FEBRUARY

Radio-Electronics

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HUGO GERNSBACK, Editor-in-chief

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Build a 5-transistor supply that will give you regulated voltage from 0.5 to 28 volts. Will supply 2 amperes regulated up to 15 volts; 3 amperes from 15 to 28.

RECORDING SOUNDS IN NATURE

(See page 44)

Professor Kellogg of Cornell gives a description of the techniques of recording bird songs and other outdoor sounds that will be interesting to all sound enthusiasts.

50c

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—on the cover—

Story on page 44

Professor P. P. Kellogg of Cornell, with Randolph Scott Little, senior in Electrical Engineering, ready to trap birdsongs.

Color original by D. S. McChesney

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the departments

News Briefs

New Tubes Use Fiber Optics

A new vidicon tube with a fiber-optics faceplate has been announced by RCA Electron Tube Div. RCA is also making available to the industry samples of a fiber-optics orthicon and two cathode-ray tubes with glass-fiber faceplates.

The new vidicon is a 1-inch tube 6½ inches long. There are more than 500,000 individual fibers in the useful area of the face. Each is .0006 inch in diameter, about one-fifth the diameter of a human hair. The tube has a resolving ability of about 600 TV lines.

The following five areas are ones where fiber-optics principles in electron tubes might be advantageous for providing higher resolution, greater photometric efficiency and increased reliability at low cost:

High-resolution reconnaissance and facsimile pickup systems.

Examination of organs within human body by using TV camera systems with a flexible telescope or "fiberscope".

Television camera systems on moving vehicles where only the lens need be stabilized.

Inspection by television of otherwise inaccessible cavities.

High-speed electronic printing using a Compositron tube that can achieve a speed of 20,000 characters per second.

Earlier fiber-optic cathode-ray tubes and storage devices were mentioned in the October 1961 issue, page 52.

Hams Have a Satellite

The efforts of the amateurs in extending the frontiers of radio, both on the earth and in space, are being recognized by the Air Force, which launched a 1/10-watt amateur short-wave radio transmitter into a polar orbit last December.

Oscar (Orbital Satellite Carrying Amateur Radio) is a "serious civilian noncommercial effort to obtain information from outer space, and to introduce to amateur radio operators throughout the world new techniques in the field of space communication," says the Amateur Radio Relay League, official amateur organization.

The miniature transmitter is programmed to key automatically the letters HI — four dots followed by two dots of Morse code. This is the universal amateur symbol for laughter, or the recognition of something important or startling. The transmitting frequency is 145.0 mc.

The first reported reception of the ham satellite signals came from a Navy amateur stationed at Marie Byrd Land in Antarctica.

With the large number of amateurs (200,000 in the United States alone) as compared to military and other official stations for observing satellites, it is hoped that new information of value will be obtained. Many hams have had experience in tracking satellites, and have experimented with reflected signals from the Echo passive satellites.

Recently, hams have even used the moon as a reflector for coast-to-coast communication. This was, of course, done earlier by the military and Bell Laboratories, but the hams did it with a very small fraction of the power used by the bigger stations.

Unused Television Channels To Fixed-Station Users?

FCC Commissioner Robert E. Lee has suggested that additional frequencies for a number of non-broadcast services can be provided by assigning nonallocated vhf TV channels to them. Commissioner Lee believes that more than 50 channels would be available, opening some 2,000 frequencies to such uses as police and fire departments, industrial plants and other public and private services that need more frequency space. He suggests that existing TV stations would be protected by permitting such operation only at distances of 150 miles or more from TV stations operating on the same channel.

Commissioner Lee has been an advocate of moving TV entirely to the uhf spectrum, and some look at this proposal as a gradualistic attempt to achieve that aim.

Coast Guard Testing New Distress Signal

A new type of distress signal, designed to clear the 2182-kc radiotelephone channel for distress messages, has been put into operation at New York and San Francisco.

The signal consists of two tones, 2,200 and 1,300 cycles per second, alternating 4 times a second over a period of 45 seconds. It will indicate to all stations listening on the 2182-kc distress frequency that a vessel or aircraft is in serious trouble or that a person has been lost overboard, and that distress traffic is to follow. Upon hearing the signal, all stations must cease transmitting on the distress frequency and listen for the distress messages.

This will allow the Coast Guard to clear this normally cluttered channel when they cannot clearly make out an incoming low-power distress message.

The system was adopted by the International Telecommunication Union at its 1959 Geneva Convention.

The alarm generator may be used with any transmitter that has a speech amplifier with an input impedance of more than 40 ohms, and requires a 48-volt power source. On pressing a button, it transmits two sinusoidal notes following each other every ¼ second for 45 seconds. It uses four identical transistors and three diodes, mounted on three boards. One contains the 2,200-cycle oscillator and switch, another the 1,300-cycle circuitry and the third the 250-msec multivibrator that switches tones, plus the output amplifier.

Radio-Controlled Moods

Technological control of human behavior is receiving heavy emphasis by the Military, the American Medical Association learned at its recent annual clinical meeting in Denver, Colo.

Dr. Otto Schmitt, head of the Department of Biophysics at the University of Minnesota in Minneapolis, described the electrical method, which injects signals into the nervous system to stimulate or depress certain emotions, and the chemical method of implanting radio-controlled pellets containing chemicals, which are activated by an outside signal.

Dr. Schmitt also states that approximately 30 special sensing instruments may be placed in the body to test reactions under stress.

A part of the recent military

(*Continued on page* 10)

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(*Continued from page* 6)

emphasis on pattern recognition, exemplified by the ability to recognize a face or predict events on the basis of experience, these studies will prove helpful in medical, economic and other fields.

A decision for the future, says Dr. Schmitt, is the matter of how much scientific behavior control is justifiable and prudent.

Pilot Radio Head Dies

Isidor Goldberg, one of the very earliest of the radio pioneers, died Nov. 23, at the age of 68. During his career he had been active in practically all areas in the field, from simple broadcast equipment through short wave and television to high fidelity, in which Pilot, the firm he founded, is now most active.

Mr. Goldberg worked for the old Electro Importing Co. (E.I. Co.) as a boy of 16. Shortly thereafter he began to make components, and in 1922 organized the Pilot Electric Mfg. Co. In the late '20's the Pilot Wasp, possibly the first of the widely marketed radio kits, appeared. It was followed by the Super-Wasp, a very popular ac kit.

In 1928 Pilot and Gernsback's *Radio News* cooperated in a pioneer television broadcast, in which TV images were flashed across the Hudson River. In more recent years, the company became one of the leading makers of high-fidelity equipment. Mr. Goldberg remained president of the company up to his death.

"Lighthouses in Sky" Coming

A complete, global, all-weather navigational system using Transit satellites as guides may be in operation by the end of 1962. This prediction was made by Rear Admiral Jack P. Monroe, director of the Astronautics Div. of the Navy, as a result of successes in launching recent Transit satellites.

A ship could fix its position to within 1/10 mile in any kind of weather by tuning in on one of the lighthouse satellites. At present, Admiral Monroe said, a navigator is lucky to come within 2 miles by using celestial navigation.

The latest Transit satellites carry a small oval-shaped atomic generator, weighing 4½ pounds and measuring about 5 x 5½ inches, to

(*Continued on page* 14)

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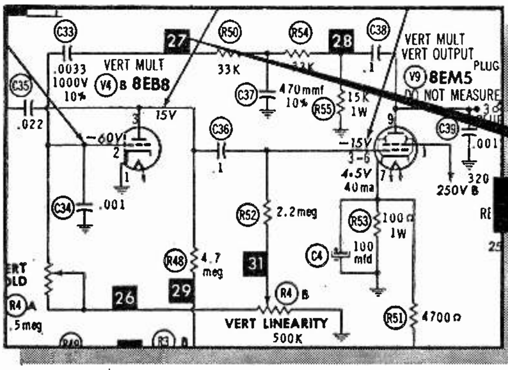

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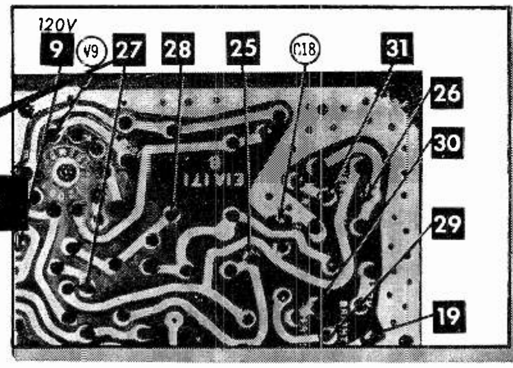

Here's how CircuiTrace works: All test points are clearly shown on the schematic and each is plainly coded (see illustration at left). The same test points are similarly coded on the printed board photo (see illustration at right) so you instantly know where to make your measurement! No more costly hunting for test points ...no more guesswork...no need to look at both sides of the board—identifies tubes, transistors, and foil connections of parts throughout circuits. CircuiTrace makes printed board servicing a breeze!

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FIELD SERVICING NOTES

SAFETY GLASS REMOVAL (MODEL KC366)

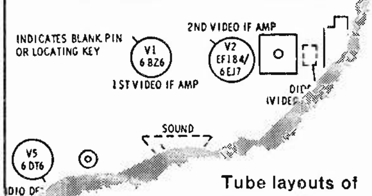
Remove 4 screws holding the trim strip at the top e... the safety glass. Tilt glass out and remove.

FUSE AND FUSE DEVICE

TV: Sweep - ½ Amp. (M1) Radio
LV Supply - Fuse Wire (M2)
Filament - Fuse Wi...
See "Tub...

Valuable instructions for making all necessary adjustments in the home, locating fuses, removing safety glass, etc.

TUBE PLACEMENT CHARTS



Tube layouts of top and bottom of chassis show sync and sound paths, tube keyways, fuses, rectifiers, etc. Helps you trace signal path to localize the trouble.

TUBE FAILURE CHECK CHART

POWER SUPPLY FAILURE
No raster, no sound Fuse Wire (LV Power), Fuse V...

SWEEP FAILURE
No raster, has sound Fuse (Sweep), V8, V9, V10,
No vertical deflection V7
Poor vert. linearity or foldover V7
Poor horiz. linearity or foldover ...
Narrow picture V8, ...
Vert...

Points out probable causes of common troubles, tells you which tubes to replace to correct the symptom. Also shows series-string filament connections.

DISASSEMBLY INSTRUCTIONS

TV CHASSIS REMOVAL

1. Remove 10 push-on type knobs
2. Remove 12 wood screws in...

You get step-by-step procedure for removing chassis, CRT, speakers, knobs, hidden bolts and connections. Avoids parts damage—saves valuable time.

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(*Continued from page* 10)

power two of the four radio transmitters, the other two by solar cells and nickel-cadmium batteries.

Brief Briefs

"High fidelity" from your hot-air heating system is promised by one manufacturer, who makes a unit that mounts on the hot-air duct above the furnace and carries music to every register in the house. "If two units are used—one on the hot-air ducts; the other on the cold-air return—a stereo effect results," says the manufacturer, Roger-Mark Corp. of Chicago. . . .

Ultra-pure fused quartz is announced by General Electric Co. The new pure quartz has higher heat resistance—deforms at half the rate of ordinary quartz at temperatures of 1,200°C or higher. . . .

RCA announces development of a new thermoelectric material—an alloy of germanium and silicon—that produces more electricity direct from heat than any previously known materials. A platelike arrangement of the new material with a square-foot surface heated to 1,000°C can produce up to 10 kilowatts, according to the report. . . .

Alternator-rectifier system to replace the dc generator in motor cars has been announced by Motorola. Silicon-diode rectifier and transistorized voltage regulator form part of the equipment. System is rated at 600 watts.

New superconducting supermagnet developed by Westinghouse is only a pound in weight, develops a flux density of 43,000 gauss. Niobium-zirconium wire, in a bath of liquid helium, carries the fantastic currents required.

Calendar of Events

ERA Annual Convention, Jan. 23–27, Hollywood Beach Hotel, Fla.

IRE Winter Convention on Military Electronics, Feb. 7–9, Ambassador Hotel, Los Angeles, Calif.

Pacific Electronic Trade Show, Feb. 9–11, Shrine Exposition Hall, Los Angeles, Calif.

IRE, AIEE International Solid State Circuits Conference, Feb. 14–16, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

International Exhibition of Electronic Components, Feb. 16–20, Parc des Expositions, Paris, France.

IRE, AIEE, NBS Scintillation and Semi-conductor Counter Symposium, Mar. 1–3, Shoreham Hotel, Washington, D. C.

EIA Committee and Section Meetings, Mar. 14–16, Statler Hilton Hotel, Washington, D. C.

EIA 38th Annual Convention, Mar. 23–25, Pick-Congress Hotel, Chicago, Ill.

IHFM High Fidelity Show, Mar. 20–25, Ambassador Hotel, Los Angeles, Calif.

IRE International Convention, Mar. 26–29, Coliseum, New York, N. Y.

Research Man Heads RCA

Elmer W. Engstrom, RCA research engineer for many years, became president of the company at the end of last year. Engstrom has been with the company for 31 years, and a vice president since 1955. Before his elevation, he was in charge of the RCA research laboratories in Princeton, N. J. Active in several fields, some of his most prominent

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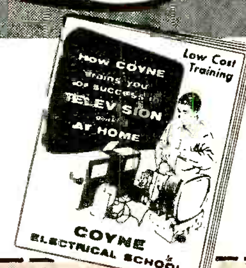

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work has been in connection with color television. It may have been this to which chairman of the board David Sarnoff referred in stating that the selection "reflects our confidence in his ability and experience, particularly in those areas where RCA anticipates great future growth."

A. Hoyt Taylor Passes

Dr. Albert Hoyt Taylor, one of the earliest radar pioneers, died in California at the age of 82. As early as 1922, Dr. Taylor noted—while making experiments in Navy radio communications—that passing ships on the Potomac created an interference pattern. He reported this to the Navy, and suggested that the effect might be used to detect enemy vessels. Continuing his work, he was able to detect planes at a distance of 50 miles by 1932, and in 1938 installed the first radar on a battleship. This work—especially after the outbreak of World War II—was done in cooperation with other inventors and developers, notably Sir Robert Watson-Watt of Britain.

Dr. Taylor received the United States Medal of Merit after the war, and was also recipient of the Stuart Ballantine Medal from the Franklin Institute, the Medal of Honor from the Institute of Radio Engineers, the John Scott Medal and the Pioneer Award of the Professional Group of Aeronautical and Navigational Electronics. He was a Fellow of the Institute of Radio Engineers, American Institute of Electrical Engineers and the American Physical Society. He was president of the Institute of Radio Engineers in 1929.

Appleton Receives IRE Medal

Sir Edward Appleton, principal and vice chancellor of the University of Edinburgh, has been awarded the 1962 Medal of Honor of the Institute of Engineers. It will be presented to him at the March 28 International Convention banquet. The medal was awarded to Dr. Appleton "for his distinguished pioneer work in investigating the ionosphere by means of radio waves."

The directors announced the 1962 officers at the same meeting that granted the Medal of Honor. The 1962 president is Patrick E. Haggerty, president and director of Texas Instruments, Inc. The vice presidents are Andre M. Angot, technical director of Telecommunications Radioelectriques et Telephoniques, Paris, France, and T. A. Hunter, president of Hunter Mfg. Co., Iowa City, Iowa, and research professor at the State University of Iowa.

The directors also made five other awards and elevated 78 leading radio engineers and scientists to the status of Fellow of the Institute of Radio Engineers.

Secretary-Eliminator Developed

A multi-lingual phonetic typewriter for transforming the human voice into typed symbols was described at the 62nd meeting of the Acoustical Society of America in Cincinnati, Ohio, by Dr. Toshiyuki Sakai of Kyoto University, Kyoto, Japan.

Using 5,000 diodes and 3,000 transistors, the unit has three subsystems—a phoneme classifier, the control system and the speech analysis system. At present, the typewriter translates speech sounds into codelike symbols, but further research will permit segmentation into linguistic symbols.

The unit has unlimited linguistic and transmission distance possibilities, says Dr. Sakai.

Optical Maser a Welder

Light from a laser (optical maser) can weld titanium, unaided by any other power source, says Lieut. Col. Elmer M. Morse, chief of the Air Force Aeronautical Systems Div. laboratory at Dayton, Ohio.

Laboratory researchers, he said, cut a dime-sized piece of titanium alloy in two, trained laser light on it and made spot welds with no difficulty.

Sound Researcher Wins Nobel Prize

The 1961 Nobel prize in medicine was awarded to Dr. Georg von Bekesy, for researches into the action of sound in the human ear. Dr. Bekesy proved by actual experiment, using solutions containing aluminum and coal particles, how sound waves actually travel in the ear. His experiments proved that the older theories of hearing, long considered inadequate but never superseded by better ones, were in fact invalid, and that the inner ear, or cochlea, works much like a microphone in converting sound energy into electrical energy and transmitting it to the brain.

Communications With Computers

A new communications system, using computer techniques, has been unveiled by the ITT Information Systems Div. It blends communication and computer technologies to process and switch telegraphic messages and data at speeds running up to at least 1,000,000 bits per second. The computer's memory contains such information as lists of all possible addresses or messages received and sent, instructions as to steps to be taken with regard to messages bearing any of these addresses, instructions as to priority, etc. Thus, the president of an international company, for example, could dictate a duplicate message to each of the branches of a certain division of his company throughout the world, and have them delivered at 9 o'clock the same morning, which might be several days later, with correction for the International Date Line.

The device is expected to have great value in processing and reporting internal information for companies or other organizations. END

Correspondence

ABOUT ELECTRONIC IGNITION

Dear Editor:

In the December 1961 issue, Mr. J. S. Pitman raises a question as to the reliability of the thyratron ignition system described in the September 1961 issue. The author himself points out that a serious problem exists.

Commander Smithey states that the 2D21 thyratrons need replacement approximately every 4,000 to 5,000 miles. Relatively simple circuit analysis suggests that peak cathode-current pulses are of the order of 5 to 10 amperes, which is many times the 0.5-amp rating of the 2D21. Use of a high-current thyratron would solve this problem and perhaps extend operating life, though it would not reduce circuit complexity.

However, Mr. Pitman does have a point. The failure rate of a system is a function of the number of components, and a complicated system using the same grade of component under similar conditions may be expected to cause trouble with a frequency in proportion to the number of components.

I do object to calling Commander Smithey's system transistorized (though it may be technically correct), since the transistors are part of a special power supply and do not perform the primary switching function. The single industrial-grade power transistor in the Transfire system manufactured by our company does directly switch the coil primary current while drawing only a fraction of an ampere through the distributor contacts. Special coil design, minimal number of components and conservative operation yield a simple and reliable system which has all the performance advantages you listed for the thyratron-tube system, and has much lower initial and maintenance costs.

W. F. PALMER

Palmer Electronics Labs
Carlisle, Mass.

UNCRIMP THE JOINT

Dear Editor:

There are many who disagree with the "Technician's Guide to Good Soldering" (November 1961 issue), which recommends wrapping or crimping.

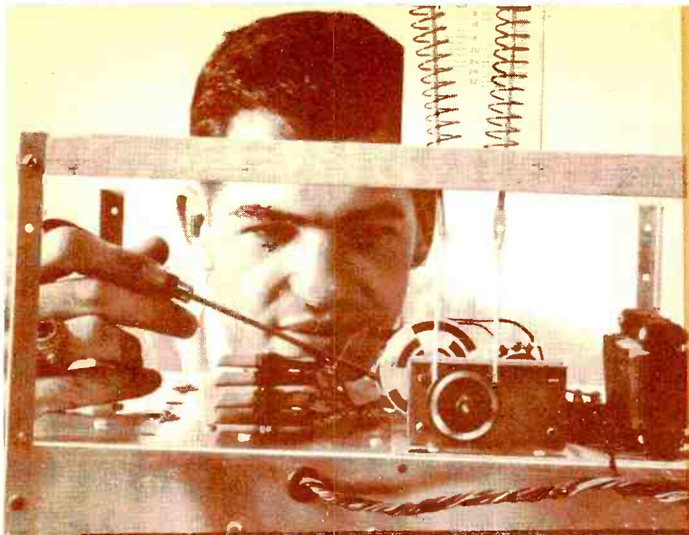
Crimping may be desirable in missile electronics where no maintenance is anticipated. Since the equipment will undergo only a half-hour's use before plunging into the ocean, it is not likely that any connecting wire will have to be removed from a terminal. Otherwise, there is a compelling case for crimpless joints—at least from the viewpoint of the wretched field engineer whose job it is to keep the equipment in working order.

Of course, crimping is highly desirable from a production foreman's point of view because it requires less soldering care and, therefore, speeds his work. Ultimately, however, it is the customer–user whose judgment is important, not the production foreman.

With a little care, you can get perfectly reliable joints without even bending the end of the lead. We have yet to hear any objections raised against crimpless soldering to the holes in etched-circuit boards (though some technicians deplore the expedient that calls for bending each lead, slightly where it emerges from the back of the board).

This plea for crimpless soldering

(*Continued on page* 22)



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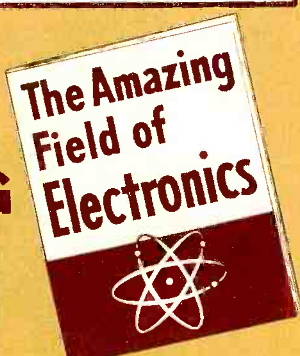

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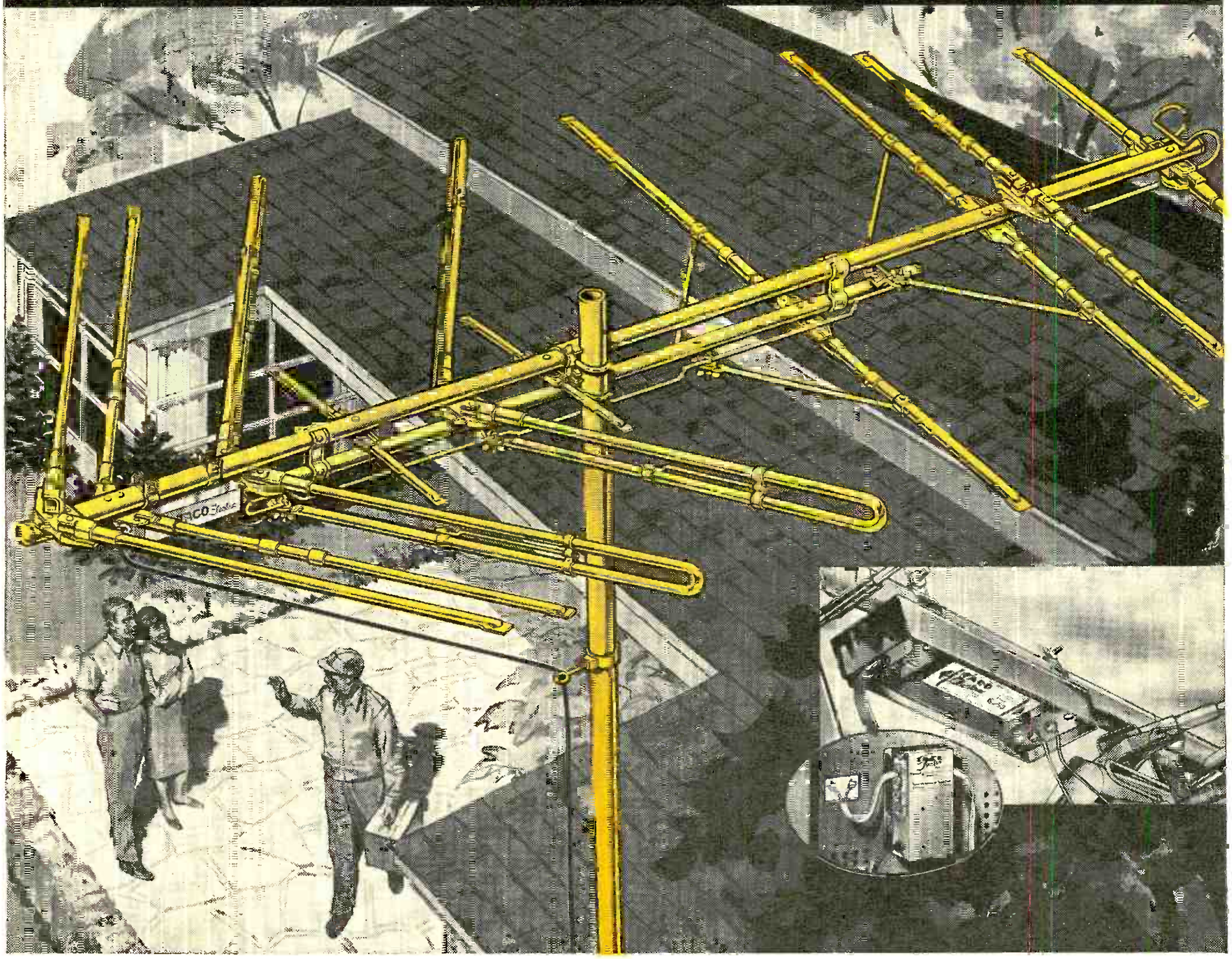
So, with the T-BIRD ELECTRA you assure customer satisfaction, even in severest "problem" areas. Rigid chrome-alloy aluminum elements and contacts eliminate the antenna "friction noise" and "signal flutter" inherent in some so-called "high gain" antennas. There's a T-BIRD ELECTRA for every TV/FM home need, priced from $79.75. And it's **completely pre-assembled** for your convenience.

Only TACO offers custom area-engineering on electronic antennas to help you solve any type of signal problem. For these special services, see your TACO distributor.



*The TACO ELECTRA preamplifier is available for use with <u>any</u> antenna.

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(*Continued from page* 18)

does not represent simply a fanatical minority view. Tektronix, for example, favors crimpless joints; and it is generally acknowledged that Tektronix produces some of the finest, most reliable, most *easily serviced* equipment in the industry.

DALE L. HILEMAN
San Francisco, Calif.

ELECTRONIC IGNITION —IN USE

Dear Editor:

Here's to three cheers for Commander Smithey and sour grapes to J. S. Pitman. Enjoying that surging, economical power more every day! I added an option—a switch that keeps the filaments on and heated for short stops. Be glad to hear of any hints that come up. Try 500 $\mu\mu$f for C4.

WM. SENDER
Parma, Ohio

AMPEREX TRANSISTORS ARE AVAILABLE

Dear Editor:

We noticed in your "Transistor Roundup" in the December 1961 issue that Amperex does not appear among the list of transistor manufacturers.

Amperex has a number of transistors in various types that sell for $5 or less. We have approximately 25 franchised semiconductor distributors and are listed in the Newark Industrial, Burstein-Applebee and Radio Shack Industrial mail-order catalogs.

We will be pleased to furnish your readers with our list of distributors as well as a free copy of our semiconductor catalog upon request.

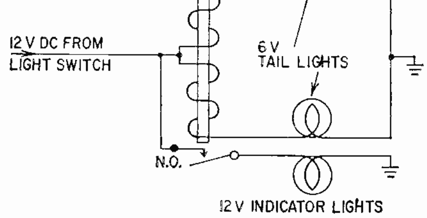
It may be interesting to note that our Slatersville, R.I. plant has been in full production for over a year, and that a number of original transistor types are being manufactured there.

M. SMOLLER
Manager,
Advertising & Sales Promotion
Amperex Electronic Corp.
230 Duffy Ave.
Hicksville, N. Y.

TAIL-LIGHT INDICATOR

Dear Editor:

Those who wish to build the Tail-Light Indicator on page 108 of the April issue, but do not care for the expense of transistors and photocells, might try one of these ideas.



Visit the local junk yard and obtain an ammeter from an old car. Change the value of the shunt and install it in series with the tail lights. The actual installation is simple and requires only inserting the meter in series with the lead to the tail lights. Add a switch to the circuit and you can check your stop lights too.

On cars with 12-volt batteries you might try the circuit shown here. When both tail lights are lit, the relay will not energize. But if either light should fail, the indicator (mounted on your dash) lights. If necessary, the polar relay can be shunted to the proper current range. The tail lights must be replaced with 6-volt units as they are in series with the relay coils, but use a 12-volt indicator lamp or a series resistor and a 6-volt lamp.

ROBERT G. CASEY
Seine, France

ATTENTION TECHNICIANS

Dear Editor:

I am not satisfied with the present New York TV service license bill sponsored by ESFETA (Empire State Federation of Electronic Technicians Associations).

Any license bill is administered by a license board. Men appointed to this board are those suggested by the state trade association (ESFETA).

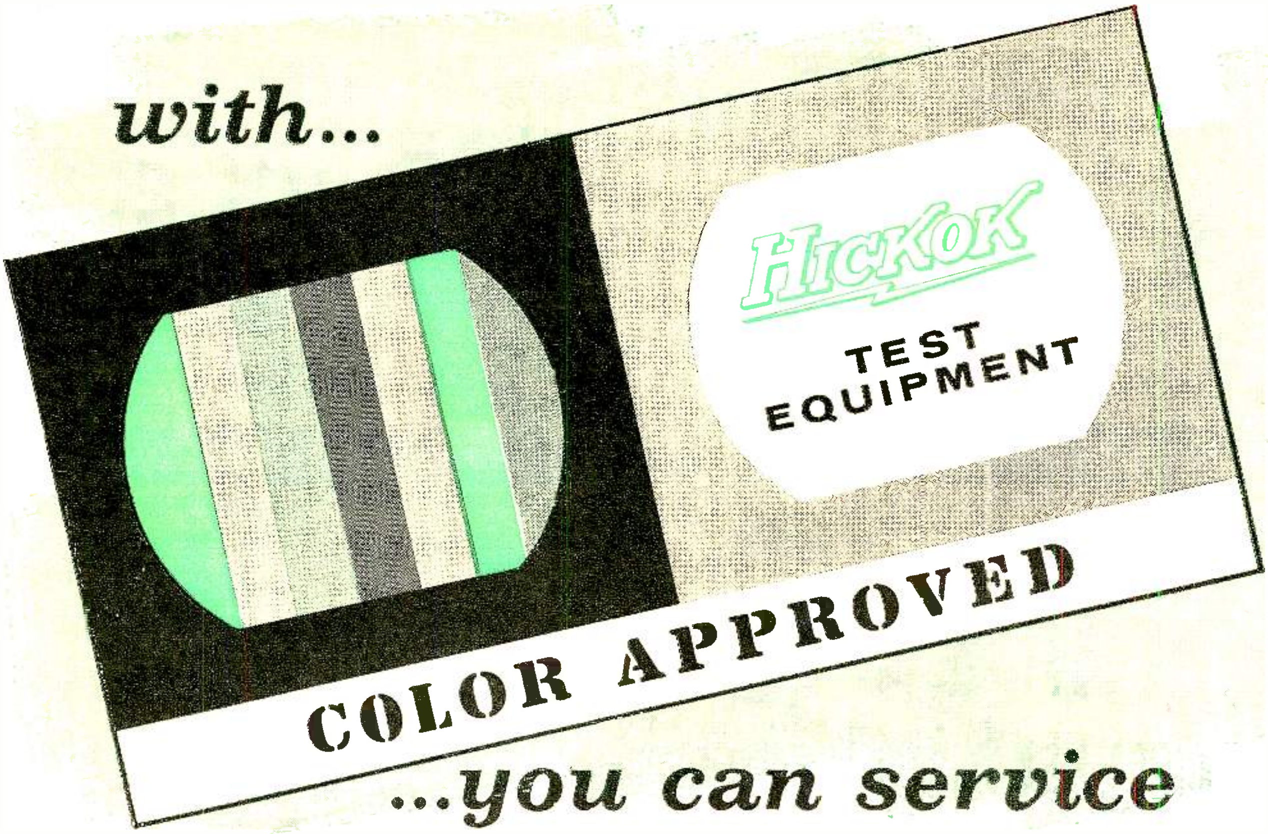
The Department of Education does not determine the scope of the license examination that will be used under the license law (after the grandfathers get in). The contents of these examinations are determined solely by the members of the license board. This, in effect, means that the standards of our license law would be set forth by the technicians' organization and not the State Education Department. The department merely prints the examinations; it does not compose them.

ESFETA does not require all their members to be qualified technicians and they have even abandoned in recent years their one-time requirement that all officers must be qualified technicians.

With this combination we are finding a lowering of the average technical standards by those who will be placed in a position to set the standards of our industry under the license law. Therefore, unless the qualifications for the position of license-board member is more strongly specified in the present bill, we have no guarantee of a good license law. If enough New York State technicians voice their opinion for high standards of the board members, we can have it. Write today before it is too late.

MELVIN COHEN
RD No. 1
Hudson Falls, N. Y.

[ESFETA members are asked to state their opinions. After all, there are two sides to every story. As the proposed law states, a certain number of board members are to be service technicians, so only technicians will be able to fill these positions. And like any appointed office, someone has to do the selecting. They may not select the best men all the time, but this holds true for every organization.—*Editor* END *with...*



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These manufacturers have announced that they will be marketing color television sets this fall.

DUMONT ADMIRAL ZENITH GE Emerson Magnavox Olympic PHILCO


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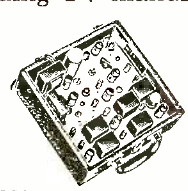
NTSC Standard Color Bar Generator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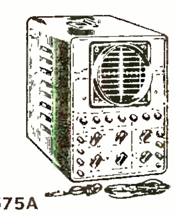
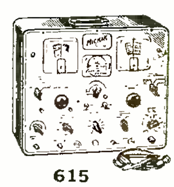
White Dot—Bar Generator


675A
Wide Band Oscilloscope


691
Heterodyne Marker-Adder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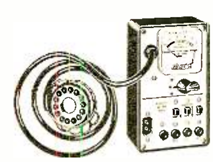
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Radio-Electronics
Hugo Gernsback, Editor-in-chief

THE NEXT PHASE OF TV

. . . A Future L-P Television Record Is Possible . . .

According to the head of the Federal Communications Commission, Mr. Newton Minow, as well as a majority of TV critics, a sizable percentage of today's television programs have sunk to an incredible low, so low, indeed, that more and more people turn to other forms of entertainment.

The flight from television is by no means new; it is of long standing. In recent years, serious attempts have been made to lure distressed TV audiences into pay-TV presentations, where viewers could see worth-while, adult television fare. But pay TV—as we have pointed out on this page before—does not seem to be the solution to the acute problem.

In the meantime, the country is turning more and more to high fidelity and stereo, where people can enjoy first-class music and all that goes with it—at the expense of TV, by doing without it.

The thought seems obvious—why not combine high-fidelity TV with high fidelity and stereo? NOT BROADCAST TV, BUT YOUR OWN SELECTED TV, on a regulation TV receiver?

Indeed, RCA has experimental tape recorder models that can do just that, but so far none are for sale. Prerecorded TV programs might be the stimulus that could lead to their manufacture at prices that could put them within the reach of the home viewer.

In our opinion, tape records do not seem to be the only solution for a number of reasons. One is that the country has grown used to phonograph discs in high fidelity and stereo. They are simple to handle, particularly long-playing (L-P) ones.

Why not, then, record TV special programs, such as "My Fair Lady" and hundreds of others, with sound and video on L-P records? Then we could feed the TV output of such programs *of our own selection* into our present television set, using its video circuits. (We do this now when we feed audio from a record player into the TV's audio system.) Then we would not be a captive audience, listening and viewing mediocrity, interspersed with often-offensive commercials.

The idea, simple and obvious as it is, has so far been technically unfeasible, even if you could record electronically the wide frequency range. To record normal TV impulses on an L-P record, it would have to be enormous in dimensions—about 25 feet in diameter for a ½-hour program. Obviously, such a system is unworkable.

Yet there seem to be other solutions to the problem. The writer suggests one which, when worked out technically, would seem feasible for the future.

To begin with, why use TV impulses? Why not use a *special* kind of motion picture and record *complete motion pictures* on a flat disc? We can do this readily today with optical micropictures.

For over 50 years, French manufacturers have made special optical lenses about ¼ inch long and about 3/32 inch in diameter. On the flat end is cemented an almost invisible photographic bit of microfilm. Usually the subject is a comely girl.* The lens is often mounted in one end of a pen or pencil. The picture, sharp and clear when viewed against the light, nevertheless measures only 1/32 x 3/64 inch.

With modern techniques, we can reduce even this size considerably yet get excellent pictures, *plus an optical sound track.*

The entire motion picture would run in a tight spiral, not in a groove, of course, but on a disc, similar to today's records.

As we wish to use both sides, obviously the record cannot be transparent, but the film spiral must be mounted on a white or, better, a mirrored surface such as polished aluminum, for instance.

The *optical* pickup head, which follows the picture track, also carries a lamp which throws a powerful beam of light on the picture, reflecting the film image into the pickup head. Here we can do two things: One would be to throw the enlarged motion picture onto a screen, pick off the sound with a photoelectric cell, and leave out the TV set entirely.

That, we believe, is not the best way. It is more logical to install the picture record and its associated gear in the top of the future TV set, where it belongs. Then we attach a special, small TV camera to the pickup head, and feed the output to the TV receiver. This, we think, solves the problem in a sensible way.

Let us caution here that TV records on flat discs are a project for the future. Enormous technical difficulties must be overcome, despite its attractive possibilities. Such records, even if finally mass-produced, would probably always cost far more than present L-P records.

When TV tape records were first contemplated, no feasible solution seemed in sight for many years, until Ampex finally evolved its brilliant super-speed, revolving magnetic transducer head. A similar breakthrough might make disc TV recording possible.

Certainly, in the future, TV set manufacturers would provide better hi-fi speakers to anticipate the new demand that is bound to follow such TV records. Yes, such receivers would be more expensive, because they must combine TV, hi-fi and stereo.

Coming back to the TV records—they naturally would be expensive too at first. Yet, as always, mass production would surely lower the prices. If a hit musical or smash drama were assured a good pereentage of income to its producers from a million or more TV records of the productions, they would not have to worry about audience attendance—indeed, we can foresee the time when such productions would be exclusively for a "record" audience first, then later played to a live audience.

The world's great operas, symphonies in the best concert halls—all can be recorded in audio and video on L-P in the future. There seems to be no limit once the system has been perfected.

Does all this spell the doom of live TV? Certainly not in the slightest. Television has its own peculiar and unrivaled pre-eminence that no home-use recording can ever challenge. News, sports, spot events, talks by eminent politicians, debates, vaudeville, panel shows and dozens of other functions —if put on intelligently and in good taste—will always have a good audience. The two systems of entertainment need never compete with each other—nor should they. —*H.G.*

*Such a lens, mounted in a religious cross, containing the Lord's Prayer, is at present sold for 50¢ by jewelry and novelty stores. If you cannot secure one, send a stamped return envelope to the author for the name of the manufacturer.

FM antennas for better listening

Types of antennas and their characteristics

By EDWARD M. NOLL

The antenna has always been important in FM. But with stereo multiplex FM, a good antenna is absolutely vital, even in metropolitan areas. The signal-to-noise ratio of the stereo signal is far below that of a conventional mono FM signal, and if the signal at the receiver input is inadequate, the multiplex subcarrier will not be strong enough to lock in the receiver's multiplex circuits. Poor stereo separation or complete absence of stereo may be the result.

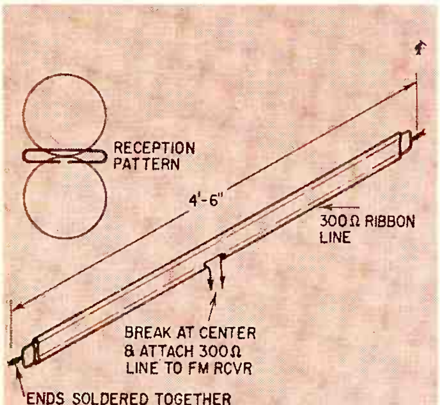


Fig. 1—Simple FM antenna can be made from a length of 300-ohm twin lead.

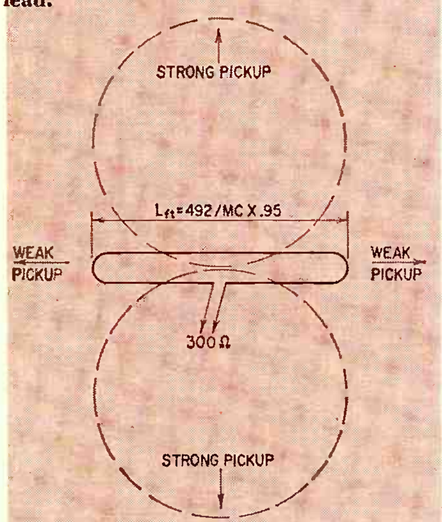


Fig. 2—The basic folded dipole and its figure-8 pattern.

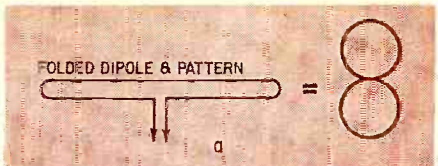
A good antenna keeps local signals well above the level at which interference and background noise can mess up the reproduced program. At the same time, longer distance signals can be raised above the noise level, reducing fading and interference. The stronger the signal delivered to the tuner input, the more it can be made to exceed the background noise of the receiver.

Sensitivity of FM tuners is usually given in terms that relate microvolts of signal to background quieting. This figure is generally presented as the minimum signal strength required for a certain amount of db quieting (usually 20 or 30 db). To say a receiver has a sensitivity of 1 μv for 30-db quieting indicates that an incoming 1-μv signal will reduce the normal no-signal background noise level of the receiver by 30 db. If the incoming signal is strong enough to press down the background noise by 40 db, the background, in a practical sense, can be called noiseless.

A correctly installed antenna can do much to optimize the weaker and more distant FM stations. By correct antenna positioning and orientation, these signals can be raised above the background noise. They can be made strong enough to dominate interference from local stations on nearby channels.

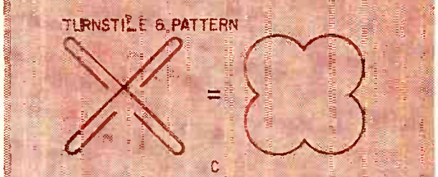
Built-in antennas are included with most FM receivers and tuners. The built-in antenna is usually a piece of 300-ohm Twin-Lead stapled to the cabinet. Such a simple antenna is often good enough for the stronger local stations. But reception is better when the antenna is improved.

Attic- or window-mounted antennas help considerably if it is not possible to go to a roof-mounted outdoor type. A ribbon-line folded dipole (Fig. 1) can be stapled to attic rafters or other convenient mounting. The length of such a ribbon antenna can be about 4½ to 5 feet. Solder the ends together as shown. Break one lead at its center and attach the 300-ohm transmission line that must be run between the folded dipole and the antenna terminals of the FM unit. As shown, the antenna is most sensitive when placed broadside to the received signal. When the transmitters in the area are located in differing directions, mount it broadside

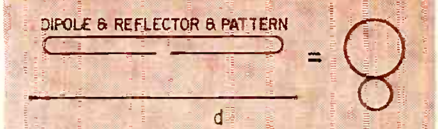


Metropolitan and suburban areas for strong signals

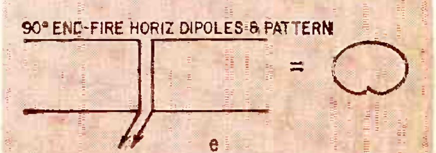
Metropolitan and suburban strong signal areas where a broader pattern is desirable because signals arrive from several directions



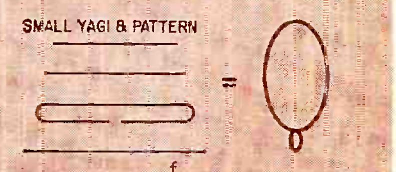
Metropolitan and suburban strong signal areas where an omnidirectional pattern is needed because signals arrive from many directions



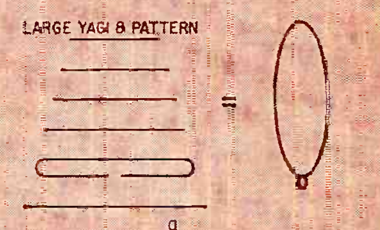
Urban and near-fringe areas where signals arrive from same direction. Stacked versions of A, B, C, or D can be used in near fringe areas 25-40 miles out



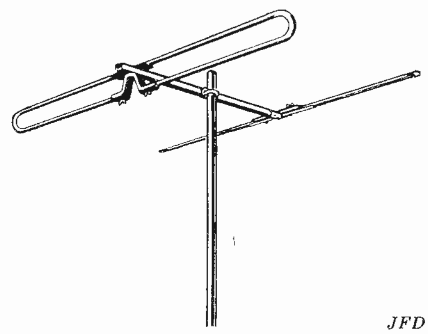
For urban and near fringe areas where a broad uni-directional pattern is needed



Fringe and other weak signal areas 30-80 miles out

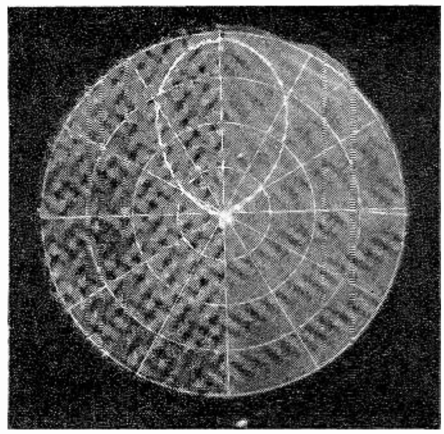


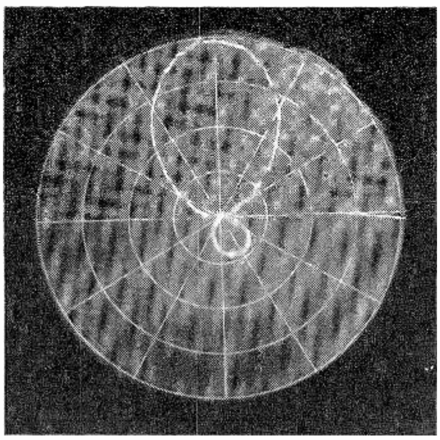
For fringe areas beyond 80 miles. Number of elements depends on how far out and how weak signals are

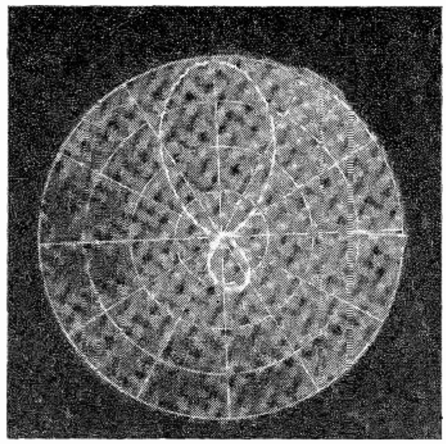


JFD

Fig. 3—A folded dipole and reflector for FM (above) and its radiation patterns at 88 mc (right), 78 mc (below) and 108 mc (lower right).







to the weakest signal you wish to receive.

An outdoor antenna is best if optimum performance is desired. There are a variety of outdoor FM antenna styles, from the simple dipole to the high-gain Yagi. Let us consider the physical and electrical characteristics of the more common styles.

Frequency, bandwidth and size

The FM band occupies a 20-mc span of frequencies between 88 and 108 mc. Spectrum-wise it is positioned just above television channel 6. Hence the FM antenna is somewhat shorter than low-band TV antennas, and the usual FM antenna is not nearly so elaborate. Typical half-wavelength dimensions at the center and ends of the FM band are given in Table I.

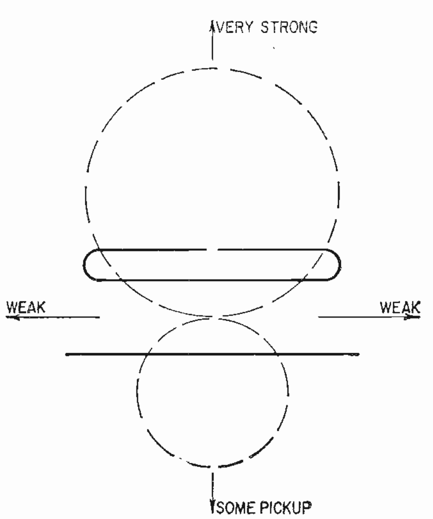
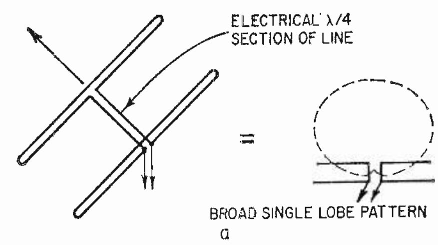


Fig. 4—Folded dipole and reflector with its horizontal directivity pattern.

Most FM antennas are cut to the center of the band or on the low-frequency side of center. This gives reasonable sensitivity over the entire span of frequencies. Some drop in sensitivity is to be expected at band edges because of the 20-mc bandwidth. If you want to receive a weak station near the band edge, you can increase signal strength by choosing a length that resonates at or near its frequency (Table I).

Often a simple folded dipole (Fig. 2) is used as an FM antenna. It is a half-wavelength long and has a resistance of 300 ohms when center-fed. Thus 300-ohm line can be used to transfer the signal from the antenna to the 300-ohm input terminals of the receiver. A horizontal dipole antenna has a figure-8 horizontal directivity pattern. Thus its sensitivity is maximum broadside to the antenna element. (Minimum pickup is in line with the antenna.) When installing an antenna in an urban or suburban area, the two minima are spaced in the directions from which no FM signals are likely to arrive. With station signals arriving from various angles, such an antenna does not give optimum results. Nevertheless, in strong-signal areas it can usually be positioned for good reception of all local stations.

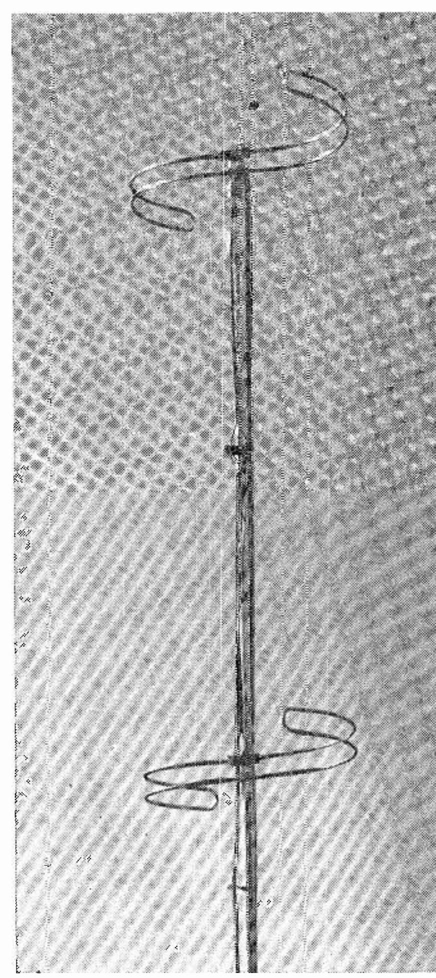
If you are fortunate enough to live in a suburban or near-fringe area where all FM transmitter signals arrive from approximately the same direction, a simple gain type antenna (one with additional elements to increase the gain in one direction—see Fig. 3) can be used. The reflector element, which is longer than the dipole, lowers the sensitivity of the antenna on its side of the driven element and increases it in a direction away from the



300 Ω ribbon	246/MC x .82
150 Ω "	" x .77
75 Ω "	" x .68
Coax	" x .6

b

Fig. 5—End-fire folded dipole and its single-lobe pattern. The table shows length of the quarter-wave section.



Taco

Fig. 6—Stacked S-folded dipoles.

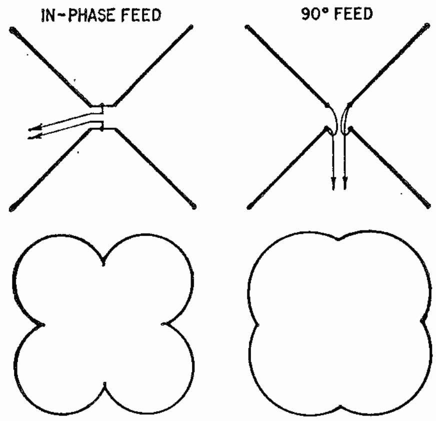
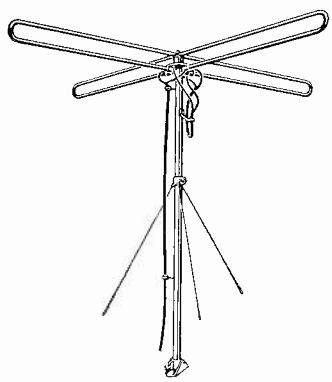
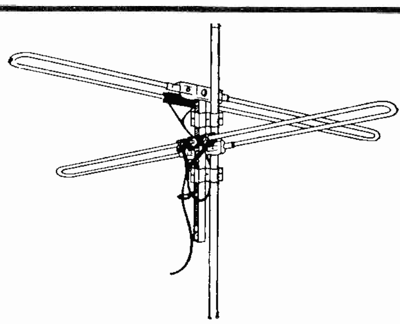


Fig. 7—Turnstile feed arrangements and their effect on the antenna pattern.



Amphenol

Fig. 8—The folded-dipole turnstile is a popular FM antenna.



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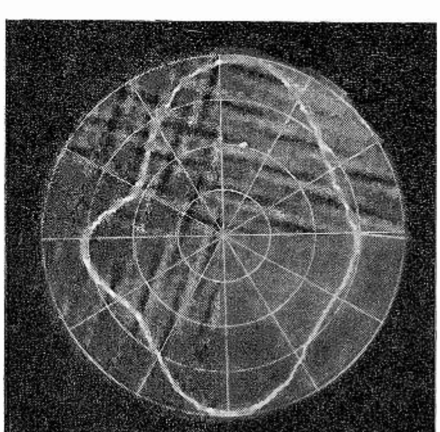

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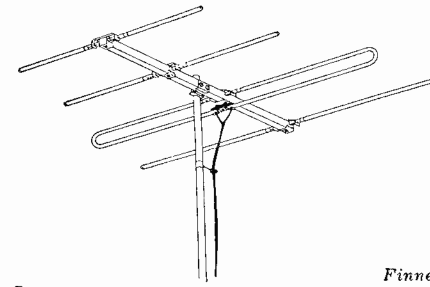
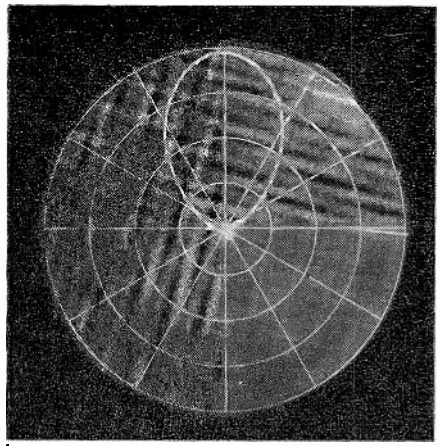
Fig. 9—A typical turnstile (a) and its pattern at 98 mc. (b).



a

Finney

Fig. 10—Four-element FM Yagi (a) and its patterns at 88 mc (b), 98 mc (c) and 108 mc (d). Note how directivity increases with frequency.



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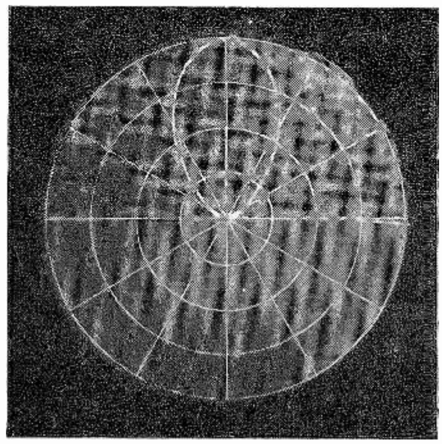

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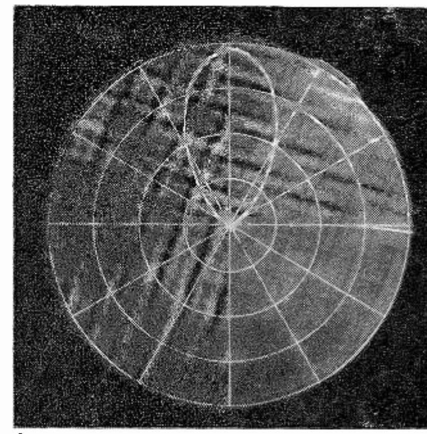


d

reflector (Fig. 4). When using such an arrangement, some 35% to 45% more signal voltage can be delivered to the receiver input than with a single dipole.

The horizontal radiation pattern for the folded-dipole and reflector combination at the center and two end frequencies of the FM band is given in Fig. 3.

Table II shows the SWR and gain figures of the various styles of antennas at specific frequencies in the FM band. Notice that the gain of the dipole and reflector combination decreases with frequency. Remember that the reflector must be cut long enough to act as a reflector at the low end of the band. The effectiveness of the combination declines toward the high-frequency end.

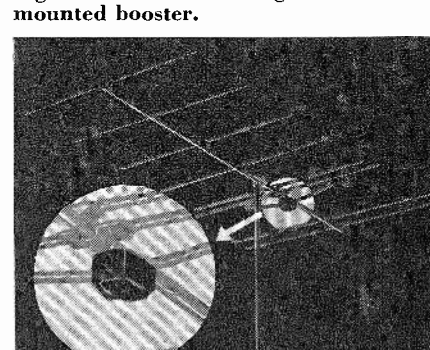
A gain antenna must be oriented carefully for best reception from the weaker FM stations you wish to receive. Such an antenna does have some back pickup and can handle strong signals that arrive from the back. The single dipole is least sensitive to signals in line with its individual antenna elements.

When a folded-dipole driven element is used, a 300-ohm transmission line is customary. For a straight dipole, a lower-impedance line can be used. This can be 75- or 150-ohm ribbon line or a 50- or 72-ohm coaxial line. Many FM receivers and tuners have terminals for connecting either high- or low-impedance lines.

Occasionally two driven elements are used, as shown in Fig. 5. In this arrangement two driven dipoles are employed. One dipole is driven in a manner that will place it in quadrature (90° related) with respect to the second dipole. This can be done by using a section of transmission line 90° (a quarter wavelength) long between the points of attachment to the two dipoles. The physical length of this 90° section is determined by multiplying the quarter-wavelength free-space dimension times the velocity factor of the particular transmission line. Typical lengths are shown in the diagram.

The advantage of this so-called end-fire arrangement is that a cardioid (heart-shaped) horizontal directivity pattern is obtained. It has a broad forward pattern that makes the antenna sensitive to many angles of arrival as far as its forward directivity is concerned. The side and rear pickup of the antenna is quite poor so noise and interference pickup from the back are minimized. It performs well for a loca-

Fig. 11—Broad-band Yagi with antenna-mounted booster.



Winegard

tion where signals arrive over a rather broad angle in the forward direction.

Turnstile antennas

A popular FM antenna is shown in Fig. 6. The driven element is basically a folded dipole. The folded dipole is shaped into a figure-S. This gives a much broader figure-8 horizontal directivity pattern. Such an antenna sacrifices its pickup, to some extent, in a direction exactly broadside to the antenna element. Its pickup at angles quite divergent from the broadside line is improved. Also, it does not have sharp minima in line with the antenna element. Stacked S-folded dipoles permit higher gain.

An FM antenna can be made sensitive in more than two directions by using two in-phase dipoles mounted at right angles (Fig. 7). The horizontal directivity of this arrangement is like a clover leaf. However, there are now four minima and, in orienting such an antenna, they can be troublesome if signals are arriving from several directions.

The most common form of turnstile antenna is shown in Figs. 8 and 9. One of the dipoles is fed in quadrature with the second. This 90° feed arrangement consists of an electrical quarter-wave section of line between the two right-angle dipoles. The 90° feed arrangement of the turnstile pair provides an omni-directional horizontal pattern as shown. Such an antenna need not be oriented when it is installed because its pickup is uniform at all compass angles. There are some minimum positions which are not very deep, and therefore, not particularly objectionable. Conical driven elements can be used to get a still more uniform omni-directional pattern.

Parasitic antennas

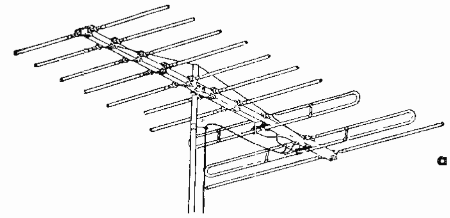
Additional parasitic elements (Fig. 10) can be added to increase the gain of an FM antenna and sharpen its directivity. This style of antenna is used to best advantage in fringe and far-fringe areas. When long-distance FM stations arrive from different directions, such an antenna is used with a rotator.

Yagi antennas have very high gain and a sharp horizontal directivity pattern. The greater the number of parasitic directors, the higher the antenna gain and the sharper the directivity pattern. If such an antenna is to be installed in a fixed position, it must be oriented very carefully in the direction of the signal.

Such an antenna picks up local stations reasonably well, even though they may not be in line with the most sensitive direction of the antenna. Hence in many locations such an antenna can be oriented in the direction of the weak distant signal and will still have enough pick up for the reception of local FM signals.

Yagi antennas of this type must be broad-banded if they are to be reasonably uniform sensitivity over the entire FM spectrum. When an FM enthusiast is interested in receiving a weak long-distance station, it is possible to cut and assemble a Yagi tuned to its precise frequency. An alternative to this plan is to make some alterations in the element dimensions of a commercial Yagi to peak its sensitivity at a given frequency. It is possible, at times, to obtain a channel-6 TV Yagi antenna at a bargain price. The elements of this Yagi can then be cut down to a specific FM frequency. Spacing between elements need not be changed.

The Yagi in Fig. 11 is a broad-band type. Note the booster mounted on the antenna. Optimum dimensions for the dipoles permit the combination to display a more uniform pickup over the entire 20 mc of the FM band. The reflector is cut into the low end of the band; directors, the high end. The patterns of the model in Fig. 12 show how the pattern sharpens when many elements are used. Hence the antennas must be oriented critically to get the most out of them. END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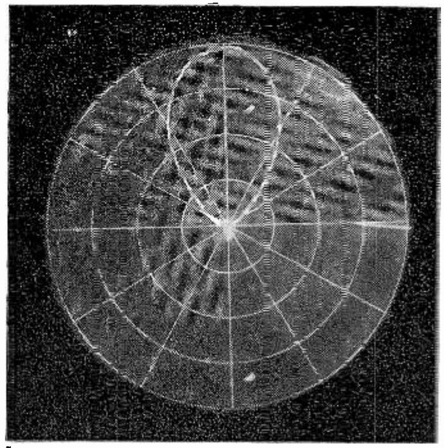
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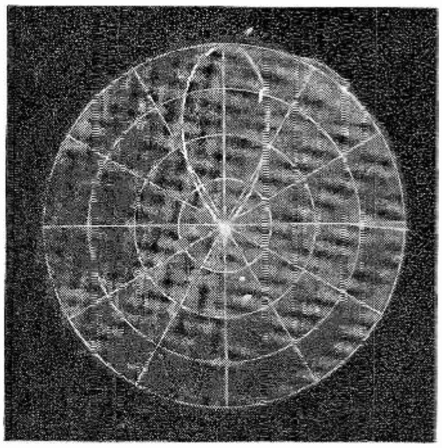
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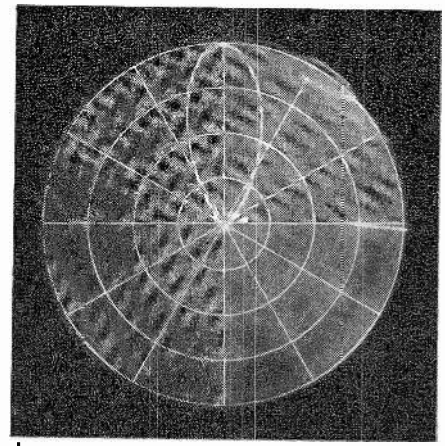
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Fig. 12—A complex 10-element Yagi (a) and its patterns at 88 mc (b), 98 mc (c) and 108 mc (d). Note that, while directivity increases with frequency, the change is slight.

Table I
HALF-WAVE FM ANTENNA LENGTH

FREQ (MC)	λ/2 FREE SPACE	CORRECTED FOR END EFFECT (5%)
88	67 in.	64 in.
98	62	59
108	54½	51¾

Table II — SWR and GAIN COMPARISONS

ANTENNA TYPE	VOLTAGE-STANDING-WAVE RATIO 88 MC	98 MC	108 MC	DB GAIN OVER REFERENCE DIPOLE 88 MC	90 MC	95 MC	100 MC	105 MC	108 MC
Folded Dipole Turnstile Quadrature Fed	1.8	1.3	1.35						
Folded Dipole and Reflector	1.5	1.9	2.5	3.0	3.2	3.0	2.4	2.0	1.5
Four-Element Yagi	1.2	1.6	2.5	5.0	5.4	5.8	6.0	7.3	7.1
Six-Element Yagi (Twin Drive)	1.5	1.4	1.5	6.8	7.4	8.4	8.8	9.4	9.6
Ten-Element Yagi (Twin Drive)	1.3	1.3	1.5	8.7	9.3	10.2	10.6	10.8	11.1

The radiation patterns in Figs. 3, 9, 10 and 12, and the information in Table II are printed through courtesy of the Finney Co.

REGULATED LOW-VOLTAGE SUPPLY
for service bench or lab

Variable from 0.5 to 30 volts, 2- to 3-ampere output, 0.5% regulation—powers most battery-operated transistor equipment

By LEONARD J. D'AIRO*

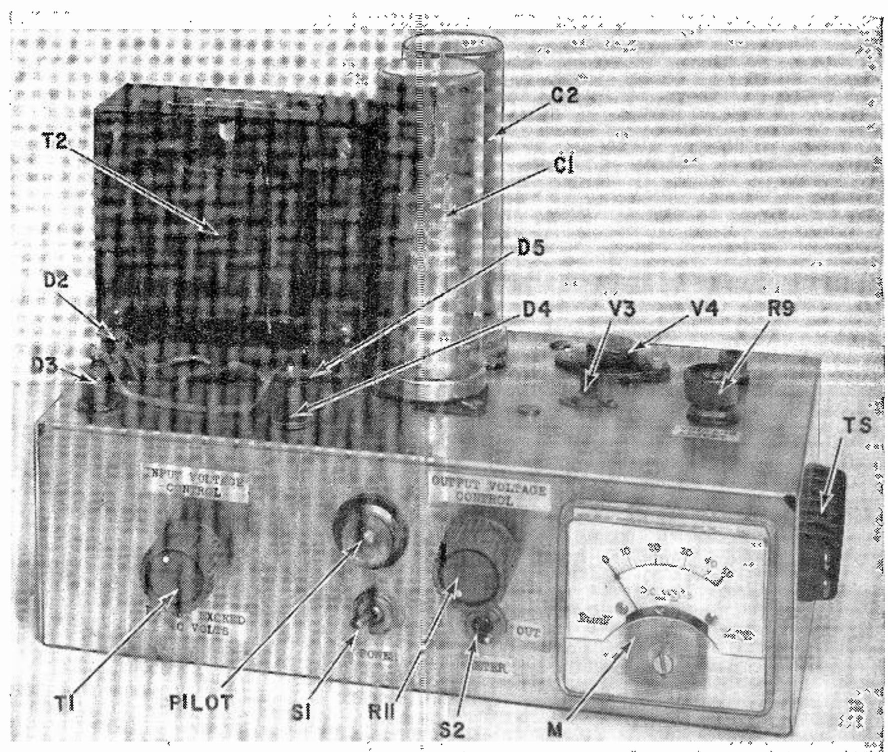
WHEN servicing and testing battery-operated equipment, a rectified ac power supply often forms the power source. This supply must be able to provide the required operating voltage and current for the equipment and at the same time present a low-impedance source to the circuit, as does the battery it replaces. Also, there must be little or no ac ripple in the output.

A conventional regulated supply uses a fixed reference voltage to set the level of the regulated output voltage (Fig. 1). Because of it, the output voltage cannot vary more than a fraction of its set value. To get a variable voltage range and still have good regulation at any point in this range, the reference voltage must be variable. But to do so defeats the purpose of regulation.

It seems that the only possible solution is to connect a potentiometer across the output (Fig. 2), and take the variable output voltage between the wiper arm and ground. But this solution presents a new problem. Once large currents are drawn through the potentiometer by the load, the voltage drop across the resistance plays havoc with the output voltage. Once again we lose regulation.

But, suppose that instead of the potentiometer a transistor is used whose conductivity can be manually controlled (Fig. 3). Its action is similar to the potentiometer alone and it would be possible to control the output voltage as required without fear of voltage drop over a wide current range. Current is then limited only by the transistor used. This arrangement is the one that is used in the regulated power supply shown in the photographs.

The supply uses four power transistors and one small-signal transistor. Output voltage is variable from 0.5 to 28 volts with 0.5% regulation at any point. Maximum ac ripple is 40 mv, and the voltage output vs temperature drift is 0.75% between 30°F and 150°F. Output current ranges from 0 to 2 amperes at any voltage up to 15, and from 0 to 3 amperes at any voltage above 15.



The completed power supply.

The circuit

The complete circuit of the regulated power supply is shown in Fig. 4. A Minneapolis-Honeywell type DA3F3 (V1) power transistor is the positive line series regulator. A 2N102/13 (V2) and 2N217 (V3) are used as the control amplifier and sensing amplifier, respectively. A second DA3F3 (V5) in the negative lead acts as the variable series regulator and a 2N1031 (V4) is its control amplifier. The DA3F3 transistor was used because of its 30-amp maximum collector current, 100-watt dissipation and low cost. (The transistors may be obtained direct from Minneapolis-Honeywell Regulator Co., Union, N. J., at $5 each.) Total cost of the regulated supply will be about $80.

Referring to Fig. 4, rectified ac is applied across V1's emitter and ground. Fixed regulated output voltage is taken between V1's collector and ground.

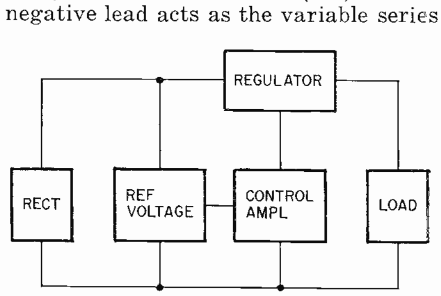


Fig. 1—Block diagram of conventional regulated power supply.

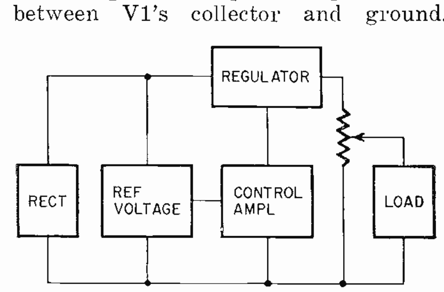
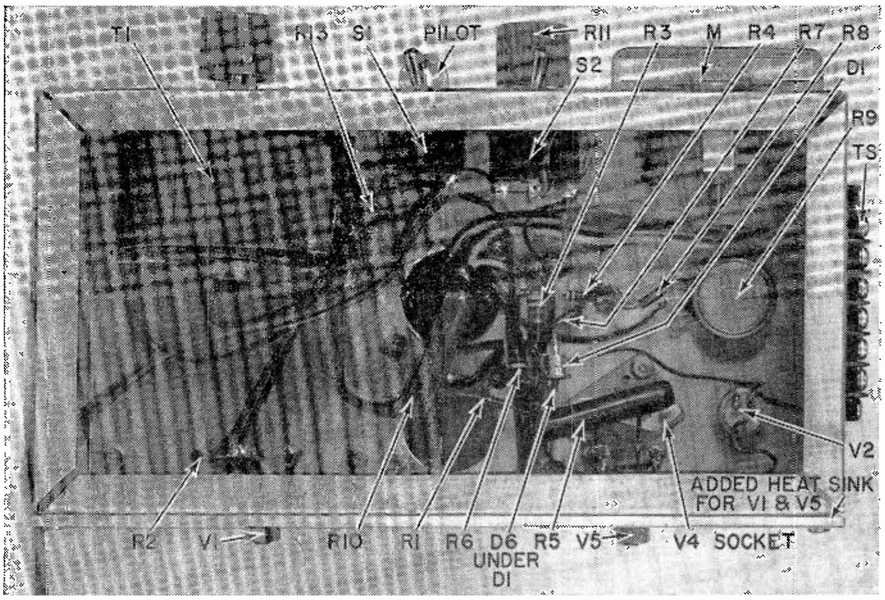


Fig. 2—Potentiometer across the output supplies a variable "regulated" voltage.

*Author, *Servicing Transistor Radios*, Gernsback Library.



Underchassis. Note the added sheet of aluminum fastened to the rear of the chassis for additional heat dissipation.

Variable regulated voltage is taken across V1's collector and V5's emitter.

Regulating action

Zener diode D6 sets the level and regulating range of V3's emitter to 27 volts. Resistors R4, R8 and R9 form a voltage-divider network for V3's base and bias V3 into conduction. (R9 is adjusted so V3's base is 3 volts more negative than the emitter. This sets the regulated output voltage at 30.) When V3 conducts, its collector tends to approach the same value as its emitter. Since the collector is connected directly to V2's base, this positive voltage (with respect to ground) causes V2 to conduct. V2's collector is connected to V1's base and to the supply voltage through resistor R2. The current V2 drawn through R2 causes a voltage drop across it that biases V1 into conduction.

If the current drawn by the load tends to increase, the output voltage will decrease in proportion due to the I/R drop across V1. This drop in output voltage is sensed by V3's base as an increase in base bias voltage, and V3 goes into saturation. With V3 saturated, the collector voltage now equals the emitter voltage. This causes V2 to conduct more heavily, drawing a larger current through R2. The increased current through R2 causes a larger voltage drop across it which, in turn, biases V1 into heavier conduction, decreasing its internal resistance and increasing the output voltage to compensate for the original drop. The same action occurs if the input voltage decreases.

On the other hand, if the load current decreases or the input voltage increases, the opposite action occurs. An increase in output voltage is sensed by V3 as a decrease in base bias. This causes V3 to go out of saturation or conduction (depending upon the degree of change). V2, in turn, conducts less and approaches cutoff. Less current flows through R2 and the voltage drop across it decreases. V1 now conducts less, increasing its internal resistance and decreasing the output voltage.

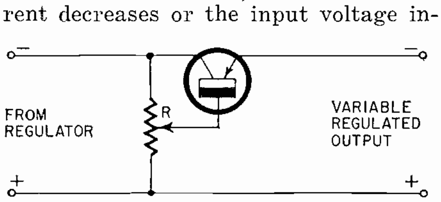


Fig. 3—Transistor provides a variable regulated output with better control and less voltage drop.

Because R2 is connected between the emitter and V1's base, this transistor is normally biased at cutoff. Any voltage applied to it will not cause it to conduct. Therefore, to turn it on, some means must be used to bias it in the forward direction. We do this by connecting a starting resistor (R1) from the supply voltage to V3's emitter to turn the regulator on.

(When V3 conducts, it starts V2 and V1 in turn.) The value of this resistor is small enough to turn the regulator on and yet large enough so as not to affect regulation. Diode D1 prevents the supply voltage from affecting the output (since it is back-biased), and, because of D6, the voltage at the emitter cannot rise above 27, regardless of the supply voltage.

Transistors V4 and V5 operate in much the same manner as V1 and V2 except that V4 conduction is manually controlled. V4 and V5 are actually emitter followers with the emitters leveling off at a voltage slightly less than that of the base. If the output requirements did not exceed 250 mw, the load could be connected between the wiper arm of R11 and ground. But, since the output is 112 watts maximum, V4 is used to multiply the 250-mw rating to 25 watts. V5 can then regulate 4 amperes at 28 volts. Resistor R12 limits V4's base current and prevents the base voltage from equaling the collector voltage (which can permanently damage or destroy the transistor).

The maximum input voltage applied to the regulator should not exceed 40 volts. This limit prevents breakdown between the collector and emitter of V1. As a protective measure, the variable autotransformer (T1) is used to adjust the input voltage to T2 so the rectified ac applied to the regulator never exceeds the 40-volt limit. T1 is necessary since the output voltage of the rectifier increases as the load current decreases. Meter M monitors this input voltage.

Construction hints

Any method of construction is feasible since there is no ac or rf signal to contend with. Layout and leads can follow any pattern that suits the constructor, provided, of course, that heavy enough wire (No. 10) is used to carry the large currents provided.

The supply shown in the photographs was built on a 5 x 10 x 3-inch aluminum chassis. T1 and T2, D2, D3, D4 and D5 and the filter capacitors are all mounted on the left-hand side of the chassis. The two regulator transistors are mounted on the rear of the chassis with a ⅛ x 3 x 10-inch piece of aluminum supplementing it as a heat sink. Transistors V3 and V4 are mounted above the chassis on the right-hand side, while V2 and the remainder of the components are mounted under the chassis. All transistors must be insulated from the chassis. A transistor socket is used to mount V3. The VOLTAGE control (R11), POWER switch, METER switch and meter are mounted on the front panel of the chassis.

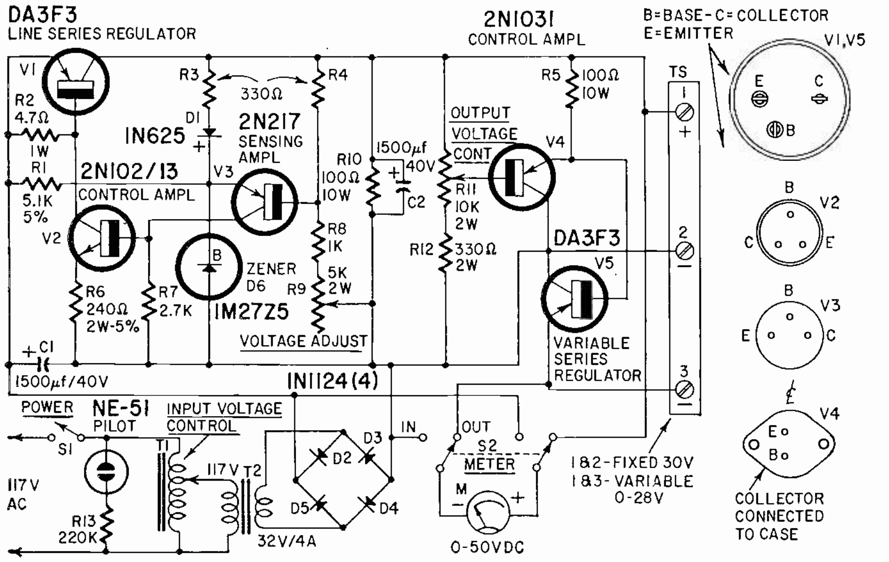
If desired, the power supply section (transformers and rectifiers) can be replaced by any convenient power supply capable of delivering the required voltage and current, such as the standard battery eliminator that often adorns the service bench.

Operation

After construction and wiring are complete, check to make sure you have made no mistakes. Assuming that all is satisfactory, connect a 30-ohm 50-watt wirewound resistor or equivalent load to terminals 1 and 2 of the regulator. This represents a 1-ampere load. Connect an accurate voltmeter to these terminals. Turn R9 to maximum resistance, input voltage down to zero. Apply power. Increase the input voltage to 34, and adjust R9 until the external voltmeter reads 30. Increase the input voltage to 40. There should be no change in the output-voltage meter reading. If the output voltage does increase, either D6 or D1 should be replaced. Decreasing the size of R4 may also help if D6 cannot be replaced. Vary the input voltage between 32 and 40. There should be little if any change—that is, no more than a 0.2-volt variation.

With the input voltage set at 40, vary the load current over the 3-ampere range. Again there should be no more than a 0.2-volt variation. If the change exceeds 0.2 volt by a large amount, D6 or V3 should be replaced, or R4 decreased (do not make R4 less than 150 ohms).

With the regulator operating properly, connect a load across terminals 1 and 3. Regardless of the load, the volt-



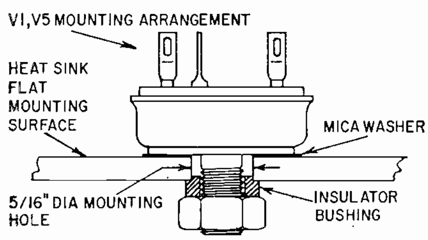


Fig. 4—Circuit of the regulated power supply.

R1—5,100 ohms, 5%
R2—4.7 ohms, 1 watt
R3, R4—330 ohms
R5, R10—100 ohms, 10 watts
R6—240 ohms, 2 watts, 5%
R7—2,700 ohms
R8—1,000 ohms
R9—pot, 5,000 ohms, 2 watts
R11—pot, 10,000 ohms, 2 watts
R12—330 ohms, 2 watts
R13—220,000 ohms
All resistors ½-watt 10% unless noted
C1, C2—1,500 μf, 40 volts, electrolytic
D1—1N625
D2, D3, D4, D5—1N1124
D6—Zener diode, 1M27Z5 (Motorola)
M—0-50 volts dc
S1—spst toggle
S2—dpdt toggle
T1—variable autotransformer, 1 ampere
T2—rectifier transformer: primary, 117 volts; secondary, 32 volts, 4 amperes
TS—terminal strip, barrier type, 3 lugs
V1, V5—DA3F3 (Minneapolis-Honeywell, see text)
V2—2N102/13
V3—2N217
V4—2N1031 (Bendix or equivalent)
Pilot-lamp assembly with NE-51 lamp
Case, 5 x 10 x 3 inches
Transistor heat sinks, see text
Miscellaneous hardware

age between these terminals should vary between 0 and 28 volts when R11 is varied.

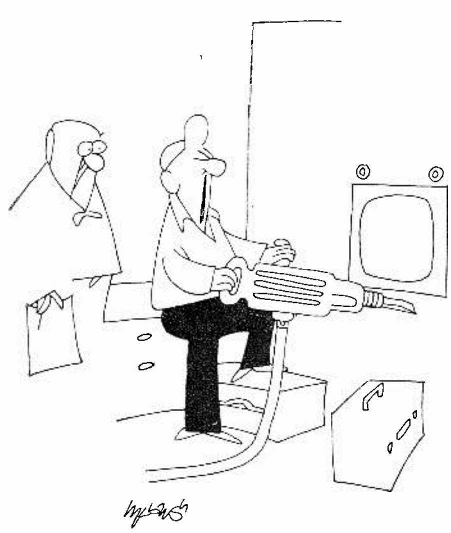
If the output voltage remains constant regardless of the setting of R11, then there is either a mistake in the wiring or V4 or V5 is defective.

One feature of this regulator is its "built-in" short-circuit protection which prevents the transistors from acting as fuses. If the load current ever exceeds the maximum of 3 amperes, or if the output terminals are accidentally shorted, the entire regulator shuts itself off. It remains in this condition until the overload or short is removed.

This action is the function of V3. As the load increases beyond 3 amperes, the voltage output decreases to a point where V3 cuts off completely. In turn, it causes V2 to cut off. With V2 no longer conducting, no current flows through R2. This places the base of V1 at the same potential as its emitter. V1 now no longer conducts and the output voltage drops to zero.

Even though the starting resistor is still in the circuit, V3 will not conduct as long as the overload or short remains. This is because the overload or short prevents V3's base voltage from building up to a point where it can conduct. Removing the short returns the circuit to normal and the regulator will once again start. For those who wish added protection, an spst pushbutton switch can be placed in series with R1. This switch can be used for starting the regulator after it has been shorted.

As an added note, because of the difference in characteristics between identical transistors, R1's value may have to be decreased to insure proper starting under full load. The value chosen should be such that it will start the regulator and at the same time not affect regulation. END



"That's the trouble with these built-in sets."

attention technicians

Here is the second RADIO-ELECTRONICS "Fold-up", a special feature aimed to help speed your service work. The page to the right is actually an 8-page booklet of tube basings for the 1961 and 1962 Sylvania TV receivers. A new booklet will continue to appear each month. Each one will cover a different make of TV receiver. When clipped together you will have a complete guide to tube layouts that will easily fit into your tube caddy.

To put your booklet together, cut out the page. Fold the top down and back, keeping the cover facing you. Then fold from left to right on the line marked *fold here*, keeping the cover facing you. Staple the booklet along the left hand edge. Now run a sharp knife or razor blade along the closed top and you're finished. You now have a useful piece of service information, exclusive with RADIO-ELECTRONICS.

If you have any comments on this booklet or suggestions for other subjects that might be covered in the same format, send them to Booklet Editor, Radio-Electronics, 154 West 14 Street, New York 11, N.Y.

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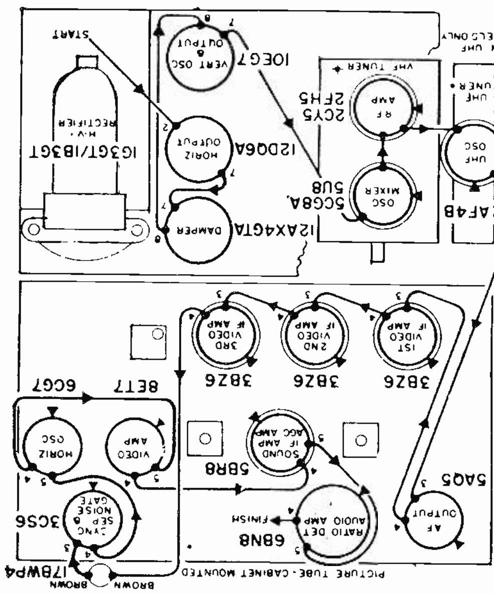
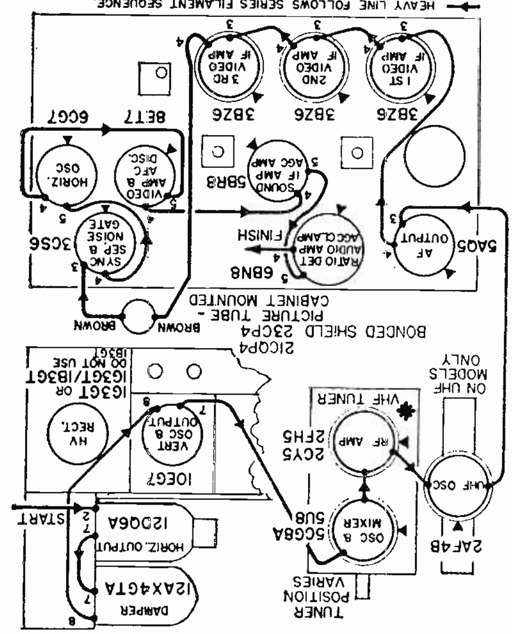


- Solid line follows series filament sequence.
- Replace tuner tubes with original tube type only.
- Indicates tube index.

CHASSIS 547-1, -2

Model 17B110LJ, -QJ, -SJ, -LUJ, -QUJ, -SUJ, 17P11R, -T, -W, -RU, -TU, -WU, 17P12T, -W, -TU, -WU, 17P14G, -S, -GU, -SU

4



- HEAVY LINE FOLLOWS SERIES FILAMENT SEQUENCE.
- REPLACE TUNER TUBES WITH ORIGINAL TUBE TYPE ONLY.
- INDICATES TUBE INDEX.

CHASSIS 549-1, -2, -3, -5, -6, -7, -9

Model 21C07W, -WU, 23C08B, -M, -W, -MU, -WU, 23C09BJ, -MJ, -WJ, -BUJ, -MUJ, -WUJ, -BJC, -MJC, -WJC, 23C10BJ, -MJ, -BUJ, MUJ, 23C18BJ, -MJ, -WJ, -BUJ, -MUJ, -WUJ, -BJC, -MJC, -WJC.

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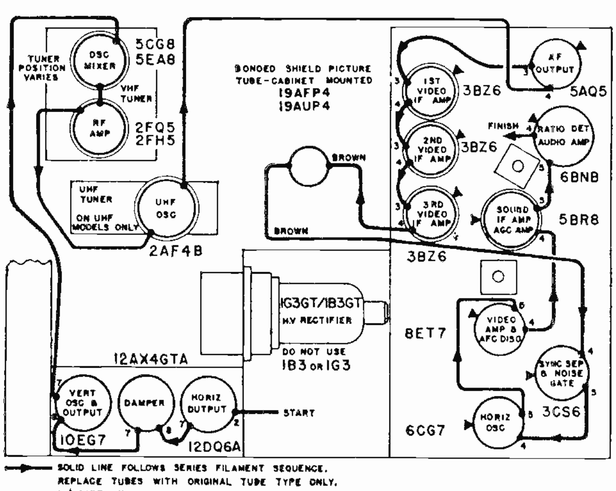


- SOLID LINE FOLLOWS SERIES FILAMENT SEQUENCE.
- REPLACE TUBES WITH ORIGINAL TUBE TYPE ONLY.
- INDICATES TUBE INDEX.

CHASSIS 546-1, -2

Model 19P10B, -G, -W, -BU, -GU, -WU, 19P11T, -W, -TU, -WU

8

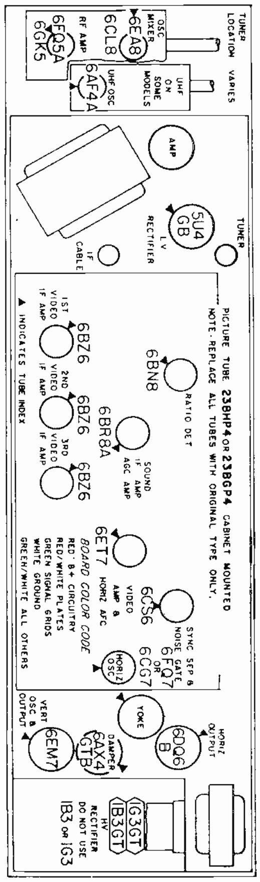
Radio-Electronics

TUBE LAYOUTS IN TV SETS

Compiled by Larry Steckler, Associate Editor

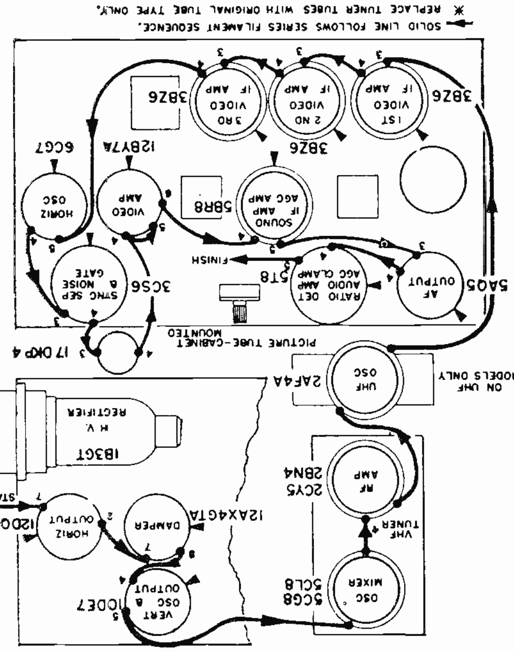
SYLVANIA 1961-1962

CUT HERE



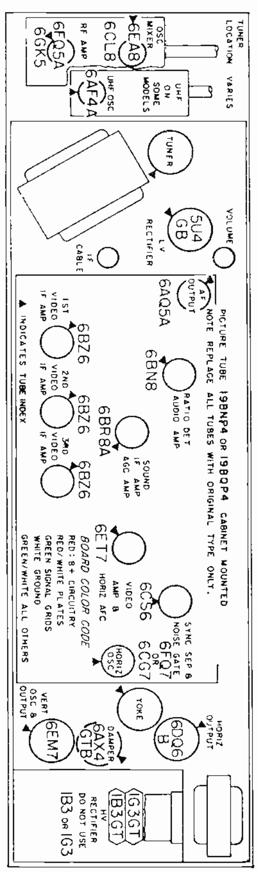
CHASSIS 554-1, -2

Model 23H53, -54



CHASSIS 543-1, -2, -3, -4

Model 17D13R, -T, -RU, -TU, 17D14G, -W, -GU, -WU, 17D15R, -T, -RU, -TU



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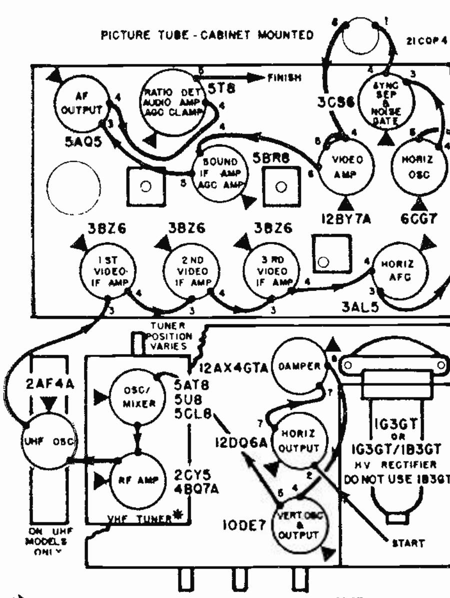
Model 19L17



CHASSIS 545-3, -4

Model 21C529BJ, -MJ, -WJ, -BUJ, -MUJ, -WUJ

COLOR CIRCUITRY

The new RCA and Zenith receivers

The two sets have some basic differences as well as similarities

By **LARRY STECKLER**
ASSOCIATE EDITOR

FOR THE FIRST TIME IN SEVERAL YEARS there are some new color TV circuits—TV circuits designed and used by someone other than RCA. Up till now, no matter whose color set you bought, you were almost certain to get an RCA chassis. But this year Zenith announced its entry into the field of color TV. Here are the Zenith circuits in a side-by-side comparison with the latest RCA has to offer.

Let's examine the basic structure of the two sets first. The Zenith 29JC20 chassis is hand-wired, uses no printed boards or printed circuits and uses Zenith-designed color circuits. RCA's CTC11 chassis has five printed boards and the latest improvements and advances in the circuits they have developed over the years.

The block diagrams (Fig. 1) show the arrangement of the color circuits in the two receivers.

Color amplifiers

Zenith takes the composite video information off the video detector through a capacitor and 4.5-mc trap (Fig. 2-a). This trap prevents any 4.5-mc signal from entering the color circuits where it might cause a 920-kc beat interference which would be visible on the screen.

A 6GH8 and a 6AU6 color amplifier system get the color information from the composite video signal. The stages are similar to video if stages. They are stagger-tuned and provide an essentially flat response of about 1 mc.

RCA takes the composite video signal for the color circuits off the output of the first video amplifier (Fig. 2-b). No 4.5-mc trap appears in this circuit because it follows the video detector and the 4.5-mc signal does not reach the video amplifier.

There is only a single 6AU6 bandpass amplifier. Of course, there is already one additional stage of amplification as the color signal is taken off the first video amplifier plate rather than the detector.

Automatic color control

To minimize changes of color level caused by slight changes in the incoming signal level, Zenith applies automatic color-control (acc) bias—a gain-control signal developed at an acc-killer phase detector (Fig. 3)—to the grid of the first color amplifier. The amount of bias depends on the burst level input, which in turn depends on the strength of the incoming signal. RCA has no equivalent circuit.

Color killers

It is desirable to have the color amplifiers turned off during black-and-white programs—to prevent color streaks or confetti from appearing in the black-and-white pictures. Automatic bias voltage from the color-killer stage is applied directly to the control grid of the output (second) color amplifier (Fig. 4-a). This −50 volts cuts off the Zenith color amplifiers when there is no color program. When a color program is being viewed, the color killer is cut off and the −50 volts removed, allowing the color amplifier to operate normally.

RCA also has a color-killer circuit (Fig. 4-b). It too cuts off the color amplifier when no color program is on. The difference between the RCA circuit and Zenith's is mainly the KILLER THRESHOLD CONTROL. There is no such unit in the Zenith receiver. This control permits setting the killer so that the color amplifier will not be cut off, even when the color signals are very weak. This is extremely important in fringe areas where the color signal may be far

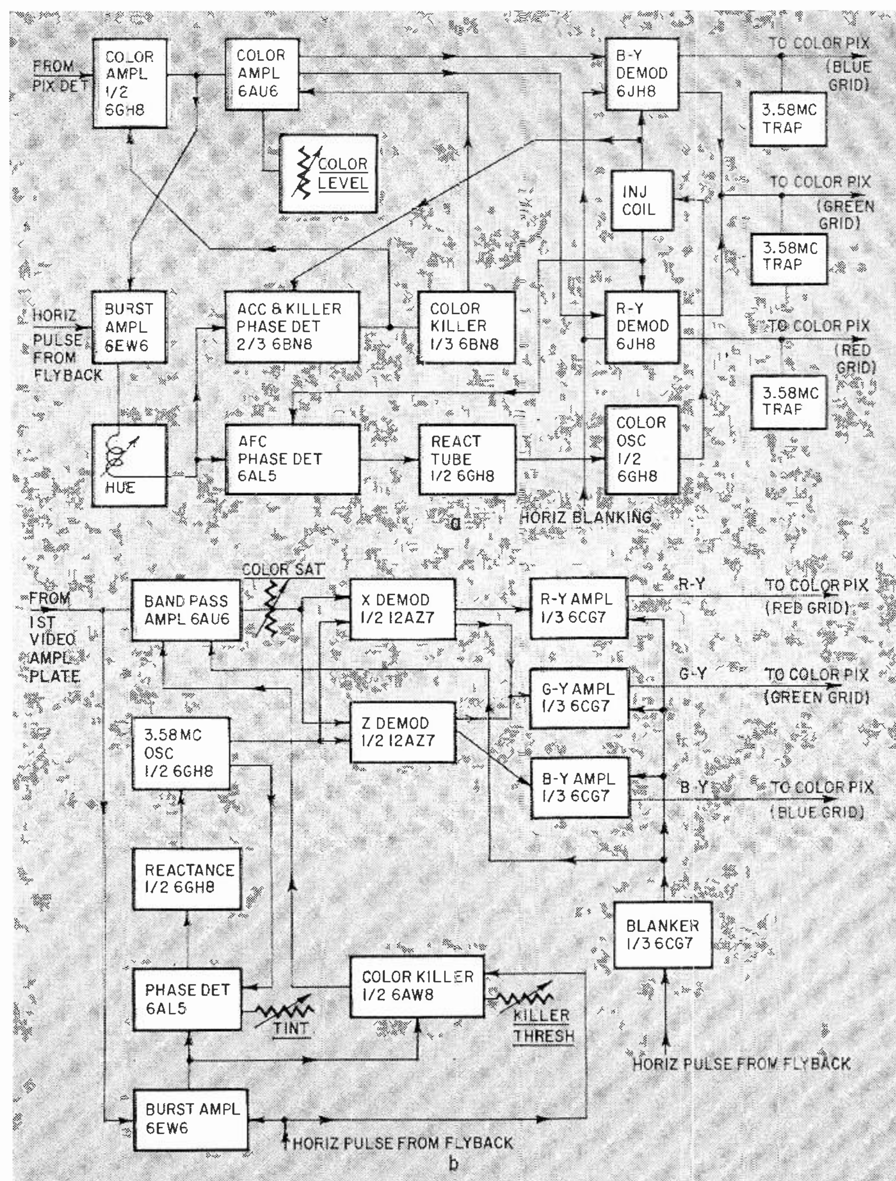
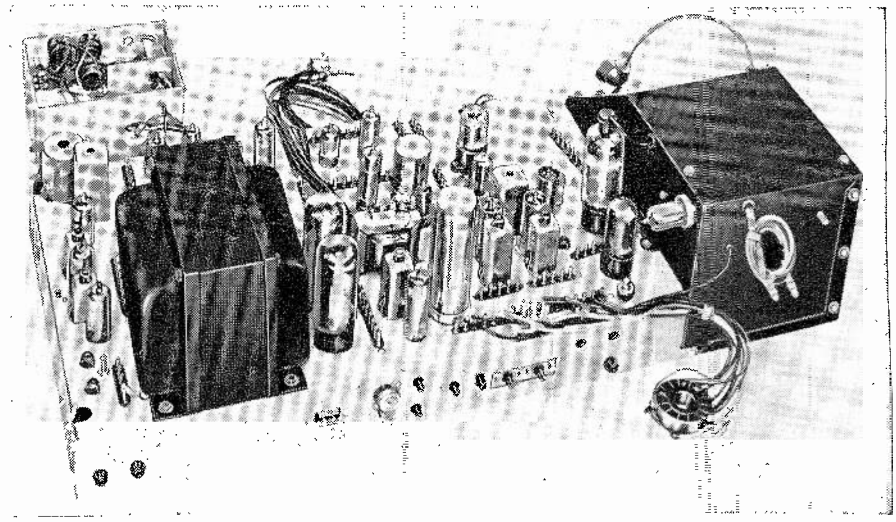


Fig. 1—Block diagrams of the Zenith (a) and RCA (b) color receivers.

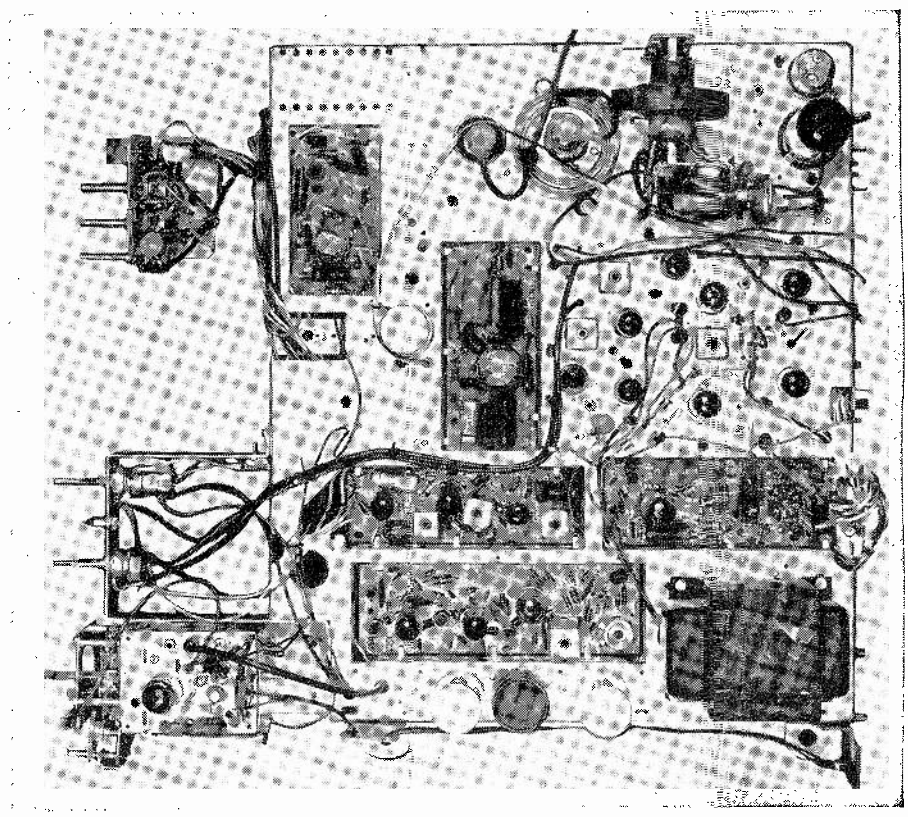
down.

Both Zenith and RCA have controls to adjust the intensity of the color in a color picture. RCA calls this control COLOR SATURATION (Fig. 2-b). It is in series with the output of the color amplifier. Zenith calls the control COLOR LEVEL. It is in the cathode circuit of the second color amplifier and varies the bias of that tube (Fig. 2-a).

Should a viewer want to watch a color broadcast in black-and-white or should the color circuits be operating improperly, they can be cut off manually. The Zenith owner simply turns the COLOR OFF switch (Figs. 2-a and 4-a). It turns on the color-killer tube and turns off the color amplifier. In the RCA receiver, the KILLER THRESHOLD control will do the same thing (Fig. 4-b). It must be set so the color killer is turned on even when a color signal is present. Zenith's switch is a push-pull unit on the COLOR LEVEL control. RCAs color-killer control is on the back apron of the set.



The Zenith 29JC20 color TV chassis.



The RCA CTC11 color TV chassis.

Burst amplifier

From the plate circuit of Zenith's first color amplifier, the burst signal is coupled through a capacitor to the grid of the burst amplifier. This 6EW6 is gated with a positive 45-volt pulse so it conducts only during the burst-time interval. This separates from the burst the color signal, which is then fed to the afc phase-detector circuit (Fig. 5-a). The HUE control, a variable coil in the plate circuit of the burst amplifier, is part of a network which varies the phase of the burst signal.

In the RCA set, the composite video signal tapped off the chroma takeoff coil in the grid circuit of the color amplifier (Fig. 5-b) is fed to the burst amplifier grid. It too is gated so that only the burst signal is passed through amplified to the phase detector. The control in this set is called TINT and is a potentiometer off to one side of the burst-phase transformer secondary. In both cases this is a front-panel control.

Color oscillator

In the color sync circuits of the Zenith receiver, half of the 6GH8 acts as the 3.58-mc color oscillator, while the other half is used as a reactance control for the oscillator (Fig. 6-a). A variable coil in the oscillator section is set to fix the oscillator frequency, while the crystal maintains frequency stability. Phase is controlled by the afc phase-detector circuit in conjunction with the reactance tube. The RCA circuit is essentially the same. There are slight differences, however. Zenith's oscillator output is coupled to the primary of a tunable transformer with two secondary windings. With the transformer adjusted for correct demodulation, the 3.58-mc signals appearing in the secondaries are 90° out of phase with each other. Also, one signal is in phase while the other is 90° out of phase with the burst signal.

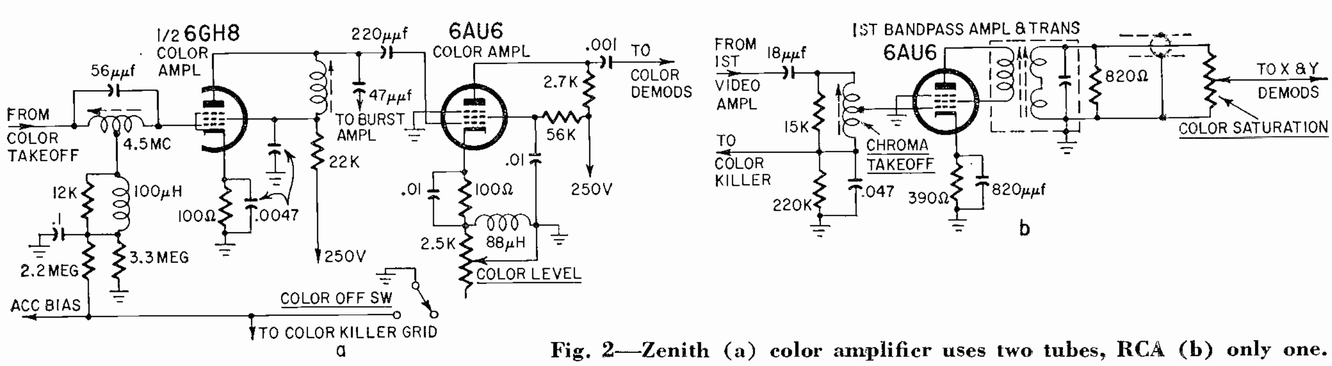


Fig. 2—Zenith (a) color amplifier uses two tubes, RCA (b) only one.

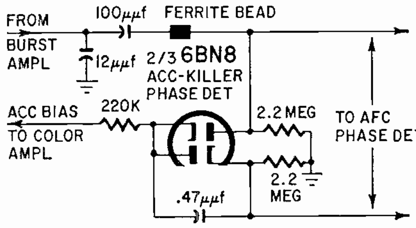


Fig. 3—Automatic color control regulates gain of color amplifiers.

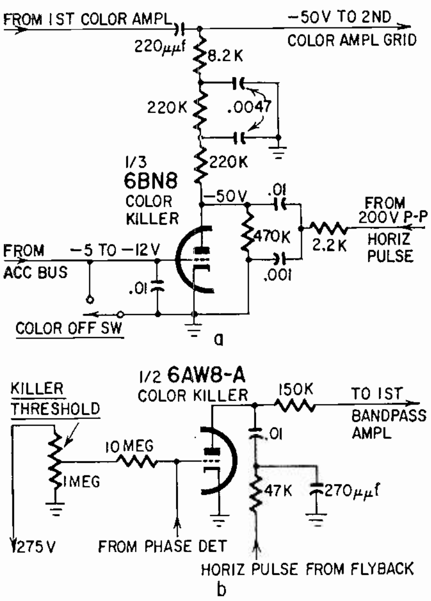


Fig. 4—Color-killer circuits are very similar. Zenith (a) uses part of a 6BN8, RCA (b) part of a 6AW8.

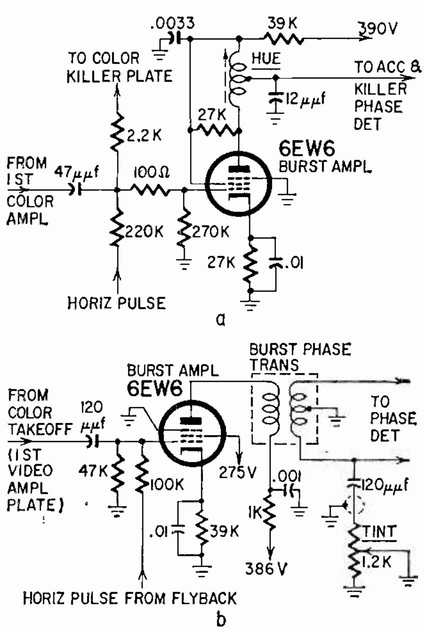


Fig. 5—The burst amplifier is where Zenith's hue and RCA's tint controls are found. Zenith (a) uses a tunable coil. RCA (b) uses a potentiometer.

Color sync is maintained by coupling the burst signal into the afc phase-detector circuit and comparing it with the phase and frequency of the oscillator output. The signal appearing in the secondary of the quadrature transformer—which is 90° out of phase with the burst signal—is coupled back to the afc phase-detector circuit as the sampling signal of the oscillator output. The operation of this circuit is very similar to the afc circuit used in horizontal oscillator systems.

RCA's 3.58-mc oscillator output is fed to a more conventional transformer with one primary and one secondary (Fig. 6-b). The additional secondary is avoided by taking off part of the oscillator output at the primary of the transformer (making it automatically 180° out of phase with the signal on the secondary) and feeding it to the phase detector. As in the Zenith circuit, color sync is maintained by coupling the burst signal into the afc phase-detector circuit and comparing it with the phase and frequency of the oscillator output.

In both sets, any deviation in phase or frequency of the oscillator signal in comparison to the incoming burst signal will cause either a positive or negative correction voltage, depending on the phase shift. This correction voltage is fed to the grid of the reactance tube, causing its plate current to decrease or increase—depending on the polarity of the correction signal—and correspondingly decreasing or increasing the oscillator frequency.

Demodulation circuits

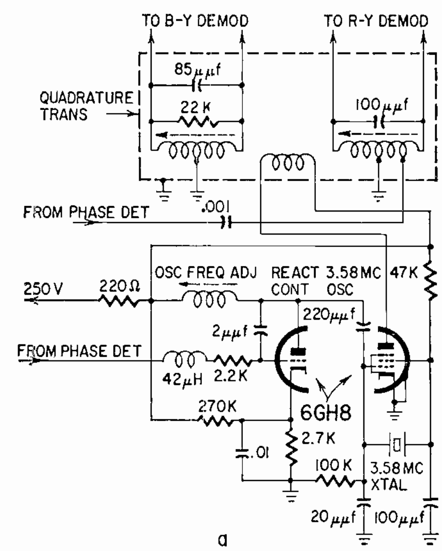
Now we come to the major difference between the two sets. It is in the color demodulators. Zenith uses a two-tube 6JH8 circuit (Fig. 7-a). One tube is used as an R − Y demodulator, the other as a B − Y demodulator. These tubes are sheet-beam tubes that contain double plates and a pair of balanced deflectors to direct the tube current to either of the two plates. A control grid varies the intensity of the current flow through the tube. These tubes develop balanced output signals of both positive and negative polarities. This eliminates the need for phase-inverter stages to obtain G − Y (or a separate G − Y amplifier—following the demodulators. Instead, the G − Y signal is recovered from the negative outputs of the two demodulators. The three color-difference signals are fed directly to the respective color grids of the picture tube.

RCA uses a more conventional circuit (at least more conventional tubes). A separate half of a 6CG7 is used for each of the color-difference amplifiers and there are X and Z demodulators to produce the R − Y and B − Y signals fed to their respective amplifiers (Fig. 7-b). The G − Y signal is derived from the outputs of the two demodulators. As in the Zenith set, the color-difference signals are fed to their respective color grids in the color picture tube. The signals are matrixed in the tube itself, resulting in proper beam intensities for correct reproduction of red, blue and green on the screen.

At this point, let's take a little time out from our comparison of circuits to see what happens in the Zenith demodulators. In the 6JH8 tube, electrons flow from the cathode to either of the two plates in the form of a planar beam or sheet. After leaving the cathode, the control grid varies the intensity of the beam. The focus electrodes direct the electrons into the required sheet beam, which is then accelerated and deflected to either of the two plates.

The B − Y demodulator has the 3.58-mc CW signal coupled from the color oscillator through the quadrature transformer to the deflector plates. Since these plates are connected directly across the secondary of the quadrature transformer, the signal on one plate is 180° out of phase with the signal on the other.

We get an output from a plate only when its associated deflector is receiving the positive cycle of the 3.58-mc signal. As the two plates are fed the same signal 180° out of phase, one is positive while the other is negative. This polarity changes each half-cycle. Therefore, the output at the plates switches back and forth from one plate to the other as each deflector receives the positive half-cycle. The color sig-



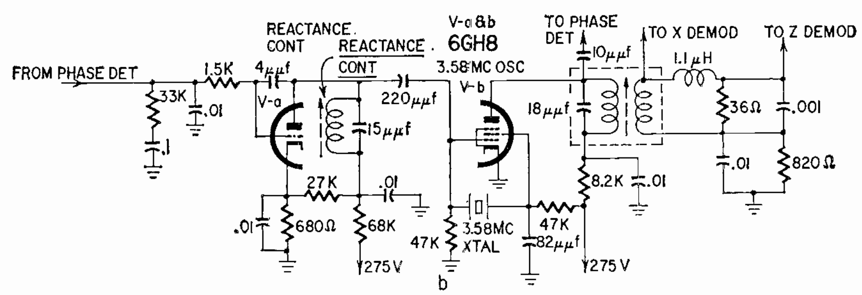


Fig. 6—Reactance–oscillator circuits are almost identical in Zenith (a) and RCA (b) circuits.

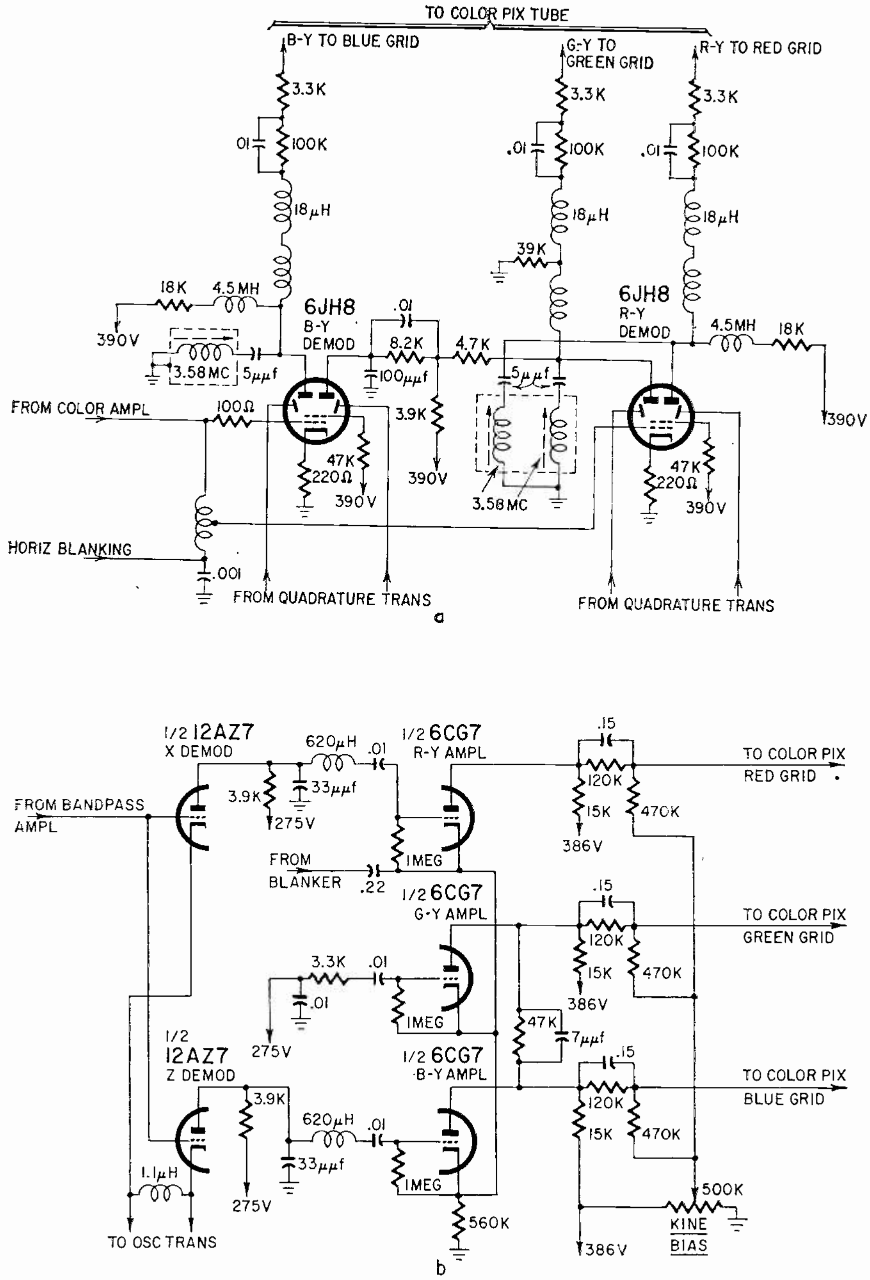


Fig. 7—Color demodulators show the greatest circuit differences. Zenith (a) uses two special double-plate tubes. RCA (b) uses five triode sections.

nal, which is also a 3.58-mc signal, is fed to the control grid of the tube. Since the deflectors are alternately positive every half-cycle, the output signals on the two plates are of opposite polarity.

The R − Y demodulator operates the same way, with two exceptions—the 3.58-mc CW signal fed to the deflectors is 90° out of phase with the signal on the B − Y deflectors, and the color signal fed to its control grid is lower in amplitude.

Convergence magnets

Zenith has a one-piece plastic assembly around the CRT neck to hold three coils and three of the four static convergence PM magnets around the neck of the picture tube. They are adjusted for convergence in the center area of the picture tube only, even if they affect the whole raster. A fourth, a blue magnet located near the base of the picture tube, affects the lateral movements of the blue electron beam, and also moves the green and red beams in the opposite lateral direction. RCAs system is almost identical.

The dynamic convergence adjustments, 12 of them, are located on one Zenith dynamic convergence panel. RCA also mounts their 12 dynamic convergence controls on a single panel.

There you have it—the circuits, the controls, the comparison—and a sneak preview of something new the service technician will be anxious to study. It may be that the new Zenith is the first of a number of sets with new ideas and new circuitry. Or other manufacturers may stick to old and well known principles. If we master each new circuit as it comes out, we will have nothing to worry about either way. END

Aligning the EICO 360

THE EICO 360 SWEEP SIGNAL GENERATOR is a versatile and capable alignment instrument when it is constructed and tuned according to the factory instructions. However, a constructor might run into trouble attempting to align the internal swept oscillator if he does not have the equipment deemed necessary in the factory instructions. If a signal tracer and accurate high-frequency receiver are not on hand, the following procedure will do the job nicely.

First, align the variable oscillator trimmer to the correct frequency by adjusting it until the rf carrier is at 108 mc as determined on the dial of an accurately calibrated FM receiver with its antenna disconnected. Align the variable oscillator as per factory instructions with the fixed swept oscillator temporarily disconnected to eliminate spurious frequencies. Then check at 54 mc for the second harmonic to fall at 108 mc on the receiver dial. This will show if the variable oscillator is tuned to the correct frequency at the 108-mc portion of the dial.

Second, replace the grid cap of the fixed swept oscillator tube, 7193, and prepare to align this section of the instrument. The ceramic trimmer for this adjustment may be reached through the small hole in the top of the instrument case, so it is advisable to have it *in the case* before going further.

According to the factory instructions, the fixed swept oscillator must be tuned to 114 mc on the nose. The differential and sum frequencies generated between the variable and fixed swept oscillator determine the fundamental output frequency. Therefore, by aligning the fixed swept oscillator to a frequency, for example 24 mc higher than the frequency of the variable oscillator (when the variable oscillator is tuned to 24 mc according to the dial), should give the correct frequency setting of 114 mc to the fixed swept oscillator.

To do this correctly, connect the customary scope and marker generator to a TV receiver as though a general video alignment procedure were in the making. Adjust the sweep signal generator dial to the center intermediate frequency of the TV set—24 or 44 mc. Check this frequency with the marker generator or crystal marker harmonics on the scope. Be sure the sweep frequency control on the 360 is turned to the OFF position. With the sweep oscillator rf control on full, adjust the fixed sweep oscillator trimmer until the moving pip appears and centers on the scope screen. This will be the fundamental output rf of the sweep oscillator and should be centered on top of the marker pip (24 or 44 mc). By turning the sweep frequency control to 10-mc sweep, the bandpass curve of the receiver should now appear on the scope screen with the marker showing at the correct frequency.—*George D. Philpott*

RADIATION METER
MEASURES MINUTE CURRENTS

Lab-quality electrometer requires no special parts—is also useful as high-intensity radiation alarm

By ELLIOTT A. McCREADY

The electrometer is an instrument rarely found outside the laboratory. Like the high school physics type electroscope, it is made to work by the electrostatic forces between two charged bodies. It is a highly sensitive instrument for measuring both a minute electric charge and the current dissipating this charge.

This instrument can be built from readily available parts for around $30 (less if you have a usable meter. Its input resistance is 10^{15} ohms and its input capacitance 12 $\mu\mu$f. It can be used to measure currents as low as 10^{-14} ampere; can be scaled in roentgens with a maximum reading of 0.5 and (with the modification described) 10 roentgens per hour. The higher r/h scale makes it usable as a fallout alarm, though not for quantitative measurement of heavy fallout. It is completely portable, with self-contained power supply. Some types of electrometers are actually calibrated electroscopes; in others, specially designed vacuum tubes detect and amplify small currents.

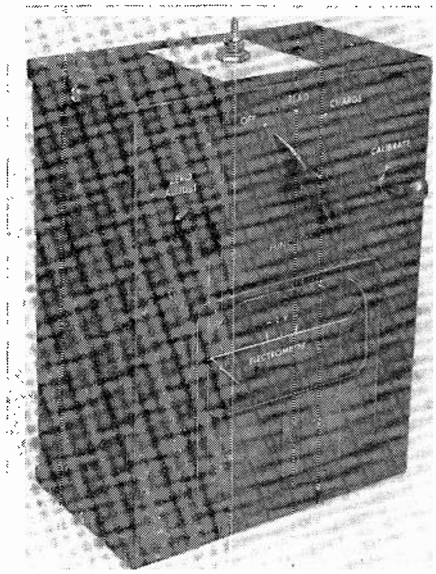
A good example of the calibrated electroscope type electrometer is an instrument used to measure accumulated dosages of radiation acquired by Civil Defense or atomic workers. This pocket dosimeter is illustrated in Fig. 1. A movable quartz fiber, plated to make it conducting and attached at both ends to a fixed wire element, is deflected away from this element by a charging voltage. The voltage is then removed and the fiber remains deflected until radiation ionizes the air surrounding it, allowing the charge to leak off and the quartz fiber to collapse toward the fixed wire element. The ionizing current required to collapse the fiber a given amount is calibrated in units of accumulated radiation.

The pocket dosimeter measures a given *quantity* of radiation. To measure the *intensity* of radiation, a vacuum-tube electrometer, coupled to a suitable probe unit (an ion chamber) is used. The ion chamber converts radiation into a minute electric current, which is measured by a vacuum-tube electrometer calibrated in units of radiation intensity.

The ion chamber is adapted to measuring very high intensities of radiation. Typical instruments have ranges of more than 500 roentgens/hour. The familiar Geiger counter, on the other hand, can measure only up to about 50 *milli*roentgens. (A roentgen is the intensity of radiation emitted by 1 gram of radium at a distance of 1 yard. A Geiger counter would be of little use in measuring the immense radiation intensities of an atom bomb explosion.

Earlier electrometers almost invariably used the deflected quartz fiber or gold leaf. Present day instruments use a specially designed electrometer tube, carefully constructed to minimize grid-current flow and stray leakage currents. One of the better instruments is currently being marketed for about $450.

If you could construct an electrometer of comparable quality for $30 or less, you could probably think of a lot of uses for it. If it were portable, you could use it as a high-sensitivity radiation detector. I used it as a detector of static electricity, to discover the best way to eliminate static charges on phonograph records. It would also be useful as a static detector in industrial machinery. It will measure the output of the negative-ion generators now being combined with air purifiers, and will detect radioactive ores.



The radiation detector and meter.

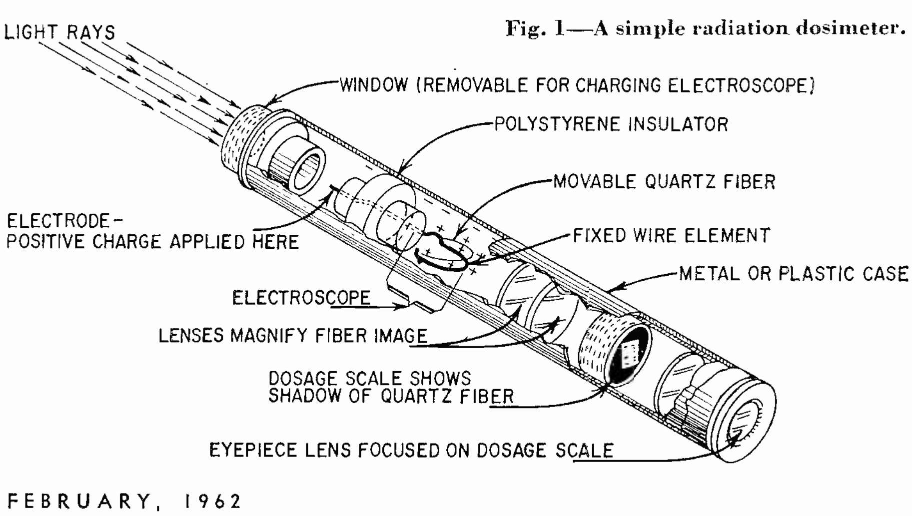


Fig. 1—A simple radiation dosimeter.

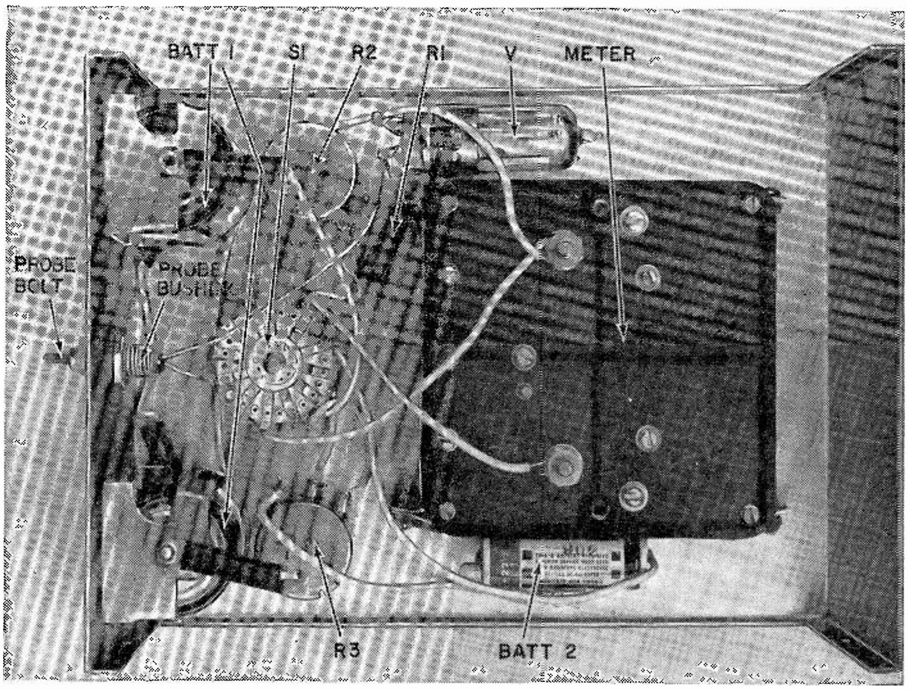
Circuit

You can build such an electrometer, and without using any special components. The secret is a rather unique circuit that eliminates one of the bugaboos of the vacuum-tube electrometer—grid-current flow.

The electron flow between the filament and positively-biased control grid of an ordinary electron tube decreases when one of the elements surrounding the control grid is given a negative charge. The size of the charge is determined by the proximity of the surrounding probe element to the control grid. A very small negative charge on the screen grid repels many electrons emitted by the filament and prevents them from reaching the control grid. This is the logical element to use as a probe and, as the screen grid is not in the filament–control-grid electron path, there will be no probe current, provided we heat the screen grid as little as possible by running the filament at a low temperature.

In practice, the electrometer (Fig. 2) consists of a 3Q4 tube, its 3-volt filament operated at close to 1 volt to obtain a control-grid current of 20 μa at a positive grid potential of 3. A known variable negative charge is now placed on the screen grid and the meter is calibrated in volts.

To measure ionizing current, the electrometer is charged and the voltage



The underchassis view.

drop through two convenient points on the meter scale is timed. Current may now be easily calculated using the known capacitance of the electrometer, the voltage drop and the time. This method of measuring current by timing a voltage drop considerably reduces the cost and complexity of the instrument. For very small currents, accuracy may be increased by subtracting the characteristic leakage current of the instrument itself from the above calculation, and readings can be speeded up by drawing a graph which plots current against time.

Construction

The electrometer is built into a 6 x 8 x 3½-inch, two-piece aluminum chassis and all components are mounted on the flanged portion. The 20-μa meter which measures grid current is mounted at the lower end of the chassis, leaving room for FUNCTION switch S1 and the tube socket near the probe. The switch is a three-section unit. The third section is used as a meter shunt when the instrument is turned off. Shunting the delicate meter damps the movement and protects it when not in use. Both tube socket and switch are ceramic for high insulation resistance.

Caution: Use a *new* socket and switch. Fingerprints and dirt on spare-parts-box components will make overall leakage current intolerable.

The probe is a 1⅛-inch 4-36 bolt mounted through a ⅜-inch polystyrene rod. It is drilled through the center and threaded on the outside to make a bushing. Place a solder lug under the bolt head on the inside of the chassis. Allow about ⅜-inch of the bushing to project from the chassis and strip the paint from a 2 x 2-inch area surrounding it.

Be very careful to avoid handling the tube socket, switch and bushing any more than absolutely necessary. Any fingerprints or dirt on these parts will increase leakage current. Clean the tube base by swabbing with denatured alcohol, or soak it in pure bleach, flush in running water and blot dry with an absorbent tissue.

As overall probe-to-chassis capacitance of the electrometer is used in making current measurements, dress your leads as shown in the underchassis photo. If you have access to a capacitance bridge, you can measure the capacitance of the instrument when it is completed. In any case use stiff, tinned copper hookup wire for the probe-to-switch-to-socket connection, and dress all other leads well away from it.

The only portion of the circuit which is connected to the aluminum chassis is the positive terminal of the charging battery, BATT 2. The rest of the circuit must be well insulated from chassis.

As the filament voltage regulation is very important, especially for small current measurements, don't attempt to use ordinary dry cells for BATT 1. The mercury cells suggested have very good regulation, although alkaline cells might do the job too, and would be less expensive.

Calibration

The initial portion of the calibration procedure should, by rights, be a part of the construction section—the selection of R1. First, tack in a 75-ohm resistor as indicated in the schematic. Now, assemble the chassis, turn the FUNCTION switch to READ, and set ZERO ADJUST control R2 for a full-scale meter reading (zero volts charge). This should occur with R2 near its center position. If it doesn't the probe may have picked up a charge. Ground this charge by grasping the chassis in one hand and the probe bolt in the other. Now release the probe bolt *first*, then the chassis. If this doesn't remedy the situation, try other sizes of R1 until the meter reads full scale with the ZERO ADJUST control near midpoint.

Now calibrate the meter in volts by connecting a high-resistance dc voltmeter between probe bolt (negative) and chassis of the electrometer. Switch the FUNCTION switch to READ, ground the probe as described and set the ZERO ADJUST control for a full-scale meter reading. Next, place the FUNCTION switch in the CHARGE position and adjust the CALIBRATE control for a half-scale meter reading. Note the voltage. Now adjust the CALIBRATE control for readings of 1 volt either side of half-scale and note the voltages.

Mark both the half-scale and the two 1-volt positions on the meter scale. Electrometer readings will be made by timing the meter drop through 2 volts. Finally, disconnect the voltmeter and, with the FUNCTION switch in the CHARGE position, set the CALIBRATE control so the meter rests slightly left of the higher voltage calibration.

Before measuring the characteristic leakage current of the electrometer, let the instrument warm up for about 45 minutes with the FUNCTION switch in the CHARGE position. This warmup period allows filament voltage to stabilize, and the constant charge on the probe and associated circuitry counteracts "insulator soak-in," or dielectric absorption, which might tend to make instrument leakage current appear rather high.

After the warmup period, place the FUNCTION switch in the READ position, ground the probe and reset the ZERO ADJUST control. Now, charge the instrument by momentarily rotating the FUNCTION switch from READ to CHARGE and back. The meter should stabilize slightly to the left of the higher voltage calibration. If not, recharge the instrument or readjust the CALIBRATE control. Now, time the meter drop over 2 volts and calculate leakage current with the equation:

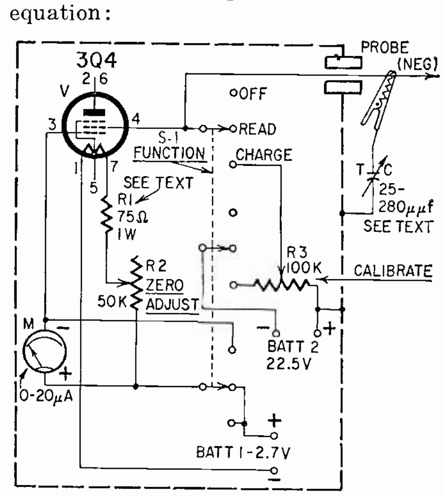


Fig. 2—Schematic of the electrometer.

R1—75 ohms, 1 watt (see text)
R2—pot, 50 ohms, wirewound
R3—pot, 100,000 ohms
C—mica trimmer, 25–280 $\mu\mu$f (see text)
M—0-20-μa dc meter
S1—3-pole 3-position ceramic rotary switch (see text)
BATT 1—two 1.35-volt mercury cells (Mallory RM42R or equivalent)
BATT 2—22.5-volt hearing-aid battery (Burgess U15 or equivalent)
Socket, 7-pin miniature ceramic (see text)
Cabinet, 2-piece aluminum, 8 x 6 x 3½ in (Bud Minibox or LMB Tite-Fit box/chassis)

$$I = \frac{CV}{t}$$

where I is the leakage current in amperes, C is the capacitance of the electrometer in farads, V is the voltage drop (2 volts) and t is the time in seconds. If you have a capacitance bridge, measure the probe-to-chassis capacitance of your electrometer and use this value in the equation. If not, use a value of 12$\mu\mu$f, which should be very close if you have constructed the instrument as illustrated. In my electrometer, a 40-minute interval is required for a 2-volt loss of charge. This figures out to a leakage current of:

$$I = \frac{12 \times 10^{-12} \times 2}{2{,}400} = 1 \times 10^{-14} \text{ amperes.}$$

Using a mid-scale value of 12 volts, the leakage resistance of the instrument is:

$$R = \frac{E}{I} = \frac{12}{1 \times 10^{-14}} = 1.2 \times 10^{15} \text{ ohms.}$$

Leakage current will vary somewhat with humidity, but this figure shows what the instrument is capable of. If your figures show a much higher leakage than this, check to make sure probe wiring is well separated from the chassis and other components and wiring. Also make sure that no solder rosin lodged between switch contacts.

The graph, drawn to expedite current readings (Fig. 3), is laid out on 3 x 3-cycle log log graph paper and plots current against time. Basic leakage current of the electrometer will be a factor at figures of about 10 times this leakage current and below. Above this figure the graph will be a straight line. If you use a meter capacitance of 12 $\mu\mu$f, the straight-line portion of your graph will be identical to that illustrated. For other values of electrometer capacitance, plot the graph from the equation:

$$I = \frac{CV}{t}$$

Subtract instrument leakage current from the calculated values below about 0.1 $\mu\mu$a (0.1 $\times$ 10^{-12} amperes).

An additional horizontal scale, calibrated in roentgens per hour (r/hr) may be added to the graph for radiation readings. Unfortunately, in its present form, the electrometer would read about 0.5 r/hr maximum. To increase this maximum reading we must add capacitance between probe and chassis and, while we are about it, we may as well make the radiation scale coincide with the current scale, giving us an instrument range of .01 to 10 r/hr.

The added probe-to-chassis capacitance is a 25–280-$\mu\mu$f trimmer to which two tinned copper wire leads have been soldered. Terminate one of these leads with a miniature alligator clip and solder the other to a lug mounted under one of the chassis screws. Theoretically, the total capacitance of the electrometer with trimmer attached should be about 175 $\mu\mu$f to make radiation and current scales coincide. Due to the added probe surface with trimmer attached, this capacitance will be greater.

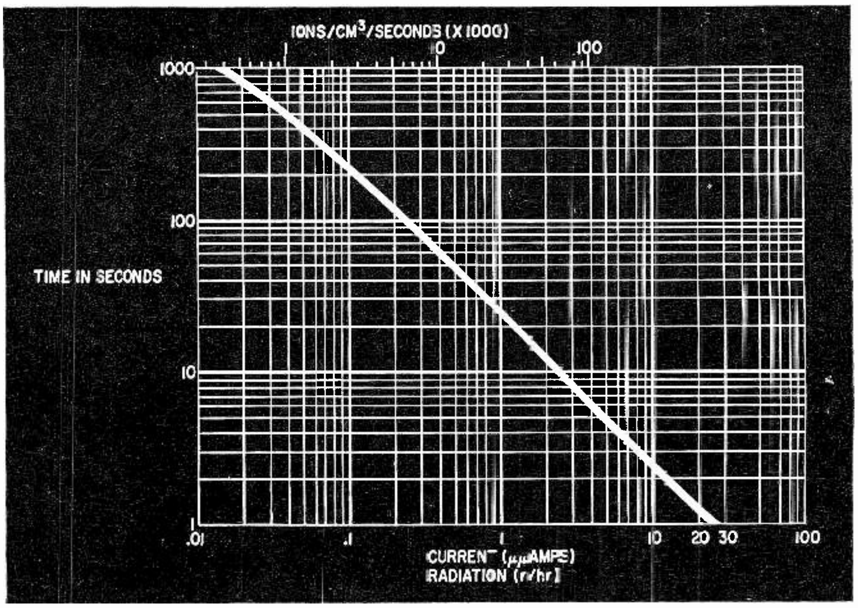


Fig. 3—Chart speeds measurements.

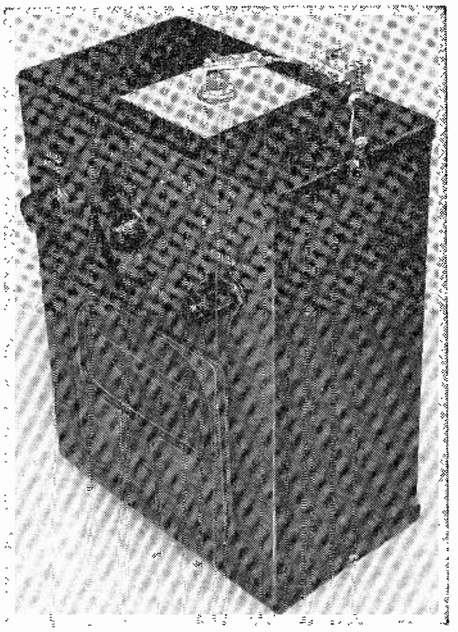
Actual measurements on my instrument have shown that a radiation intensity of .03 r/hr will result in an ionizing current of 0.58 $\mu\mu$a. If the chassis, bushing and probe sizes of your electrometer are as specified, your instrument will show the same current–radiation relationship. To calibrate the electrometer in r/hr, consult your graph and determine the times corresponding to 0.58 $\mu\mu$a (t_1) and .03 $\mu\mu$a (t_2). Next, with trimmer disconnected, place a small piece of radioactive material (the luminous hand from an old watch will do) in such a position that the electrometer will drop through 2 volts in 10 seconds. Now connect the trimmer and adjust it so that, with the radioactive material in the same position, the 2-volt drop will occur in

$$\frac{10 \times t_2}{t_1} \text{ seconds.}$$

The upper scale of the graph is plotted in ions per cubic centimeter per second, which is a standard unit for measuring the output of negative-ion generators. This scale was plotted on the assumption that the volume of air contributing mostly to electrometer discharge was approximately 250 cubic centimeters (based on the size of the instrument). This assumption is fairly accurate and in any case serves as a means of comparison between generators. This scale is also plotted logarithmically and, if you use an electrometer capacitance of 12 $\mu\mu$f, will be identical to the graph of Fig. 3. For different values of electrometer capacitance use the equation:

$$\text{Ions per cm}^3 \text{ per second} = \frac{CV}{4t \times 10^{-17}}$$

where C is the capacitance of the electrometer in farads, V the voltage drop (2 volts) and t the time in seconds. This equation is derived from the fact that the product of CV is the charge in coulombs, and the charge on one electron (ion) is 1.6 $\times$ 10^{-19} coulombs.



Modification for high-intensity radiation measurement.

Operation

The electrometer is extremely sensitive to static charges. About the worst possible set of operating conditions would be an operator clothed in fuzzy wool or flannel, wearing rubber-soled shoes and working on a wool rug.

The electrometer can measure radiation intensities from about .001 to 10 r/hr in two ranges. The lower range (trimmer capacitor disconnected) is not calibrated, but an extra logarithmic scale may be added to the graph using a current of 0.58 $\mu\mu$a as the equivalent of .03 r/hr. Radioactive ores may be detected and compared by placing the ore near the probe.

While this instrument was not designed to cope with large quantities of radiation, but rather to measure minute currents, it can be a useful alarm for heavy and dangerous radiation. A 1-second discharge period corresponds roughly to 25 roentgens/hour, which means that a person could remain in the area safely for about 2 hours (see below). Discharge in half a second or less indicates that the area is definitely dangerous, and, if the needle drops immediately, radiation is probably present in lethal quantities.

Should it ever become necessary to measure fallout radiation, the following dosages, together with their probable effects on the human body, will be of interest:

Less than 50 roentgens (r) — relatively little risk
50–300 r — some injury and radiation sickness.
300–500 r — serious injury or death.
500–1000 r — death almost certain.
Above 1,000 r — death certain.

The above figures are total-body dosages. A dosage of 1 roentgen being that acquired by exposure to an intensity of 1 r/hr for a period of 1 hour.

The electrometer can measure the output of a negative-ion generator:

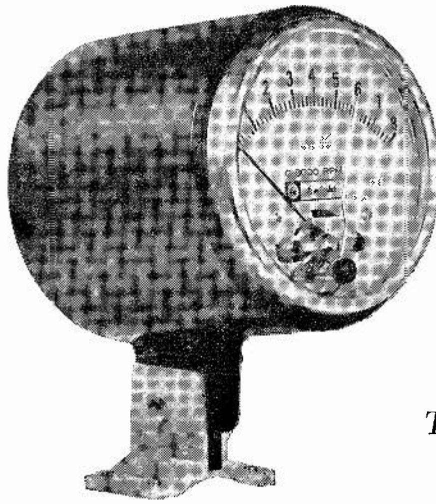
As with all low-current measurements, allow the instrument to warm up for a period of 30–45 minutes. Now, with the generator operating in a closed room to eliminate spurious air currents, place the electrometer about 3 feet away, in the air flow of the generator. Charge the electrometer, time the voltage drop and use the graph to determine the output. Several readings should be taken, and a little practice will demonstrate where the instrument should be placed for the highest reading. I have found that ion generators produce a higher output after operating for 30 minutes or more.

Static charges of electricity may be detected at great distances with the aid of the electrometer. No warmup period is required for this operation and the instrument should be operated with the probe discharged. As an example of its sensitivity to static electricity, run a hard rubber comb through your hair and bring the charged comb toward the electrometer probe. A sizable meter deflection can be obtained at a distance of up to a foot.

All the examples to this point have dealt with negatively charged objects. What if a material bearing a positive charge is brought near the electrometer probe? You would expect the meter to indicate an increase in grid current. It does, momentarily. But when the positively charged object is removed, the instrument acts as if it had acquired a negative charge—the meter is deflected several volts. The reason for this is simple. When the charged object was held near the probe, electrons from the screen grid were attracted to the probe bolt, leaving the screen grid with a deficiency of electrons, or positive charge. This positive charge attracted electrons from the filament and, when the charged object was removed, the screen grid, probe bolt and associated wiring had a surplus of electrons, or a negative charge.

If you ever have had occasion to use an electrometer but couldn't locate one, don't let it happen again. If not, build this one anyhow—you never can tell when it will be a lifesaver! END

EQUIPMENT REPORT



Knight-Kit tachometer

This little unit offers 3% accuracy

By LEN BUCKWALTER

IN MEASURING BOAT OR CAR ENGINE rpm, the electronic tachometer is faced with a set of stringent operating conditions. Surrounding temperatures constantly shift, voltage varies with engine speed and signal input rarely presents ideal waveforms. There's an added problem of versatility—the tach should operate in a variety of ignition systems from 2-cycle outboard motors with magneto power to any conventional auto engine.

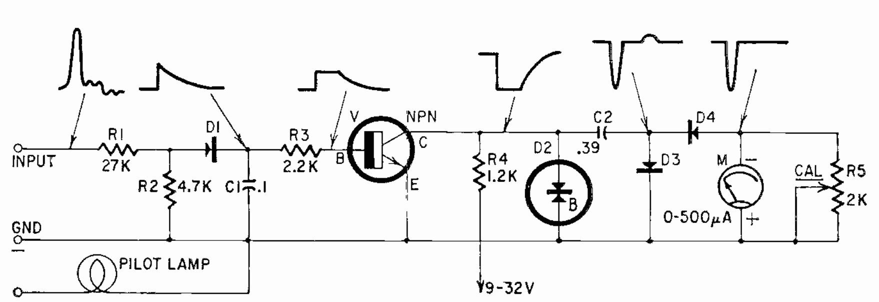
A recent circuit with several unusual design elements to meet these requirements is in the Knight-Kit tachometer. Despite overall simplicity, the unit has been refined to the point where readout accuracy is held to 3% under adverse conditions. Tracing out the circuit (see diagram) reveals where some five design steps are used to keep error within tolerable limits.

Signal input to the tach is a pulse tapped from the breaker points of either magneto or distributor. In a 6-volt car, the value is typically 200 volts. (The points make and break 6 volts, but the ignition-coil secondary impresses much higher potentials across them.) An initial design consideration occurs here. To make the tach a universal instrument, input impedance is kept high—more than 27,000 ohms. Otherwise the unit would short out the characteristically high impedance of magneto systems (motorcycles, outboards, etc.). R1 and R2 form a divider for isolation and to drop the signal voltage to a manageable level (about 15% of original value).

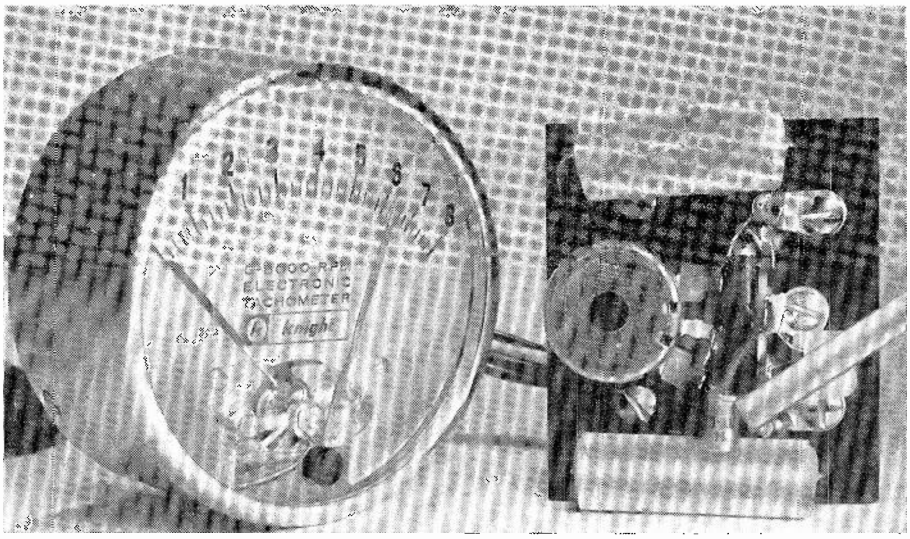
The signal encounters D1 and C1 next. They form a network that gives each incoming pulse a uniform shape. Key function is to eliminate the effects of ringing in the ignition coil. Ringing sets up a train of damped oscillations that trail along with each pulse. Under some conditions the tachometer could be deceived into counting them as separate pulses. In fact, some ignition systems intentionally use a certain amount of oscillation during normal operation. The diode capacitor serves as an integrator that makes the circuit insensitive to the trailing edge of the main pulse. R3 limits current and clips the signal somewhat to protect the transistor base.

The transistor amplifies the pulses. An n-p-n unit is shown here for a negative-ground application. An equivalent p-n-p is used for positive-ground operation. Leakage is the prime concern here. The transistor is selected for less than 3-μa leakage at room temperature.

Kingpin of the circuit's stabilty with fluctuating battery voltage is Zener diode D2 across the transistor's



Circuit of the versatile unit.



Circuit board inside the instrument. Pointer indicates the Zener diode which is actually a double unit.

collector. Operating at a nominal Zener voltage of 6, it insures equal amplification for each pulse. When the output pulse at the collector is positive-going, the Zener prevents it from exceeding 6 volts. This is shown by the flattening of the waveforms at the collector. The lower portion is leveled as the transistor collector reaches saturation. Thus, limits are set and pulses emerge with equal amplitude. This will hold true for input signals that might range between 10- and 500-volt amplitudes.

The Zener diode serves another function too. Any battery rated between 9 and 32 volts may power the circuit. Voltage is automatically reduced to the desired level by the Zener diode. This action also corrects small fluctuations that occur as the vehicle generator changes speed. (D2, a Hoffman RT-6, is a double-anode unit that consists of two Zener diodes back-to-back. This configuration sharply reduces the adverse affects of heating. The temperature coefficient of the pair is just a tiny fraction of that of a single diode.)

Now that pulse *amplitude* is made equal in all cases, the next section of the circuit can act upon pulse *width*. C2, D3 and D4 form another shaping network. The short time constant set by C2 produces the waveform shown at the junction of C2 and D4. (the negative-going dip of short duration). Any positive-going component is shunted to ground by D3 while the desired signal moves on to the meter via D4.

The meter is calibrated directly in rpm. It measures the average voltage of incoming pulses. As pulse repetition rate rises with rpm, higher average voltage is indicated. Calibration control R5 is used to set the instrument for readings on any type ignition system.

Since the tachometer will operate over a wide range of signal input voltages, highly accurate calibration is possible with line voltage as a reference. A simple formula takes into account line frequency, number of engine cylinders and cycles. For example: for an 8-cylinder 4-cycle engine, R5 is used to set the meter to 900 rpm when input is 60-cycle house current. END

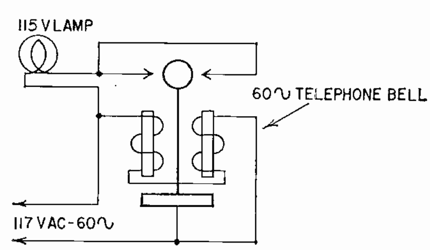
WHAT'S YOUR EQ?

It's stumper time again. Here are three little beauties that will give you a run for the money. They may look simple, but double-check your answers before you say you've solved them. For those that get stuck, or think that it just can't be done, see the answers next month. If you've got an interesting or unusual answer send it to us. We are getting so many letters we can't answer individual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). Also, we're in the market for puzzlers and will pay $10 and up for each one accepted. Write to EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

For answers to last month's puzzle see page 58.

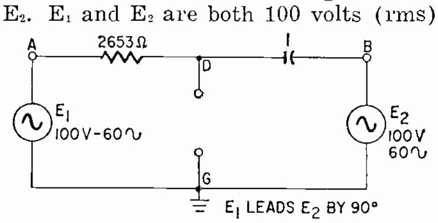
Forbidden Current Path

In this hookup, a standard ac ringer is so hooked up that the clapper makes a good contact with a pair of contacts at each end of its swing, putting the lamp across the line. Why doesn't the lamp light when the bell is ringing and the clapper is making contact?—*I. S. Kerstetter*



Simple (?) Ac Problem

In the circuit shown two ac generators furnish the two voltages E_1 and E_2. E_1 and E_2 are both 100 volts (rms)



60 cycles, but E_1 leads E_2 by 90°. (In other words, the potential of point A with respect to ground G reaches its maximum or peak value one quarter-cycle earlier than the potential of point B with respect to G does.)

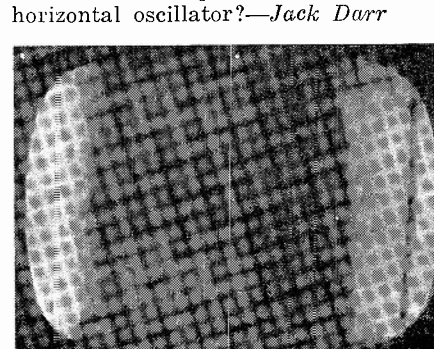
a. What will be the voltage between points A and B, and what will be the voltage between points D and G?

b. Will it make any difference, as far as these two voltages are concerned, if the resistor and capacitor are interchanged (that is, the capacitor is placed between points A and D, and the resistor between points D and B)?

(To save calculation, the capacitive reactance of a 1-μf capacitor at 60 cycles is 2653 ohms.)—*Walther Richter*

Service Stinker No. 3

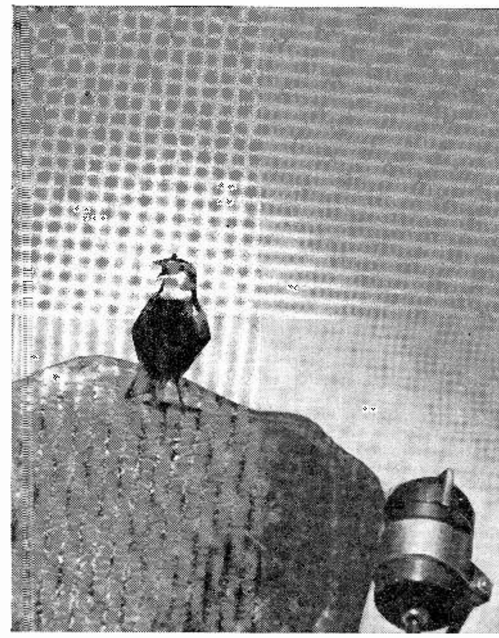
Look at the picture. What is the trouble? Horizontal phase diode out? Bad horizontal oscillator?—*Jack Darr*



COVER STORY

CAPTURE NATURE'S SOUNDS ON TAPE

It takes patience and practice to get a bird to sing for your tape recorder



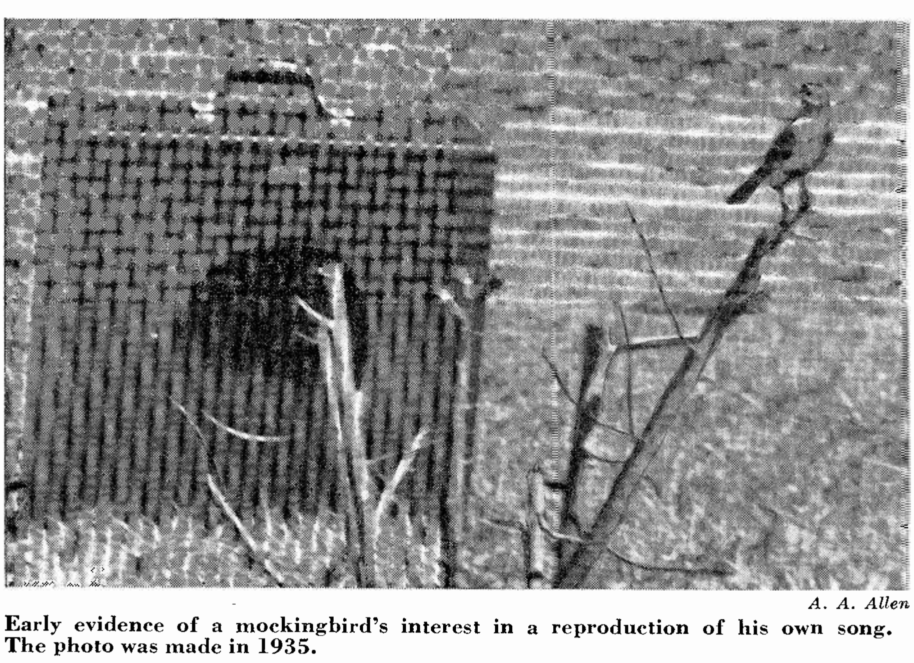
Chestnut-collared longspur sings for microphone placed by his song perch.

By PETER PAUL KELLOGG*

EVERY YEAR HUNDREDS OF LETTERS COME to Cornell University asking about recording sounds in nature. Many come from people who think it might be interesting, but don't know how to start. Other letters come from those who have tried but are dissatisfied with the results. Many who started recording as a hobby combining their interests in electronics and the out-of-doors become so fascinated by the possibilities of making scientific contributions in the field of bio-acoustics that they have joined organizations or expeditions where their efforts have been very valuable.

This article shows how to get started with the simplest of equipment —perhaps with what you already have. Then we show how to improve and modify home equipment so it will be better suited to this rather special field. Here we are concerned with recording bird sounds. But the same principles also apply to almost every phase of natural history sound recording.

*Dr. Kellogg is Professor of Ornithology and Biological Acoustics in the Department of Conservation and assistant director of the Laboratory of Ornithology at Cornell University, Ithaca, N.Y. He began recording sounds in nature in 1929. This article has been amplified and brought up to date by the author from an earlier paper published in the *Atlantic Naturalist* and is used here with permission.



A. A. Allen

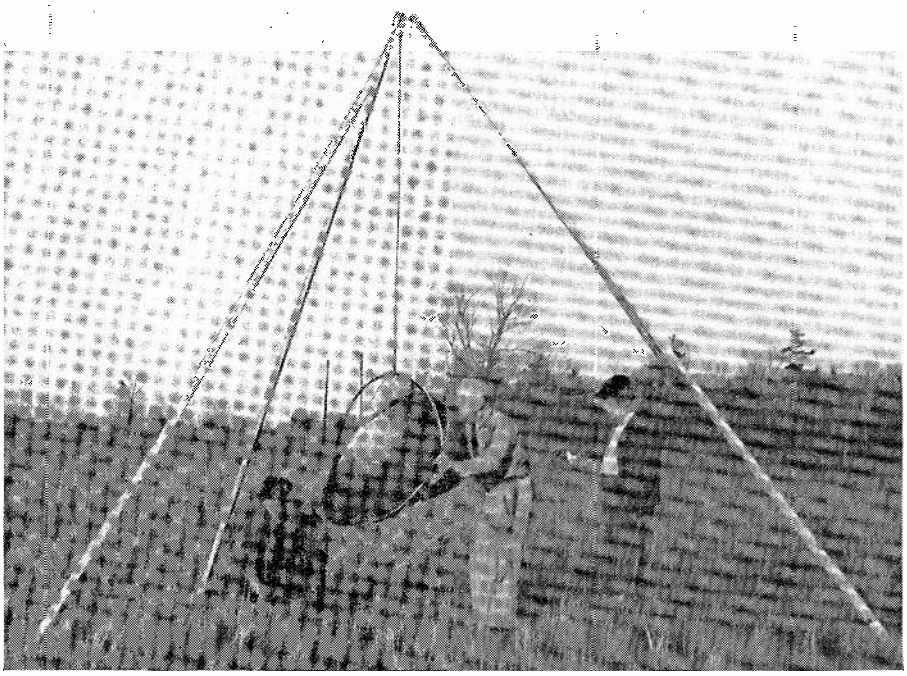
Early evidence of a mockingbird's interest in a reproduction of his own song. The photo was made in 1935.

Basics of nature recording

Almost any recorder, even the inexpensive home types, will give pleasing results with a number of bird species. The trick is to get close. To do so, you can take advantage of normal bird behavior. First, try attracting your quarry by playing his voice back to him. You can also use any available recording of the same species. When birds are in the mood to sing, they often respond so well to a recorded song that it can be embarrassing. We have had wrens come right into the house. A semipalmated sandpiper searched between my boots looking for his rival as I stood near the loudspeaker, and a white-crowned sparrow sat on the rim of our parabolic reflector and sang when we played his song back to him on the edge of Hudson Bay.

The best way is to plan your attack a little ahead. As soon as you have evidence that a bird is interested in responding, get ready. Place your recorder in an open window or other hiding place with curtains drawn so you can see what is going on and can operate the recorder without being seen. Arrange the microphone in front of the window at a point close to where you expect the bird to alight. Arrange a convenient perch for the bird close to this point and cover or eliminate all other likely nearby perching places. If you want to be very realistic—and it often pays big dividends—place a small mirror near the perch.

Most home type recorders have only a built-in speaker but, if you have an auxiliary or external speaker, place it in the group with the perch, microphone and mirror. Now put on your recorder a reel of tape on which you have recorded three or four of the best available songs of the species you are after. They don't have to be top quality. Most birds don't seem to mind if the recordings are poor and very noisy by our standards. Play through the three or four songs and wait. If the bird flies in, be prepared to record. If not, rewind the tape and play it again. Success doesn't crown every effort like this but it is a real thrill once in a while.

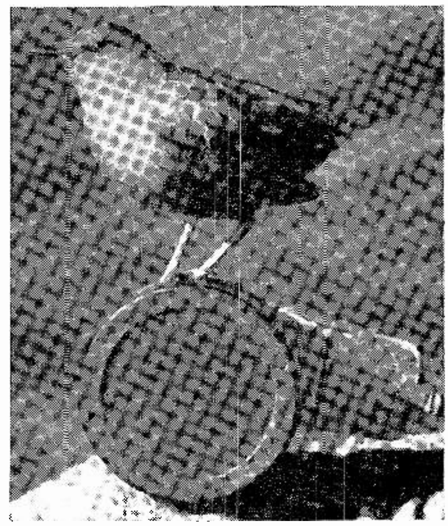


A. A. Allen

Parabolic reflector suspended from tripod by soft rope can be used for following birds in flight.

Another technique worth trying is to take advantage of song perches. Birds are creatures of habit and sometimes it almost seems as though they mark out the boundaries of territory by flying from one song perch to another and singing from each one. Watch for the song perches and select the one that seems to offer the best possibilities. You will have to get your recorder close to the song perch and it would be best if you could hide there, too. It would be much better to have a long cable on your microphone but this is not possible with the ones that come with home recorders.

While most birds come back again and again to favorite song perches, the psychological attachment to the perch is not very strong. Small changes or the addition of anything that seems dangerous or suspicious to the bird may cause him to abandon a perch. Therefore, avoid conspicuous changes or camouflage them with natural materials. Also avoid the use of bright objects, or put a cover over them. Once the bird has accepted your setup, it's easy to get your recording. But since acceptance may take a little time, it is sometimes worth while to make your first setup using dummy equipment. A small box with a cord attached can substitute for your real microphone until you are ready to work. Any packing box or a pile of brush can be placed where you propose to hide. If you see that these changes do not bother the bird, then it is a simple matter to arrange things the way you want them without much change in the appearance of things and the bird will probably never notice you.



A. A. Allen

The little Water Ouzel sat right on the microphone and sang within inches of the diaphram.

Extending your mike cable

You may be very successful with the methods described above, but opportunities will increase if you can lengthen your microphone cable. This seems simple, but it is not just a matter of buying more cable and attaching it. Doing this ruins the signal because of added noise and sometimes introduces frequency distortion as well. The secret of using a long line from the microphone is that the microphone and the line must be low impedance. Most home recorders are designed to use high-impedance crystal microphones and short lines. These microphones are usually of poor quality.

Perhaps the best solution is to buy a new low-impedance dynamic microphone, a new shielded line of the desired length and a transformer, to be used close to the recorder, to match the low-impedance microphone and line to the high impedance of the recorder input.

This may sound complicated to the uninitiated, and certainly the person considering it should have either some familiarity with audio circuits or the help and advice of an expert. This modification should cost between $50 and $200, depending on the quality of microphone and transformer selected. Several manufacturers offer special cable transformers for this purpose. They are spliced into the cable near the tape recorder.

Most important are shielding and proper grounding if hum is to be avoided. It is best to use 2-conductor shielded cable between the microphone and the transformer. Connect the microphone case to the shield at one end and the transformer case at the other. The signal leads from the microphone run only to the transformer primary, which is strapped to match the microphone impedance, usually 50 to 200 ohms. It is sometimes tricky to connect the transformer to the recorder without introducing hum. Often it is best to ground the shields at the transformer only through the ground lead of the shielded cable. The shield goes on to the body of the plug which goes into the recorder (Fig. 1). If the transformer is not well shielded magnetically, it may be desirable to orient it with respect to the recorder to minimize hum pickup.

Choosing a mike

Microphones are always a compromise between output for a given signal and the frequency range over which they give a reasonably flat response. Crystal units normally supplied with home type recorders generally have high output in the mid-range but poor low- and high-frequency response. Any effort to broaden the frequency response usually decreases sensitivity.

Most bird-sound studies are made with dynamic microphones. These instruments have the advantage of reasonable response over most useful frequencies, fair output, great ruggedness

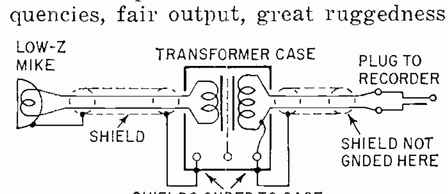


Fig. 1—Grounding arrangement when a matching transformer is added to the long mike cable.

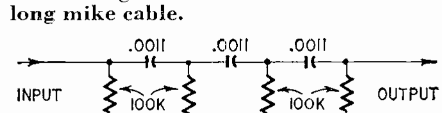


Fig. 2—A 1.5-kc high-pass filter.

CORNELL UNIVERSITY | LIBRARY OF NATURAL SOUNDS | LABORATORY OF ORNITHOLOGY

FIELD AND EDITING NOTES

No. and Family | Name Sci. Com. Ref. | Cut No. | Date and Time | Recorded By: Expedition and Personnel

Locality | Lat. Long. Alt. | Habitat | Level of Recording | Length of Cut | Quality | Weather Temp.: Air Water

Recorder | Tape Speed "/Sec. | Microphone | Parabola? Dia./f. | Dist. from Animal | Identification By: How? | If Rerecording, Type of Original Catalog No. of Orig. | Specimen Collected By Where Located

Number of Animals: Male Female Immature Indeterminate | Physical Description of Sound; How Distinguished

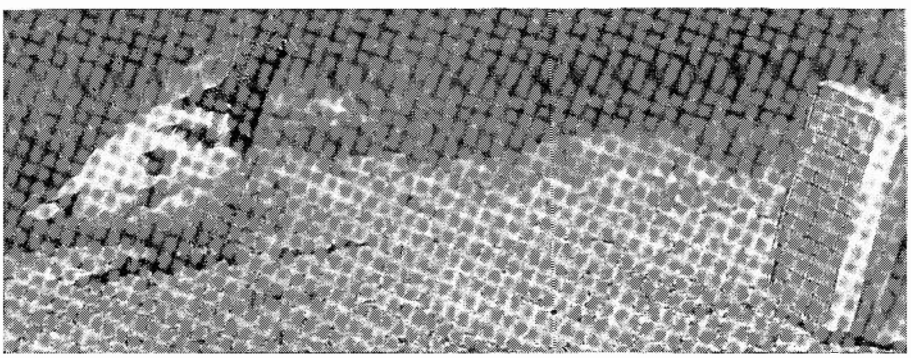
Apparent Biological Purpose of Sound | What Behavior Accompanied Vocalization | What Did Animal Do When Not Vocalizing?

Response to Imitation, Playback, Decoy etc.; Equipment Used | Edited By:

Description of Exact Place From Which Sound Was Made; Special Set-up etc. | On Species Reel | Cataloged | Region

Background Sounds (Underline Species To Be Cross-Indexed)
How Are Other Species Distinguished?

Fig. 3—A file of these sheets is used for each reel of tape in Cornell's library. They identify every bit of material recorded on the reel.



A. A. Allen

Willow Ptarmigan attracted to speaker by playing back its own voice.

and low impedance which enables them to transmit energy over long lines with relatively little loss.

Ribbon microphones have many of the advantages of the dynamic type, but are usually heavier, not so rugged and very sensitive to wind disturbance.

Capacitor (condenser) microphones have excellent frequency response throughout the entire spectrum. Many have useful output even at 100 kc and are used when exploring ultrasonic frequencies such as those encountered in studies of dogs, bats and some other mammals. The low output and extremely high impedance of capacitor microphones, plus the need for a high polarizing voltage, make it mandatory that the preamplifier, and usually the power supply, be located within inches of the microphone head. Until recently, this requirement almost excluded this microphone from the field. Now, with small, efficient transistor amplifiers and power supplies two companies (A.K.G. and Neumann) have offered capacitor microphone systems with battery-operated power supplies suitable for field use. Although these systems are expensive compared to simpler microphones, they are superior and will probably be popular with those who want the best available.

Parabolic reflectors

Parabolic reflectors are almost a necessity for anyone planning on doing much bird-song recording. However, they are expensive and cumbersome and have other limitations. The cost of a suitable unmounted aluminum parabola is about $50, but good ones can sometimes be found on the surplus market. The effectiveness of a parabolic reflector increases with size. A 40-inch parabola will collect about 1,600 times as much sound energy from the direction in which it is pointed as the microphone alone would do from the same point. Unfortunately, as the size of the reflector increases, so does the inconvenience of handling it. The choice of size is always a compromise. At Cornell we use mostly 40-inch reflectors with a 10-inch focal length, but for most bird songs a 36-inch reflector with a 10- or 12-inch focal length would be satisfactory. Smaller reflectors have poor low-frequency response, are less directional and pick up less sound energy from the source. Always mount the microphone at the focal point with its sensitive part facing the parabola, not the bird.

With a good reflector, properly adjusted to the microphone and correctly pointed, excellent recordings have been made of a bird song at distances of over 100 yards. This, however, requires excellent weather and noise conditions. In practice, distances of 25 to 100 feet are more usual. Better recordings should theoretically be possible when the microphone alone is within a couple of feet of the bird, but it is often impossible to tell the difference between recordings made with a parabola and with the microphone close up. Certainly, however, it is much less work to get a desired song when using a good parabola.

Portable recorders

Portable recorders are especially useful in bird-sound recording. According to our definition, a portable recorder is battery-powered and weighs less than 30 pounds. Such recorders, if quality instruments, are rather special and usually cost many times the price of home recorders. They vary from 8 to 20 pounds in weight and are marvels of electrical and mechanical perfection, comparing favorably with the finest professional studio machines. Most recorders in this class are designed for use with high-quality low-impedance microphones, and can readily be used with long or short microphone cables as the occasion demands.

Home type recorders can be used away from commercial current outlets if you use a converter to change the battery current available in a car to 60-cycle ac at 117 volts. This gives a much greater degree of freedom with this type of recorder and, when combined with a long microphone cable, it is possible to record in very remote places. Converters of this type cost between $50 and $100.

Tape speed

Some birds have very high-pitched songs and notes which begin or change with such suddenness that they are very difficult to record, even with the best professional equipment available today. Therefore, it is desirable to record at the highest tape speed available. Good recordings of many bird songs can be made at 7.5 ips, but many warblers and finches have song qualities which make them difficult to record even at 15 ips. We have found many advantages in using 15 ips and have standardized on it. We have modified many recorders to operate at this speed, and strongly recommend it for serious work.

Recording quality

In general, anything that causes a recorded bird song to be different from what is heard in the field should be avoided. This imposes a difficult problem because in the field we have sounds coming from all about us. Our ability to segregate these sounds and to concentrate on those coming from one direction, while disregarding sounds from all other directions, permits us to "hear through the noise" and to disregard it to a great extent. Recorders, unless they record stereophonically, receive sound through one microphone and play it back through one speaker. All sounds, desired and undesired, come out from the same point and there is no chance for the ears to separate them or distinguish between them.

Noise mixed with the desired sound is perhaps the easiest fault to look for in a recording. However, there are two kinds of noise. One is in the environment when the recording was made. While this type of noise is not the fault of the person doing the recording, careful workers try to choose a time when such noises are lowest and do everything possible to minimize them. Wind screens often help reduce the blast effect of the wind. One type fits tightly over the microphone and is usually purchased from the microphone manufacturer. The other, equally effective, is made from a tightly woven material, such as organdy, cut to fit over the entire parabolic reflector and microphone, and held tight with an elastic hem. Electronic filters can often be used to reduce greatly the low frequencies of traffic and wind noise without affecting the bird songs. Fig. 2 shows a simple 1.5-kc high-pass filter that can be inserted between the recorder's high-impedance input and a crystal mike or line-to-grid transformer. Especially effective are adjustable bandpass filters such as the Krohn-Hite, model 310-AB (Krohn-Hite, 580 Massachusetts Ave., Cambridge 39, Mass.) These filters permit the removal of objectionable low and high frequencies at the same time, but be sure you avoid cutting into the desired sound frequencies. If you don't, you'll get an unpleasant "thin" quality to the sound or may even eliminate important parts of the sound.

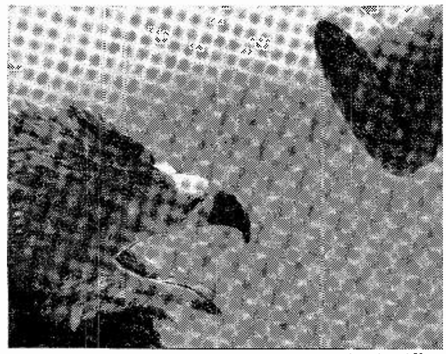
The second type of noise comes from the recording equipment itself and may vary from occasional or regular rumbles to steady hiss or hum.

Distortion is usually distinguished from noise and defined as tones or frequencies in the recorded version which were not in the original. The ear will tolerate small amounts of distortion much more readily than it will tolerate noise. The more familiar the sound, the easier it is to detect distortion. In general, recorders having less than 2% or 3% distortion are very satisfactory. For analytical work, minimum distortion becomes more important.

Wow and flutter are caused by irregular motion of the tape as it passes over the magnetic heads. They are very objectionable because they can add trills and tremulos to a recorded bird sound. These faults are more likely to occur in low-grade recorders, but they can be caused by dirty parts or poor maintenance in good recorders. Again, these faults are more evident when listening to familiar sounds. Therefore this type of imperfection is dangerous in bird-sound recording since, if we are not too familiar with the bird, the fault may pass unnoticed and be attributed to the bird.

Dynamic range

No recorder can handle as wide a range of sound intensities as the human ear can perceive. Therefore, there must



A. A. Allen

This young Golden Eagle came right up to the mike.

always be some compression in recorded sound if it has a wide dynamic range. Intensity is usually limited at the upper end by the same amount of distortion we are willing to tolerate. In modern professional recorders, this is usually set at 1% to 3%. In home recorders it may run much higher. The lower end of the dynamic range is determined by noise introduced by the equipment. With the best equipment, the dynamic range is usually satisfactory if not adequate for recording the total range of a great orchestra.

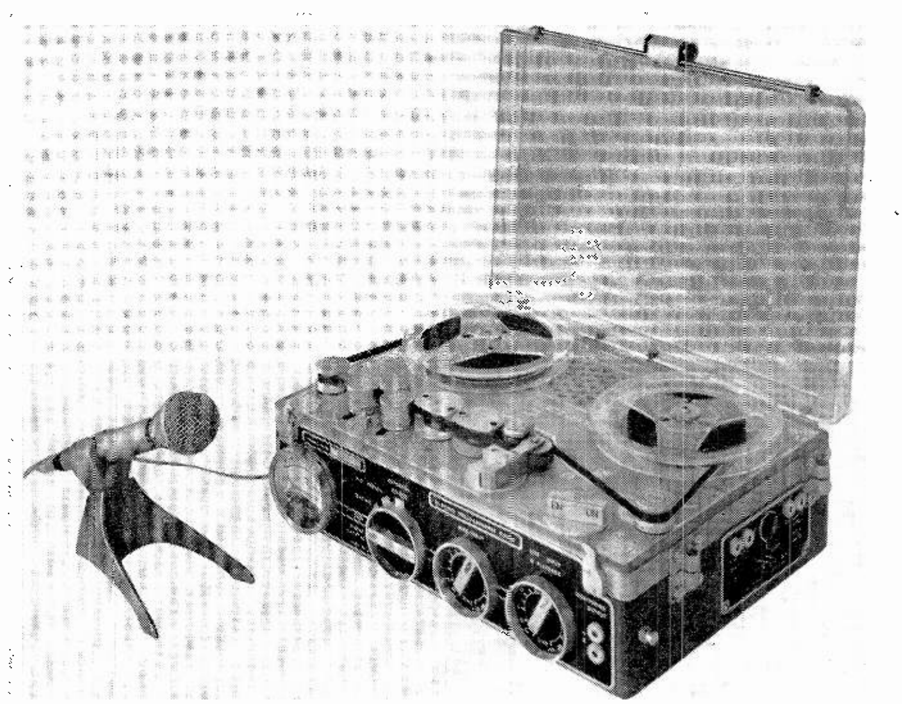
Frequency response

This characteristic has been left until last because so much emphasis is usually placed upon it. The frequencies to which human beings respond are between 20 and 20,000 cycles for young people. Older people tend to lose their responses to high frequencies first. It is questionable if many people, young or old, can detect the presence or absence of frequencies above 10,000 or 12,000 cycles in human voice—or in bird songs. In advertising, great emphasis is usually placed on uniformity of response throughout the sound spectrum. This may be desirable or even necessary for technical work involving the analysis of bird songs but it is not of great importance for listening to them, since most people are hard pressed to detect the difference in loudness represented by doubling the power of sound or cutting it in half. Such a change in loudness is referred to technically as a change of 3 decibels. Therefore, a system which is uniform throughout the spectrum within this 2-to-1 power range is satisfactory for all but critical measurements.

Care and use of recordings

Some system must be developed if tape recordings are to be of much use. As soon as possible after a recording is made, play it back. Pick out the parts to be saved, splice them together and erase the remainder. The Cornell Library of Natural Sounds has a separate reel for each species and all recordings of that species are given a cut number and added to that reel as soon as possible. Each cut is separated from the next by a foot or two of white, plastic leader tape, and a short announcement is spliced onto the beginning of each cut giving the scientific and common names, the cut number and the name of the person who made the recording. A separate editing sheet (Fig. 3) is prepared for each cut. On this sheet complete notes are kept showing all details of the recording, such as locality, date, time and background sounds, and especially information about the bird, its activities at the time and how it responded to a reproduction of its voice. In this way it is possible to find easily any recording in the collection and to recall the entire experience.

The use of sound recordings is still in its infancy. Educational uses are most obvious. They include combin-



Professional tape recorder for field recording and the one used by the author is the Nagra-III. Price is over $1,000.

ing phonograph records with pictures. Some sound studies have indicated relationship of species. Others have related to bird behavior and might be thought of as vocabulary studies. Other studies show how voice changes when members of a species are isolated for long periods, such as has occurred sometimes with insular birds which are also represented on the mainland. Some studies have been made in search of beauty in bird song and the quest has led to every part of the world. Perhaps one of the most rewarding efforts is to select a single species and try to record and catalog all of its songs and calls—throughout the day, the season, the year and throughout the range. This is a big job, but eventually it must be done. Certainly it is fully as important as collecting specimens of the birds themselves and it will probably reveal just as many important facts.

Of the 8,000 species of birds in the world, hardly more than 1,000 have had any record made of their voices. Even in the United States many birds are still to be recorded. One of the most challenging of these has been Townsend's solitaire. It is a beautiful songster, as we found out this year.

I would like to suggest that if you should get seriously interested in the recording and study of bird songs, please consider permitting the Library of Natural Sounds at Cornell University to copy your tapes and include them in their collection where they will be catalogued, preserved and made available for scientific study to scholars throughout the world and with credit to the contributor. END

Suggested Reading on Technical Aspects of Recording

Herman Burstein, and H. C. Pollak. *Elements of Tape Recorder Circuits*. New York: Gernsback Library, Inc., 1957.

Nathan M. Haynes, *Elements of Magnetic Tape Recording*. Englewood Cliff, N. J.: Prentice-Hall, Inc., 1957.

W. E. Lanyon, Editor *Animal Sounds and Communication*. Washington, D. C.: American Institute of Biological Sciences, 1960.

Joel Tall, *Techniques of Magnetic Recording*. New York: Macmillan Co., 1958.

GHOSTLY BATHTUB

In the old days of radio, people occasionally heard voices or music coming from kitchen sinks, metal rain gutters and downspouts or other pieces of metal sometimes miles away from radio stations. Now, in the age of TV, we have found a video counterpart of this phenomenon in an eerie green-glowing bathtub.

Recently, a husband woke up in his Kansas City home to see a greenish-white light coming from the bathroom. Investigation revealed the bathtub was luminescing.

Next night nothing happened. Then a week later it happened again. The next night it was gone. Each Wednesday night it happened. Finally he figured it out. Every Wednesday night his wife took a sun-lamp bath. The cast iron of the tub absorbed enough rays from the sun lamp to cause a long-persistence afterglow!—*Walter Inman*

DX SHORT-WAVE FORECAST

Jan. 15–Feb. 15

By STANLEY LEINWOLL†

During late January and February the ionosphere is affected by three major changes in earth/sun relationships.

First, because of the lengthening hours of daylight in the northern hemisphere, the number of hours during which the higher daytime frequencies can be used for long-distance short-wave communication increases.

Second, as the distance between the earth and the sun increases, the intensity of ultraviolet radiation striking the ionosphere decreases. As a result, daytime MUF's fall from peak mid-winter levels.

Finally, because the sun is headed more directly overhead, its heating effects on the ionosphere increase, and the ionosphere expands.

The combination of an expanded ionosphere and the fact that there are fewer hours of night for recombination of ions and free electrons to take place results in an increase in maximum usable frequencies at night.

The tables show the optimum broadcast band, in megacycles, for propagation of programs between the locations shown during the time periods indicated.

To use the tables, the listener selects the one most suitable for his location, reads down the left side to the region he wishes to hear, then follows the line to the right until he is under the appropriate time. (Time is given at the top of each table in 2-hour intervals from midnight to 10 pm, *in your local standard time.*) The figure thus obtained is the short-wave band (in megacycles) nearest to the optimum working frequency.

For example, a listener in Chicago would use the Central USA table. He would be most likely to hear broadcasts from West Europe in the 6 megacycle band at 8 pm, Central Standard Time.

EASTERN US to:

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	6	6	9*	21	21	21	17	11	9	9	6
East Europe	7	7*	6*	9*	21	21	17	11	9	7	7	7
Northern Latin America	11	9	9	11	15	17	15	17	17	15	11	11
Southern Latin America	11	11	9	11	15	15	15*	17	17	15	11	11
Near East	7	7	6*	11*	17	17	17	11	11	11	9	7
North Africa	7	7	7	11*	17	17	15	15	11	11	9	9
South & Central Africa	9	9	7*	17	21	21	21	15	11	11	11	11
Far East	11	9	9	7	9	7*	9*	7*	9*	15	15	11
Australia & New Zealand	11	11	9	9	11	11	15*	15	15	17	17	11

CENTRAL US to:

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	7*	7*	9*	21	21	17	11	9*	7	6	6
East Europe	7	7	7*	9*	15	11	9*	9*	9	9	7	7
Northern Latin America	11	9	9	15	17	17	15	17	17	15	11	11
Southern Latin America	11	9	9	15	15	17	17	17	17	15	11	11
Near East	9	7*	7*	9*	17	15	11	9	9	9	7	7
North Africa	7	7	7*	7*	17	17	17	11	9	9	9	7
South & Central Africa	9	9	9*	17	21	21	21	17	15	11	11	9
Far East	7*	7*	7	7	9	9*	7*	9*	21	21	11	9
Australia & New Zealand	11	11	9	9	11	11	15*	15	17	17	15	11

WESTERN US to:

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6*	7	7*	11*	17	17	15	9	7	6	6	6*
East Europe	7	7	7*	7*	11	15	15	9	9	7	7	7
Northern Latin America	9	9	9	9	15	15	15	17	17	15	11	11
Southern Latin America	11	9	9	11	15	15*	17	17	17	15	11	11
North Africa	9	7	7	11	17	17	15	9	9	9	7	7
South & Central Africa	9	9	9*	15	21	21	21	15	15	11	11	11
Far East	7	7	7	7	7	9	9	17	17	17	15	9
South Asia	7	7	7	7	9	15	11	11*	15	15	15	9
Australia & New Zealand	11	11	9	7	11	11	15	15	21	21	17	15

†Radio-frequency and propagation manager, RADIO FREE EUROPE.
*Reception may be very poor or impossible on this path at this hour.

FM STEREO CIRCUIT DEVELOPMENTS

There are three main detection systems—switching, matrixing and envelope. Here's how they work

By NORMAN H. CROWHURST

PRESENT REACTIONS TO FM STEREO VARY from surprise that it works at all to skepticism whether it will ever be possible to get good quality with it. Actually, as several sensible, nontechnical people have already guessed, FM stereo is having the same kind of troubles stereo disc had when it first came in.

It's no use to transmit stereo unless someone can listen to it. On the other hand, the adapter makers cannot field-test their products unless someone transmits. The real neck-sticker-outers of the hi-fi industry have gone ahead and designed the best adapters they knew how, with very little to go on. Initially, only one manufacturer had the advantage of advance field testing.

So they worked with home-made generators, to simulate the transmitted signal, and made adapters that gave what they felt was acceptable separation, distortion, SCA (Subsidiary Communications Authorization) subcarrier rejection, etc. Mostly they started by trying the G-E or Zenith circuit. In some instances, they satisfied themselves with "optimizing" these circuits — making minor changes that improved performance. But in more cases they felt they could do better by trying for some completely new way of doing it.

This has resulted in a number of claims to having produced "unique" circuits, supposedly quite different from everybody else's. On the assumption that everybody else more or less copied G-E or Zenith, their claim to uniqueness may be supportable. But when one examines the various circuits, it seems they have mostly discovered the same things, independently, so they end up not being the least bit unique! However, it's to the credit of the industry that it has so many engineers who can think up and develop something original — even if they end up finding essentially the same things.

Detection methods

So far there are three main detection methods: switching, following the original Zenith concept; filtering, reinserting subcarrier into the L – R modulation, detecting and matrixing; envelope detection, utilizing the fact that, when the subcarrier is added in correct phase to the composite signal, the top of the envelope is left program waveform, while the bottom is right. Fig. 1 shows these three concepts.

The Zenith circuit used a beam-switching tube to switch from left to right. If a relatively large-amplitude, symmetrical-waveform switching signal (regenerated subcarrier) is used, we get square-wave switching. Close to the zero switching-waveform level, the entire signal is transferred from the "left" plate to the "right" plate, and back again (Fig. 2).

Notice that, if left and right momentarily are of the same phase and magnitude, the output at each plate is a half-time sample of the waveform. But, if they are momentarily out of phase

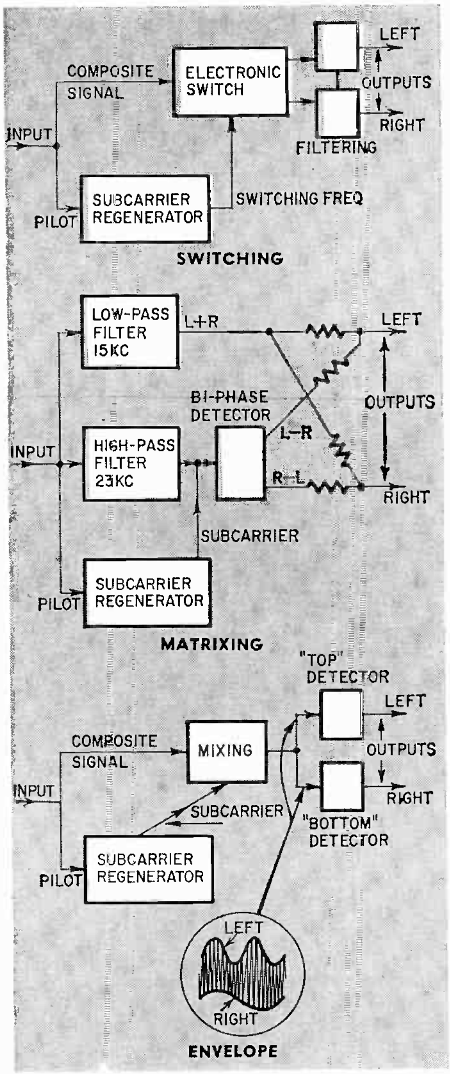


Fig. 1—Comparison of the three basic detection methods developed to date.

(and, say, approximately equal magnitude), the output at each plate is a succession of half-waves of 38 kc, with a peak value on the waveform for that channel (Fig. 3).

During half-cycles of the 38-kc switching waveform, in the case where L and R are identical (Fig. 3, top), each output gives the momentary waveform value for half the time—a complete half and half. When left and right are opposite (bottom), although the 38-kc switching occurs abruptly, a half-cycle of the *received* 38 kc appears in each output, whose peak touches the momentary waveform value for that side (L or R). The average value of this half wave will be less than the peak — representing some leak from left to right and vice versa. An averaging-type filter will cause the output in one channel to be affected by the output from the other.

The remedy for this is the injection of opposite channel—or composite —in opposite phase, so each channel is itself unaffected by the instantaneous value in the other (Fig. 4). This was shown in the original Zenith circuit.

In the cathode a small replica of L + R appears in opposite phase from the L and R appearing at the respective switching plates. By appropriate adjustment of values (or the slider on the cathode pot), this exactly neutralizes the "leak" from left to right and right to left, with a slight loss of "wanted" channel as well.

Scott and several others use, or have experimented with, essentially the same method, but with semiconductor diodes instead of a beam-switching tube

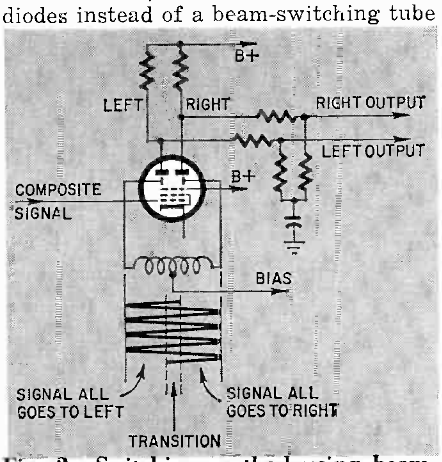


Fig. 2—Switching method using beam-switching tube. Composite signal goes to control grid, switching frequency to beam-switching electrodes.

(Fig. 5). A feature employed by Scott is the use of a form of vestigial sideband operation, by the filter response shaping. This deviation is compensated by the phasing of the regenerated subcarrier.

The people who worked with filters and matrixing have been having troubles. As our previous article pointed out, it is not feasible to design a phase-linear filter including high-pass function, which such a circuit needs. The frequencies above 23 kc have to be separated from those below 15 kc. Consequently, normal linear detection will not retrieve the L – R signal, correct in magnitude and phase at all audio frequencies.

What may be regarded as a slight misadjustment, or compensation, can get complete separation between left and right, after matrixing, at any one audio frequency. Careful adjustment, using the matrixing adjustment to get maximum separation at lower audio frequencies while the subcarrier reinsertion phase is adjusted for maximum separation at the higher frequencies, can give *acceptable* separation throughout the audio range (Fig. 6).

It can never be perfect, however good the circuit design and adjustment. But it can be made fairly good, and it's more tolerant of tuner alignment errors that upset the output linearity than are some other circuits.

The third form of detection is the one most engineers have "discovered" independently. Each of the previously published circuits—Zenith, G-E and Scott—was unique. Although they are by no means identical, they have similarities. But each one has its individuality too. This third form—envelope detection—appeals because it requires no filters at all for the stereo function (Fig. 7). More than a cost-saving device, this avoids the problems they bring, in correct alignment or setting values.

This method works on a very simple principle: if the regenerated subcarrier is added to the composite received signal in the correct phase, the left-channel waveform forms the top of the envelope and the right channel the bottom (Fig. 8). Detection is just a matter of having one detection element follow the top (positive) peaks and another the bottom (negative) peaks. As with the switching method, there is some slight interaction, equivalent to leakage, which can be offset by precisely similar methods.

Subcarrier regeneration

Every reception method calls for subcarrier regeneration. Every method also requires that the subcarrier be used in the correct phase. Otherwise separation suffers, and distortion may increase.

The term subcarrier regeneration is used for the whole operation of isolating the 19-kc pilot frequency from everything else and producing a 38-kc signal whose phase is correctly controlled by the 19-kc pilot. The method may simply frequency-double, or it may

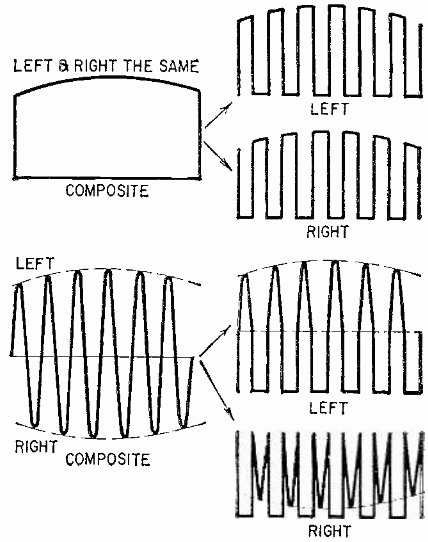


Fig. 3—Effect of one channel on the other when the switching method is used. When both signals are momentarily the same (top), the switching delivers half the waveform at each output. When the signals are different (bottom), only the peaks reach the instantaneous value of the signal at each output.

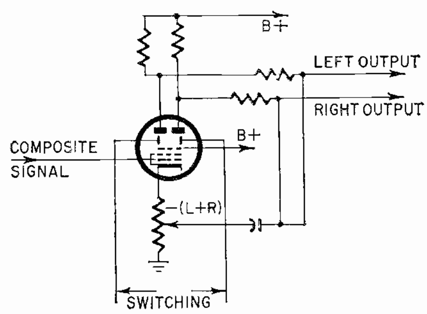


Fig. 4—Method of compensating for the cross-mixing used by Zenith with the beam-switching tube.

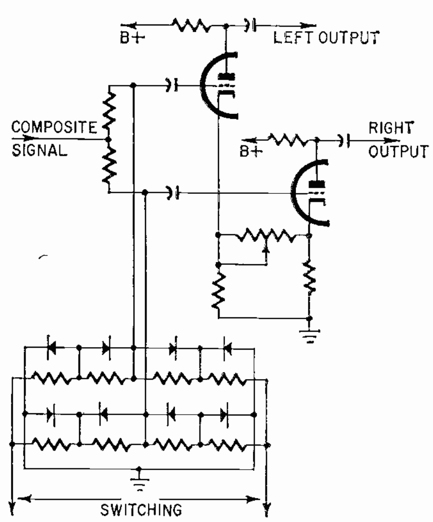


Fig. 5—Diodes for detection by switching. The diode bridge is used by Scott. Compensation for cross-mixing is slightly simplified.

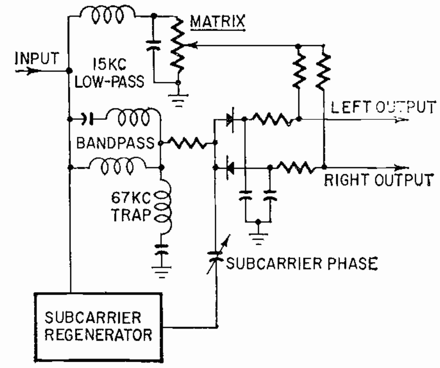


Fig. 6—Basic elements of matrixing detection. For maximum separation, set matrix adjustment for maximum low-frequency separation at the same time as the carrier phase control is set for maximum separation at 12,000 cycles.

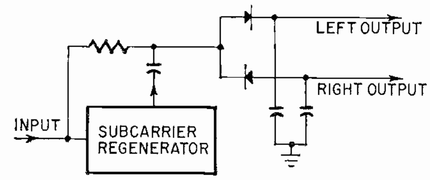


Fig. 7—The basic circuit for envelope detection is extremely simple.

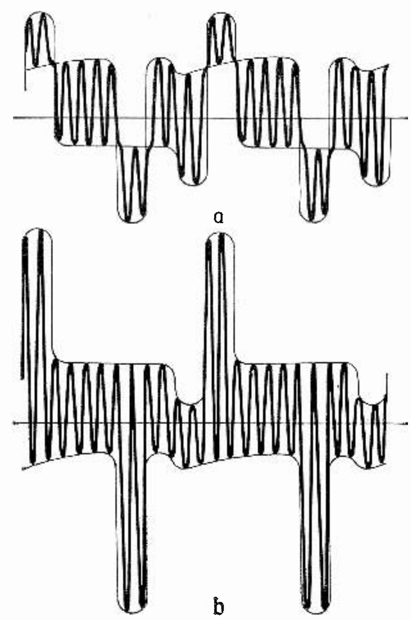


Fig. 8—The basis of envelope detection. By adding to the composite signal (a) the regenerated subcarrier in correct phase, the waveform (b) has the left-channel waveform as its top edge and the right-channel waveform as its bottom edge.

use a synchronized (locked) oscillator at either frequency—19 or 38 kc. The circuit configuration does not change very much. The difference that will identify which is used is usually in the coils. Where an oscillator is used, the coil either has a regenerative winding or the cathode is tapped up from ground on the grid winding—a cathode-coupled Hartley circuit.

A problem several ran into was

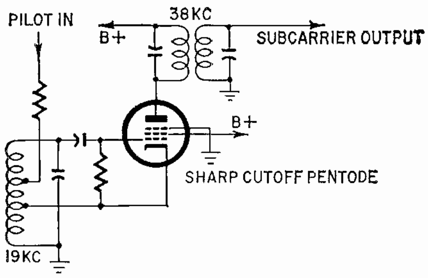


Fig. 9—A common form of oscillator-cum-doubler circuit.

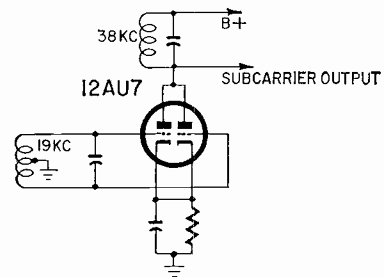


Fig. 10—A fairly simple doubler circuit with extremely good performance.

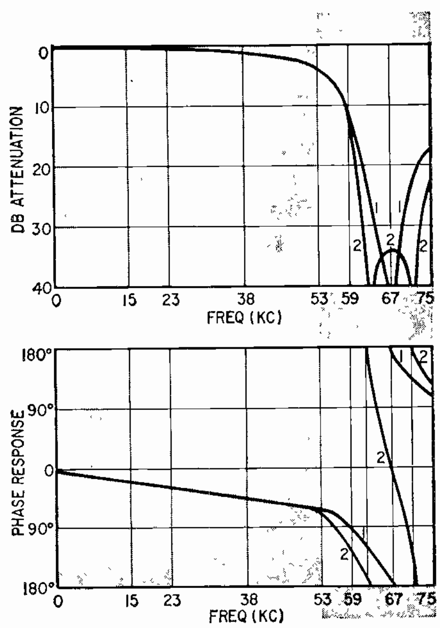


Fig. 11—The filter approach to eliminating SCA trouble. Curves 1 show the response of original single-reject filters. Curves 2 show the response of improved types with extra rejection.

that of satisfactorily separating the 19-kc pilot from everything above and below it. A high-Q tuned circuit is a big help, but several found this could also be influenced by the second harmonic of 9.5 kc in the program, and possibly the third harmonic of 6⅓ kc. The presence of audio frequencies near these values could shift the subcarrier phase enough to cause considerable degradation of separation.

The solution is to use stages with very low distortion (which one would think they needed for high fidelity, anyway) before the pilot is separated from the rest. Some have used a 9.5-kc trap instead, but this seems the wrong way to do it.

Some preferred amplifying and doubling the pilot frequency to produce the subcarrier. They found that phase of the reinserted 38 kc varied less with signal level at the antenna than when they used an oscillator. But, of course, the regenerated subcarrier's magnitude fluctuates.

On simulated signal this may be all right. But field testing showed the magnitude fluctuation proved worse, at least in circuits using matrixing or envelope detection. The amplitude fluctuations in the subcarrier are indistinguishable from those caused by the received sidebands and get detected as noise.

After field tests, practically everyone has gone over to a synchronized oscillator in one form or another. Some use 19 kc, some 38 kc, as the oscillator frequency. Most are content with a curvature type doubler using the plate circuit of a tube that also serves as oscillator in its grid circuit. Fig. 9 shows such an arrangement with a pentode. Triodes have also been used this way.

A very good doubler, needing few parts beside a 12AU7, applies push-pull 19 kc to the 12AU7 grids and gets 38 kc at the common plates (Fig. 10).

Coupling between tuned circuits has been another problem. To get better selectivity or rejection of all but 19 kc, double-tuned circuits may be used. But it was difficult to find a coil or transformer manufacturer who knew how to wind an "undercoupled if" for 19 kc. The same trouble may also account for some unnecessarily distorted 38-kc outputs.

SCA subcarrier rejection

A number of the circuits work quite well on transmissions without an SCA subcarrier as well as the stereo multiplex. But they run into trouble when tried out on a transmission with SCA subcarrier. Mostly it shows up, not as breakthrough, but as birdies. Several have tried putting in extra filtering to get rid of the 67-kc sidebands as well as the 67 kc itself (Fig. 11).

This works, as far as getting rid of the interference is concerned, but it poses more serious problems in gaining the phase linearity needed in the low-pass filter action, below 53 kc. And considerable rejection is needed, in most receivers, to get rid of the birdies over the whole range from 59 to 75 kc.

The rejection either has to be so far down that any slope detection, as the frequency modulation shifts the nominal 67 kc through the range between 59 and 75 kc, does not produce enough amplitude-modulated output to be audible. From this viewpoint, it is better not to use any filters, because this avoids any slope detection (Fig. 12). But to be completely "clean", the response at the output of the tuner needs to be flat out to 75 kc, which is a tough requirement.

Another possible cause of the birdies, and one which is doubtless responsible in many adapter circuits, is

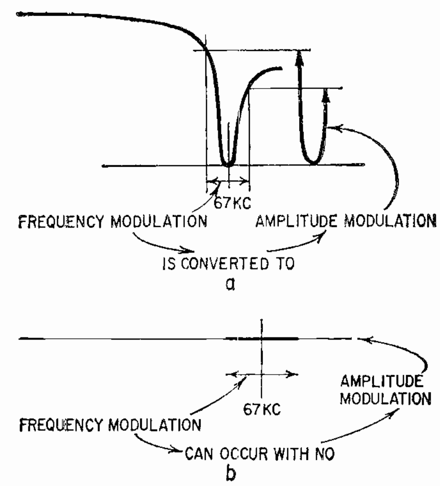


Fig. 12—Why the filter approach (a) always converts the basic FM of SCA to a form of AM, causing it to be detected and form beats with the stereo. These beats appear as birdies. The no-filter approach (b) avoids detecting the FM by using the flattest possible response.

the presence of third and fourth harmonics of 19 kc, along with the wanted second—38 kc. These frequencies, 57 and 76 kc, beat with 67 kc to produce 10 and 9 kc, respectively. But when the 67 kc is modulated, the birdies "dip" to much lower frequencies, often to 1,000 cycles or lower.

Where this is the cause, the remedy is a much cleaner regenerated subcarrier, as well as whatever other measure is used to control what happens to the SCA subcarrier itself. Actual adapter circuits seem to have almost run the gamut of possible combinations of the features we have discussed: type of detection, method of subcarrier regeneration and procedure for SCA rejection.

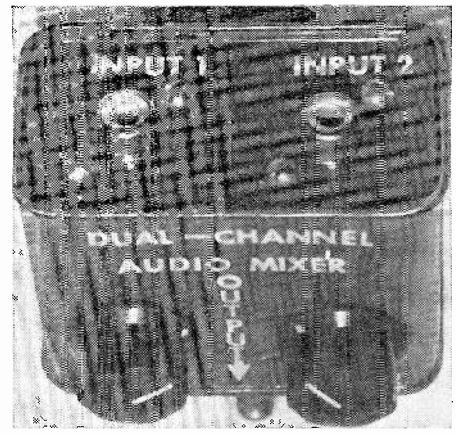
Transmissions

Not to be overlooked among all the problems is the possibility that the transmissions used for reception and field testing may not be perfect. Lack of separation or other problems may not be caused by poor adapter design or alignment. It may be failure of the transmitter to conform to the FCC requirements about subcarrier phasing, or some other feature about the signal.

Although SCA subcarriers may have been overmodulated before stereo was introduced without trouble on monophonic transmission, now they could cause severe trouble unless the modulation is brought in line for stereo. The best solution for the station might be to forego the SCA revenue and concentrate on good stereo. Some adapter makers are hoping this will happen. But there's no guarantee. Meanwhile, if someone hears birdies, the adapter gets the blame.

As with stereo discs, at the beginning we needed both good discs and good pickups, so each could check the other. We got them before too long. Undoubtedly the same thing is happening with FM stereo. END

Spice-Can Audio Mixer



By JAMES A. FRED

THOSE spice cans in your wife's kitchen cabinet make handy containers for housing small electronic gadgets. You will also find other small cans such as bandage cans, 35-mm film cans, food containers around the home and shop.

I had been intending to make a two-input, one-output audio mixer for several years, but never seemed able to find volume controls small enough to fit into the real small spice cans. When I learned that Mallory had introduced a type MLC carbon control that was only ½ inch in diameter, I knew that it was time to build the audio mixer.

An audio mixer of this type is especially useful with an amplifier that only has one input jack. The mixer described will accept two signals, one from a microphone and a record player. Or one signal from a microphone and one from an electric guitar. For that matter, practically any two signals can be fed into the mixer where individual volume controls allow independent control of their amplitude. Thus you could have a musical background and, when you want to make an announcement, you merely turn up the gain on the microphone input and the microphone will override the music. Used with a tape recorder you dub in your voice with a musical background.

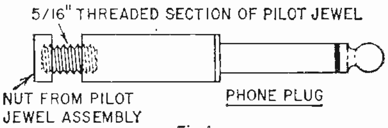


Fig.1

The first thing to do is to assemble the necessary parts. If your wife has saved a spice can for you, you are ready, but if she hasn't look through her stock and find one that is nearly empty. You can buy her a replacement on your next visit to the supermarket. I used phono jacks for the inputs and used a headphone plug for the output. You should use whatever type plugs and jacks fit your particular equipment.

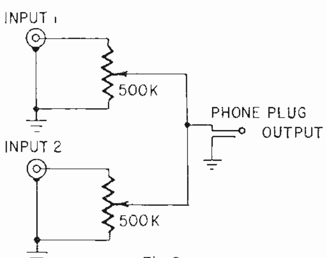


Fig.2

The phone plug needed a modification and a small threaded addition to make it work. The phone plug is a Mallory type 85 miniature plug with an aluminum barrel. Modify it by cutting off 5/16 inch from the threaded end of the barrel. Then take a glass jewel assembly from a Dialco pilot-light assembly and cut 5/16 inch of the threaded portion off it. Screw this threaded portion into the short piece you cut off the barrel. Insert the threaded part of this assembly through the hole in the spice-can lid and screw on the hex nut that was part of the pilot-light assembly (Fig. 1).

Several circuits can be used. Two are shown that are quite different in action. The first (Fig. 2) is better if your inputs have equal amplitude. The other (Fig. 3) is preferable if you are using a high-output phonograph and a low-output microphone.

Make the holes in the spice can before painting it to cover up the advertising on the can. Mount the parts before the wiring is started. The input jacks and volume controls can be wired through the lid opening. The leads are very short so it won't be necessary to use any shielded wire. Short wires are left sticking out through the lid opening and are soldered to the output plug, and the lid is then pushed on. Now paint, apply decals or other printing and the audio mixer is ready to use. END

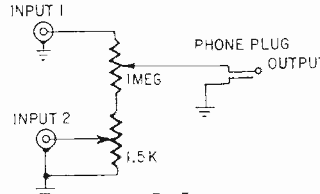
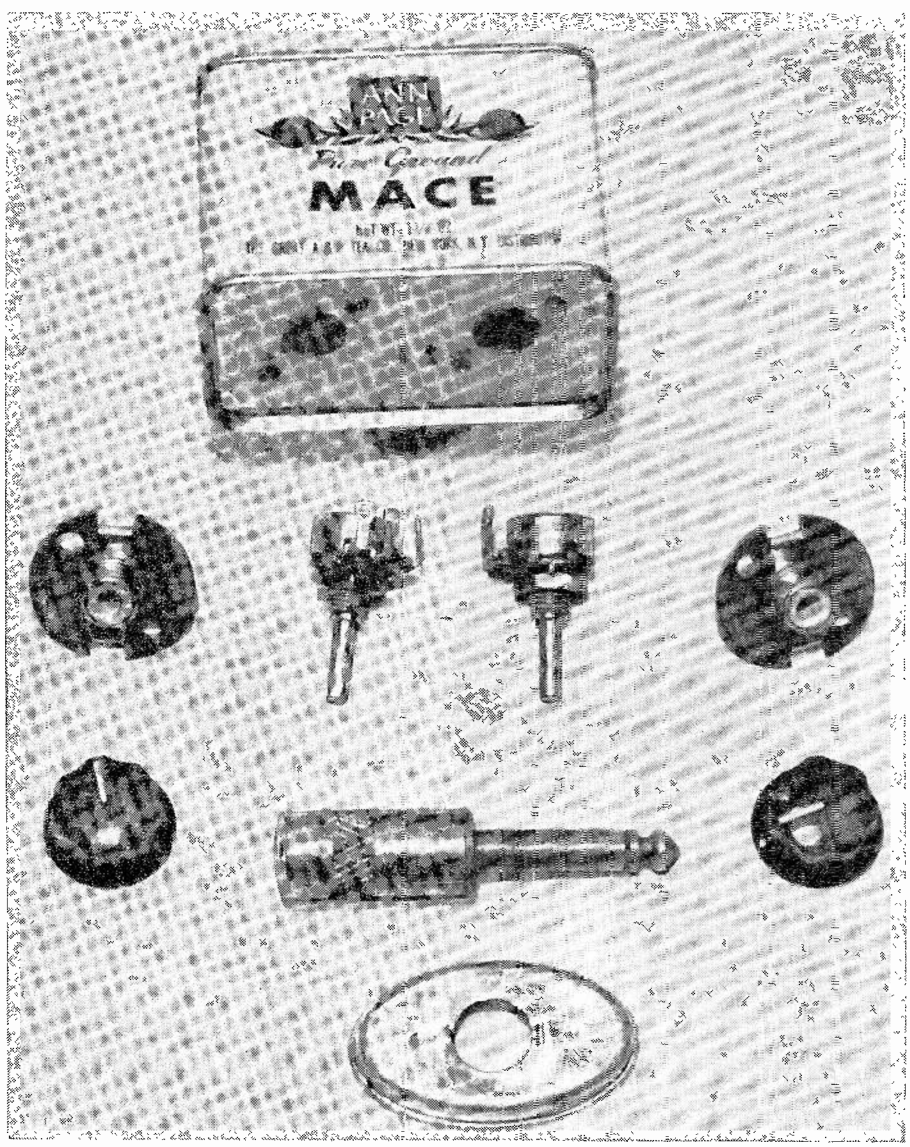


Fig.3



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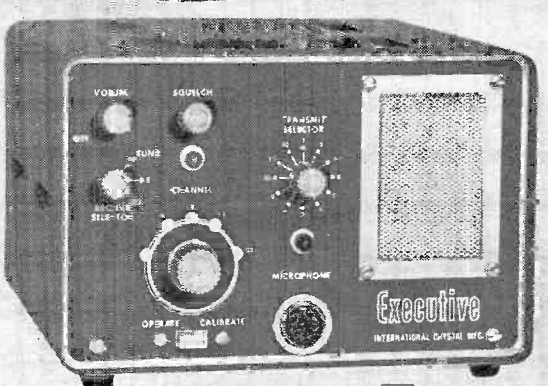

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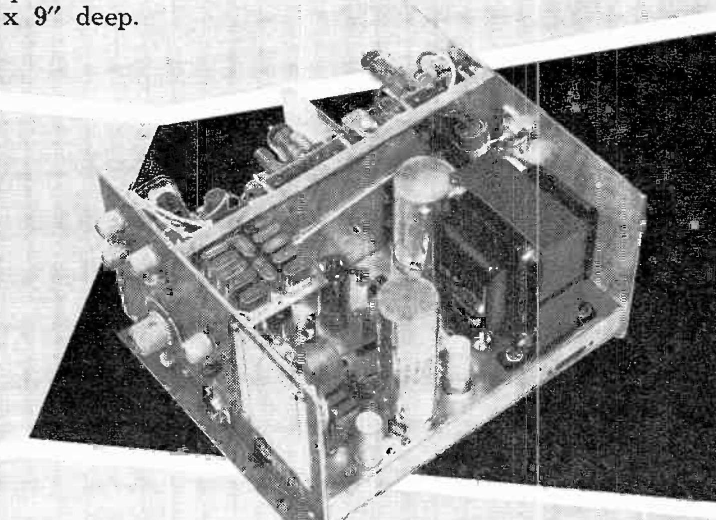

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INDUSTRIAL ELECTRONIC DICTIONARY

From pulsation welding to register control

By ED BUKSTEIN

Pulsation welding: A form of resistance welding in which the power is alternately applied and disconnected. During the off intervals, the electrodes dissipate heat into the surrounding air but the useful heat at the junction of the metals to be welded remains practically undiminished. This technique avoids overheating the electrodes and prevents them from becoming welded to the work.

Pulse equalizer: A circuit that produces output pulses of uniform size and shape in response to input pulses which may vary in size and shape. The one-shot multivibrator is often used for this purpose.

Pulse resolution: The minimum time separation between input pulses that will permit a circuit or component to respond properly. Many circuits will not respond to a second input pulse until the circuit has recovered from the effect of the first input pulse. This recovery time (pulse resolution) is usually specified in microseconds (μsec) or millimicroseconds (mμsec.).

Pyrometer: A temperature-measuring instrument. (See Photoelectric pyrometer.)

Radio-frequency heating: The process of heating a substance by exposing it to a field of high-frequency energy. When the material to be heated is a conductor of electricity (a bar of metal, for example), *induction heating* is used. As shown in Fig. 24, the metal to be heated is placed in a coil connected to a high-power rf oscillator. The rapidly alternating magnetic field established in the coil induces eddy currents in the metal to be heated. These currents flowing through the resistance of the metal produce power losses and raise the temperature of the metal. Induction heating is used industrially to solder lids on metal containers, dry paint on metal surfaces, detonate explosive rivets, etc.

At higher radio frequencies, the induced currents tend to flow on the surface of the metal (skin effect), causing the surface to heat while the interior remains relatively cool. This technique is used to surface-harden gears, cams, blades, etc. Compared to conventional heating methods, induction heating has the advantage of being easily and accurately controllable both in terms of temperature and localization of heat.

When the material to be heated is a nonconductor (rubber or plastic, for example), *dielectric heating* is used. As shown in Fig. 24, the material to be heated is placed between a pair of metal

What's Your EQ? *January Solutions*

Zenith 17B20

The FRINGE-LOCK control, a 5-meg unit in first and second grids of 6BU8 noise-clipper/agc, open. This allowed the sync clipper section of this tube to run wild. Figs. 1 and 2 show the pulses found on the plate (pin 2) and cathode (pin 3) of the 6CN7 afc. The pulses from the horizontal discharge tube on pin 2 are OK, but the pulses from the 6BU8 are quite a mess. Replace control.

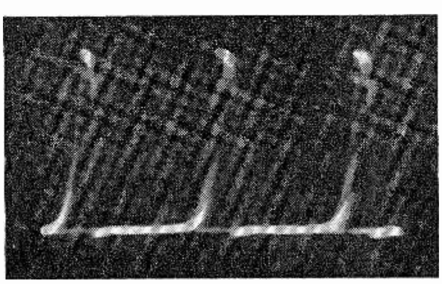


Fig. 1—Horizontal pulses from flyback, found on plate, pin 2 of 6CN7 horizontal afc.

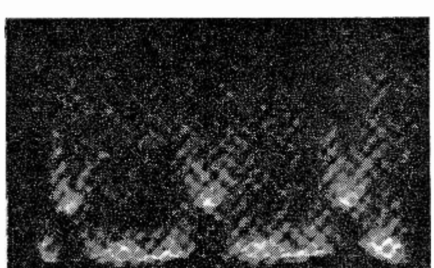


Fig. 2—Blurry mess found on pin 3, cathode, of 6CN7. After repair, these looked like Fig. 2, but 180° out of phase, of course.

High Output Black Box

The gain through a simple, unloaded R – C integrator or differentiator (Fig. 1) varies with the phase shift through the network. It varies with the cosine of the phase angle, being 1 at 0°, 0.866 at 30°, 0.500 at 60° and 0 at 90°. If two or more units with the same phase shift are cascaded, and the impedance of connected networks so chosen that they do not load one another, the phase shift through the cascaded networks is the sum of the individual phase shifts

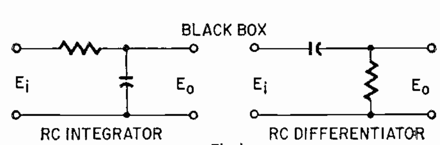


Fig.1

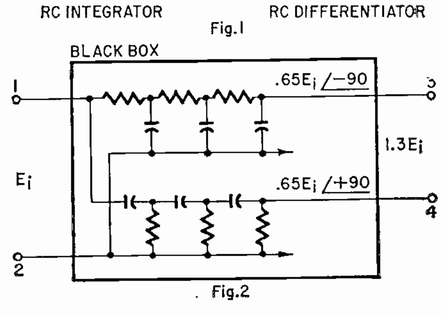


Fig.2

and the network gain is the product of the gains of the individual networks. Therefore, a "Black Box" can be connected as in Fig. 2 to obtain a voltage approximately 1.3 times the input voltage at the frequency for which it is designed. The three 30° sections cascaded have a total phase shift of 90° and an overall gain of 0.866^3, or approximately 0.65. (The theoretical maximum gain of such a network is 2.) Such "amplifying" R – C networks may be used to construct cathode-follower oscillators."

Puzzle in fours

Since the sum of the power dissipated by all three resistors must equal the total power supplied:

$$IE_1 + P_2 + R_3I^2 = P_T$$

Since E_1 is equal to 4, as is R_3, we substitute and rearrange:

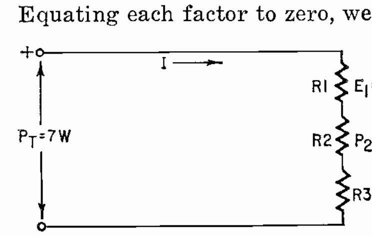
$$4I^2 + 4I + 4 = 7$$

$$\text{or: } 4I^2 + 4I - 3 = 0$$

Solving the quadratic:

$$(2I + 3)\ (2I - 1) = 0$$

Equating each factor to zero, we have



or	$2I + 3 = 0$ and	$2I - 1 = 0$
then:	$2I = -3$	$2I = 1$
and	$I = -3/2$	$I = ½$ amp

The negative current has no meaning to us in this problem, so we use ½ ampere, and find that it gives correct results. R1 equals 8 ohms and R2 equals 16 ohms.

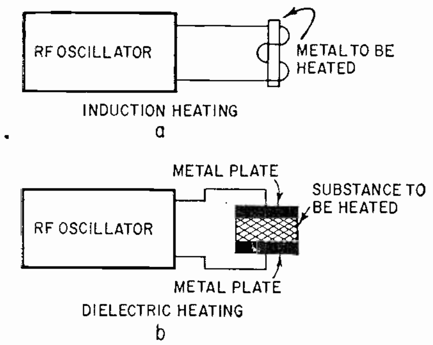


Fig. 24—Rf energy is used for heating metals (a) and nonconductors (b).

plates connected to an rf oscillator. The material to be heated becomes the dielectric of a capacitor, and dielectric losses produce a temperature increase. This technique is used to bond plywood, cure rubber and soften plastics for molding operations.

Radiography: The process of obtaining an X-ray photograph. The object to be examined is placed between the X-ray tube and a sheet of photographic film. After penetrating the specimen in proportion to its density, the X-rays expose the film. When developed, the film shows a shadowlike picture of the internal structure of the specimen. Radiographic inspection is used industrially to inspect welded joints, locate internal flaws and air bubbles in metal castings, check alignment of internal components of complex assemblies, etc. When inspection speed is more important than fine detail and resolution, a fluorescent screen may be used instead of the film. This technique is known as *fluoroscopy*.

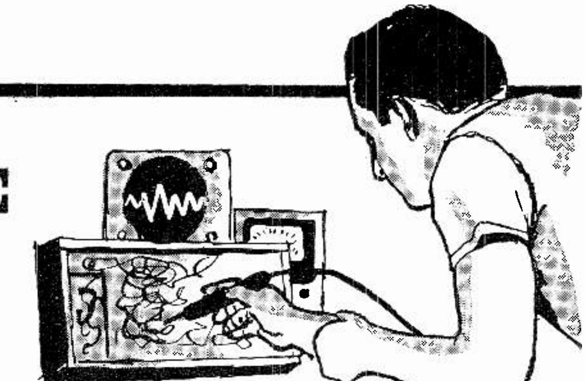
Register: (1) An electromechanical counter consisting of a set of numbered discs similar to those used to indicate automobile mileage. Each input pulse to the register energizes a solenoid which provides the mechanical force to advance the numbered discs. The register is widely used for product counting and packaging. In these applications, a moving part of the machine closes a switch (once for each operation), and the switch completes the circuit to the register solenoid. For counting objects moving along on a conveyer belt or assembly line, a photo-relay circuit activates the register as each object passes through a light beam.

(2) In computer terminology, a register is a circuit used to store a number while that number is being used in a calculation. Since the numbers are usually expressed in binary notation (a succession of ones and zeros), the register commonly consists of a number of flip-flop stages. Some of the stages are *on* to represent the ones of the binary system, and the other stages are *off* to represent the zeros.

Register control: A system of circuits and mechanical components used to control the relative position of a strip of material (paper, cloth, metal, etc.) with respect to the active parts of the machine through which the strip is passing. (See Photoelectric register control.)

TO BE CONTINUED

SERVICE CLINIC



Conducted 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.

THE AVERAGE TV TECHNICIAN HAS ONE very useful test instrument in his shop that doesn't get nearly as much wear and tear as it should. It will furnish a lot of very useful information about lots of circuits, if used when it should be. This is the milliammeter section of the shop's vom.

The typical shop vom is a pretty accurate instrument, or ought to be, usually with a 50-μa 250-mv basic meter movement. This gives us a voltmeter with 20,000-ohms-per-volt resistance.

Current ranges, which is what we're interested in, run from 50 μa up to 10 amperes. One typical unit has the following scales: 0 to 50 μa, 1 ma, 10 ma, 100 ma, 1,000 ma, and 10 amperes. This covers about any reading you will need.

Using the milliammeter

What can we do with one of these? Quite a lot. For instance, one of the most important readings in a TV set is the cathode current of the horizontal output tube. By opening the cathode circuit and connecting the 500-ma vom scale in series with it, we can check the current to see if the new tube we just put in is going to last.

For instance, the 'BQ6 series should never draw more than 110 ma. Normal current should run from 70 to 100 ma. If you find the tube pulling about 120 ma, you can expect a callback at this address within 3 weeks. Correct currents for any other similar tube can be found in the tube manuals.

In stacked-B circuits, a milliammeter can often help locate those obscure defects that drive you mad. If voltages are all off, break the circuit at the audio tube cathode, or any other "source" of the low half, and measure the current there. There are two basic causes for low voltages—low supply voltages and overloads caused by something in the lower half drawing excessive currents. Hanging the milliammeter there will show whether the low voltage is caused by an overload.

To get normal current, pick some resistor in the circuit and calculate the current through it by Ohm's law. There is usually a small dropping or filter resistor somewhere in or around one of these circuits. For example, a cathode resistor in the audio tube's bias circuit. If it is about 500 ohms and has a 10-volt drop across it, current flow is 20 ma.

One item that seems to bug technicians is the little transistor radio. A milliammeter can be a big help when servicing these little monsters. Hook it in series with the battery and check the total current drain. This will give you a lot of helpful information in a hurry. If the current is lower than it ought to be, you've got a weak battery, incorrect bias on an audio transistor, open filter capacitor, etc. Too much current could mean a leaky filter capacitor, shorted transistor, incorrect bias on audio transistors, etc.

Hybrid and all-transistor auto radios are also easier to service with a current meter. If the fuse is blown, connect the 10-ampere scale of the meter in its place and turn the set on. If there's a short, it'll tell you right away. Be ready to turn the radio off in a hurry if that meter pointer seems headed for outer space. If there is something else wrong, such as an open transistor, open audio transformer, burned bias resistor, bias adjustment potentiometer set wrong and the like, current checks will tell you that, too. When replacing a power transistor, use the current meter to set the collector current of the new transistor at the correct value. Wrong operating currents will cause premature failure.

Blown B-plus fuses in TV sets can be checked by connecting the milliammeter in place of the fuse and reading the actual current. This is especially valuable if you suspect some kind of intermittent short in some of the power supply circuits. Set the meter on a scale high enough to prevent meter damage if a sudden short does show up. After you know it's safe, you can drop down to the 100-ma scale and read the exact value of the current.

After you accustom yourself to the idea of reading currents instead of voltages in certain circuits, you'll find that new uses for this section of the vom will suggest themselves all the time.

Stacked-B trouble

I have a DuMont RA-165 for repair. The picture is snowy and the sound is distorted on all stations. The contrast control must be fully advanced.

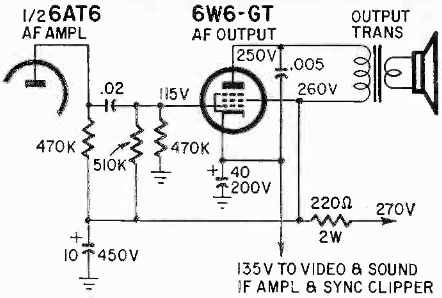


Fig. 1—Stacked B-supply of a DuMont RA-165.

The 135-volt line is too high and the 270-volt line is too low.—J. S., Queens, N. Y.

This could be a voltage distribution problem, quite common in some sets with stacked-B circuits. This set takes the video if, part of the tuner and several other voltages from the audio stage (Fig. 1). The 150-volt line begins at the cathode of the 6W6 and supplies a lot of other things in the set.

Shorts in the 6W6 can burn up the 220-ohm 2-watt resistor in the 270-volt line, upsetting the voltages. Normal resistor drift can upset the voltage divider in the grid of the 6W6—the 510,000 and 470,000-ohm resistors in series to ground, with the control grid tied to the tap. If the 470,000-ohm resistor to ground opens or if its resistance increases, the plate current flow of the 6W6 (which is the main factor in determining what the cathode voltage shall be) changes accordingly, and all the stages supplied by the 135-volt line are upset.

Snowy picture

A very snowy picture appears on the screen of a Westinghouse V-2313-25 chassis. Tubes are all good, plenty of signal from antenna, but I can't get it

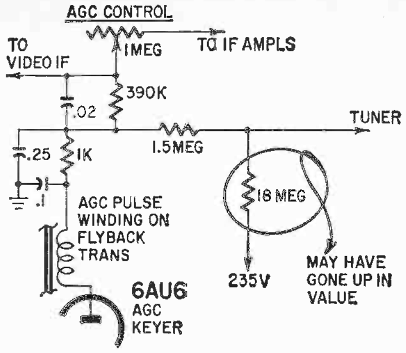


Fig. 2—The 18-megohm resistor often increases in value.

to clear up. The agc control doesn't have the right action—very little effect on the picture.—R. B., Poteau, Okla.

This is agc trouble. If you check the agc line, you'll probably find that it is pretty low compared to what you should have with a good signal. Check out the resistors and capacitors in the agc network, especially the 18-megohm resistor which furnishes the agc buckling voltage (Fig. 2). They have a bad habit of increasing to about 25–30 megohms, which is not enough to let the set block but make it very snowy.

Replacing 12WP4 tube

What cathode-ray tube would be suitable to replace a 12WP4 in a Philco 51-PT-1207? A 12- or 14-inch round or rectangular tube will do.—C. C., Lincoln, Neb.

Philco representatives say it is not practical to use any other picture tube as a replacement for the 12WP4. This is a special type tube with a non-standard base and a thin neck that requires a special deflection yoke and associated assembly. A standard tube cannot be fitted into the existing assembly.

Circuits in Philco sets using this tube develop only about *one-fourth* the power required for standard tubes, and the boosted B-plus voltage is only about 225—one-third to one-half less than that developed by sets using standard 12-inch tubes. Thus, in addition to mechanical alterations, you will have to redesign the horizontal and vertical deflection circuits to operate from a higher B-voltage and to supply the additional deflection power needed by other 12-inch and larger tubes. Many of the set's other components would probably have to be changed to insure proper operation and freedom from breakdown.

Considering all of these factors, the cost of converting the set to use a standard 12-inch tube would probably be more than what it would cost you to go out and buy a new 12AWP4—available at Philco distributors for around $65. END

selective calling for CB

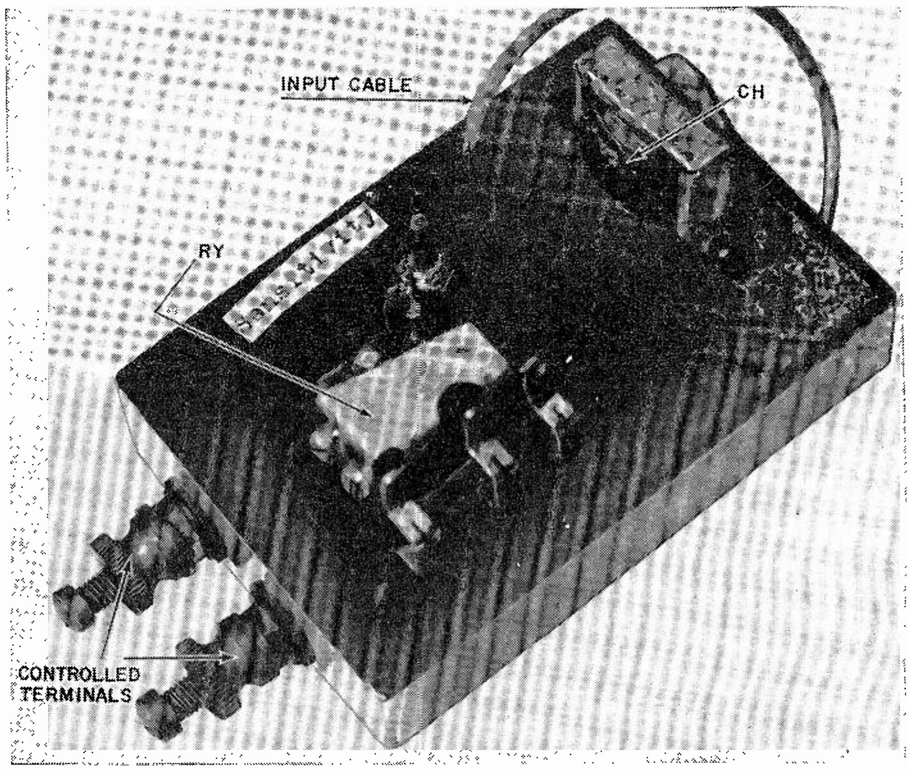
Don't monitor the channel. Let an alarm tell you when you're being called

By GEORGE DE SALVO

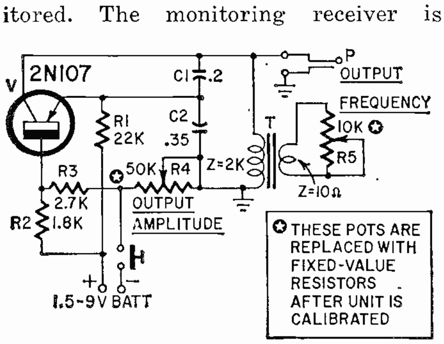
This article describes the operation, construction and calibration of a device designed to improve the reliability of communications on the Citizens band. The system consists of two units—one at the receiving station and one at the transmitting station. The unit used at the called (receiving station) triggers a signaling device to alert the called station when a special signal is received. The system is simple to build and calibrate, noncritical in tuning and has been proved reliable during 6 months of operation.

Conditions on today's Citizens band are becoming more and more crowded and difficult. It is estimated that by the end of 1962 there will be more than 800,000 licensed stations. What this congestion will do to decrease the reliability of contacts is already evident in large metropolitan areas. A strong nearby station operating on an adjacent channel can easily drown out an important call on the monitored channel. If the operator is not listening carefully, the message goes unnoticed. This is especially significant to the many commercial CB users. We will describe a device which will partially solve these problems. It can be built for about $15.

The idea behind the system is very simple. The calling transmitter sends a tone over the air on the channel monitored. The monitoring receiver is equipped with a filter system which attenuates all signal components except for the transmitted tone. This tone actuates a relay which signals the operator that a call is coming thru for him alone. This method has several advantages. First, only a message directed toward the particular receiver is heard. This eliminates the annoyance of having to listen to the conversation of other users. Second, the tone is easier to distinguish than a voice call when buried in noise and other conversations. When coupled to the decoder, a key tone as little as 2 db above the background noise is enough to alert the receiving operator. Third, when used on the radio-control channels, as much as 25 watts input can be used for signaling. This will really get through the 5-watt noise and extend the signaling range. The users can then switch to a clear channel for voice communication.



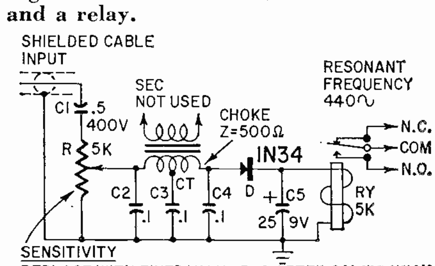
Top view of the decoder.



R1—22,000 ohms
R2—1,800 ohms
R3—2,700 ohms
R4—pot, 50,000 ohms (see text)
R5—pot, 10,000 ohms (see text)
All resistors 10%, ¼ watt or higher
C1—0.2 μf, miniature ceramic, 9 volts or higher
C2—0.35 μf, miniature ceramic, 9 volts or higher
BATT—1.5-9 volts (see text)
P—phone plug
S—spst pushbutton switch
T—audio transformer: primary, 2,000 ohms; secondary, 10 ohms (Lafayette TR-93 or equivalent)
V—2N107
Miscellaneous hardware

Fig. 1—The coder unit is a simple 1-transistor oscillator.

Fig. 2—The decoder is a tuned filter and a relay.

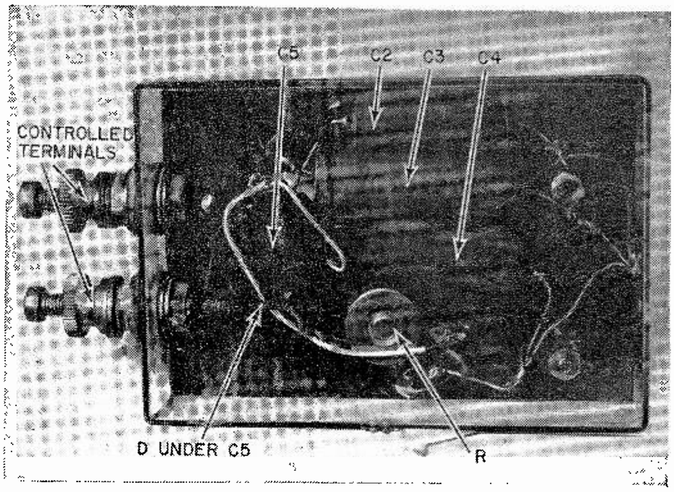


R—pot, 5,000 ohms (see text)
C1—0.5 μf, 400 volts
C2, C3, C4—0.1 μf, 9 volts or higher
C5—25 μf, 9 volts or higher, miniature electrolytic
CH—primary of audio transformer, 500 ohms (Lafayette TR-95 or equivalent)
D—1N34
RY—spdt relay 5,000-ohm coil (Sigma 4F-5000-S/SIL or equivalent)
Miscellaneous hardware

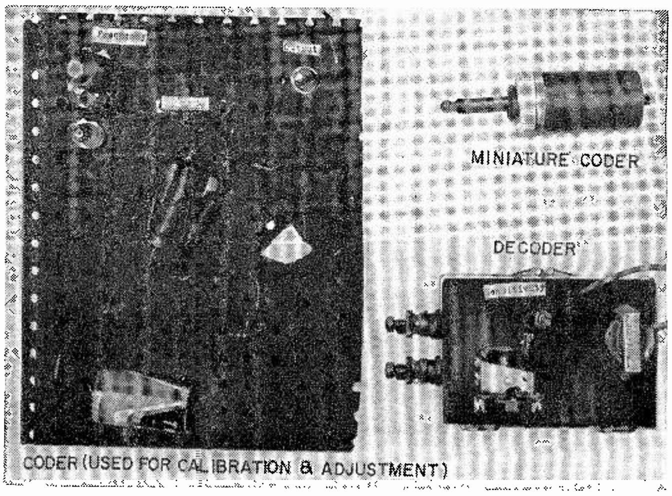
How the circuit works

The system itself consists of two units. The coder, actually a tone generator, is used at the transmitter. A decoder, actually a filter, demodulator, and relay combination, is used at the receiver.

The choice of the triggering tone must be left to the individual constructor. We chose 440 cycles. This frequency was chosen because it is a widely used standard and tests for frequency devi-



Underchassis of the decoder. Note that this unit is built into a plastic case.



The complete system.

ation and drift can be carried out with a high degree of accuracy.

The coder consists of a simple Colpitts sine-wave oscillator with modifications. Its frequency is determined by tank circuit T, C1 and C2. (Fig. 1). T is a transistor type audio output transformer. When its secondary is open, the frequency of oscillation is

$$\frac{1}{\sqrt{\frac{C1C2}{C1 + C2} L}},$$

when L is the inductance of the primary of T. However with the inclusion of R5 the frequency can be varied over a 2-to-1 range and set. This is possible because the resistor loads the transformer, effectively changing the inductance of the primary. R4 controls the output amplitude. The other resistors bias the transistor for proper operation. The battery can be between 1.5 and 9 volts, depending on the output required. Transistor V can be any p-n-p unit which can take 9 volts collector-to-emitter and has a beta (β) of 10 or better. All values shown are for a resonant frequency of 440 cycles. The circuit is quite stable and did not drift more than 1 cycle from 32° to 120°F (the limits of our test).

The decoder consists of double-pi network filter followed by a half-wave demodulator (rectifier) coupled to a high-impedance relay (Fig. 2). Capacitor C1 blocks the dc from the plate circuit and passes the signal to choke CH, which is the 500-ohm center-tapped primary of a transistor output transformer. It's secondary is left open. C2, C3 and C4 tune this winding to a resonant frequency (in our case 440 cycles). Diode D and C5 form a half-wave peak rectifier that provides a dc output to drive the sensitive relay—a 10-mw Advance unit with a 4,000-ohm coil. However, any high-impedance relay with 10-mw sensitivity is suitable. The contacts can be used to sound a buzzer or other signaling device.

Alignment and calibration

Alignment is simple if both the coder and decoder are constructed to resonate at approximately the same frequency. Use a dummy load for your transmitter during this procedure. First we must set the resonant frequencies exactly. This is done by tuning the coder to match the decoder. There are two ways to do this. The first requires no instruments other than a voltmeter and can be completed easily and quickly.

Plug the coder into the mike jack of your CB transmitter. Connect the decoder to the plate of the audio power amplifier tube of the receiver as shown in Fig. 3. Set the coder's output amplitude control at maximum. Key the transmitter on.

Set the coder's frequency control at maximum resistance. Slowly turn up the sensitivity control of the decoder until the relay trips. If the resonant frequencies are reasonably matched, this should occur at approximately half rotation. Place a dc voltmeter across the relay coil and adjust the frequency control of the coder for maximum voltage. Then turn the decoder's sensitivity control back to zero and bring it up slowly as before. The relay should trip at a lower setting than before. The frequency controls are now set. Lower the coder's amplitude control while raising the decoders sensitivity control. Adjust for maximum decoder sensitivity.

If a scope and audio generator are handy, a much more exact alignment is possible. Connect the scope's vertical input across the filter's output (across the relay coil) and set the signal generator at the frequency that produces maximum deflection on the scope (Fig. 4). This is the resonant frequency of the decoder's filter. Apply the signal from the coder's output into the horizontal plates of the scope. Adjust the coder frequency control until a slowly rotating ellipse is observed. The slower the better. Both coder and decoder are now matched.

Even if the circuits are designed perfectly from the standpoint of equations for resonance, one of the preceding methods must be used for optimum matching. This is because the components, particularly the transformers, may vary considerably from unit to unit or brand to brand.

A code frequency between 200 and 2,000 cycles should be used. They are easily passed by the audio circuits of the transceiver and are easily obtainable with standard components. We could have tabulated capacitor values to be used for a certain transformer for a set bandpass, but as mentioned previously component variation makes this futile.

The final model of the decoder was built into a small plastic box and the signal was taken through shielded

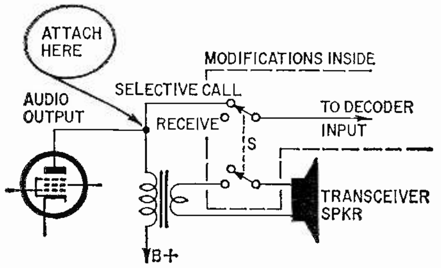


Fig. 3—How to connect the decoder into your CB receiver circuit.

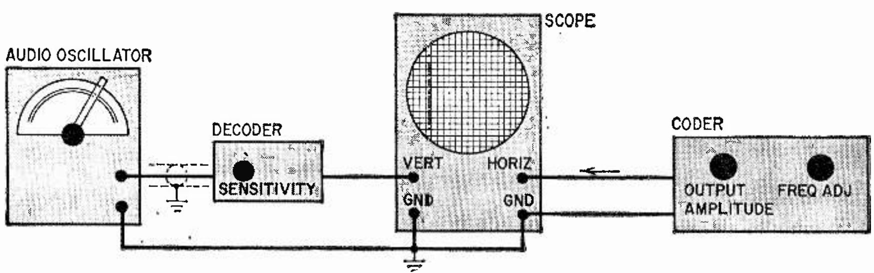


Fig. 4—Use this calibration setup to adjust your coder and decoder.

cable from the plate of the audio tube through a switch which chooses either connection to the speaker or to the decoder. We used a loud buzzer for a signaling device.

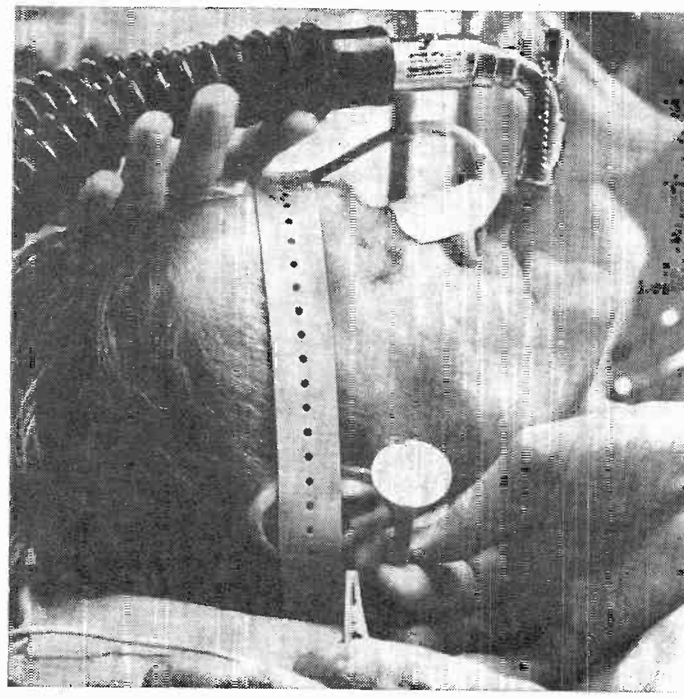
The coder was first built in a haywire fashion. It was then calibrated as indicated. Pot settings were noted, then replaced with fixed resistors. To reduce size, subminiature high-capacitance ceramic capacitors replaced the usual paper units. The mounting frame was removed from the transformer and the whole unit shrunk enough to fit in a small pill bottle which we terminated on one end in a phone plug and an on-off pushbutton switch on the other.

When you want to call a station equipped with a decoder, plug in the coder into the mike jack, key the transmitter and switch on the coder. The transmitter may be keyed with a signal that indicates what channel to use for voice communication or "Come home—soup's on." This reduces air time.

On the receiving side, the decoder's sensitivity is adjusted so that voice or noise does not trip the relay accidentally while even a weak key frequency tone will trigger the signal. A superhet receiver is needed to insure proper operation. It should also have some sort of squelch.

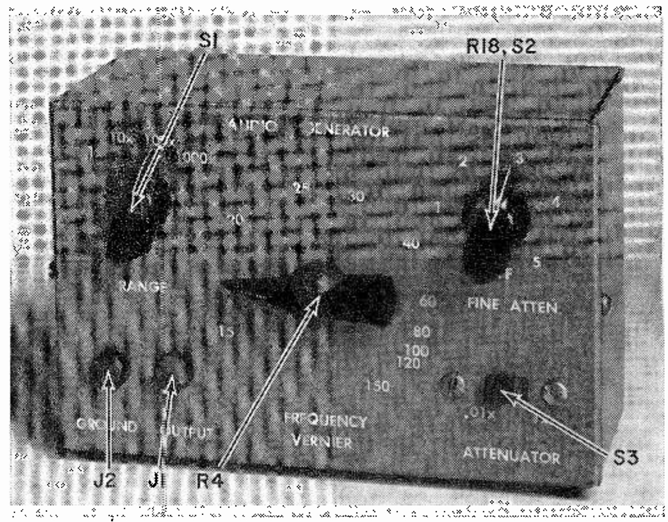
Either or both units have other uses too. The coder can act as an audio sine-wave generator or as a code-practice oscillator. The decoder could be used in any application where a tone-controlled response is required. END

electrical anesthesia



Electrodes are placed against the head of a simulated patient in a demonstration of a new electric anesthesia technique being developed by Dr. James D. Hardy of the University of Mississippi Medical Center. The instant the 700-cycle current is turned on the patient becomes unconscious. As soon as it is turned off the patient awakens. Best of all there appear to be no after-effects. Research is being continued by the university under a contract with Army Medical Research Development Command.

audio generator fits your tube caddy



Completed unit is only 2 inches deep.

Portable 4-transistor unit is excellent for hi-fi work

By STANLEY E. BAMMEL

Here is an all-transistor wide-range sine wave audio generator. It covers 15 to 150,000 cycles in four slightly overlapping ranges. It is portable and just the thing for testing hi-fi equipment and is easily built from non-critical parts. The cost is relatively little.

The circuit is basically a Wien-bridge oscillator. Direct coupling throughout makes its wide frequency range possible, eliminates such problems as motorboating and reduces the cost. The Wien-bridge oscillator (Fig. 1) consists of an amplifier with a phase shift of 0° or 360° and a voltage gain of 3. Feedback is taken through the Wien bridge network which feeds a third of the output voltage back to the input. The oscillator works at the frequency at which the network gives a phase shift of zero.

Transistor V1 provides a high input impedance through the use of an unbypassed emitter resistor (Fig. 2). The input impedance of the stage is approximately $R_e(B + 1)$ where R_e is the emitter resistor and B the ac beta of the transistor. All the 2N1265's I have tested have had an ac beta of 50 to 100. Therefore, the input impedance of this stage ranges between about 165,000 and 330,000 ohms. Negative feedback through R11 raises this impedance even higher.

V1 is biased through a network made up of R1, R6, R7, R9, R23 and R4-b. The network also limits the effective range of R4-b.

The signal is direct-coupled from V1's collector to V2's base. Returning V2's emitter to a tap on the battery is a convenient way of providing it with a low impedance at the proper voltage. This arrangement also allows a fairly high-value collector resistor for V1 which makes for high gain.

V2's output impedance is fairly high, so an emitter-follower or common-collector stage (analagous to a cathode follower in a tube circuit) is used at the output. This stage (V3) provides a low output impedance.

V4 in conjunction with the diodes and other components forms an automatic amplitude control. This is what makes the generator possible. Anyone who has tried to build a transistorized variable oscillator has undoubtedly run into the problem of providing a constant amplitude across the whole frequency range. V4 and the diodes take care of this.

V4 is normally biased to cutoff but, when oscillator amplitude goes high enough, it conducts on negative peaks. A pulse proportional to the excess amplitude appears at V4's emitter. This pulse is coupled through C10 to D1 and D2. These diodes rectify the pulse and apply a forward bias to D3 and D4. C11 and C12 filter the rectified current. As the forward bias on a semiconductor diode increases, its resistance decreases. Therefore, the resistances of D3 and D4 decrease and they pass some of the signal at V1's collector to ground through C11 and C12. When this happens, gain decreases. Overall, the circuit regulates output voltage within ±10%.

The extra components in the two high ranges are necessary to get the desired sweep of 10 to 1 per range. Without them, the ratio is only about 9 to 1 on the ×100 range and 4 to 1 on the ×1000 range.

BENCH TESTED

Unit performs well. Produces clean sine wave over range of 13 cycles to 150 kc. All ranges overlap enough so that no frequency is at the absolute end of the dial rotation. Unit fits easily inside tube caddy and can be handy for checking hi-fi equipment in the home.

Construction hints

I built my unit in a 3 x 4 x 6-inch chassis box. Anything with enough room on the front panel for the controls should be OK. Keep the leads in V1's base circuit as short and as isolated as possible because this is a high-impedance circuit. Otherwise, layout is not critical.

I mounted most of the small parts on a piece of phenolic board. The parts are mounted on one side and all connections are made on the other.

The oscillator should work with the values shown. It is not especially sensitive to variations in different transistors. In fact, almost any general-purpose transistors should be all right. The only exception may be V1. It should have as high a beta as possible.

If you build this circuit and find that it does not oscillate evenly over the whole range or will not oscillate at all (in the latter case, check for wiring errors first), raise the value of R11. This lowers the negative feedback and raises the overall gain. If you have difficulty getting it to oscillate on the low end of each range, lower the value of R5. If the difficulty is on the high end, lower the value of R22.

On the other hand, if the output is distorted, gain is too high. Lower the

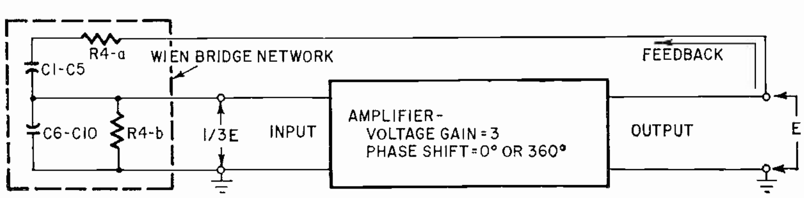


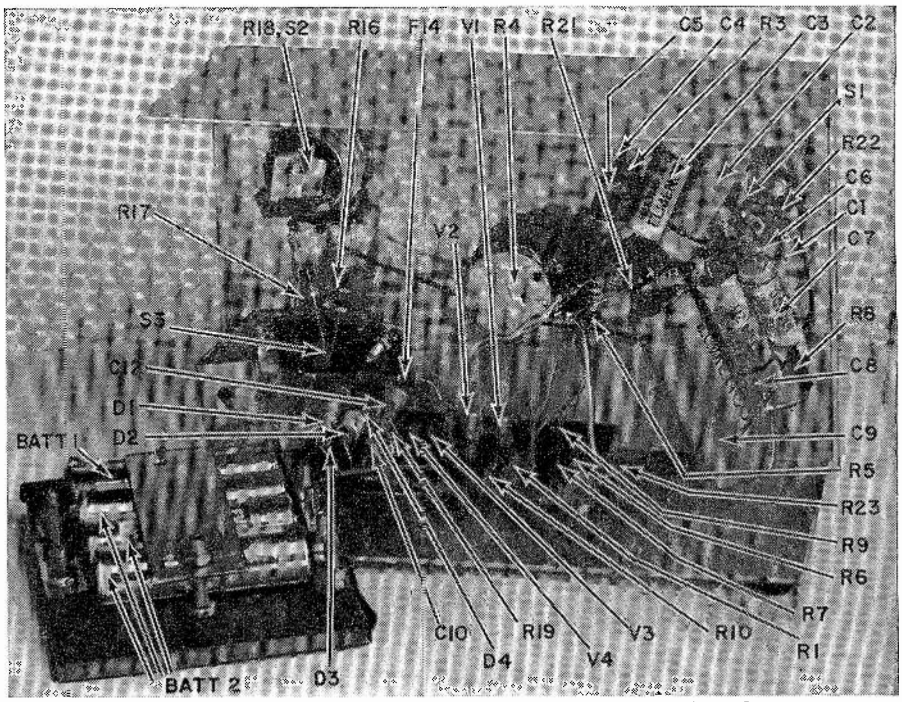
Fig. 1—A Wien-bridge oscillator is at the heart of the unit.

value of R11 or raise the value of R22 or R5.

These adjustments are fairly easy to make by adding resistors in parallel or in series. To lower the value, insert a relatively high value parallel resistor. To raise the value, insert a relatively low-value series resistor. Experiment until you have it exactly right.

Other adjustments that might be necessary may be the extra components in the two highest ranges. These values were determined experimentally and must be adjusted the same way.

(Mr. Bammel states that R21, R22, and R23 were used for calibration and may not be needed or may vary with the exact value of the 10% resistors used in the frequency-determining network. He suggests eliminating R13 entirely and changing R14 to 4700 ohms. In some cases, calibration requires placing R23 in parallel with R6 instead of in series with it as shown.—*Editor*)



Inside the case. Note subassembly on phenolic board.

Calibration

The unit is easy to calibrate with the aid of an oscilloscope. Set the scope's horizontal sweep for line sweep and hook the generator's output to the vertical input terminals. With the RANGE switch on ×1, set the generator's FREQUENCY VERNIER for a stationary pattern. Now divide the number of vertical peaks on the scope screen by the number of horizontal peaks and multiply by 60 ($F = \frac{V}{H} \times 60$).

The next higher range should be exactly 10 times the frequency of the lower. If the frequency is higher, more capacitance is needed; if lower, less capacitance.

If one range oscillates weakly, there is not enough feedback. If one is distorted, there is too much feedback and it is overloading. In either case, the two capacitors for that range are not exactly equal, or at least they are not in the same relationship as the capacitors in the other ranges. If the capacitor in one leg (S1-b) is too large or the capacitor in the other leg (S1-a) is too small, there will not be enough feedback. If it is the other way around, there will be too much feedback.

All changes must be made in respect to all variables (frequency and amplitude). For instance, if the frequency is too high and there is not enough feedback, the total capacitance should be increased. To get more feedback, the capacitor selected by S1-a must be increased in value or the capacitor selected by S1-b must be decreased. Since you want to increase the total capacitance, increase the one selected by S1-a. In this way both problems can be solved with one change.

Capacitance can be adjusted in much the same way as resistance. This was

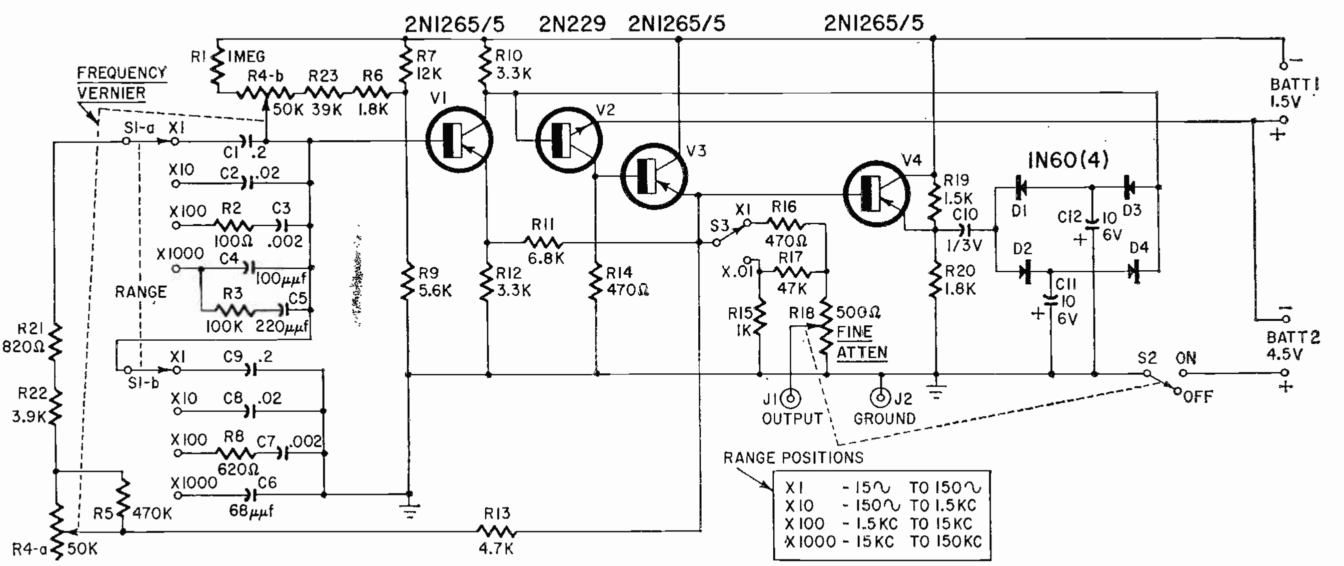


Fig. 2—Four transistor circuit is straightforward and easy to build.

R1—1 megohm
R2—100 ohms
R3—100,000 ohms
R4—dual pot, 50,000 ohms each section (Clarostat AD47-50K S or equivalent)
R5—470,000 ohms
R6, R20—1,800 ohms
R7—12,000 ohms
R8—620 ohms
R9—5,600 ohms
R10, R12—3,300 ohms
R11—6,800 ohms (see text)
R13—4,700 ohms
R14, R16—470 ohms
R15—1,000 ohms
R17—47,000 ohms
R18—pot, 500 ohms, with spst switch
R19—1,500 ohms
R21—820 ohms
R22—3,900 ohms
R23—39,000 ohms
All resistors ½-watt 10%
C1, C9—0.2 μf, paper
C2, C8—.02 μf, paper
C3, C7—.002 μf, paper
C4—100 μμf, tubular ceramic
C5—220 μμf, mica
C6—68 μμf, ceramic disc
C10—1 μf, 3 volts disc ceramic (Centralab UK-105 or equivalent) or electrolytic
C11, C12—10 μf, 6 volts, electrolytic
BATT 1—1.5 volts (D cell)
BATT 2—4.5 volts (3 D cells)
D1, D2, D3, D4—1N60
J1, J2—tip jacks
S1—2-pole 4-position rotary switch (Centralab PA-1002 or equivalent)
S2—spst on R18
S3—spdt slide switch
V1, V3, V4—2N1265/5
V2—2N229
Case—3 x 4 x 6 inches, chassis box
Miscellaneous hardware

described earlier. The only difference is that in paralleling, a relatively low-value capacitor is used and in series a relatively high-value capacitor is used. (Paralleling will increase total capacitance; a series connection will decrease total capacitance.) Sometimes extremely high value units must be in series, and it may be much easier to just try different capacitors of the same value.

If a scope is not available, feed the generator output through an amplifier and speaker. Then compare the tone to a piano or other musical instrument. By consulting a frequency chart, you'll know just what frequency you are getting.

Variations

The generator could be modified in several ways. For example, it could produce only a single fixed frequency. Simply substitute two fixed resistors for R4-a and R4-b and eliminate the RANGE switch.

Another possible modification would replace the continuously variable FREQUENCY VERNIER with a step control. To do this, use a multi-position rotary switch and a group of fixed resistors to replace R4. Fig. 3 shows one possible

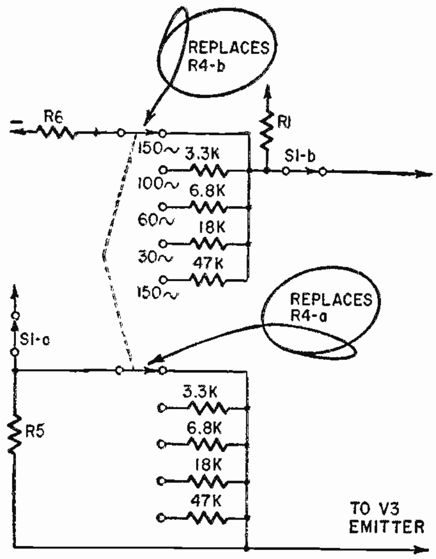
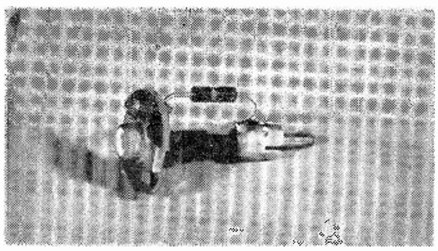


Fig. 3—This step frequency selector can be used instead of the continuously variable control shown in Fig. 2

arrangement. You might want to use different value resistors to get desired frequencies. But keep the resistors within the range of 5,000 to 50,000 ohms. END

Tape bias test adapter



By HAROLD REED

THE little gadget described here will make it easy for the audiophile to check the bias current to the record head of his tape recorder as well as to measure the erase current flowing through the erase head. Also, it is one of those welcome time-savers for the service technician.

These measurements should be made if quality of reproduction from a recorded tape is below par or if erasure of the tape is incomplete. The recommended procedure for measuring bias and erase currents is to break the ground side of the connections to the head and insert a 100-ohm resistor in this circuit—usually inconvenient.

Most recorders have standard phono jacks and plugs to connect the electronic section and the tape deck, with the jack mounted on the deck assembly.

The tiny test adapter consists of one of these jacks and plugs. The center conductors of these two items are connected with a short length of No. 14 bus wire. This size wire gives rigidity to the gadget. Spaghetti tubing slipped over the wire prevents shorting to the ground side. Then solder a 100-ohm resistor between the ground sides of the jack and plug, as shown in the photo.

To use the test adapter, remove the plug going to the head jack on the deck and plug it into the adapter jack. Insert the adapter plug into the head jack. Now, connect an audio vtvm across the 100-ohm resistor with the high side of the vtvm toward the head. Set the recorder in the record mode to place the bias oscillator in operation, and read the voltage drop across the resistor on the meter. The same procedure holds for either record or erase head measurements.

The bias or erase current, whichever is being measured, is determined by

$$I = \frac{E \times 1000}{R}$$

where I is the current in milliamperes, R is the resistor value (100 ohms) and E is the voltage drop across R.

Bias current will usually range from 0.5 to 1 ma, and erase current will run from 5 to 15 ma. Compare the results with the recommended values given in the service manual of the recorder.

Where necessary, other connectors may be used. Since the oscillator frequency is normally above 50 kc, for greatest accuracy the test should be made as close to the heads as possible—there is usually a voltage drop in the connecting cable between the oscillator and record or erase head. Keep test adapter leads as short as possible. END

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CLOSED-CIRCUIT TV FOR THE SCHOOL

How an efficient low-cost system can be set up

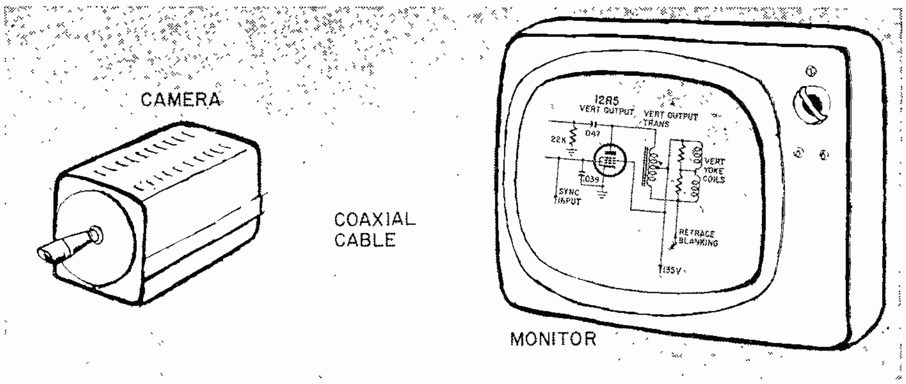


Fig. 1—Basic closed-circuit system consists of camera and monitor tied together by coax cable.

By JACK BEEVER

CLOSED-CIRCUIT TELEVISION IS A VERY broad term, one that encompasses every use of a television camera and viewer that does not include a broadcast transmitter as part of the system. In complexity, it ranges from a simple camera and monitor connected by coaxial cable all the way to the state-wide educational systems, which include the coaxial cable linking of all schools within a school district, and the linking of school districts by microwave.

Microwave links do not eliminate the closed-circuit concept since a microwave transmission is not broadcast—it is point-to-point, and almost as private as a length of coaxial cable.

The applications most interesting to us are in the small-business area. They extend from the simplest surveillance setup of a single camera to the largest in-building multiplex installation. Large building systems may involve a group of buildings on commonly owned ground—such as a college campus or a large hospital. Even prisons are adding complex CCTV systems.

A quick look at the most commonly talked-about application, the industrial camera and monitor setup, should clear the way for the more interesting multiplex automatic-studio systems.

The basic output of an industrial TV camera is composite video that contains currents from dc to as high as 8 mc, depending on the quality and adjustment of the camera. A video monitor accepts such signals and produces TV pictures from them. Therefore, if we connect a camera and monitor with coax cable, as in Fig. 1, we have a basic closed-circuit system. It provides a picture whose quality is limited by the characteristics of either the camera or monitor.

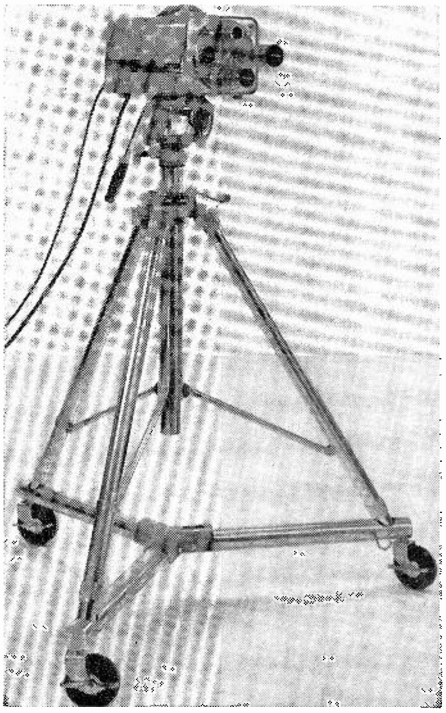
System limitations are:

- It provides no sound signal. Audio, if needed, must be provided by a separate system.
- It operates in a range of frequencies that includes power-line frequencies, and is subject to hum troubles due to ground loops. On long runs, grounding may become a problem.
- The cable can carry only one signal. It cannot be multiplexed.
- Due to the wide range of frequencies in use, the cable's loss varies widely, and compensating amplifiers are needed if long runs are intended. These amplifiers have high gain at the high frequencies, and low or no gain at the lower frequencies.

The camera/monitor system also has advantages—don't sell it short. Some of them are:

- It uses a minimum of apparatus.
- Maintenance costs are low.
- Installation is generally simple.
- Longer runs are possible without amplifiers than with rf systems.

Such systems are most commonly used for surveillance in factories, warehouses, department stores, banks, railroad yards and traffic control.



Argus CCTV camera on its mobile tripod.

Educational CCTV

When you enter the educational field, new problems arise—you need flexibility and you can't afford to get it by hiring a full-time crew of technicians and cameramen. The chances are that the equipment will be operated by instructors and students.

Let's take a look at the requirements of a high school or preparatory school when the curriculum is aimed toward scientific or academic career building. Keep in mind that the main object is to "spread out" a teacher or an experiment. We might want to be able to place a camera in the physics, chemistry, biology or general science laboratory, gymnasium, assembly hall and any other special service rooms.

It is not necessary that these rooms all have cameras operating simultaneously, and since the camera is the most expensive single piece of equipment in closed-circuit systems, it is likely that the school's budget cannot afford very many.

We need viewing devices—TV receivers or monitors—in every room where students assemble. We also need provisions to pipe off-the-air educational TV programs to every viewing location.

Take a look at what going video with simple camera and video monitors entails. You need coaxial cables from each camera location to a centrally located patch panel, a kind of telephone switchboard for coaxial cable. From this same point, cables would run to each room where monitors would be located—which means all rooms.

CCTV via rf

Such spiderweb wiring is extremely expensive and requires very large conduits or raceways and pull boxes. There is a less expensive and more flex-

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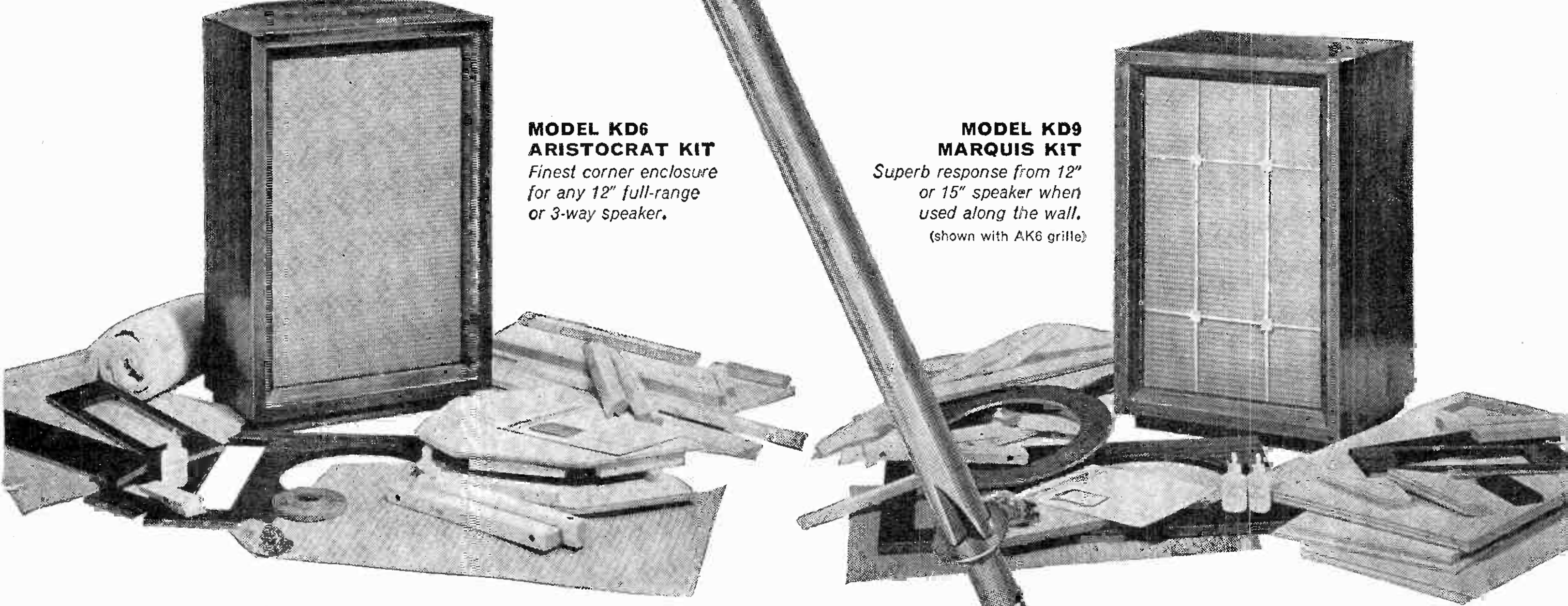

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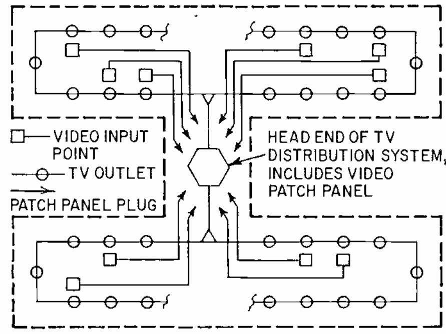


Fig. 2—Spiderweb of coax cables is needed for school video CCTV system.

CHANNEL	LOWER BAND EDGE	VIDEO CARRIER	AUDIO CARRIER	UPPER BAND EDGE
07	4.75	6	10.5	10.75
09	16.75	18	22.5	22.75
011	28.75	30	34.5	34.75
013	40.75	42	46.5	46.75

FREQUENCIES IN MC

Fig. 3—Table of specifications for the four subchannels possible using an rf system.

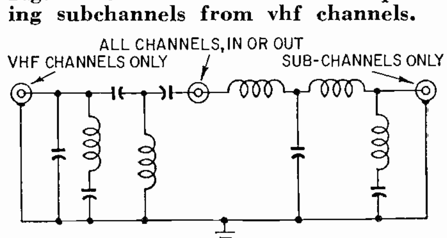
ible method—going rf—which means that you use self-originated programs modulating vhf carriers, just as is done in a TV broadcast.

Only one exception is made—you do not broadcast. Instead, you feed the vhf into a coaxial cable. And since you can multiplex on vhf, it is practical to run 10 channels on the same cable and, at a higher cost, up to 16 simultaneous channels.

The simplest form of vhf TV transmission is found in cameras such as the Argus (RADIO-ELECTRONICS, Nov. 1959). It contains a built-in modulator and, when operating, puts out a 0.1-volt signal at any one of the low-band TV channels (2, 3, 4, 5 and 6). Such a signal can be sent over more than 1,000 feet of RG-59/U coaxial cable or 2,000 feet of RG-11/U before it falls below a level of 3,000 μv, and any television set will perform well on 3,000 μv.

However, the big improvement is that we can feed camera signals into the cable simultaneously, one on channel 2, another on 4 and still another on 6. Any standard TV receiver tapped onto that cable can show the picture of any of the cameras at will. A point to remember is that these cameras put out a double-sideband signal, so you can't use channel 3 when using 4, or channel 5 when using 6. If you did, you would be getting mixed up with the lower sidebands of the higher channel.

Fig. 4—Crossover network for separating subchannels from vhf channels.



One big advantage of such systems is economy. Standard television receivers can be used; and, thanks to mass production, they cost less than the technically simpler video monitors.

Video monitors, however, are usually of very high quality. They are classed as test instruments, and close tolerances are held in their construction.

Vhf distribution systems

For a school of any size to use off-the-air educational TV properly, it needs a television distribution system so the signals received can be piped into the various classrooms. This system does almost exactly the same job for off-the-air channels as was just described for the vhf-output cameras. As a matter of fact, if one of the off-the-air channel inputs is replaced by a camera with a vhf output, it will distribute this signal to all receivers in the building. The only thing it does not do is provide points of origination within the building itself.

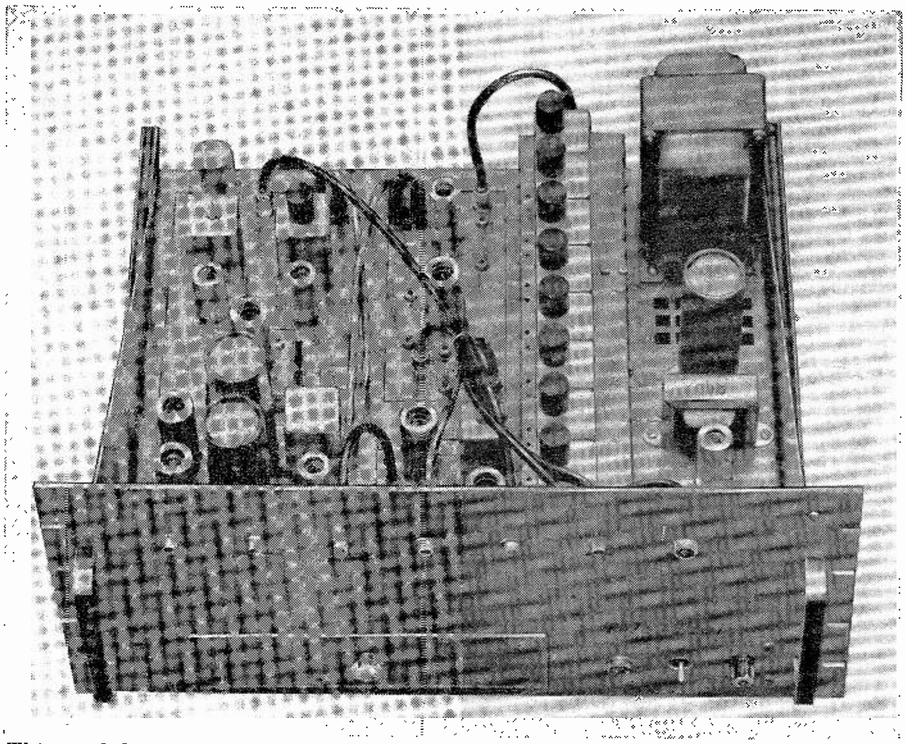
One way of doing this (and the approach used in some early installations) is to install a system of coaxial cables originating in various rooms and terminating at some point convenient to the distribution system's head end (Fig. 2). Note that certain areas have been selected as input points for video signals from a camera so a camera operating in these rooms can feed its signals back to the head end location. At the head end, these cables end in patch-panel plugs, or coaxial connectors. Here they are made convenient to a patch panel which allows the input of any camera to be connected to a modulator which produces a vhf carrier with the proper video modulation. This modulator is in actuality a miniature TV station and with a microphone and camera produces an actual TV signal.

With the system described, a number of modulators on different channels may be used to run simultaneous programming—the camera outputs going to the patch panel, from patch panel to modulator, and from modulator onto the television distribution system's head end. Signals are now available at any receiver within the building.

Another approach

This system is quite workable, but has limitations. The school planners must determine in advance what rooms are to be used for program origination. If too many rooms are chosen, the cost of coaxial cable becomes astronomical, since each camera input runs all the way to the head end or studio location. The system lacks flexibility and rapidly becomes cumbersome and expensive. Another approach uses only one cable passing from room to room and which can be used to transmit pictures in both directions. These pictures may originate in the building, from any room which has a television outlet.

This new system calls for a new concept in coaxial cable wiring. Basically, coax is a practical transmission line for all frequencies between dc and 300 mc. Above this range, losses of practical



This modulator produces a complete vhf TV carrier. The strength of the rf output signal is 1 volt. Unit is made by Jerrold.

cables becomes too great and we get into trouble with amplifiers. However, in the usable band, coax is our own private broadcasting space, and we can do anything we like. We can broadcast TV on frequencies other than those assigned by the FCC, for instance. And just as channel 4 signals from New York City cross channel 3 signals from Philadelphia at Trenton, N. J., going in opposite directions, we can similarly broadcast two ways in our own private space, the coaxial cable. We must obey the physical laws, however. We cannot, for example, broadcast two channel-3 signals simultaneously. It confuses the TV receivers.

Four "extra" channels

Let's look at the unused spectrum space we have—the space not used by standard TV receivers or FM sets. Since TV uses frequencies between 54 and 88 mc and 174 and 216 mc, we have a good area below 54 mc where losses will be low. We can broadcast (in the cable) at these frequencies (called, in the trade, subchannels). Creating these subchannels is simple: we convert a standard TV channel to a subchannel by a simple heterodyne converter.

TV channels are 6 mc wide, but the job of working with TV is easier if there is a blank, unused channel between each working channel. Therefore, we find that we can easily have four channels below channel 2, which starts at 54 mc. For example, we could have channels which we'll designate 07, 09, 011, 013. Fig. 3 shows the frequencies chosen for these subchannels.

This arrangement has a secondary value since a single broad-band converter can change all these frequencies at one time, with one oscillator, to the high channels—7, 9, 11 and 13—an economy in some applications.

Since we can do these things, we need to look at devices for coupling into a coaxial cable which loops from room to room. This is not too easy if we stick to the concept of using a wall plate outlet which contains the necessary matching and isolation networks. It is likely to make it necessary to take out the plate whenever we wish to change the function in the room. For instance, to change from an rf receiver to a video monitor or camera, we would have to change the outlet circuitry. This is too cumbersome, especially for nontechnical operating people.

One approach to this is simply to refrain from putting any works into the wall in the first place. Just bring out the cable ends and plug whatever devices you need between the ends. If the outlet is not to be used, merely

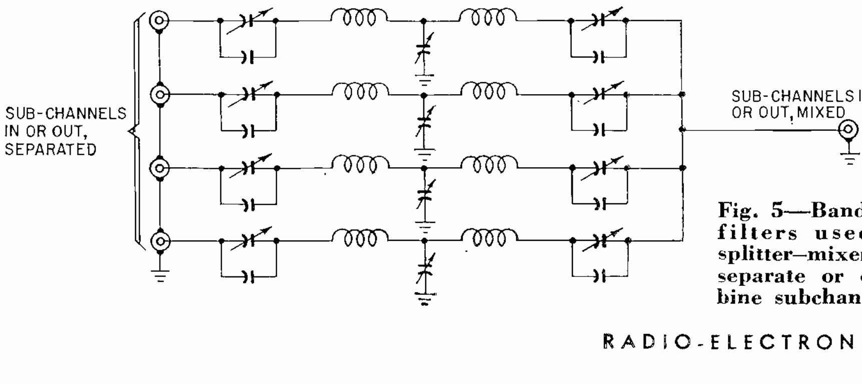
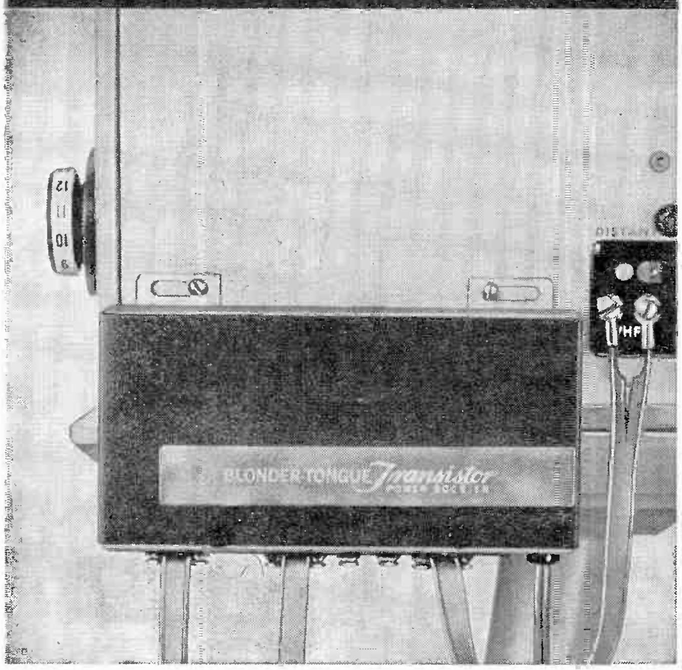
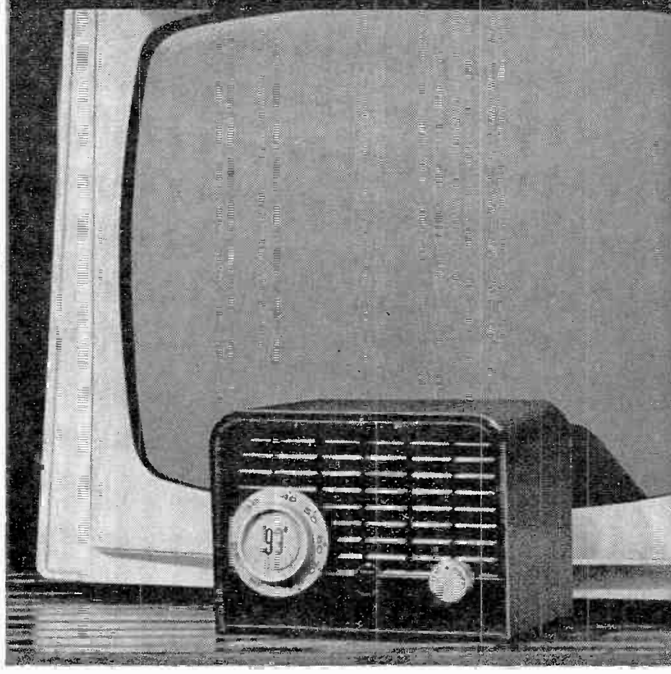


Fig. 5—Bandpass filters used as splitter–mixer to separate or combine subchannels.

WEAK SIGNAL?

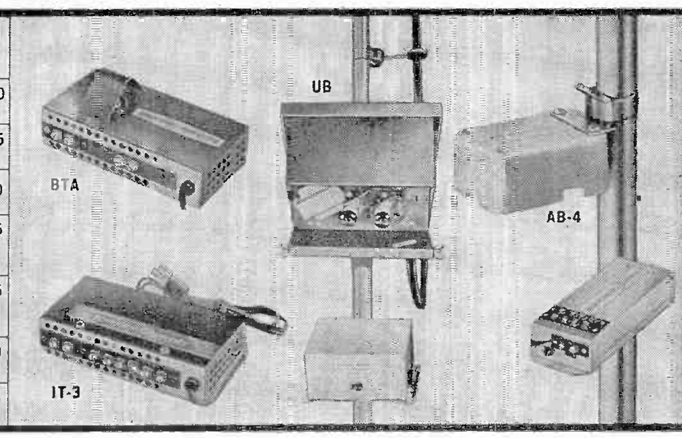


READY FOR UHF?



TV & FM AMPLIFIERS

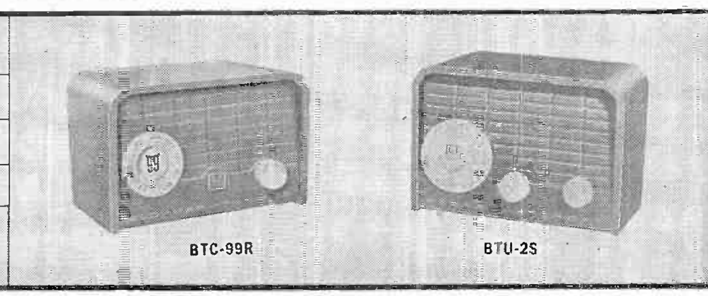
MODEL	DESCRIPTION	GAIN AVERAGE	AMPLIFIER	MOUNTING	LIST PRICE
BTA	Home VHF/FM booster for single set.	8 db	Tube	Indoor	15.70
B-24c	Home VHF/FM booster for up to 4 sets.	9 db	Tube	Indoor	24.95
IT-3	Home VHF/FM booster for up to 4 sets.	12 db	Transistor	Indoor	33.00
AB-4	Home VHF/FM booster, battery powered., For up to 4 sets.	12 db	Transistor	Indoor or Mast Mounted	29.95
AB-2	Home VHF mast mounted booster. Remote power supply.	10 db	Tube	Mast Mounted	53.95
UB (70-83)	UHF booster (ch 70 thru 83).	15 db	2 Tubes	Mast Mounted	84.50
UB (72-76)	UHF booster (ch 72 thru 76).	21 db	2 Tubes	Mast Mounted	103.75



UHF CONVERTERS

MODEL	IMPEDANCE	INPUT CHANNELS	OUTPUT CHANNELS	GAIN	LIST PRICE
BTC-99R	300 Ohm	14 thru 83	5 or 6	—	23.95
BTU-2S	300 Ohm	14 thru 83	5 or 6	5 to 8 db	39.95
BT-70	300 Ohm	70 thru 83	5 or 6	5 to 8 db	41.50

Where all other methods fail to bring in UHF channels, use the model UB-UHF amplifier with the BTC-99R, the BTU-2S converter, or any all channel (VHF and UHF) receiver.



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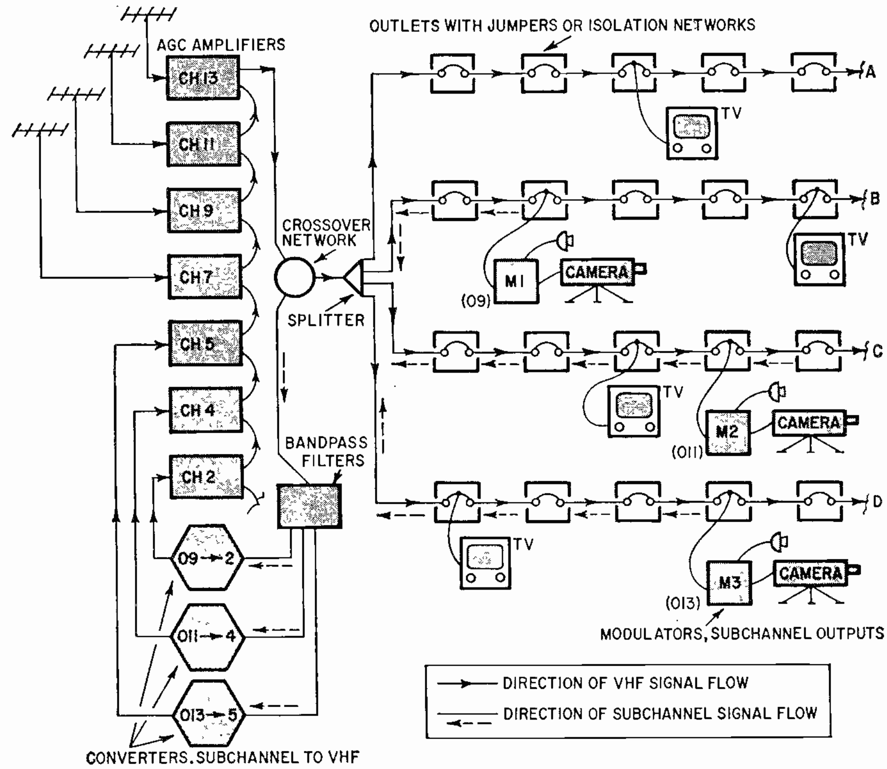


Fig. 6—Typical educational CCTV system layout.

connect the ends with a jumper plug. The approach is simple, but not so easy in practice. The designer must be extremely careful that the necessary connections show no discontinuities and look to the signal exactly as though the cable were unbroken. Else he will be plagued with troubles caused by reflections, ghosts and standing waves.

Auxiliary equipment

Before a system can be designed around these concepts, some auxiliary pieces of equipment are necessary. One of these is a crossover network quite similar in function to the familiar crossover networks of the hi-fi fan, but working at an entirely different frequency range.

For reasons which will become clear later, we need a crossover at around 50 mc. Fig. 4 gives the schematic of a unit that matches 75 ohms (for coaxial cable) and splits all frequencies below 50 mc out at one terminal and all those above at the other.

Another requirement is met by a multiple bandpass filter (Fig. 5) designed to separate subchannels found in a cable to individual terminals. Once separated they may be processed separately. It can also be used to combine separate subchannels into a single cable. The usual splitters and pads (attenuators) found in vhf television distribution systems are also needed and we must be sure that these devices do not discriminate against the subchannel frequencies.

With these components we can build a system following the usual rules about distribution system layout. Fig. 6 is the circuit of a simple system we can study for its method of operation. Basically, we have a 7-channel TV distribution system. Each channel is amplified by an amplifier having automatic gain control. Such amplifiers hold their outputs within 1 db of the set level even if input changes as much as 20 db. The amplifiers are bridged in their output circuits so all seven signals appear in the cable leaving the top (channel 13) amplifier. Four are conventional off-the-air television signals—channels 7, 9, 11 and 13. (Don't worry about where you can find such a channel allocation in a given area—if you haven't got a usable setup like this, you can make one by rearranging the channels with vhf-to-vhf converters.)

The other three signals—2, 4 and 5—originate within the building. All signals proceed to the crossover network, entering through the leg that passes frequencies above 50 mc and emerging from the all-pass terminal.

From here, following the solid arrows, they go to the splitter and thus to the four branches of the system. These system branches have the outlets inserted at strategic points—and *all outlets have an insert of some sort,* either the proper network or a jumper plug.

So far, with the exception of the crossover network, we have a conventional TV distribution system. The difference comes with the cameras and modulators shown connected to outlets in branches B, C and D. These modulators either have subchannel outputs or

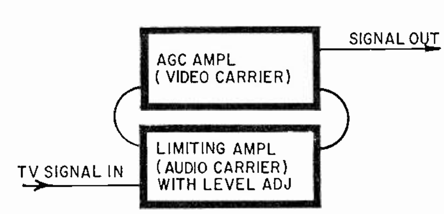
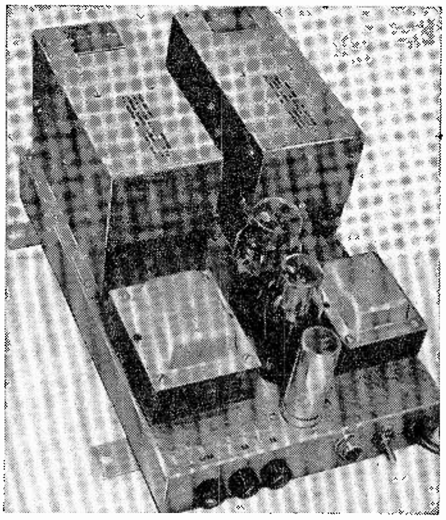


Fig. 7—How audio carrier level is reduced to prevent interference with the video signal.



Crystal-controlled converters.

else their outputs are converted to subchannels.

By using the proper insertion plugs, the subchannel signal from the modulator of each camera is inserted into the system, the energy being sent back toward the amplifier, along the path indicated by dotted arrows. These plugs do not in any way interfere with vhf signals, which pass straight through. Arriving at the crossover network, the subchannel signals are shunted away from the amplifier outputs (which would interfere by acting as a tuned stub) and toward the bandpass filters (illustrated in Fig. 5). The bandpass filter splits them apart and feeds them to the proper converters, where they are converted to vhf channels 2, 4 and 5. From the converters, these vhf signals are sent to the amplifiers and return to the system as vhf signals.

Now, here is what we have. Any camera can be taken, with its modulator, to any outlet and its signal will be seen in every room where the receiver is turned to its channel. All cameras may be operated simultaneously without in any way affecting the others or the off-the-air channels. Note that the head-end equipment does not have to be touched—it is fully automatic.

How to get 16 channels

The system described uses only seven channels—the greatest number possible with ordinary vhf television receivers. This limitation is imposed by the lack of selectivity in the receivers, which cannot satisfactorily separate adjacent channels such as 2 and 3 or 7 and 8. As mentioned earlier, up to 16 channels may be used, but this requires additional apparatus.

Let us explain. The difficulty with adjacent channels is a beat produced in the video amplifier of the receiver between the aural (sound) carrier of the lower channel with the video carrier of the desired channel. This beat (heterodyne) is the difference between these two frequencies, 1.5 mc, and falls right into the video range, producing a herringbone pattern on the screen. The remedy is to lower the power of the audio carrier considerably. This reduces the power of the beat below a visible point since a beat note is always directly related to the weaker of the two signals producing it. This can be done with the audio signal because all TV receivers use an FM sound system, and have much surplus audio gain.

Reducing the audio carrier 10 to 14 db is enough, and is done as shown in Fig. 7. The two devices represented by blocks are an agc amplifier and a sound limiter, both with adjustable output levels. The signal to be regulated is brought into the sound limiter, where the sound carrier is stripped off. The video carrier and its sidebands are passed on to the agc amplifier. In the sound limiter, the sound signal is amplified, limited (clipped) and its level set by an output controlling potentiometer. The video signals are amplified in the agc amplifier and their levels set by the level control. The two signals are then mixed, with any ratio desired. The ratio needed is largely a function of the receivers used, and should be set up so that the worst receiver is out of trouble. In this way, the 12 vhf channels (2–13) can be used, and, if we add on the 4 subchannels, we have a 16-channel system.

The kind of system described has other features which greatly extend its use. For example, we could easily isolate any of its branches by removing a jumper plug, terminating the line coming from the direction of the head end, and then do anything we liked in the isolated branch—go video or go on-channel uhf, subchannel vhf, or use the cable for audio, alarm, or ringing a doorbell for that matter. At the splitter, we can interconnect any two branches and make an isolated interconnecting system. The possibilities are limited mostly by the user's imagination.

One of the desirable features from the viewpoint of the user is the freedom from obsolescence—a piece of cable doesn't readily go out of fashion—and that is all there is inside the walls. Anything else is external and can be installed as needed without labor expense.

So there you are, a new, simple concept which gives the system designer immense scope for his imagination. END

EARLY-WARNING ICE ALARM

ICE formations are a problem on microwave relay, radar, vhf and uhf broadcast and on community TV antenna installations. Ice distorts the beam pattern, increases power losses through leakage and may cause hazardous loadings on the structure.

Several types of detectors have been developed to sound an alarm or turn on heaters *after* ice forms. The new early-warning ice alarm, developed by Hygrodynamics, Inc., 949 Selim Rd., Silver Spring, Md., monitors air temperature and precipitation and detects conditions—low temperature and precipitation—that favor ice formation. Thus, it actuates an alarm or turns on heaters *before* ice actually forms. This system is valuable in detecting incipient icing conditions around airports, turnpikes and other sites where advance warning of icing is important.

The circuit of the early-warning ice alarm is shown in Fig. 1. The detection unit, connected between the grid of the control tube and ground, consists of a precipitation detector and a Thermoswitch (Fig. 2) that closes at a critical predetermined temperature—generally around 35° to compensate for evaporative cooling. The two detector elements are in series so the alarm is inoperative until precipitation and freezing temperatures occur simultaneously.

The precipitation detector consists of two parallel coils of fine nichrome wire wound around the outside of a plastic tube. When the coils are dry, the resistance between the terminals is infinite. A drop of water shorts the coils together and the resistance drops to around 500,000 ohms.

A 2.8-watt 6-volt heater inside the detector coil form melts sleet or snow so the detector responds equally to all types of precipitation. It also keeps the detector warm to hasten drying so that it clears itself when precipitation stops. It is fed 6 volts through the cable shield.

When temperature closes the Thermoswitch and precipitation shorts the detector coils, current flows from the upper end of the 6-volt winding through the relay, grid biasing resistor and detection head to ground. The voltage developed across the detection unit upsets the bias on the grid and causes the relay to pull in and flash the alarm or operate an auxiliary relay to turn on heaters.

The 5-megohm pot enables the operator to adjust the threshold sensitivity to compensate for accumulation of dirt on the precipitation detector. The momentary switch is for testing the amplifier and alarm circuits. END

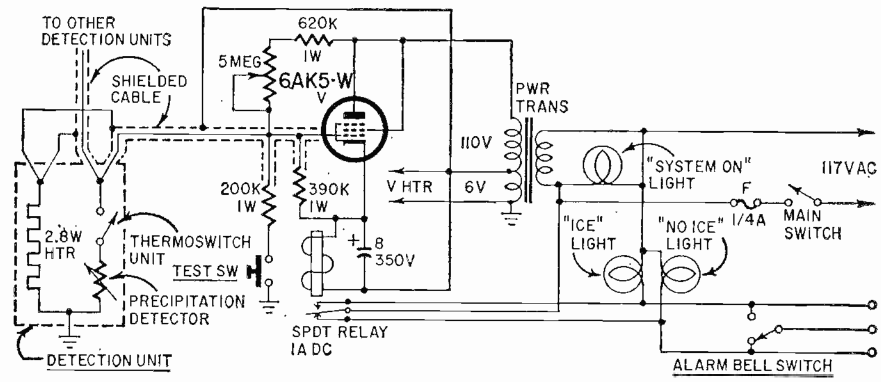


Fig. 1—Diagram of the circuit used to detect incipient icing conditions.

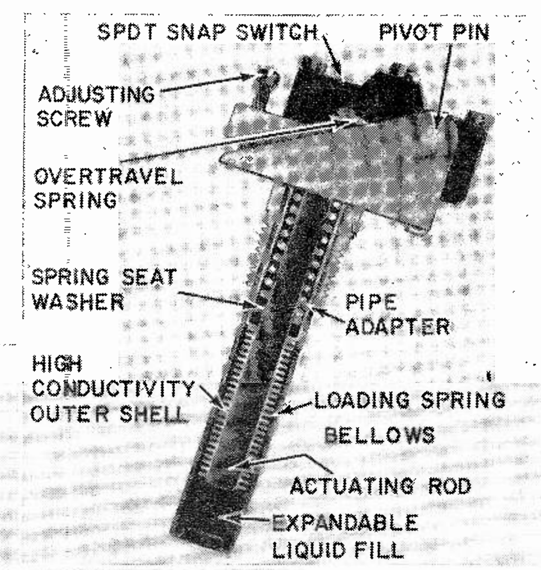
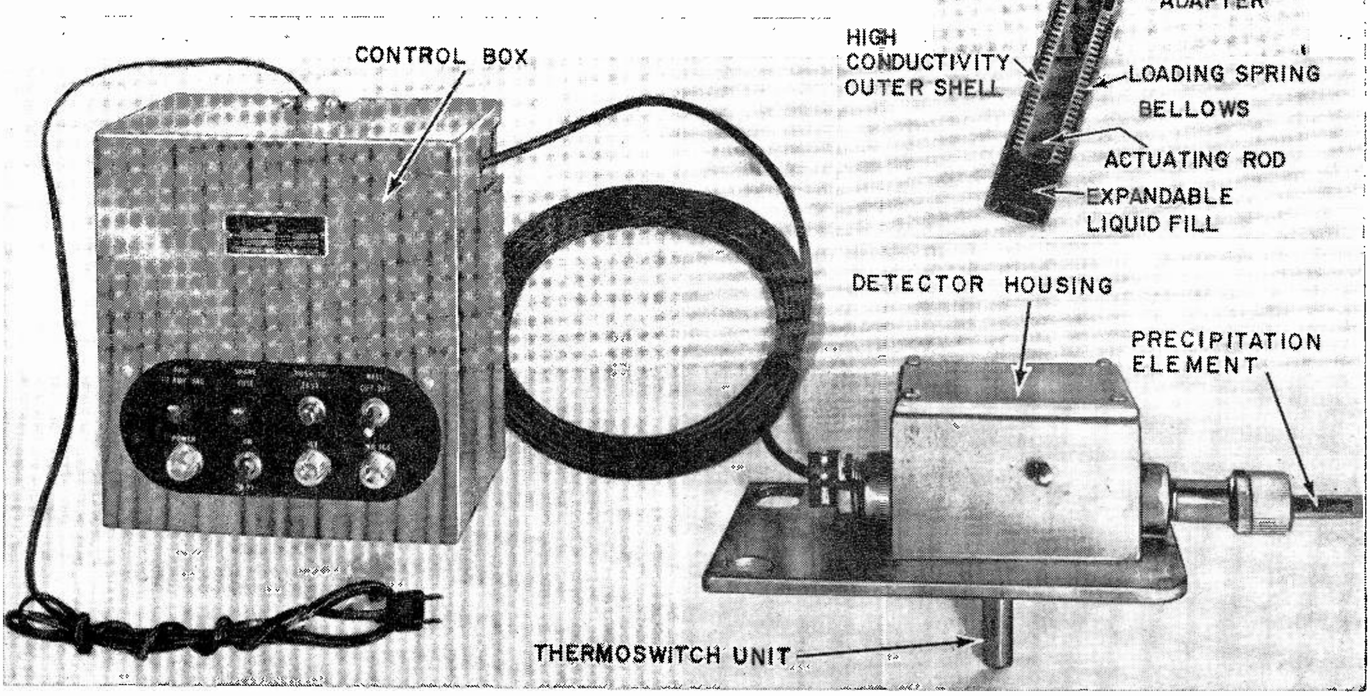


Fig. 2—Internal construction of the Fenwal Thermoswitch.

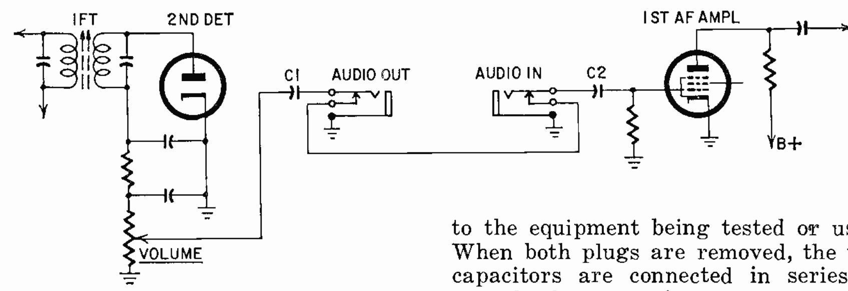


The complete ice alarm system.

NOTEWORTHY CIRCUITS

HANDY TESTER FROM OLD RADIO

By using the circuit modification shown, any transformer type receiver can be used as an audio amplifier for testing tuners, preamplifiers, etc., for signal tracing or troubleshooting, and as a signal source for checking earphones, amplifiers and signal-operated relays.



The two jacks shown in the diagram can be placed anywhere on the chassis, but the closer to the takeoff point the better. If the connection between the grid lead and the AUDIO IN jack is more than a few inches long, the wire should be shielded. Remove the original coupling capacitor from the set and substitute two capacitors, C1 and C2, each having double the value of the capacitor removed. Installing two capacitors, one in series with each jack, eliminates the need for external coupling capacitors to the equipment being tested or used. When both plugs are removed, the two capacitors are connected in series to provide the original coupling capacitor value. (NOTE: Do not use this arrangement in ac–dc receivers, nor plug ac–dc equipment into the jacks because of the potential shock hazard.)—*Louis Maggi*

MINIATURE PHOTOELECTRIC ALARM

Tiny silicon diodes, cadmium sulphide photocells and an acorn-size radio-control relay make it possible to construct photoelectric alarms much smaller than comparable units of a few years ago. Using the parts specified, you can construct a photoelectric alarm in the small plastic box in which the relay is shipped and still have room to spare. The alarm operates satisfactorily at 12 feet with a 50-watt lamp and a double convex lens to concentrate the beam. I used a Jewell relay (Lafayette F-260), Lafayette MS-827 photocell, a 1N538 silicon rectifier and a miniature pot and electrolytic.

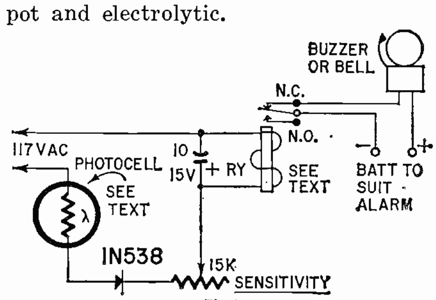


Fig. 1

Fig. 1 shows the circuit wired so the alarm sounds while the light beam is broken and stops when light is restored. To adjust, set the pot for maximum resistance and plug in the line cord. The alarm will sound. Point the photocell at a light and slowly adjust the pot until the alarm stops. Interrupt the light beam with your hand and the alarm should sound again.

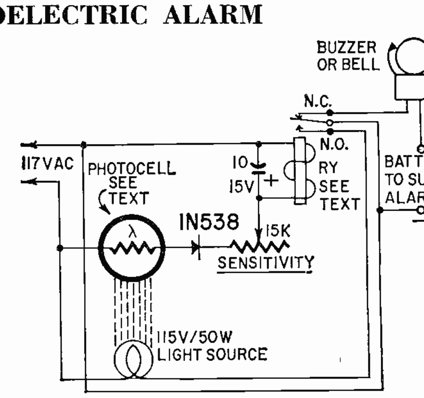
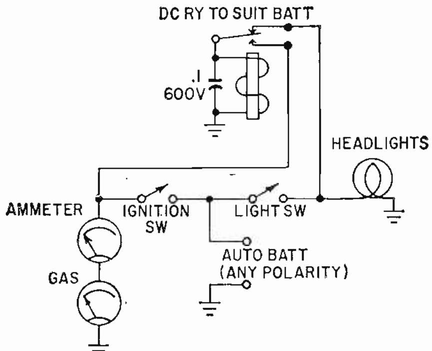


Fig. 2

Fig. 2 is the circuit arranged so the alarm sounds continuously when triggered. Here, the light source (exciter lamp) is wired through the normally open relay contacts. To set the alarm, use another light source to trip the relay so it pulls in and turns on the exciter lamp. Interrupting the exciter lamp's beam causes it to go out and the alarm sounds until the relay is reset with an auxiliary light source. —*Martin H. Patrick*

MODIFIED HEADLIGHT REMINDER

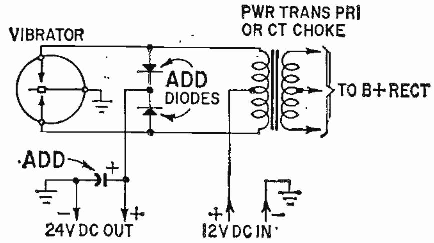
Here is my simplified version of the headlight reminder described on page 116 of the September 1961 issue. I've substituted a buzzer, made from a spdt relay, for the transistor oscillator and audio amplifier. Mount the buzzer at some point under the dash that provides a good sounding board. With the lights on and the ignition off, the coil circuit is completed through the normally closed contacts and the relay vibrates like a buzzer. When the ignition is turned on, the relay locks in through the normally open contact.



With a little effort, you can connect the buzzer to a separate speaker or to the radio speaker in the car. If you use the radio speaker, be careful to eliminate the possibility of shorting out the audio voltage or feeding high-voltage pulses from the buzzer into the radio's output circuit.—*Thomas A. Markland*

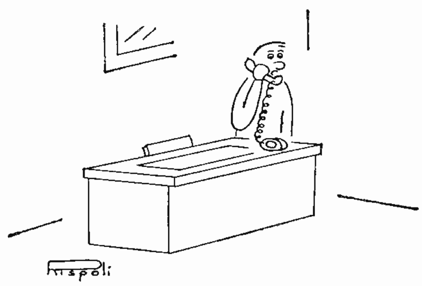
NOVEL DC-TO-DC CONVERTER

You can obtain 24 volts dc for surplus relays and other equipment from a 12-volt vibrator power supply by using the circuit shown. The added diodes form a full-wave rectifier that "adds"



12 volts to the battery voltage. Add a capacitor of a few hundred microfarads to smooth out the voltage on the 24-volt line.

This method of voltage doubling is adaptable to any voltage and current by appropriate choice of vibrator, diodes and transformer. A center-tapped choke can be substituted for the transformer if a B-plus voltage is not needed. —*Richard L. Koelker* END

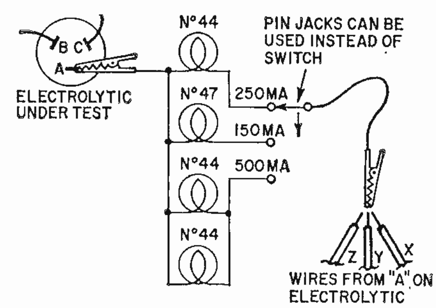


I'll get him for you, would you mind holding the line a few milliseconds.

SIMPLE SHORT LOCATOR

A few days ago one of the bench men was servicing a Philco 51-T1602. The filter choke was well cooked. After checking the filters—they tested good—he temporarily replaced them with new filters and a new choke, which was at least twice as big as the original. But when he turned on the set, the choke began to get hot.

Next, he unsoldered all leads from the electrolytic—section A in the sketch—and connected his multimeter (500-ma range) to A and then, one at a time, touched all the leads that had been connected to A with the meter's other lead. Result? Do you know anyone who wants



to buy a vom with its needle wrapped around the pin?

Since then, I've developed a little gadget which tests for shorts, but uses pilot lamps rather than a meter—pilot lamps are much less expensive than meter movements. The simple circuit is shown in the diagram. Note that I actually have a four-range milliameter. Of course, the unit will locate shorts that show up only under operating voltage, a very pleasant point to ponder.—*Nate Silverman*

MOUNTING SPEAKERS

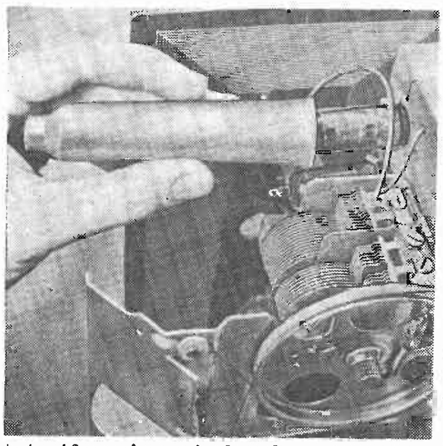
The service technician often finds himself confronted with a perplexing speaker replacement problem simply because the bracket, nuts and bolts supplied as mounting accessories will not fit. Usually this happens when the original speaker was held in place with metal screws driven directly into the magnet-shoe assembly.

The logical answer, it seems, is to drill identical holes in the replacement unit and go from there with the metal screws. But this is usually the road to ruin, for nine out of ten magnet shoe assemblies are at least ⅛ inch thick. Drilled but untapped, the metal screw will go in for only a few turns and snap off.

The easy way out is to drill the mounting holes where they belong, making sure the drill size is just under the diameter of the metal screw to be used. Then countersink the hole with a drill larger than the body of the screw, to a depth, from the bottom of the hole, approximately the thread width of the metal screw. With this thread clearance, the screw will now be able to tap its way into the remaining bottom wall of the hole, cut clean and hold firmly.—*George D. Philpott*

CLIP INSULATOR IS TUBE PULLER

Need a tube puller to remove a hot or hard to reach tube? A Mueller No. 43 clip insulator makes a good substi-

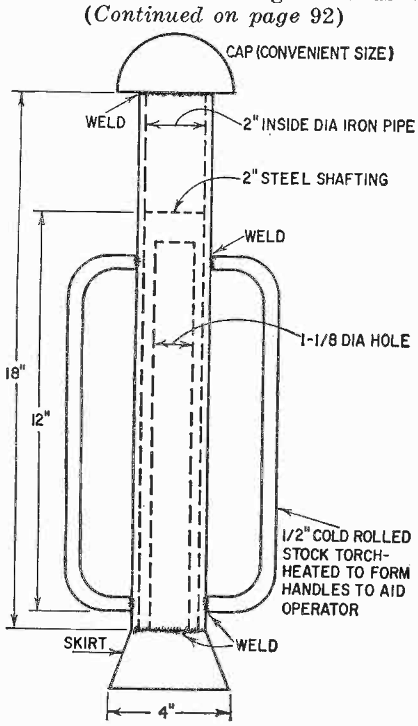


tute if you've misplaced your regular puller or it's busy elsewhere on the shop bench.—*Joe Crane*

DRIVE GROUND RODS EASIER!

Ground rods are placed where needed, be the ground hard or soft. The odds are that the going will be tough, since no one places equipment in a swamp if he can avoid it. Driving the rods to

(*Continued on page* 92)



RCA Announces 2 NEW HOME TRAINING COURSES to Help You Build a Career in Electronics!

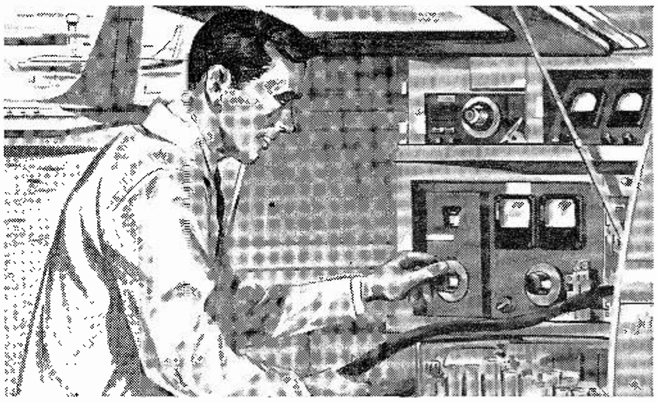
RCA Institutes has created two new home training courses designed to give you the very latest, up-to-the-minute training in the fastest-growing areas of this important field. With the addition of these courses, RCA Institutes now offers you the widest selection in its 53-year history!

Founded in 1909, RCA Institutes is one of the largest technical schools in the United States devoted exclusively to electronics. A service of the Radio Corporation of America, RCA Institutes offers the finest facilities for technical instruction, especially designed to fit your needs. The very name "RCA" means dependability, integrity and scientific advance.

Computer Programming

You train for a career in the vital field of business computer programming—for electronic data processing—one of the fastest growing opportunities in the business world today.

No Previous Technical Experience Necessary!



Communications Electronics

You get the latest technical training needed to service and maintain 2-way radio and mobile communications, plus the technical foundation for today's space and aviation communications.

Prepares You for an FCC License

(*Continued from page* 87)

permanently moist soil means 10-foot units, which in turn means driving from a stage to get them started. Sledging at that height is a bit tricky and slow, hence we improved on the old technique by fabricating a "drive barrel" that can readily be manipulated by two men with a force equal to sledging.

The D-shape side handles are made of ½-inch cold-rolled stock torch-heated for bending in the blacksmith's vise. They were arc-welded to the barrel. It consists of an 18-inch length of 2-inch pipe into which is welded a 1-foot section of 2-inch steel shafting with a 1⅛-inch bore extending to within 1 inch of the upper end to form the ram section.

The bottom of the barrel has a skirt welded so the device can stand upright in tool truck or shed. An oval cap welded to the top serves as a hand grip as one man manipulates the ram while the second holds the rod steady in getting it started plumb.

Once the rod is started straight, both men grip the side handles and proceed to alternately lift and slam down the device to penetrate most soils as effectively as with a compressed-air tool.—*Paul C. Ziemke*

SEALING UHF LEAD-IN

Because uhf lead-ins of the oval and round types are hollow, moisture must be prevented from entering the tube. The usual method is to leave both ends of the lead-in open with the end connected to the antenna curved over the top of the mast, keeping rain out. A much surer method is to seal the ends.

After the lead-in length has been determined, place the coil of wire in a gas or electric range oven which has been preheated to about 150°F. Allow the lead-in to remain in the shut-off oven for about an hour to dry out any moisture. Then seal both ends of the lead-in with a hot soldering iron. The polyethlene insulation melts readily and an airtight moistureproof seal results.
—*Warren J Smith*

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

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

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

In February, 1912, *Modern Electrics*

The Quenched Spark, by C. A. LeQuesne, Jr.
The Marconi Valve Receiver.
Wireless Transmission of Secret Messages.
Universal Detector, by R. Cowden.
An Improved Poulsen Ticker, by Ellery W. Stone.
A Simple Loading Coil, by Allen Dahlquist.
A "Micrometer" Tuning Arrangement, by F. E. Sickles.

TECHNICIANS' NEWS

MAKE COMPLAINTS PAY OFF

New York, N. Y.—Handle customer complaints immediately and you may save the customer. You spend money on advertising to get new customers, so why not spend a little to save one you already have. These words were part of a talk given by Jules W. Rubin, national advertising manager of Allied Radio, at a meeting of the American Management Association.

Another interesting point of the talk was Mr. Rubin's statement that prompt action on a complaint, in addition to turning the complaining customer into a public relations representative for the firm, probably will convert the customer to one of the firm's best sources of new business—he will recommend the company to friends.

If the customer has a complaint, real or imagined, and sees it handled quickly to his satisfaction, he will sing your praises.

AL MERRIAM DEAD

Elbert (Al) Merriam, national service manager of Symphonic Electronic Corp., died of a heart attack late in November. Service manager of Sylvania Home Electronics Corp. for years, he was known to numerous radio technicians throughout the country.

FREE ADS FOR TECHS

Aurora, Mo.—The local radio station, KSWM, is going to cooperate with TESA of SW Missouri by giving spot announcements plugging TESA and telling the public how to identify a TESA shop. TESA will boost the station by setting pushbuttons on car radios and home sets that have pushbuttons to the station when they service such sets.

TECHS NEED UPGRADING

Harrisburg, Pa.—Upgrade your business to survive, was the message given to delegates of the Pennsylvania Federation of Television & Radio Service Associations by Edward Wimmer, vice president of the National Federation of Independent Businesses, to a meeting of the FTRSA in the Hotel Harrisburg.

Mr. Wimmer's subject was "Unfair, Unjust Competition." He included suggestions on how to upgrade a business: "Instead of spending your money on trading stamps and other gimmicks, lay a bright new rug on the floor of your store and put up a bright neon sign to let the public know you're in business. Paint the walls and ceiling in bright contrasting colors, and upgrade your store to the point where your customers will find it a pleasure to walk in."

TEXAN ELECTRONICS

Weatherford, Tex.—State tax on radio and electronic components has been repealed. A general retail sales tax has been substituted.

Also repealed was the bond required of the service dealer and the technician.

This word comes from James M. Cotten of the Texas House of Representatives.

COLOR TV TRAINING

Philadelphia, Pa.—Almost 300 TV service technicians attended the second in a series of six seminars on the intricacies of maintenance and repair of color TV at the Drake Hotel.

A session is being held every three weeks, and every technician who completes the course successfully will be awarded a certificate stating that he is qualified to service and repair color TV sets. The program is being sponsored by Almo Radio Co.

Morris Green, president of Almo, pointed out that service follows sales and service dealers should be prepared to handle every technical problem.

Mr. Green said Almo has arranged for some of the top service engineers in the country to conduct the classes. These factory experts, he explained, will show service technicians every conceivable timesaving shortcut known in the color-TV field today, which in turn will benefit the customer, who will receive finer workmanship at a lower cost.

TECHS AND TAPE

New York, N. Y.—Service calls on tape recorders can be reduced if the customer is shown how to operate the device, according to Allan E. Bachman, executive vice president of the National Better Business Bureau. Although today's tape recorder is not difficult to operate, he states, the customer should be shown exactly how to operate it. The Better Business Bureau has found that customer dissatisfaction with electric and electronic equipment is due largely to lack of knowledge and understanding of how it works, rather than an inherent fault of the equipment itself.

WEST COAST ROUNDUP

Oakland, Calif.—Yellow Page advertising was the topic of a recent Alameda County Television & Radio Association meeting at the Driftwood Restaurant. Guest speaker was Jack Morrison, assistant sales manager of Pacific Telephone & Telegraph directory advertising.

Sacramento, Calif.—This California State Electronics Association chapter discussed a system that would allow the association to provide service to the public on Sundays and holidays. The objective is to give the public confidence that when they call the association, they know that they will be referred to a firm that is reliable and can be trusted.

Hermosa Beach, Calif. — Three groups sat in the Hot-n-Tot Cafe for a meeting during which the 1962 Sylvania TV chassis was shown and discussed by factory service representatives. Groups attending were the South Bay RTA-CSEA, and the San Antonio and Los Cerritos chapters of CSEA.

Los Cerritos, Calif.—The telephone as a business tool and classified advertising as a sales aid made the meat of a recent meeting of the Los Cerritos chapter of the California State Electronics Association.

San Diego, Calif.—Color TV course was flooded, with 88 instead of the expected 40 technicians attending. The course is free to association members. There is a charge of $2 per session for nonmembers. The course was planned by the San Diego and North Shore chapters of CSEA.

Burbank-Glendale, Calif.—About 150 members of this CSEA chapter attended a 2-hour discourse on color TV by Charles Wack, RCA field-service engineer. Slides were used to illustrate the talk.

Bakersfield—A representative of Sprague Electronics spoke to the local technicians group on "Condensers Are Here to Stay." The speaker went into the Sprague capacitor concept and the future of electronic equipment.

San Diego—This chapter and North County chapter joined for their combined installation dinner and dance at the El Cortez Hotel. The newly elected officers for San Diego are Eugene H. O'Brien, president; Howard D. Ellis, vice president, and G. S. Lowell, secretary-treasurer. For North County, G. W. Douglas, president; Jack Cornell, vice president, and Edgar Paden, secretary-treasurer.

San Bernardino—Pricing was subject of talk by Walter Burns. Forty dealers attended.

Stockton—This was second session of a three-part jam course on transistor theory and repair. Jack Hutt, local electronics engineer and instructor, was hired for this program. END

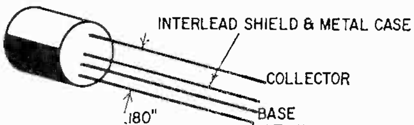
"New type of capacitor, my eye! That's a filter-tip butt!"

NEW TUBES and SEMICONDUCTORS

WITH SEMICONDUCTORS AT THE REINS WE start with a group of germanium units for FM radios, continue along with a uhf oscillator, break stride on three TV horizontal output tubes and wind up with a group of flat conduction-cooled selenium rectifiers.

2N2089, 2N2090, 2N2091

These three germanium transistors are designed for use as an rf amplifier, oscillator–mixer and if amplifier, respectively, for FM and FM–AM radios. All three are post alloy diffusion transistors (PADT). They feature low collector leakage, high current gain, high f_{max} and a high collector–base



2N2089,90,91

breakdown voltage. Also, they will work well even when supply voltages are as low as 3 volts.

The 2N2089 is controlled for low noise and high power gain at 100 mc. The 2N2090 features high conversion gain up to 100 mc. The 2N2091 has low output capacitance and conductance at 10.7 mc as well as low noise and good agc performance.

Maximum ratings of these Amperex transistors are:

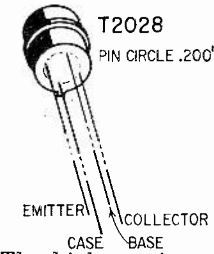
V_{CB}	20
V_{CE}	20
I_C (ma)	10
P_C (mw)	83
I_E (ma)	11
(reverse ma)	−1
I_B (ma)	1

Characteristics of these transistors are:

	2N2089	*-90*	*-91*
NF (noise figure) (typical db)			
(at 100 mc)	8	9.5	—
(at 10.7 mc)	—	3	3
(at 1 mc)	—	1.5	1.5
h_{FE} average	150	150	150
Z_{RB} (Base impedance, ohms)	20	25	27

T2028

Here is a germanium micro-alloy diffused-base transistor (MADT) designed for use as either a vhf or uhf amplifier in communication and radar circuits operating at frequencies up to



800 mc. The high maximum frequency of oscillation (typically 1600 mc) and exceptionally low noise figure assure proper operation in such circuits.

Maximum ratings of the Philco T2028 are:

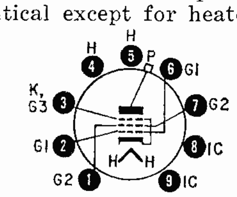
V_{CB}	20
V_{CES}	20
V_{EB}	0.5
P_{total} (mw)	60

High-frequency characteristics when $V_{CE} = -10.4$, $I_C = -1.3$ ma and f = 200 mc are:

PG (power gain, typical db)	18
3 db bandwidth (typical mc)	9
NF (noise figure, typical db)	4.0

6GJ5, 12GJ5, 17GJ5

These three tubes comprise a series of high-perveance beam power tubes intended for use as the horizontal deflection amplifier in TV receivers. They come in a Novar envelope. All three are identical except for heater ratings



6GJ5, 12GJ5, 17GJ5

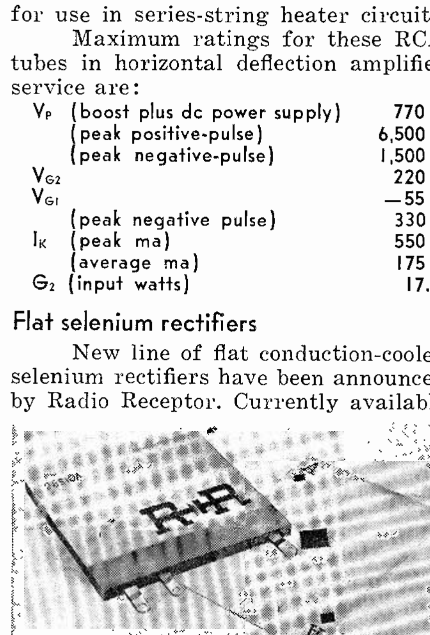
which are: 6.3 volts, 1.2 amps for the 6GJ5; 12.6 volts, 600 ma for the 12GJ5 and 16.8 volts, 450 ma for the 17GJ5. Also, both the 12GJ5 and the 17GJ5 have an 11-second controlled warmup for use in series-string heater circuits.

Maximum ratings for these RCA tubes in horizontal deflection amplifier service are:

V_P	(boost plus dc power supply)	770
	(peak positive-pulse)	6,500
	(peak negative-pulse)	1,500
V_{G2}		220
V_{G1}		−55
	(peak negative pulse)	330
I_K	(peak ma)	550
	(average ma)	175
G_2	(input watts)	17.5

Flat selenium rectifiers

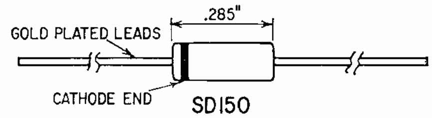
New line of flat conduction-cooled selenium rectifiers have been announced by Radio Receptor. Currently available



units include half-wave, doubler and bridge arrangements in single- or three-phase circuits for voltages up to 130 rms and current outputs to 10 amps dc. These units are only a quarter the size of equivalent air-cooled units.

SD150

A very-high-speed silicon switching diode for computer circuits and general-purpose applications. The diode incorporates an oxide passivated planar structure built in a high-resistivity epitaxial layer grown on a low-resistivity silicon substrate. This structure makes



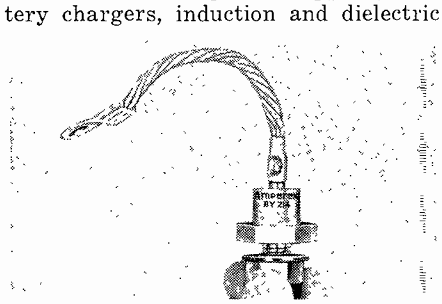
possible a diode having high conductance, fast recovery time, low leakage and low capacitance. Minimum conductance is 50 ma at 1 volt, and recovery time is less than 2 nanoseconds.

Maximum ratings of the General Electric SD150 are:

V	(reverse)	50
I	(average rectified ma)	75
	(forward steady-state dc ma)	115
	(recurrent peak forward ma)	225
	(peak forward surge amps)	2
P	(dissipation, mw)	250

BYZ14, BYY15

These are double-diffused silicon power rectifiers rated at 20 amperes. They are mounted in 50-ampere cases for added reliability and durability. Both Amperex units are designed for use in industrial power supplies, battery chargers, induction and dielectric

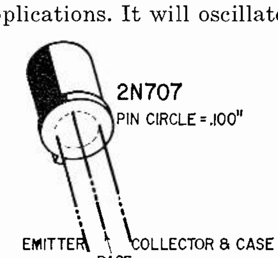


heating equipment and broadcast transmitters. They can also be used in series-parallel arrangements for heavy duty.

They have been specifically designed to cope with high-voltage surges in heavy-duty rectifying circuits. Their 400-volt recurrent peak-inverse-voltage rating is supplemented by a transient peak-inverse-voltage rating of 600 for the BYZ14 and 800 for the BYY15.

2N707

An n-p-n silicon planar transistor intended for vhf oscillator and amplifier applications. It will oscillate at fre-

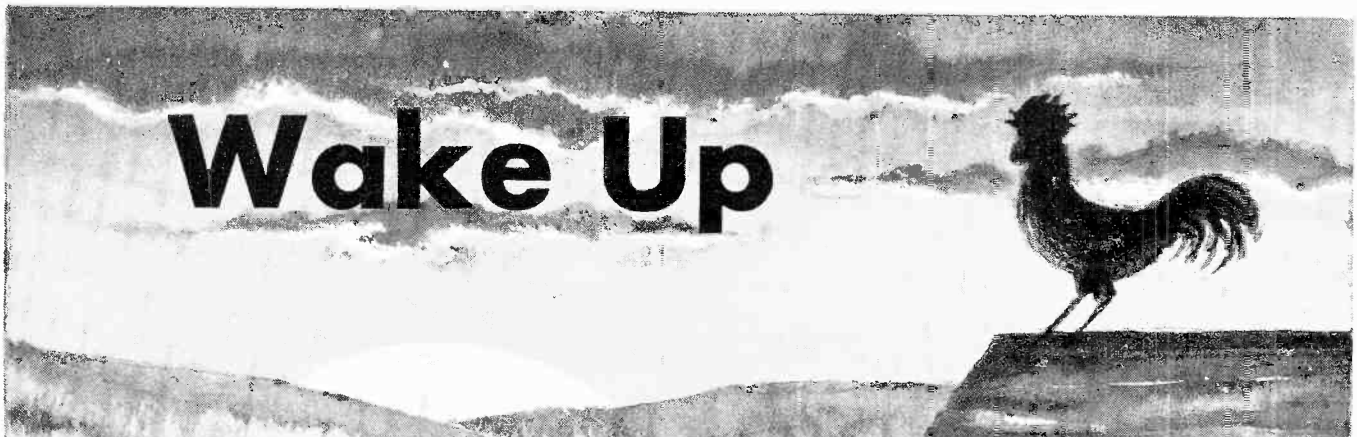


quencies up to 400 mc and will provide an 8-db power gain at 100 mc.

Maximum ratings of this General Instrument transistor are:

V_{CBO}	56
V_{EBO}	4
V_{CER} (10-ohm resistor between base and emitter)	28
P_{total} (mw)	300

END



A new day is dawning in electronics. Transistors are here to stay . . . they are now being used everywhere; in radio, television, Hi-Fi, intercoms, and in nearly all new electronic equipment . . .

Why put off transistor circuit servicing any longer . . . there's gold in them thar hills. But you must be equipped to do the job fast and efficiently. Here are the tools that you will need.

NEW SENCORE TRANSI-MASTER

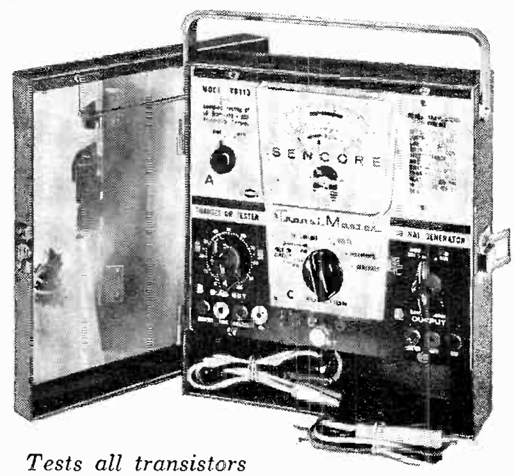
This Tester will analyze the entire circuit in minutes and test transistors in-circuit or out of circuit. Here is how you can pin point troubles step by step.

First, check the batteries with the 0 to 12 voltmeter. If the batteries are O.K., check the current drain with the 0 to 50 milliamp meter. A special probe is provided so that you do not need to break the circuit. Excessive current indicates a short; low current indicates an open stage or cracked board. All PF schematics indicate average current.

If trouble is not located by now, isolate the trouble to a specific stage by touching the output of the harmonic generator to the base of each transistor and note spot where sound from speaker (or scope where no speaker is used) stops or becomes weak. The generator becomes a sine wave generator for audio stages to help find distortion.

If trouble points to a transistor, check it in a jiffy with the exclusive in-circuit power oscillator check provided by the TR110. A special probe is also provided for this.

If the transistor checks bad in-circuit, remove it and give it an out of circuit check with the oscillator check or the more accurate DC check. The DC check is provided for comparison reasons, experimental or engineering work and to match transistors in audio output stages. Beta (current gain) is read direct or on a good-bad scale for service work. DEALER NET. ONLY **$49.50**



Tests all transistors in-circuit or out-of-circuit

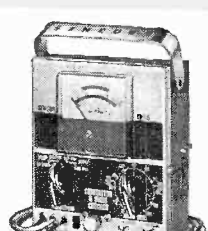
Model TR110

***It's a* COMPLETE TRANSISTOR TESTER**

- **SIGNAL TRACER** • **VOLTMETER**
- **BATTERY TESTER** • **MILLIAMMETER**

NEW SENCORE TRANSISTOR AND DIODE CHECKER

Here is a low cost tester that has become America's favorite. The TR115 provides the same DC out of circuit checks as the TR110; leakage and current gain. Beta (circuit gain) can also be read direct or as good or bad. Opens or shorts in the transistor are spotted in a minute. The TR115 checks them all from power transistors to the small hearing aid type. Japanese equivalents are listed also. This famous tester is used by such companies as Sears Roebuck, Bell Telephone and Commonwealth Edison. New circuits enable you to make service checks without set-up charts even though charts are provided for critical checks.

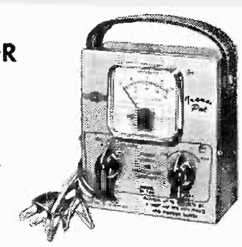


Model TR115
Dealer Net
$19.95

SENCORE BATTERY ELIMINATOR AND TROUBLE SHOOTER

For replacing batteries during repair.

Many servicemen say that they wouldn't service transistor circuits without this power supply. The tried and proven PS103 is a sure fire answer. It can be used to charge the nickel cadmium batteries as well. Dial the desired output from 0 to 24 volts DC and read on meter. Low ripple insures no hum or feedback. Total current drawn can also be read on the PS103 by merely flicking the function switch to milliamps. The PS103 is the only supply that will operate radios with tapped battery supplies such as Philco, Sylvania and Motorola. No other supply has a third lead.



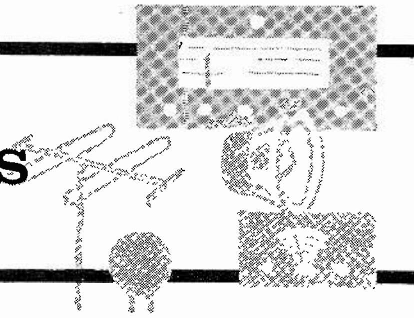
Model PS103
Dealer Net
$19.95

Now in stock at your Authorized Sencore Distributor

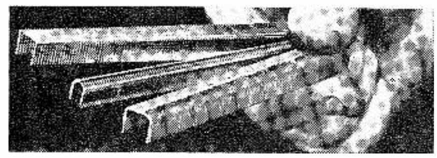
ALL PARTS SENCORE ® MADE IN AMERICA

SENCORE
ADDISON, ILLINOIS

NEW PRODUCTS



INDUSTRIAL STAPLES for fastening low-voltage wiring indoors or out. '*Heller-Ply*' staples

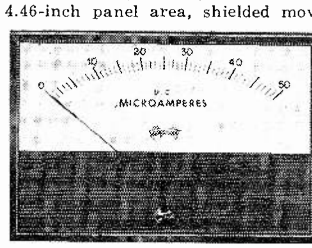


made of steel base, electroplated with copper, for rust, corrosion and salt-water proofing.—**Heller Roberts Instruments Corp.**, 6115 Carnegie Ave., Cleveland 3, Ohio.

SOLDERLESS TERMINAL KIT. Tool for crimping terminals, stripping and cutting wire; assorted terminals for all popular uses, snap-opening pouch for hanging. *Solderless Terminal*

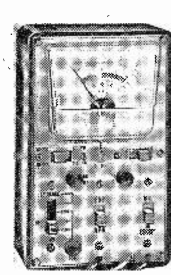
Connect-All Kit: 10 compartments hold more than 90 insulated terminals, color-coded for size, and selector chart.—**Vaco Products Co.**, 317 E. Ontario St., Chicago 11, Ill.

PANEL METER, *model 420-R.* 4.53-in. scale, 2.93 x 4.46-inch panel area, shielded movement.



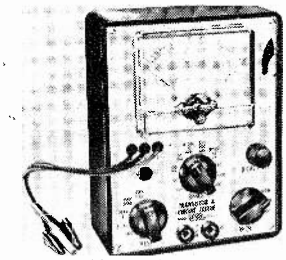
—**Triplett Electrical Instrument Co.**, Harmon Rd., Bluffton, Ohio.

TRANSISTOR ANALYZER, *model 212.* Tests dc gain in 3 ranges to 200; gain or leakage on high or low-power transistors; oscillator; in-circuit transistors. Checks condition of diodes and internal battery without removal of instru-



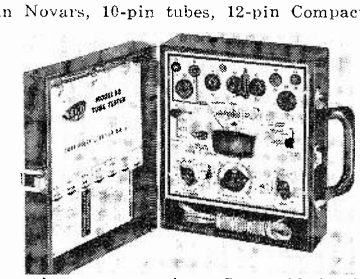
ment from case; measures battery voltage on 0–12-volt scale, dc drain on 0–80-ma scale. 3 external leads and socket for transistor check, also test leads for measuring voltage and current.—**Electronic Measurements Corp.**, 625 Broadway, New York 12, N. Y.

TRANSISTOR AND CIRCUIT TESTER, *model 680.* 50-μa, 3½-in meter movement reads actual transistor parameters plus all vom ranges for servicing transistor equipment. Dc ranges:



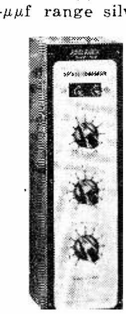
50 μa, 5 ma, 500 ma. Dc voltage ranges: 5 and 50. Resistance ranges: R $\times$ 1 (0 to 2,000 ohms, 12 ohms center scale), R $\times$ 100 (0 to 200,000 ohms, 1,200 ohms center scale), R $\times$ 10K (0 to 20 megohms. 120,000 ohms center scale.—**EICO**, (Electronic Instrument Co. Inc.), 33-00 Northern Blvd., Long Island City 1, N. Y.

TUBE TESTER, *model 88.* 10 sockets. Tests 9-pin Novars, 10-pin tubes, 12-pin Compactrons



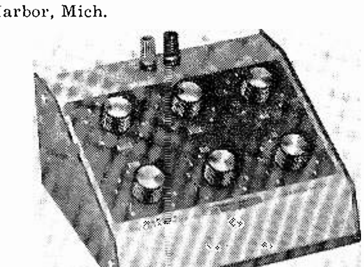
and nuvistors, many others. Seco grid-circuit test plus cathode-emission, filament-continuity and open-element tests.—**Seco Electronics Inc.**, 5015 Penn Ave. So., Minneapolis 19, Minn.

CAPACITOR SUBSTITUTION BOX, *model 1803.* 18 capacitors. Rotary switches select desired value between 100 $\mu\mu$f and 0.22 μf. Capacitors in 100-470-$\mu\mu$f range silver-mica, ±5% ac-

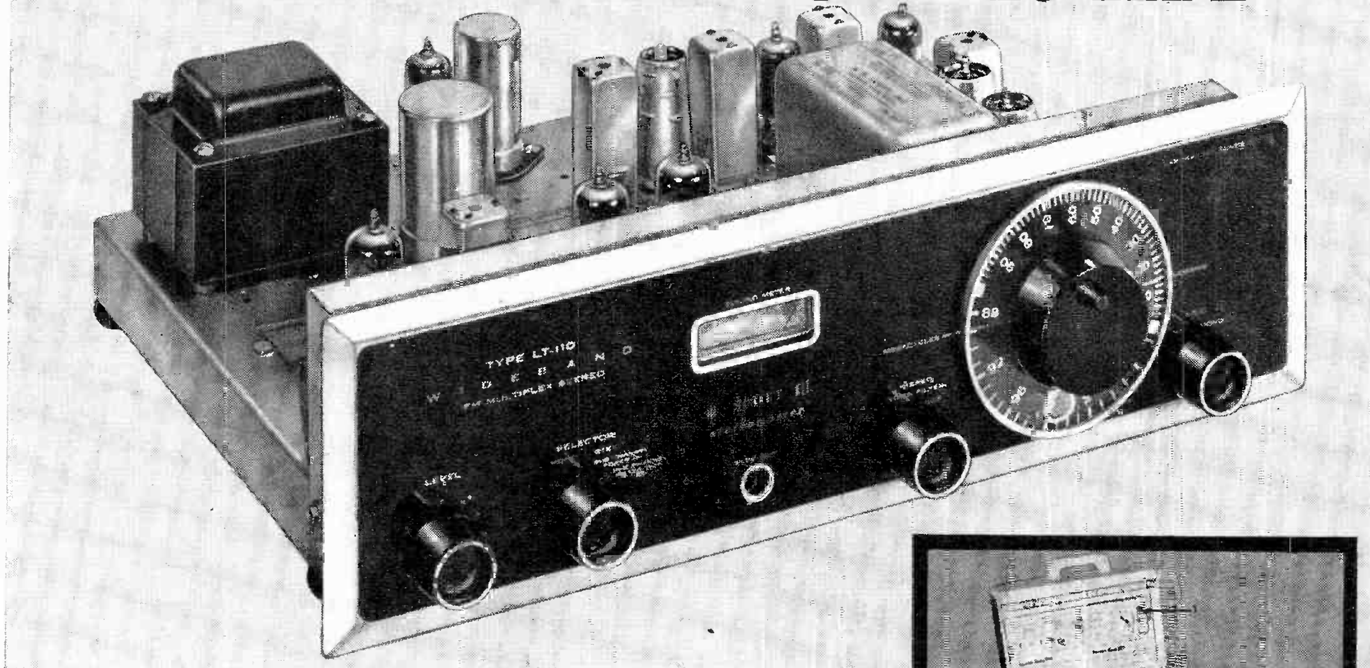


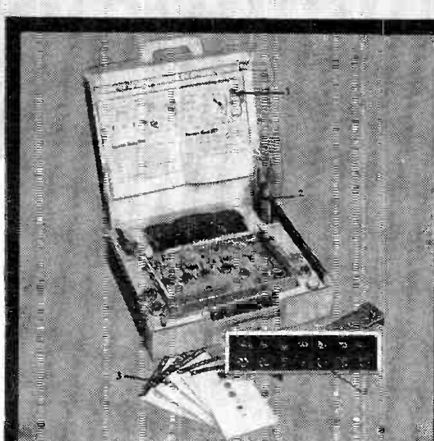
curacy, 500 volts; in .001–0.22-μf range, molded, ±10%, rated at 600 volts.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, N.Y.

6-DECADE RESISTANCE KIT, *model IN-11*, (illus). Switch selection of resistance values from 1 to 999,999 ohms in 1-ohm steps; forty-three ½% 1-watt resistors. *Model IN-21* 3-decade capacitor kit: capacitance values from 100 $\mu\mu$f to 0.111 μf in 100-$\mu\mu$f steps. 1% silver mica capacitors. Ceramic wafer switches.—**Heath Co.**, Benton Harbor, Mich.



SUPERB NEW SCOTT MULTIPLEX TUNER KIT





These Exclusive Scottkit Features Make Kit Building Foolproof and Fun

1. All assembly diagrams show parts in exact size and in **full color**, eliminating mistakes.
2. All wires cut to exact length and pre-stripped assuring correct lead placement and dress.
3. Exclusive Part-Charts with parts mounted in order of assembly, eliminating confusion and mistakes. **No loose bag of parts.**
4. Handsome appearance makes Scottkits completely professional in looks as well as in performance.

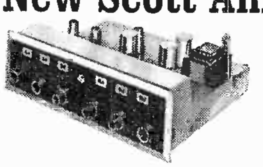
Now you can build a Multiplex Tuner that meets rigid factory standards

Now have the fun of building a genuine H. H. Scott Wide-Band FM Stereo Tuner in just a few hours . . . and save money, too. Revolutionary Scott-developed kit building techniques assure you of performance equaling Scott factory units.

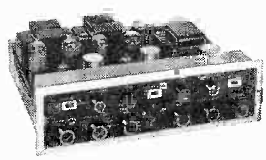
The new LT-110 Scottkit features a pre-wired and tested multiplex section plus the famous silver-plated factory built and aligned front end. Sensitivity of this magnificent new tuner is 2.2 µv. IHFM. There are special provisions for flawless tape recording right "off-the-air."

Scott Wide-Band multiplex tuners are the standard of the industry. They have been chosen by leading FM stations from Boston to San Francisco. If you want to build a truly professional component choose a Scottkit. All H. H. Scott kits are backed by over 15 years experience in the design and production of superb components. Important features include front panel tape recorder output and precision illuminated tuning meter. All critical parts heavily silver plated. Unique Ez-a-Line system assures factory performance without expensive test equipment. Dimensions: 15½ W x 5¼ H x 13 D in accessory case.

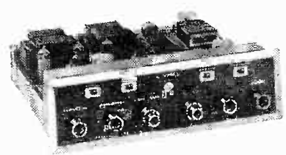
New Scott Amplifier Kits to match the LT-110



LC-21 Preamplifier Kit
Performance so outstanding this kit is used for laboratory purposes. Hum level —80 db. distortion less than 0.1%, frequency response 8 to 50,000 cps. **$99.95***
Matching LK-150 130 Watt Power Amplifier **$169.95***



LK-72 80 Watt Stereo Amplifier Kit —
Plenty of power for any hi-fi system. Complete tape recording and monitoring facilities. Oversized transformers weigh 12 pounds! Performance equal to the best pre-amp/power amp systems. **$159.95***



LK-48 48 Watt Stereo Amplifier Kit —
12 front panel controls. Gives full power down to 20 cps. Husky output transformers. All aluminum chassis and DC operated preamps. Scott quality at a best-buy price. **$119.95***

H.H.SCOTT

H. H. SCOTT, INC., Dept. 570-02-3, 111 Powdermill Road, Maynard, Mass.

Send me your new Scottkit catalog and complete information on FM Stereo.

Name ______________________

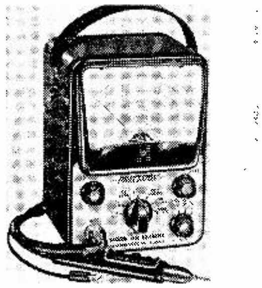
Address ______________________

City ______________ *State* __________

Export: Morhan Exporting Corp., 458 Broadway, NYC.
Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto.

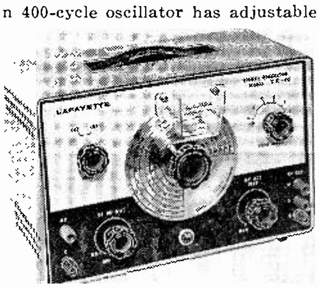
**Case extra. Slightly higher west of Rockies*

VTVM, *model 48.* Balanced vacuum-tube bridge circuit for all voltage and resistance measurements. 7 dc ranges (7⅓ meg-ohms per-volt sensitivity on 1.5-volt range). 7 ac ranges, peak to peak and rms, response ±1 db, 40 cycles



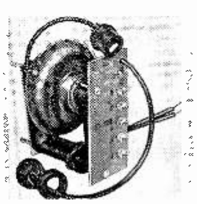
to 4 mc (600-ohm source, 5-volt range). 7 db ranges, −6 to + 66 db (0 db = 1 mw, 600 ohms). 7 electronic ohmmeter ranges (10 ohms center scale, initial range).—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, N. Y.

RF SIG GEN, *model TE-20.* Factory-wired and calibrated. 4½-in etched-steel vernier tuning dial. Fundamental output 120 kc to 120 mc in 6 bands, calibrated harmonic band 130 to 260 mc. Built-in 400-cycle oscillator has adjustable output



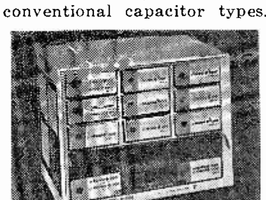
to 8 volts; continuously variable rf attenuator and high and low rf outputs. Frequency accuracy ±5%. Tube complement: 1 12BH7-A, 1 6AR5, 1 selenium rectifier. Power requirements: 105–105 volts ac, 50 cycles, 112 watts.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

REPLACEMENT FLYBACKS for wide range of models without circuit or chassis alteration. *Model HO-325* (illus) replaces Trav-ler part No.



TR 28; *Model HO-330*, Sparton part No. PC-70036.—**Stancor Electronics**, 3501 Addison St., Chicago, Ill.

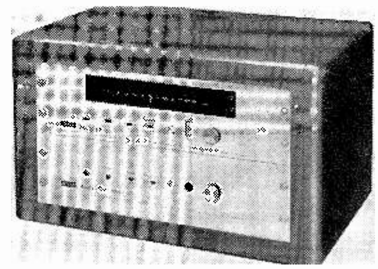
CAPACITOR KIT, *model K-100.* 19 tubular electrolytic capacitors, 14 types, replace more than 50 conventional capacitor types. Ranges:



2–500 μf, voltage maximums 50 to 475 volts.—**General Electric**, Electronic Components Div., Owensboro, Ky.

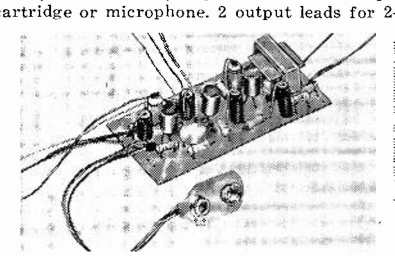
25-VOLT CERAMIC CAPACITOR, *type HCC.* Available ratings: .01, .05, .10 and 22 μf, tolerance +80% and −20%. Minimum leakage resistance at +25°C exceeds 50 megohms at 5 volts and 2 megohms at 25 volts. Maximum power factor 10%.—**Cornell-Dubilier Electronics**, Div. Federal Pacific Electric Co., New Bedford, Mass.

MODULATOR, *model AT (Audio-Trol).* Replaces audio distribution system in hotels, motels and institutions. Uses unused TV channels of standard receiver for audio reception. Source FM tuner, AM radio, Muzak, records, tape or microphone. Audio programming piped from head end of TV distribution system, where Audio-Trol is installed. Feeds 5 separate channels of audio through circuitry which prevents cross-modulation between adjacent channels. Channel



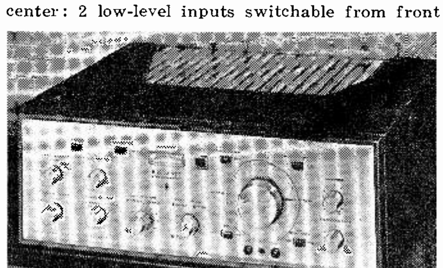
conversion achieved by crystal-controlled video carrier and FM sound carrier. 4.5-mc separation produces audio program through TV speaker. Power requirements 45 watts at 117 volts, 60 cycles ac. Shown rack-mounted with FT-100 FM tuner.—**Jerrold Electronics Corp.**, 15th and Lehigh Ave., Philadelphia, Pa.

SUBMINIATURE AUDIO AMPLIFIER, *model PK-522.* 2 13/16 x 1¼ x 3¼ inches; 3 transistors: 2 input leads for tape record/playback heads, radio tuner, crystal or ceramic phono cartridge or microphone. 2 output leads for 2–10-



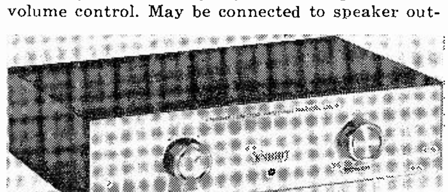
ohm speakers and 2 for on-off spst switch. 3 leads for volume control and 2 terminating in battery clips. Available accessories: 9-volt battery, 5,000-ohm volume control, miniature crystal mike, miniature speaker.—**Lafayette Radio Electronics Corp.**, 111 Jericho Tpke., Syosset, N. Y.

TUNER/AMPLIFIER SYSTEM. *model 355.* Multiplex section: 5 tubes and 11 diodes. Modular concept allows isolation of power amp to 50 feet away. FM section: silver-plated cascode front end, 2-mc wide-band detector and if's. Control center: 2 low-level inputs switchable from front



panel, separate bass and treble controls and stereo balancing features, tape recording and monitoring facilities with front-panel control and output. Each section self-powered.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

REVERBERATION UNIT, *Knight model KN-702:* Hammond type 4 reverberation chamber for delay of audio signal, 4-tube amplifier with volume control. May be connected to speaker out-



put terminals of any existing hi-fi amplifier without circuit changes.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

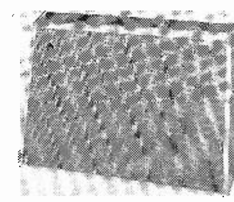
SPEAKER AND TWEETER. *Nova 3:* 8-in full-range speaker (illus). 2 cones mounted sepa-

rately but connected to same 2-in. voice coil. Response 30–16,000 cycles, impedance 8 ohms, magnet 1-lb Alnico V, baffle opening 7 5/16-in diameter. *Nova T-1* tweeter: twin-cone laminar construction, response 1.2–25 kc ±2 db, built-in crossover at 1,200 cycles.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

REMOTE SPEAKER SWITCH, *model 671,* for switching any of 5 monaural speakers to

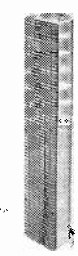
monaural amplifier. Mounts on wall or cabinet.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago.

MONITOR SPEAKER SYSTEMS employ 12-inch coaxial loudspeakers with flat response. High-frequency drivers with diffraction horns



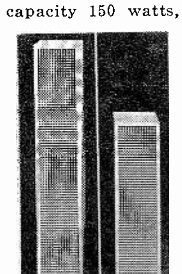
extend response to 20,000 cycles. Impedance connections available for 16, 50 and 600 ohms. *Sentry I* for wall or ceiling mounting, *Sentry II* floor model.—**Electro-Voice, Inc.**, Buchanan, Mich.

COLUMN SPEAKERS. Vertical stack of six adjusted-range cone speakers, for a fan-shaped, broad horizontal, narrow vertical pattern for paging and PA applications. 20-watt *Columair* unit measures 5 x 5 x 28 inches, 40-watt unit



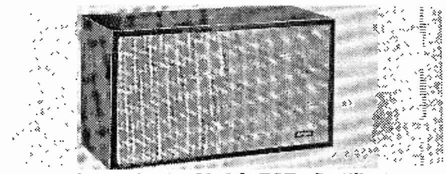
8 x 6 x 42 inches. May be rear, side or corner-mounted.—**Atlas Sound Corp.**, Div. American Trading & Production Corp., 1419-51 39th St., Brooklyn 18, N. Y.

COLUMNAR LOUDSPEAKERS for music and speech. Acoustic tapering reduces effective length of column at high frequencies, maintaining proper vertical dispersion at all frequencies. *Uniline model UCS-6* (left), 60-in column; 6 extended-range 8-in. speakers. Range 35–17,000 cycles, power capacity 150 watts, impedance 16



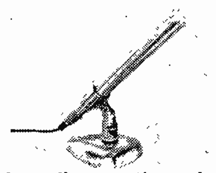
ohms, vertical angle 16°, horizontal angle 120°. *Model CS-4* (right), 40-in column; 4 extended-range 8-in. speakers. Range 45–17,000 cycles, power capacity 80 watts, impedance 8 ohms, vertical angle 22°, horizontal angle 120°.—**University Loudspeakers Inc.**, 80 S. Kensico Ave., White Plains, N. Y.

BOOKSHELF ENCLOSURES, with matching Jensen speakers. Tube-vented design avoids bass booming near cone-resonance frequency of woofer, boosts entire bass range. Speakers connected in crossover network to 8-ohm output



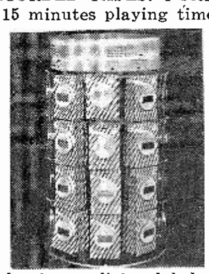
terminals on back. *Model TSE-4S* (illus): one 12-in. woofer and two 3½-in. tweeters. *Model TSE-2AS:* one 8-in. woofer and one 3½-in. tweeter.—**Argos Products Co.,** 301 Main St., Geona, Ill.

NONDIRECTIONAL MICROPHONES, *400 series.* Wide response, pressure-operated moving-coil dynamics. Can mount on ⅝-in. 27-thread desk or floor stand. Grip cam lock for insertion or



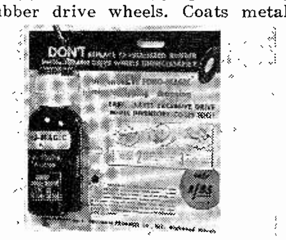
removal without disconnecting, adapter supplied. *Models 401* and *402,* adjustable impedance and response.—**Turner Microphone Co.,** 901 17th St. N.E., Cedar Rapids, Iowa.

PRERECORDED TAPES. 4 stereo selections on 3-in reel, 15 minutes playing time. Each *Add-*



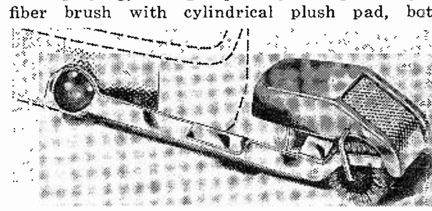
A-Tape includes four splicing labels for additions or editing. Compatible for 4- or 2-track stereo playback.—**Coleman Electronics, Inc.,** 133 E. 162nd St., Gardena, Calif.

COATING FOR PHONOGRAPH PARTS, *Fono-Magic,* liquid compound of rubber and carbide particles, applied with brush, eliminates turntable slipping and dragging caused by crystallized rubber drive wheels. Coats metal drive



surfaces with nonslipping rubber to increase traction; carbide particles scratch crystallized surface and expose live rubber.—**R-Columbia Products Co., Inc.,** 2008 St. John Ave., Highland Park, Ill.

AUTOMATIC RECORD CLEANER, redesigned *Dust Bug* model. Sweeps record just before playing, using specially designed nylon fiber brush with cylindrical plush pad, both

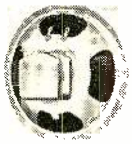


dampened with antistatic fluid. Installs on any tone arm, no vertical stylus loading on cartridge. User-replaceable brush and pad.—**Electro-Sonic Laboratories,** 627 Broadway, New York, N.Y.

PA TRANSFORMERS. Outputs 4 and 8 ohms, power steps of 0.5, 1.0 or 2.0 watts. Standard open-channel frame mounting with solder lugs for primary and secondary leads. *Model A-8109* (illus), for 70.7-volt line, has taps for primary impedances of 2,500, 5,000 and 10,000

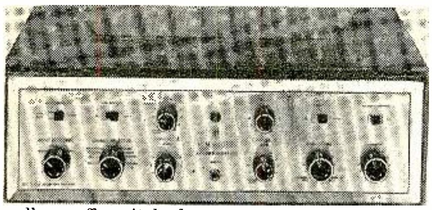
ohms. *Model A-8099* for 25-volt line, has taps for primary impedances of 312.5, 625 and 1,250 ohms. —**Stancor Electronics, Inc.**, 3501 Addison St., Chicago 18, Ill.

PA SPEAKER, *model 8A6PAD.* Voice-coil impedance 8 ohms, diameter 1 inch. Transformer



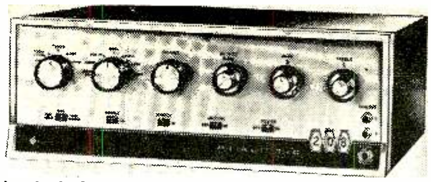
mounting bracket, rim mounting holes, aluminum baked-enamel finish. Alnico V magnets.—**Quam Nichols Co.**, 234 E. Marquette Rd., Chicago, Ill.

STEREO AMPLIFIERS. *Model 222C* (illus), 44 watts; *model 299C*, 72 watts. Both full power over audio spectrum from 20 to 20,000 cycles. Stereo headphone output on front panel, push-



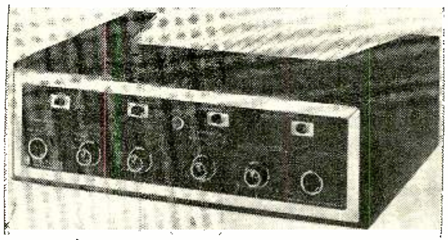
pull on-off switch for presetting all controls.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

TRANSISTORIZED STEREO AMPLIFIER, *model TA-208.* 50 watts; 18 transistors plus 1 rectifier and 2 driver transformers. Basic elements on PC board, rear output sections separated. Front-panel controls: 5-position input selector; 7-position function switch; ganged volume control; concentric balance and blend;



clutched bass and treble; tape-head control; rumble, loudness and scratch controls; tape recorder input and earphone jacks. Rear panel: 1 switched and 1 unswitched ac receptacle; speaker phase switch; tape recorder outputs. Equalization ±1 db, deviation not more than ±1 db, 20 cycles to 20 kc, output 2.0 volts.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17.

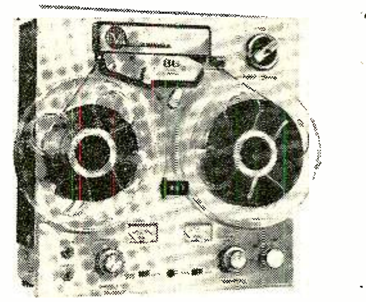
STEREO AMPLIFIER KIT, *model LK-48.* 48-watt unit includes separate bass and treble on each channel, stereo balance control, front-panel tape monitoring facilities and derived



center-channel output. Parts mounted on separate charts; wires precut and prestripped; mechanical parts preriveted to the chassis.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

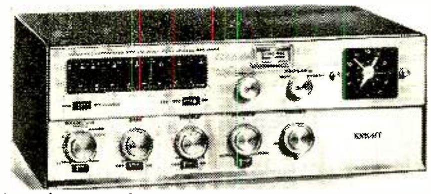
STEREO TAPE-MONITOR AMPLIFIER, *model A-1220.* Tapes monitored through headphones during recordings. For tape systems with preamps but not power amplifiers.—**Koss, Inc.**, 2227 N. 31st St., Milwaukee, Wis.

STEREO-COMPACT TAPE RECORDER, *model 86.* Heterodyne filter for distortion-free recording. Independent stereo VU meters for recording or playback models. Recording amplifiers and playback preamps. Automatic equalization of recording playback at 7½ or 3¾ ips, adjusted as speed control is set. Range: 25–18,000 cycles.



Model ERQ: half-track stereo or monaural recording: half or quarter-track stereo or monaural playback, *RMQ:* quarter-track recording, stereo or monaural; quarter or half-track playback, stereo or monaural. *ESM:* half-track only recording and playback, stereo or monaural.—**Viking of Minneapolis, Inc.**, 9600 Aldrich Ave. So., Minneapolis 20, Minn.

STEREO FM RECEIVER, *Knight model KN-310MC.* Compact all-in-one unit. Tuner with



transistor–nuvistor circuit, signal-strength meter and afc. 40-watt all-transistor amplifier section and automatic clock timer for preset on on-off switching. Output: 20 watts per channel, less than 1% harmonic distortion. Response: ±1 db, 20–20,000 cycles at rated power.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

STEREO SPEAKER, *model B-4000,* for large rooms. 8 tweeters in column for even distribution of highs, special mid-range unit and two woofers.

(*Continued on page* 110)

EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship at our risk one or more of the testers described on these pages.

SUPERIOR'S NEW MODEL 770-A

VOLT-OHM MILLIAMMETER

FEATURES:

- Compact—measures 3⅛" x 5⅞" x 2¼".
- Uses "Full View" 2% accurate 850 Microampere D'Arsonval type meter
- Housed in round-cornered, molded case.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.

6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.

2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm.

3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps.

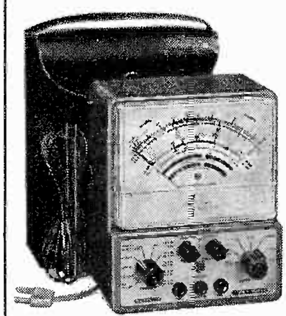
3 DECIBEL RANGES: —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with test leads and operating instructions. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL VIEW METER



SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
INDUCTANCE: .15 to 7 Henries. 7 to 7,000 Henries.
DECIBELS: —6 to + 18, + 14 to + 38, + 34 to + 58.

The following components are all tested for **QUALITY** at appropriate test potentials. Two separate **BAD-GOOD** scales on the meter are used for direct readings.
All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. All Germanium Diodes.
All Silicon Rectifiers. All Silicon Diodes.

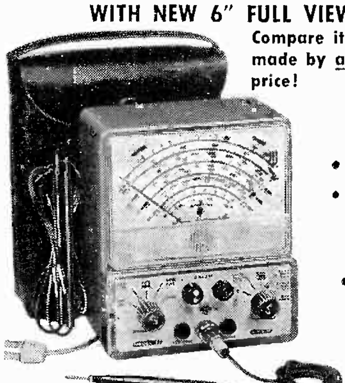
Model 79 comes complete with operating instructions, test leads and carrying case. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL VIEW METER

Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price!



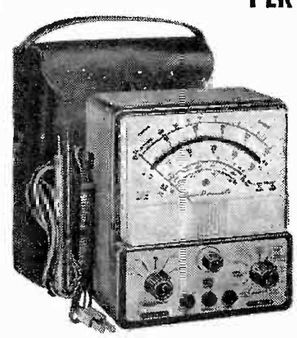
SPECIFICATIONS:

- **DC VOLTS**—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1500 volts.
- **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2000 volts.
- **ELECTRONIC OHMMETER**—0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- **DECIBELS**—10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads and carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER



6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

SPECIFICATIONS:

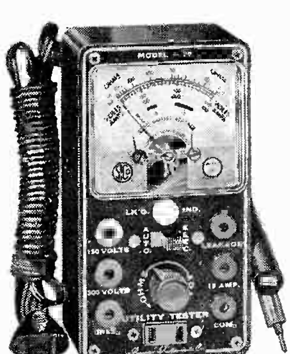
7 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
6 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 CAPACITY RANGES: .00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES: —6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 70 UTILITY TESTER

FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS ★ AUTOMOBILES



INCLUDED FREE
64 page condensed course in electricity. Profusely illustrated. Written in simple, easy-to-understand style.

As an electrical trouble shooter the Model 70:
• Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc. • Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:
• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book and test leads. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

DID YOU EVER?

- ▶ Order merchandise by mail, including deposit or payment in full, then wait and write...wait and write?
- ▶ Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?
- ▶ Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business . . . We ship at our risk!

NO

CONTRACT TO SIGN

CO-MAKERS

EMPLOYER NOTIFICATION

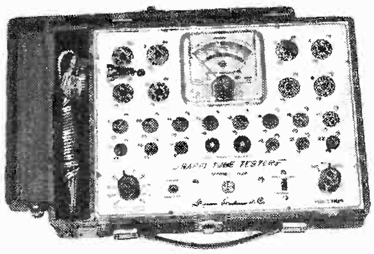
The simple order authorization included in this offer is *all* you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 82A

MULTI-SOCKET TYPE TUBE TESTER



SPECIFICATIONS:

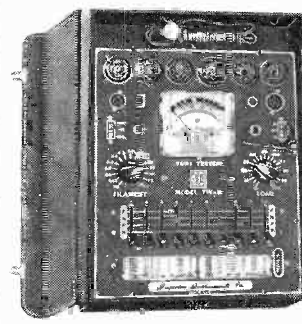
- Tests over 1000 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types.
- Dual Scale meter permits testing of low current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Model 82A comes housed in handsome, portable case.

Price is $36.50. Terms: $6.50 after 10 day trial then $6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER



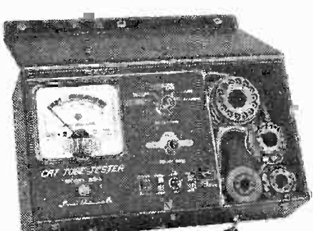
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large-easy-to-read type.
- **NOISE TEST:** Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- **SEPARATE SCALE FOR LOW-CURRENT TUBES**—Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 comes housed in a handsome, portable, saddle-stitched Texon case. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 83A

C.R.T. TESTER

Tests and Rejuvenates ALL PICTURE TUBES



ALL BLACK AND WHITE TUBES
From 50 degree to 110 degree types—from 8" to 30" types.

ALL COLOR TUBES
Test ALL picture tubes —in the carton —out of the carton —in the set!

Model 83A provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.

Model 83A properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

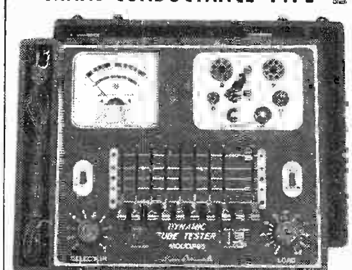
Model 83A will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus.

Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83A applies a *selective* low voltage *uniformly* to assure increased life with no danger of cathode damage.

Model 83-A comes housed in handsome portable Saddle-stitched Texon case—complete with socket for all black and white tubes and all color tubes. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 85

TRANS-CONDUCTANCE TYPE TUBE TESTER



- Employs latest improved **TRANS-CONDUCTANCE** circuit. Test tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- **SYMBOL REFERENCES:** Model 85 employs time-saving symbols (*, +, ●, ▲, ■:) in place of difficult-to-remember letters previously used. Repeated time-studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes necessary and advantageous.
- **"FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube.
- **FREE FIVE (5) YEAR CHART DATA SERVICE.** Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. **Price is $52.50. Terms: $12.50 after 10 day trial then $8.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TV-50A

GENOMETER
7 Signal Generators in One!

- **R.F. Signal Generator for A.M.**
- **R.F. Signal Generator for F.M.**
- **Audio Frequency Generator**
- **Bar Generator**
- **Cross Hatch Generator**
- **Color Dot Pattern Generator**
- **Marker Generator**

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 88

TESTS ALL TRANSISTORS AND TRANSISTOR RADIOS

AS A TRANSISTOR RADIO TESTER

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble is located and pinpointed.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium arsenide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors *as they are released!*

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-on Cables for Transistor Testing; an R.F. Diode Probe for R.F. & I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SEND POSTCARD TODAY (NO POSTAGE NECESSARY)

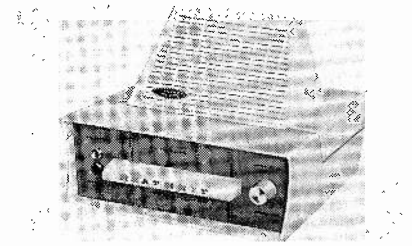
Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC., DEPT D-920 3849 TENTH AVENUE, NEW YORK 34, N.Y.

(*Continued from page* 105)

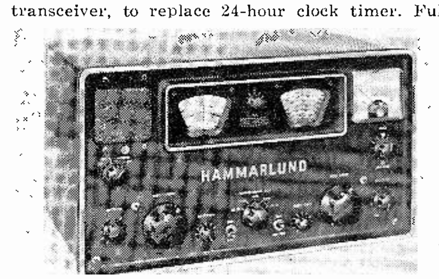
Response 35–20,000 cycles, crossover at 200 and 1,500 cycles, impedance 8 ohms, 30 watts. *Model B-2000*, bookshelf unit. *B-3000* for apartment-sized rooms; *B-1000*, indoor-outdoor speaker.—**R. T. Bozak Sales Co.**, 587 Connecticut Ave., S. Norwalk, Conn.

WIRELESS INTERCOM KIT, *model GD-51.* Power line is transmission medium for low-frequency rf signal. No interunit connecting



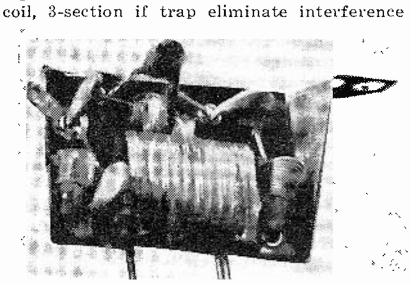
leads, no additional wiring for added units. All-transistor circuit, self-contained 117-vac power supply, squelch circuit, overload diode and 2 indicating lights.—**Heath Co.**, Benton Harbor, Mich.

BUILT-IN CB SPEAKER for HQ-105 TR transceiver, to replace 24-hour clock timer. Full



coverage. Available factory-wired as HQ-105 TRS.—**Hammarlund Mfg. Co., Inc.**, 460 W. 34 Sts., New York 1, N.Y.

ANTENNA COIL ASSEMBLY, *model 1359A*, replacement for RCA and Admiral tuners. Balun coil, 3-section if trap eliminate interference be-



tween TV sets over if band. Mounted in phenolic board/metal plate assembly.—**Coleman Electronic Products**, 1017 N.E. 3rd Ave., Amarillo, Tex.

All specifications from manufacturers' data

NEW BUSINESS GETTERS

NEW LITERATURE

WALL CHART explaining FM stereo for dealer personnel and consumers.—**Harman-Kardon, Inc.**, Plainview, L.I., N.Y.

DIAMOND NEEDLE DISPENSER DR-1.—**Duotone Co.**, Keyport, N.J.

PICTURE TUBE REPLACEMENT GUIDE *Pub. No. ETR 702-F.* 24 x 30-in wall chart lists essential data on 460 types of TV picture tubes, including interchangeability guide.—**General Electric,** Electronic Components Div., Owensboro, Ky.

FM STEREO BROADCASTING described in 7-page leaflet, BK-50. Diagrams and text outline G-E–Zenith system.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N.Y.

PLATE ASSEMBLY REPLACEMENT GUIDE *No. PRG-612.* 6-page chart of printed circuit R-C units gives manufacturers' parts numbers, identification printed on the part, and Aerovox catalog number.—**Aerovox Corp.,** Distributor Div., New Bedford, Mass.

NEEDLES AND ACCESSORIES presented in 52-page catalog, including illustrated charts for needle identification and replacement.—**Astatic Corp.,** Conneaut, Ohio.

TRANSISTOR TRANSFORMER NOMOGRAPH, for design of class-A and class-B transformer-coupled transistor audio and servo amplifiers, determines required primary and secondary impedances of output and driver transformers.—**Microtran Co., Inc.,** 145 E. Mineola Ave., Valley Stream, N. Y.

MASTER INDEX lists 20 radio and 15 TV "Most-Often-Needed" service manuals, with cross-reference for individual sets.—**Supreme Publications,** 1760 Balsam Road, Highland Park, Ill. **25¢.**

DISCOUNT RECORDS AND TAPES detailed in 144-page *Catalog No. 211. Lists* more than 1,600 stereo records, 300 monophonic recordings and 800 four-track stereo tapes.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

INDUSTRIAL AIDS, scientific, mathematical and optical, offered in 160-page *Catalog No. 621.* Includes technical data and illustrations on instruments and components, photographic and optical items as well as math training aids.—**Edmund Scientific Co.,** Barrington, N. J.

RF INTERFERENCE SHIELDING described in reprinted 4-page article "Shielded Rooms For Electronic Equipment." Outlines techniques, materials, design and construction details, including 5 photos.—**Ace Engineering & Machine Co.,** C. C. Borden, vice president, Tomlinson Rd., Huntingdon Valley, Pa.

RADIO EQUIPMENT listed in 50-page illustrated catalog. Items include wire, cable, tubing and electronic hardware, as well as radio–TV accessories and components.—**Birnbach Radio Co., Inc.,** 145 Hudson St., New York 13, N. Y.

TAPE RECORDERS and hi-fi equipment described in 16-page illustrated catalog. Technical details given on 8 Sony models and 3 professional mikes plus accessories.—**Superscope, Inc.,** 8150 Vineland Ave., Sun Valley, Calif.

HI-FI EQUIPMENT CATALOG offers eight pages of photos and specs on four Norelco tape recorders with *Buyer's Guide and Applications Chart.* Full line of loudspeakers also included.—**North American Philips Co., Inc.,** High Fidelity Products Div., 230 Duffy Ave., Hicksville, N. Y.

TAPE-LOG, 32-page illustrated catalog, lists over 1,500 4-track stereo tapes, covering libraries of 38 major labels.—***Danken Associates,*** 8244 Vista Del Mar, Playa Del Rey, Calif. ***60¢.***

COMMUNICATIONS PRODUCTS shown in 4-page *Bulletin No. 7010.* Illustrations and specs given on Telerite line, including MIL-spec and miniature jacks and plugs as well as hybrid and standard assemblies.—**Ucinite Co.,** Div. United-Carr Fastener Corp., Newtonville 60, Mass.

VHF TRANSLATORS. Illustrated 4-page leaflet contains information on indoor and outdoor models, plus double-conversion system.—**EMCEE,** Electronics Missiles & Communications, Inc., 262 E. 3rd St., Mount Vernon, N. Y.

WIREWOUND RESISTORS presented in 20-page *Catalog 14 RF,* with full illustrations, specs and performance characteristics.—**Cinema *Engineering,*** Div. Aerovox Corp., 1100 Chestnut St., Burbank, Calif.

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.

"ONE DOLLAR" buys

As much as $15 worth – Everything Brand New and sold to you with a money back guarantee.

10% OFF & FREE GIFT — ON PURCHASE OF $10 OR OVER!

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- 5 – SETS SPEAKER PLUGS male & female, wired, long leads — $1
- 3 – AUDIO OUTPUT TRANSFORMERS 50L6 type — $1
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- 3 – AUDIO OUTPUT TRANSFORMERS 6K6 or 6V6 type — $1
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- 10 – FILTER CHOKE TRANS 75 Ω, 1 henry, 100ma — $1
- 3 – I.F. COIL TRANSFORMERS 456kc, most popular type — $1
- 3 – I.F. COIL TRNSFRMRS 456kc transistor type ¾x¾" — $1
- 2 – G.E. #RTL-143 I.F. COIL TRNSFRMRS 456kc w/flange — $1
- 3 – I.F. COIL TRANSFORMERS 10.7mc for FM — $1
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- 4 – OVAL LOOP ANTENNAS assorted popular sizes — $1
- 3 – LOOPSTICK ANTENNAS hi-gain, ferrite, adjustable — $1
- 3 – VARIABLE CONDENSERS superhet 420/162 mfd — $1
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- 12 – RADIO OSCILLATOR COILS standard 456kc — $1
- 3 – ½ MEG VOLUME CONTROLS with switch — $1
- 5 – ½ MEG VOLUME CONTROLS less switch — $1
- 5 – 1 MEG VOLUME CONTROLS less switch — $1
- 5 – 50K VOLUME CONTROLS less switch — $1
- 5 – ASST. 4 WATT WIRE-WOUND CONTROLS — $1
- 10 – ASSORTED VOLUME CONTROLS less switch — $1
- 5 – ASSORTED VOLUME CONTROLS with switch — $1
- 100 – VOLUME CONTROL HEX NUTS fits ⅜" bushing — $1
- 10 – SURE-GRIP ALLIGATOR CLIPS 2" plated — $1
- 1 – GOLD GRILLE CLOTH 14"x14" or 12"x18" — $1
- 10 – SETS PHONO PLUGS & PIN-JACKS RCA type — $1
- 2 – $2.50 SAPPHIRE NEEDLES good for 10,000 plays — $1
- 20 – ASST. PILOT LIGHTS #44, 46, 47, 51, etc. — $1
- 10 – PILOT LIGHT SOCKETS bayonet type, wired — $1
- 50 – ASSORTED TERMINAL STRIPS 1, 2, 3, 4 lugs — $1
- 100' – FINEST NYLON DIAL CORD best size, .028 gauge — $1
- 35 – ASST. RADIO KNOBS screw and push-on types — $1
- 100 – ASSORTED KNOB SET-SCREWS best sizes — $1
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- 25 – ASSORTED CLOCK RADIO KNOBS in colors — $1
- 50 – ACORN RADIO KNOBS ½" diameter, push-on — $1

- 100 – ASSORTED ½ WATT RESISTORS some in 5% — $1
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- 25 – ASSORTED MICA TRIMMER CONDENSERS — $1
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- 10 – HI-VOLTAGE CONDENSERS .007-1600v — $1
- 3 – ELECTROLYTIC CONDENSERS 50/30-150v — $1
- 2 – ELECTROLYTIC CONDENSERS 80/80/20-150v — $1
- 10 – ASST. RADIO ELECTROLYTIC CONDENSERS — $1
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- 4 – DIODE CRYSTALS 1-1N34 1-1N60, 1-1N69, 1-1N82 — $1
- 3 – SELENIUM RECTIFIERS 2 – 65ma and 1 - 75ma — $1
- 2 — SELENIUM RECTIFIERS 1 — 100 ma and 1 – 250 ma — $1
- 2 – SELENIUM RECTIFIERS 1 — 75ma and 1 - 350ma — $1
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- 20 – ASST. TUBE SHIELDS for 7 pin and 9 pin Tubes — $1
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- 15 – ASSORTED ROTARY SWITCHES regular $15 value — $1
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- 50' – HI-VOLTAGE WIRE for TV, special circuits, etc. — $1
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- 250 – ASST. SOLDERING LUGS best types and sizes — $1
- 1 – LB SPOOL ROSIN-CORE SOLDER 40/60 — $1
- 600 – ASST. HARDWARE KIT screws, nuts, washers, rivets, etc. — $1
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- 150 – ASST. 6/32 SCREWS & 150 – 6/32 HEX NUTS — $1
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- 100 – ASST. RUBBER FEET FOR CABINETS best sizes — $1
- 15 – ASST HANDY RADIO & TV BRACKETS many uses — $1
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- 35 – MICA CONDENSERS 20 – 5 mmf and 15 – 25 mmf — $1
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- 35 – CERAMIC CONDENSERS 20 - 2000mmf & 15 - 5000mmf — $1
- 10 – ASSORTED TUBES Radio, TV, Industrial — $1
- 4 – TUNGSOL 1U4 TUBES also serves as a 1T4 — $1
- 3 – SYLVANIA 35W4 TUBES factory cartoned — $1
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- $15.00 TELEVISION PARTS "JACKPOT" best buy ever — $1
- 1 – $10 INDOOR TV ANTENNA hi-gain, 3 section, tiltproof — $1
- 5 – TV CHEATER CORDS with both plugs — $1
- 75' – MINIATURE ZIP CORD 2 conductor, 101 uses — $1
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- 1 – 70° FLYBACK TRANSFORMER incl Schematic Diagram — $1
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- 1 – TV VERTICAL OUTPUT TRANSFORMER 10 to 1 ratio — $1
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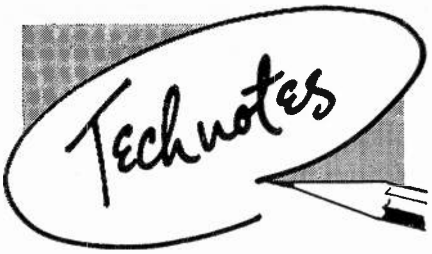
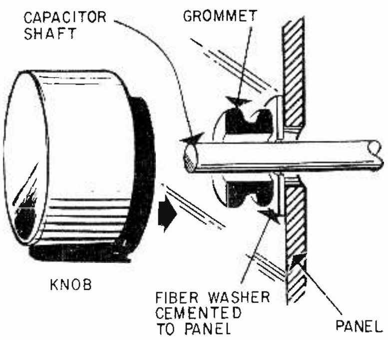


RCA 8EY4DJ

A common trouble in these record players is excessive hum. There are two causes. One is heater–cathode leakage in the 12AX7 and is cured by replacing the tube. A more subtle 60-cycle hum can be reduced by adding a length of insulated wire from pin 4 of the 12AX7 to the middle terminal on the tone control. Both of these points are at B-minus, but adding the wire cancels hum pickup caused by circulating currents.—*M. L. Leonard*

BC-221 FREQUENCY METER

Complaint: At times the frequency on both the low and high band would drift badly. This condition would not improve no matter how long the set was left operating.

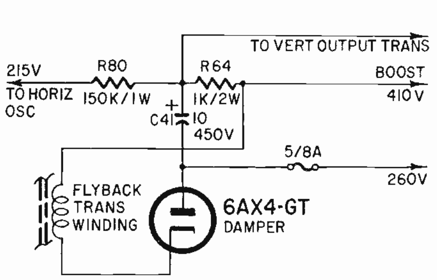


Test: The drift was traced to a defective corrector control. It was loose and had a wobbly shaft. However, replacement was almost impossible unless I wanted to rip up the precise oscillator section and take a chance on disturbing the dial calibration.

Cure: After hours of thought, I decided to try to correct the drifting of the spacing of the corrector control capacitor by inserting some pressure between the control knob and the front panel. I placed a fiber washer over the control shaft of the capacitor and cemented it between the shaft and panel to keep the control shaft from wobbling. Then I placed a rubber grommet between the fiber washer and the control knob. By adjusting the control knob to give enough pressure to keep the control rotation stiff and to steady any movement between the rotor and stator plates, once the control has been set, I solved my problem.—*George P. Oberto*

OLYMPIC 1TB61

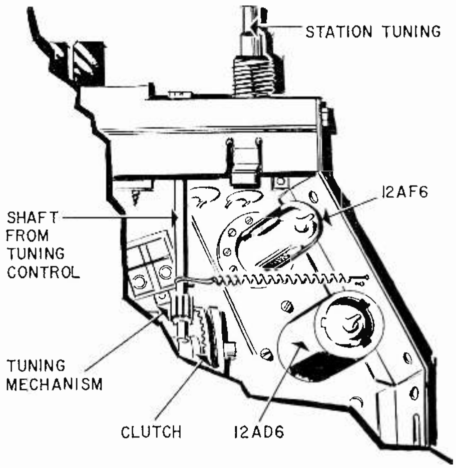
Horizontal sync was unstable and, while the picture had straight sides, it was about 4 inches narrower at the bottom. After much checking, we replaced C41 and cleared up the trouble.



The vertical output stage and the horizontal oscillator get B-plus from the same source. When this capacitor opened, the output of the vertical output tube was fed to the horizontal oscillator, causing the symptoms above.—*William R. Seabrook*

FORD 75BF AUTO RADIOS

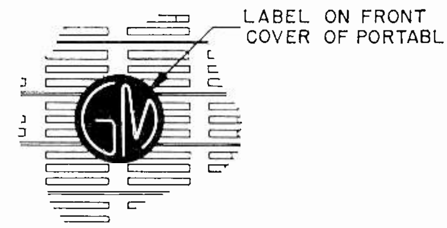
Complaints of tuning-dial slipping where the slippage is in the clutch mechanism can be cured by mounting a phonograph or dial-cord spring from the tuning shaft close to the gear drive to the right side of the cabinet to exert more pressure on the clutch mechanism. Don't use too heavy a spring or the pushbuttons won't work properly and will wear excessively.—*George P. Oberto*



GM PORTABLES

Scattered throughout the United States are some Delco Radio portable radios with a "GM" label. These portables have an anodized aluminum case which gives the radio a gold appearance, and a black front cover. They are complimentary radios and service information is not available.

The problem is what to do if one of these radios is brought into your shop.



If you were to look at a 1959 Buick portable radio, you would immediately notice the similarity between this radio and the GM portable. This not only applies to the external appearance but also the circuit. The main difference between the two radios is the lack of a connector in the GM portable. Since it was not designed to be part of a car radio, the connector has been left out.

If one of these GM portables is brought into your shop for repair, dig out the 1959 Buick, Pontiac or Oldsmobile service bulletin and go to work.—*Delco Testing Tips* END

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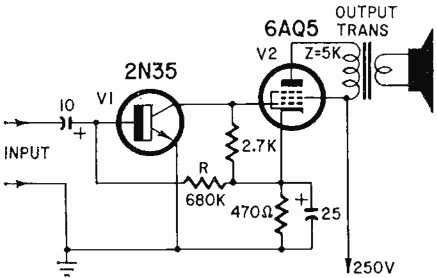
new PATENTS

TRANSISTOR-TUBE AMPLIFIER

Patent No. 2,979,664

Wm. F. Palmer, Carlisle, and Geo. Schiess, Watertown, Mass. (Assigned to Sylvania Electric Products, Inc., Wilmington, Del.)

V1 is energized by the dc drop across the cathode resistor. This voltage remains steady in class-A operation. V1 is coupled directly to V2. R sets the transistor bias current. It is also a



feedback resistor to stabilize the first stage. For example, if the base input goes positive, less current flows into the cathode resistor, driving the cathode more negative.

With 30-mv input, the output is 1 watt and the gain is about 60 db. At 4 watts output, distortion is 10%.

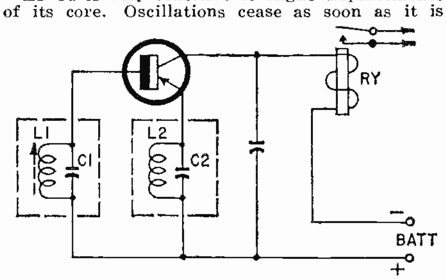
CONTROL CIRCUIT

Patent No. 2,972,116

Charles E. Lowe, Fenton, Mich. (Assigned to General Motors Corp., Detroit)

At frequencies near alpha cutoff, a transistor has negative resistance and will oscillate. If L1-C1 is tuned to a frequency slightly above that of L2-C2 (both being near cutoff), oscillations persist. The frequency will be between the resonant values, where the inductive reactance of L1-C1 cancels the capacitive reactance of L2-C2.

L1-C1 is very sensitive to slight displacements of its core. Oscillations cease as soon as it is



tuned to the frequency of L2-C2—when the core connected to a detector indicates the proper setting.

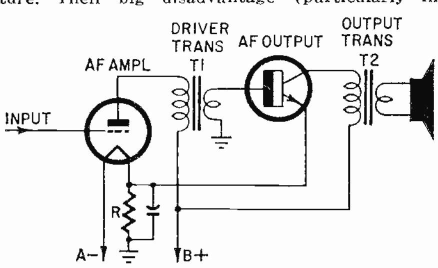
Transistor current will be higher during oscillation, so the relay is energized while L1-C1 is tuned higher than L2-C2.

HYBRID RADIO

Patent No. 2,970,213

Francis M. Dukat, Waltham, Mass. (Assigned to Raytheon Co.)

Tubes are ideal amplifiers. They have high input and output impedances, and are not readily damaged by overload or affected by temperature. Their big disadvantage (particularly in portable radios) is that they require filament power. Since the audio output tube requires the most filament power, it is especially desirable to substitute a transistor in this stage.



This inventor shows a simple method for obtaining power for the output transistor. The emitter-base circuit is in series with the filament string. R bypasses some of the current to prevent too high emitter input. The B-battery supplies the tubes and also the collector. In a set using midget tubes, this supply may be 30 volts. The vacuum tube feeds the transistor through T1. T2 is the output transformer.

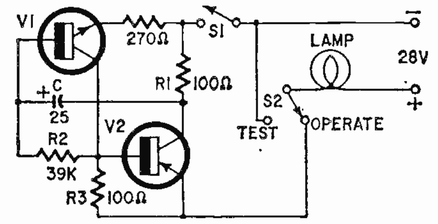
LIGHT FLASHER

Patent No. 2,977,581

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

Components used here are so small they may be housed in a compact, plug-in cylinder. The lamp flashes on and off when S1 is closed and 28 volts is applied.

When S1 is closed, a small charging current



flows into C through R1, R2, R3 and the lamp. The rising voltage at V1's base drives it into conduction. Current through R3 biases V2 to conduction too. Enough current can now flow through the lamp to light it.

V2 conduction discharges C, allowing V1 to block again. V2 blocks, also, so the lamp is extinguished and the cycle repeats.

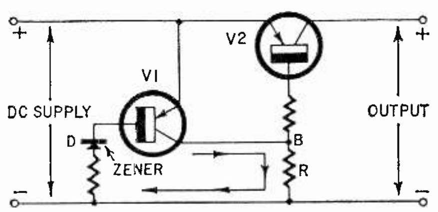
S2, a test button, checks the lamp and the voltage supply.

TRANSIENT ELIMINATOR

Patent No. 2,971,102

Robert T. Schultz, 1250 N. Tressy Ave., Glendora, Calif.

This circuit is placed between a power supply and its load to eliminate transient overloads that may damage transistors and other delicate components. D is a Zener diode whose



breakdown value is higher than the supply voltage. Therefore V1 is normally blocked. V2 conducts, transmitting power between its emitter and collector.

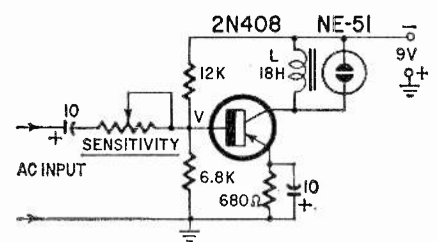
When a transient arrives, the diode breaks down, closing V1's base circuit. Hole current flows in the direction of the arrows through R. This generates a positive bias at B, blocking V2 during the overload.

TRANSISTORIZED LEVEL INDICATOR

Patent No. 2,972,705

Joseph A. Howells, Riverton, N.J. (Assigned to Radio Corp. of America)

With only a 9-volt supply, this circuit uses a neon lamp to indicate audio level. Normally V is biased to conduction but, when a



large signal arrives, it overcomes the bias and blocks V. Collector current ceases abruptly, causing L to generate a high instantaneous voltage. This signal is indicated by the neon glow. END

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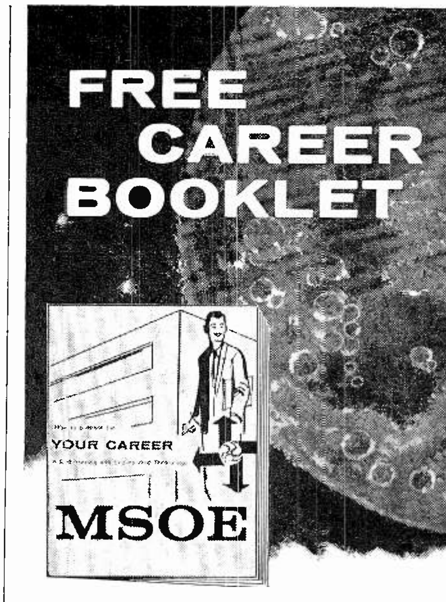

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DON'T BUY HI-FI COMPONENTS, Kits, Tape, Tape Recorders until you get our low, low return mail quotes. "We Guarantee Not To Be Undersold." Wholesale Catalog Free. Easy Time Payments Plan, 10% down—up to 24 months to pay. **HI-FIDELITY CENTER**, 220 RC E 23 St., New York 10, N.Y.

TAPE recorders, Hi-Fi components, Sleep-learning equipment, Tapes, Unusual values. Free catalog. **DRESSNER**, 1523R Jericho Turnpike, New Hyde Park, N.Y.

PROMPT DELIVERY. Lower prices. Amplifiers, Tape Recorders, Tuners, etc. No catalogs. Individual Quotes. Compare. **L. M. BROWN SALES CORP.** Dept. R, 239 E. 24th St., New York 10, N. Y.

SAVE 30%. Stereophonic music on tape. Request tape, recorder Catalog R-1. **SAXITONE TAPE SALES**, 1776 Columbia Rd, Washington 9, D.C.

RENT STEREO TAPES—over 2,000 different—all major labels—free catalog. **STEREO-PARTI**, 811-RE, Centinela Ave., Inglewood 3, Calif.

SALE ITEMS. Component quotes. Bulk tapes. **BAYLA CO.**, Box 131-RE, Wantagh, N.Y.

WEST COAST HI-FI—send for lowest quotations Tuners, Amplifiers, Recorders, Pickups, Speakers, Etc. 6-transistor radio, $12.95. **ELECTRONICS**; 10217 Venice, Los Angeles 34, Calif.

General

ENGRAVE panels, nameplates, models using "Dupliscaler" engraving machines. Details, sample engraving, 20¢. Write **DESCO PRODUCTS**, 4329-RF Woodman, Van Nuys, Calif.

QUIET noisy TV tuners and controls with Lectroclean. 4-oz. unbreakable bottle, 50¢. **HANDLE**, Box 146, Brooklyn 19, N.Y.

BUSINESS AIDS

500 PRINTED GUMMED Name and Address Labels, $1.00. No COD's. Print clearly. **ADDISON MAIL ORDER**, RE-6, 1840 Addison, Chicago 13, Ill.

NIPPO Check Protectors, $9.95. Warranteed! Free Trial Offer! **ALBRIGHT**, Tipton 1, Ind.

RUBBER STAMPS—name, address, $1.00. 1,000 Business Cards, $3.99. Free catalog. **ALCO**, Box 244-R, Urbana, Ill.

BUSINESS CARDS, LABELS, RUBBER STAMPS. Send for free descriptive literature, **HEIGHTS INDUSTRIES**, Capitol Heights 27, Md.

TV SHOP BILLBOARDS. Key circuit symbols; resistor, wiring codes; helpful time-saving hints. 10 2¾x6¼ wall-mounting billboards, assorted colors, $1.00. **MILLETT**, 5208 Longton, Cleveland 24, Ohio.

WANTED

WANTED: BC-348's, laboratory equipment, manuals, klystrons. Cash, swap. **ENGINEERING ASSOCIATES**, 434 Patterson Rd., Dayton 19, Ohio.

WANTED—MISCELLANEOUS Quicksilver Platinum, Gold, Silver. Ores analyzed. **MERCURY TERMINAL**, Norwood, Mass.

CASH PAID! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special purpose, Magnetrons, Klystrons, broadcast types, etc. Want military & commercial lab/test and communications equipment such as G.R., H.P., AN/UPM prefix. Also want commercial receivers and transmitters. For a fair deal write **BARRY**, 512 Broadway, New York 12, N. Y. WAlker 5-7000.

STROMBERG-CARLSON AU-35 amplifier wanted. **GEORGE GENRICH**, Crescent St., Farmington, Conn.

EDUCATION/ INSTRUCTION

SLEEP LEARNING. Startling method 92% effective. Brochure free. **ASR FOUNDATION**, Box 21RE, Henry Clay Station, Lexington, Ky.

LEARN WHILE ASLEEP, Hypnotize with your recorder, phonograph or amazing new Electronic Educator endless tape recorder. Catalog, details free. **SLEEP-LEARNING ASSOCIATION**, Box 24-RD, Olympia, Wash.

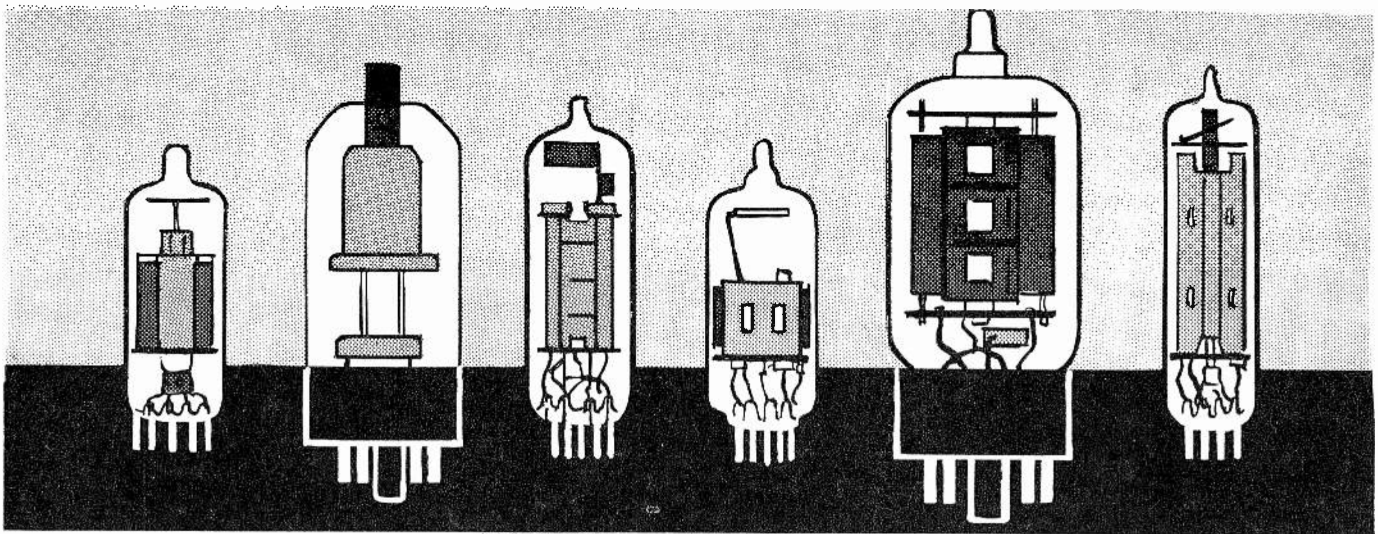
NEW CONCEPT OF LEARNING SELF-HYPNOSIS! Now on tape or record! Free Literature. **McKINLEY-SMITH CO.**, Dept. T5, Box 3038, San Bernardino, Calif.

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

SCHOOL DIRECTORY PAGE 117

Printed in USA



Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
___0Z4	.79	___5CQ8	.84	___6BN6	.74
___1AX2	.62	___5CZ5*	.72	___6BQ6	1.05
___1B3	.79	___5EA8	.80	___6BQ7	1.00
___1DN5	.55	___5EU8	.80	___6BS8	.90
___1G3*	.79	___5J6	.68	___6BU8	.70
___1J3*	.79	___5T8	.81	___6BX7	1.02
___1K3*	.79	___5U4	.60	___6BY5	1.15
___1R5	.62	___5U8	.81	___6BY6	.54
___1S4	.59	___5V3	.90	___6BY8	.66
___1S5	.51	___5V6	.56	___6BZ6	.55
___1T4	.58	___5X8	.78	___6BZ7	1.01
___1U4	.57	___5Y3	.46	___6BZ8	1.09
___1U5	.50	___6A8G	1.20	___6C4	.43
___1X2B	.82	___6AB4	.46	___6CB6	.55
___2AF4	.96	___6AC7	.96	___6CD6	1.42
___2BN4	.64	___6AF3	.73	___6CE5*	.57

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___2EN5*	.45	___6AF4	.97	___6CF6	.64
___3AL5	.42	___6AG5	.68	___6CG7	.61
___3AU6	.51	___6AH4	.81	___6CG8	.77
___3AV6	.41	___6AH6	.99	___6CK4*	.70
___3BA6	.51	___6AK5	.95	___6CL8	.79
___3BC5	.54	___6AL5	.47	___6CM6	.64
___3BE6	.52	___6AM8	.78	___6CM7	.66
___3BN6	.76	___6AQ5	.53	___6CM8*	.90
___3BU8	.78	___6AR5	.55	___6CN7	.65
___3BY6	.55	___6AS5	.60	___6CQ8	.84
___3BZ6	.55	___6AS6	.80	___6CR6	.51
___3CB6	.54	___6AT6	.43	___6CS6	.57
___3CS6	.52	___6AT8	.79	___6CS7	.69
___3DG4*	.85	___6AU4	.82	___6CU5	.58
___3DK6*	.60	___6AU6	.52	___6CU6	1.08
___3DT6	.50	___6AU7	.61	___6CY5*	.70
___3Q4	.63	___6AU8	.87	___6CY7	.71
___3Q5	.80	___6AV6	.41	___6DA4*	.68
___3S4	.61	___6AW8	.90	___6DB5	.69
___3V4	.58	___6AX4	.66	___6DB6	.51
___4BQ7	1.01	___6AX5	.74	___6DE6	.58
___4BZ7	.96	___6AX7	.64	___6DG6	.59
___4BZ8	1.10	___6AX8*	.92	___6DK6	.59
___4CS6	.61	___6BA6	.50	___6DN6	1.55
___4DT6	.55	___6BA8	.88	___6DQ6	1.10
___5AM8	.79	___6BC5	.61	___6DT6	.53
___5AN8	.86	___6BC7	.94	___6DT8*	.79
___5AQ5	.52	___6BC8	.97	___6EA8	.79
___5AS8*	.86	___6BD5	1.25	___6EB5*	.72
___5AT8	.80	___6BE6	.55	___6EB8	.94
___5AV8	1.01	___6BF5	.90	___6EM5*	.76
___5BC8	.79	___6BF6	.44	___6EM7	.82
___5BE8	.83	___6BG6	1.66	___6EU8	.79
___5BK7	.82	___6BH6	.65	___6EW6	.57
___5BQ7	.97	___6BH8	.87	___6EY6*	.75
___5BR8	.79	___6BJ6	.62	___6F5GT	.39
___5BT8*	.83	___6BJ7	.79	___6FE8	.75
___5CG8	.76	___6BK7	.85	___6GH8	.80
___5CL8	.76	___6BL7	1.00	___6GK6*	.79
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Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
___6H6	.58	___12AQ5	.60	___12J8	.84
___6J5GT	.51	___12AT6	.43	___12K5	.65
___6J6	.67	___12AT7	.76	___12L6	.58
___6K6	.63	___12AU6	.51	___12SA7	.92
___6L6	1.06	___12AU7	.60	___12SF7	.69
___6N7	.98	___12AV6	.41	___12SH7	.49
___6S4	.51	___12AV7	.75	___12SJ7	.67
___6SA7GT	.76	___12AX4	.67	___12SK7	.74
___6SG7GT	.41	___12AX7	.63	___12SL7	.80
___6SH7GT	.49	___12AY7	1.44	___12SN7	.67
___6SJ7	.88	___12AZ7	.86	___12SQ7	.78
___6SK7GT	.74	___12B4	.63	___12U7	.62
___6SL7GT	.80	___12BA7	.84	___12V6	.53
___6SN7GT	.65	___12BD6	.50	___12W6	.69
___6SQ7	.73	___12BE6	.53	___12X4	.38
___6T4	.99	___12BF6	.44	___17AX4	.67

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___6T8	.85	___12BH7	.77	___17BQ6	1.09
___6U8	.83	___12BK5	1.00	___17DQ6	1.06
___6V6GT	.54	___12BL6	.56	___17W6	.70
___6W4	.60	___12BQ6	1.06	___18FW6*	.49
___6W6	.71	___12BR7	.74	___18FX6*	.53
___6X4	.39	___12BV7	.78	___18FY6*	.50
___6X5GT	.53	___12BY7	.77	___19AU4	.83
___6X8	.80	___12BZ7	.75	___19BG6	1.39
___7A8	.68	___12C5	.56	___19C8	1.14
___7AU7	.61	___12CN5	.56	___19T8	.80
___7B6	.69	___12CR6	.54	___21EX6	1.49
___7EY8*	.73	___12CU5	.58	___25AV5	.83
___7F8	.90	___12CU6	1.06	___25AX4	.70
___7N7	.90	___12CX6	.54	___25BK5	.91
___7S7	1.01	___12D4*	.69	___25BQ6	1.11
___7Y4	.69	___12DB5	.69	___25C5	.53
___8AU8	.83	___12DE8	.75	___25CA5	.59
___8AW8	.93	___12DL8	.85	___25CD6	1.44
___8BQ5	.60	___12DQ6	1.04	___25CU6	1.11
___8CG7	.62	___12DS7	.79	___25DN6	1.42
___8CM7	.68	___12DT5*	.76	___25EH5	.55
___8CN7	.97	___12DT7*	.79	___25L6	.57
___8CS7	.74	___12DT8*	.79	___25W4	.68
___8CX8	.93	___12DU7	1.01	___32ET5	.55
___8EB8	.94	___12DW8*	.89	___32L7	.90
___8SN7	.66	___12DZ6	.56	___35B5	.60
___9CL8	.79	___12ED5	.69	___35C5	.51
___11CY7	.75	___12EG6	.54	___35L6	.57
___12A4	.60	___12EK6	.56	___35W4	.42
___12AB5	.55	___12EL6	.50	___35Z5	.60
___12AC6	.49	___12EM6	.79	___36AM3*	.36
___12AD6	.57	___12EN6	.78	___50B5	.60
___12AE6	.43	___12EZ6	.53	___50C5	.53
___12AE7	.94	___12F8	.66	___50EH5	.55
___12AF3	.73	___12FA6	.79	___50L6	.61
___12AF6	.49	___12FM6	.43	___70L7	.97
___12AJ6	.46	___12FR8	.91	___7025	.69
___12AL5	.45	___12FX8	.85	___807	.70
___12AL8	.95	___12GC6	1.06	___117Z3	.61

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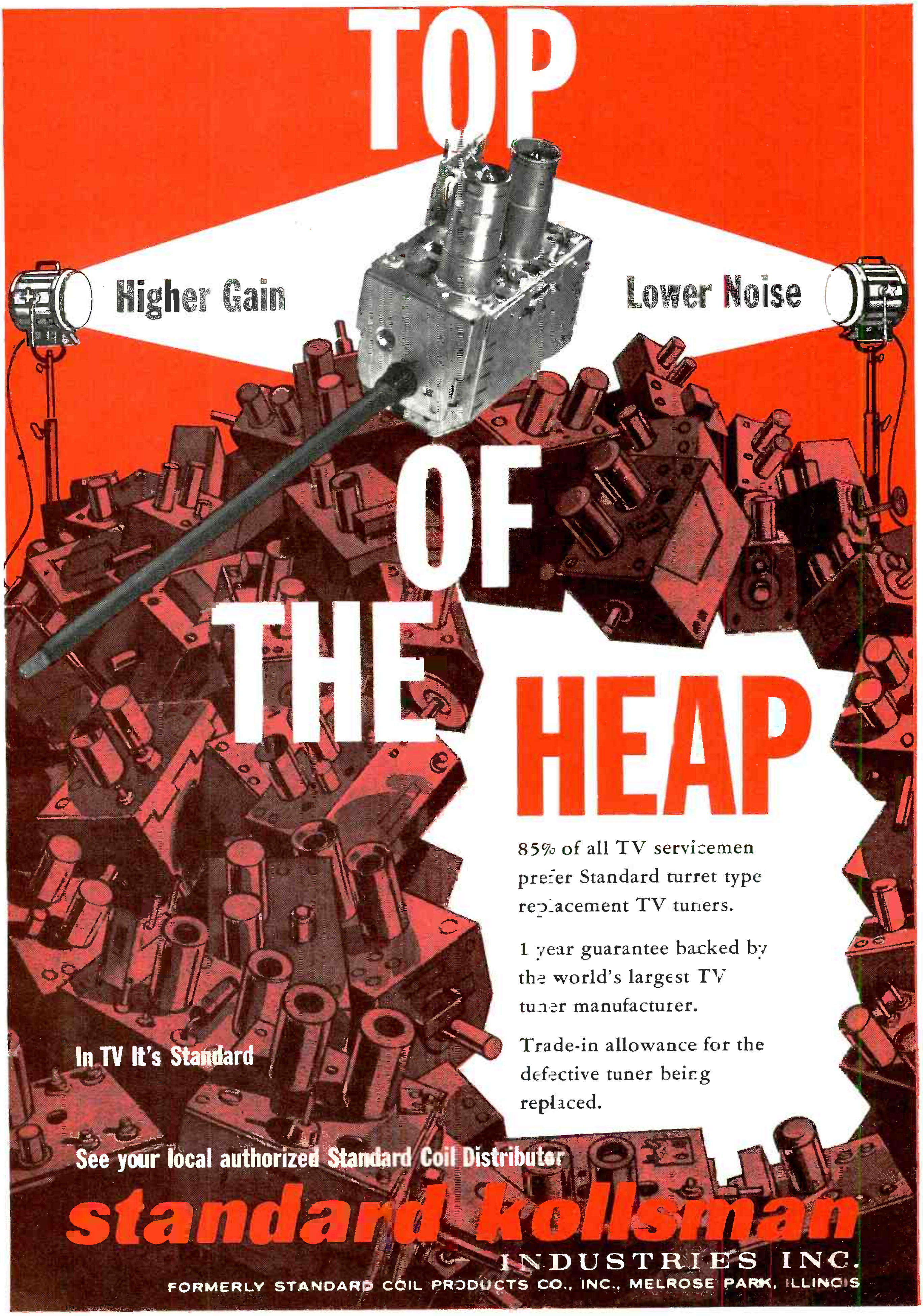
TERMS: 25% deposit must accompany all orders, balance COD. Orders under $5: add $1 handling charge plus postage. Orders over $5: plus postage. Approx. 8 tubes per 1 lb. Subject to prior sale. No COD's outside continental USA.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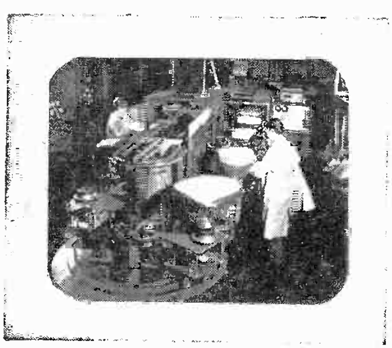

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