6KL8, 12KL8

A pair of 9-pin miniature tubes housing a diode and sharp-cutoff pentode combination suited for use as combined i.f. amplifier and AM-detector in AM and AM/FM receivers. The pentode section might also be used as an rf or i.f. amplifier or limiter. Both RCA tubes are identical except for their heater ratings—6.3 volts, 300-ma for the 6KL8; and 12.6 volts, 150-ma for the 12KL8. Also, the 12K8 has a 17-second controlled-warmup time.



6KL8,12KL8

Typical characteristics of the pentode section in class A1 amplifier service are:

V_P	100
G3	(connected to cathode at socket)
Internal shield	(connected to cathode at socket)
V_{G2}	100
V_{G1} (supply)	0
R_{G1} (bypassed, megohms)	2.2
R_P (k ohms)	550
gm (μmhos)	4,300
I_P (ma)	5.5
I_{G2} (ma)	2.2

AS-17-21

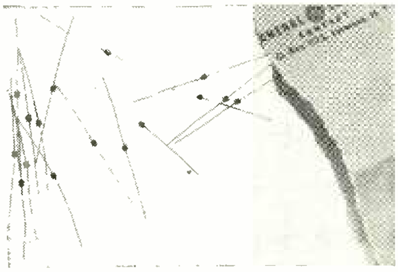
A storage-type cathode-ray tube that can retain an image for a time variable between a few seconds and several hours. The maximum writing rate

is about 30,000 centimeters per second. The tube is electrostatically focused and electromagnetically deflected.

The trace appears as a dark purple line on a light background. The image can be erased within 10 seconds by applying a current across two socket terminals. The CRT is made by International Telephone and Telegraph Components Div.

1N3712 through 1N3721

A series of 10 high-performance germanium tunnel diodes for low-level switching circuits and small-signal applications at high frequencies. Five of these units are premium types with very tightly controlled characteristics, making them desirable for use in level de-



tectors and other applications where small variations may be critical.

The diodes differ in their peak-point current characteristic. In this series of G-E diodes are units with peak-point current ratings of 1.0-, 2.2-, 4.7-, 10-, and 22 ma. This parameter is held to 2.5% variation in the premium versions and to 10% in the others. END

Corrections

Reverse the polarity of the battery in the diagram of the precision frequency standard on page 76 of the July issue. The positive end of the battery goes to ground and the negative end to the collector supply line.

We thank Mr. I. C. Chapel, of Warsaw, Ind., for telling us about the error.

Mr. Lawson informs us of two errors in the schematic and parts list of his article "Put Electronic Ignition in your Car" in the July issue. C6 should be 1.0 μf, not 0.1 μf as in the parts list and diagram. It was made by paralleling two 0.5-μf bathtub type capacitors, as stated in the text. S1 is listed in the parts list as a 32-pole unit. Obviously, this is a 3-pole unit.

There is an error in the bill of materials for the CB ground-plane antenna on page 74 of the July issue. The radiator and radials are made from standard (10-foot) lengths of ½-inch aluminum electrical conduit. The lengths were listed erroneously as 8 feet. Note well that this is a thick-wall type of conduit, not the thin-wall type that requires compression fittings. We thank Mr. Sheldon Rosenberg of New York City for calling this to our attention.

There is a typographical error in the table of the article "Handling the Metric Prefixes" on page 80 of the July issue. To convert units to pico-units, multiply by 10^{12}, *not* 10^{9} as indicated. We thank Mr. Basil De Selm, of Elizabeth, Ill., for pointing out this error.

Curing Audio Amplifier Oscillation

High-quality audio amplifiers using a large amount of negative feedback often break into high-frequency oscillation when speaker leads are extended beyond the critical length, especially if they are shielded. This oscillation is due to a phase shift in the output transformer (caused by the distributed capacitance of the speaker leads combined with the interelectrode and other stray capacitances within the amplifier), resulting in positive feedback in the neighborhood of 100 kc. It can often be cured by connecting a small air-core choke in series with the hot or ungrounded lead between the output transformer and speaker. The choke gives an opposite phase shift and maintains negative feedback at much higher frequencies, usually eliminating the tendency to oscillate. A suitable choke coil can be made of 40 turns of No. 20 dcc wire wound on a ¾-inch form 3 inches long. To determine whether a particular amplifier is oscillating, connect a .05-μf paper capacitor across the output terminals and observe the waveform with a scope. Speaker and leads should be in their usual positions during this test for an accurate analysis.—*Warren J. Smith*

Microphone Plug Adapter

With the increasing popularity of miniature mike connectors, I found it useful to make an adapter that will quickly and easily connect a miniature mike plug to a standard phone jack. This simple shielded adapter will be useful to experimenters, audiophiles and service technicians.

Fig. 1 shows its simplicity. Remove

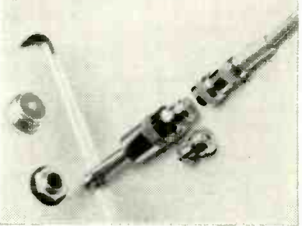


Fig. 1

the hardware from a miniature mike chassis unit and remove the metal barrel from a standard shielded phone plug.

Insert the threaded shank of the miniature chassis unit into the opening on the end of the phone plug barrel and lock the two units together using a hexagon nut inside the barrel. Connect one end of a short length of hookup wire to the center electrode terminal on the phone plug. Pass the other end of the wire through the eyelet in the center of the miniature chassis unit; screw the barrel onto the phone plug and solder the end of the wire to the eyelet in the miniature chassis unit. The ground lead is automatically made when the chassis unit is joined to the metal phone plug.

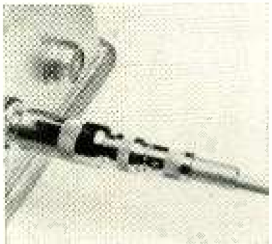


Fig. 2

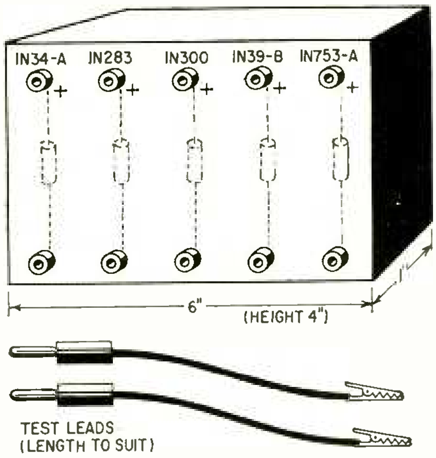
Fig. 2 shows the adapter in use. A miniature mike connector is being connected to a standard phone jack on an amplifier chassis.

The miniature mike chassis unit is a Switchcraft Mini-Con 5501MP. The miniature mike plug is a Switchcraft Mini-Con 5501F.—*Art Trauffer*

Diode Substitution Box

Substitution boxes are worth their weight in gold when quick substitution of various components is needed. Since crystal diodes are now widely used, a diode substitution box should be a valuable time-saver.

I use five diodes in my box—a 1N34-A, 1N283, 1N300, 1N39-B and a 1N753-A. The 1N34-A is a good all-



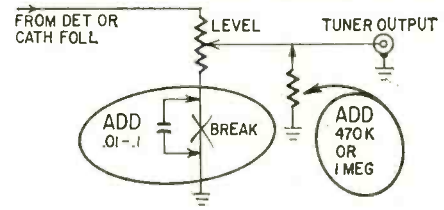
around general-purpose unit; the 1N283 a high-conductance type; the 1N300 a silicon diode; the 1N39-B a high back-voltage unit; the 1N753-A a 6.3-volt Zener.

Ten banana jacks are mounted on the top of a 6 x 4 x 1-inch case. The five diodes are connected across these terminals as shown. By using two test leads—banana plugs on one end and alligator clips on the other—we can substitute diodes wherever we run into them, easily and quickly.

If additional diodes are considered necessary, add them to the box. Just remember to label the terminals.—*A. von Zook*

Hi-Fi Tuner Hints

To boost the bass in the output of your hi-fi tuner (AM or FM), this simple but effective circuit may be used. Your tuner must have a level control and the output must be more than adequate. Simply open the ground lead of the level control and insert a .01 to .1-μf capacitor in its place (smaller values give more bass). Then wire a 470,000-ohm or 1-megohm resistor from the slider of the control to ground. This replaces the resistance of the control in the circuit. The boost depends on how



far down the control is turned. If the control is turned down too far, the treble will be removed entirely.

If the noise rejection of your FM tuner is not quite sufficient, you can sometimes substitute a higher-transconductance tube for the limiter. Usually a 6AU6 tube is used in this stage. In this case, a 6AH6 may be substituted with no wiring changes. However, alignment may need touching up. Sometimes the same substitution may be made for 6AU6's in the i.f. stages, but be careful here as the higher gain may cause regeneration or oscillation. Realignment may be necessary here also.

Another improvement for an FM tuner is to peak the rf circuits for a desired station. This is useful in localities where there is only one receivable station or where there are one or more strong stations and one weaker station. —*Clyde E. Wade, Jr.* END

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END

Correction

Our reviewer goofed last month. Ed Bukstein's book (near bottom of page 103) is *Industrial Electronics Measurement and Control*, not Industrial Electronics.

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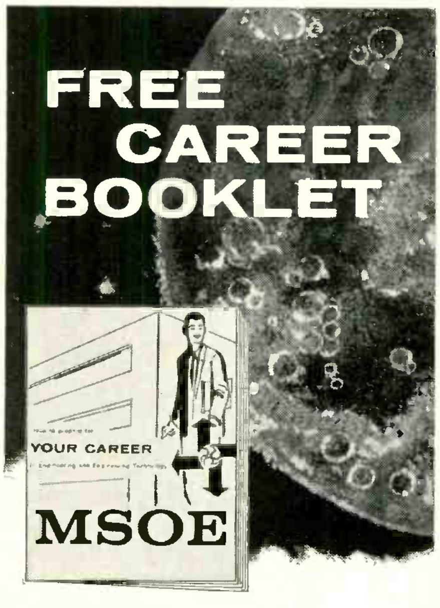

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5EU8	.80	6DB5	.69	12AT7	.76	25BQ6	1.17
5J6	.72	6DE6	.61	12AU6	.51	25C5	.53
5T8	.86	6DG6	.62	12AU7	.61	25CA5	.59
5U4	.60	6DJ8	1.21	12AV6	.41	25CD6	1.52
5U8	.84	6DK6	.59	12AV7	.82	25CU6	1.11
5V3	.90	6DN6	1.55	12AX4	.67	25DN6	1.42
5V6	.56	6DQ6	1.10	12AX7	.63	25EH5	.55
5X8	.82	6DT5	.81	12AY7	1.44	25L6	.57
5Y3	.46	6DT6	.53	12AZ7	.86	25W4	.68
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6AB4	.46	6EA8	.79	12BA7	.84	32L7	.90
6AC7	.96	6EB5	.73	12BD6	.50	35C5	.51
6AF3	.73	6EB8	.94	12BE6	.53	35L6	.60
6AF4	1.01	6EM5	.77	12BF6	.60	35W4	.42
6AG5	.70	6EM7	.82	12BH7	.77	35Z5	.60
6AH4	.81	6EU8	.79	12BK5	1.00	36AM3	.36
6AH6	1.10	6EV5	.75	12BL6	.56	50B5	.69
6AK5	.95	6EW6	.57	12BQ6	1.16	50C5	.53
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