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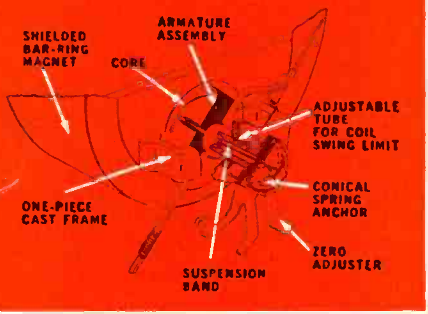

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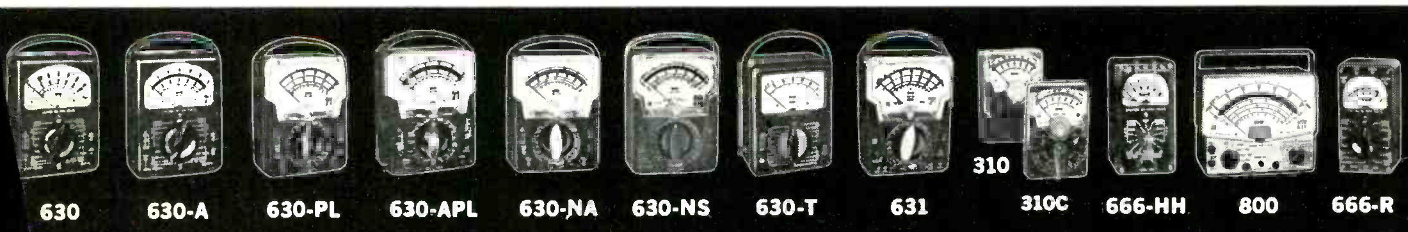

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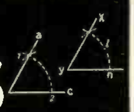
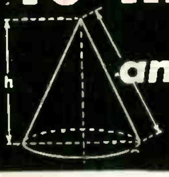
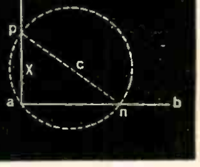


$x = \frac{-5 + \sqrt{25 + 48}}{6} = \frac{-5 + \sqrt{73}}{6}$

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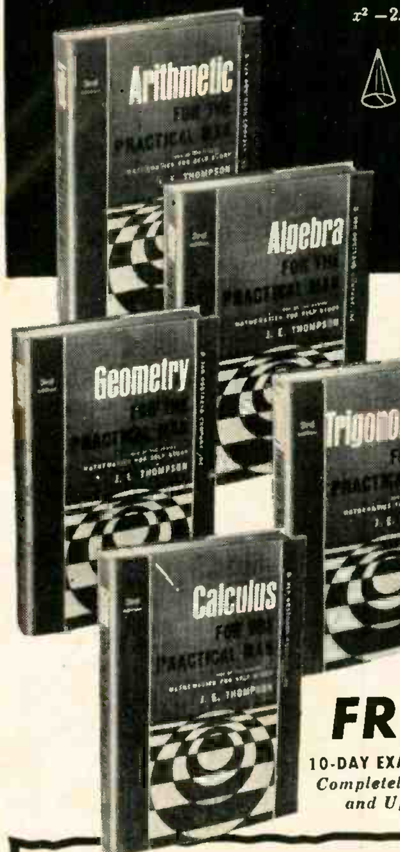

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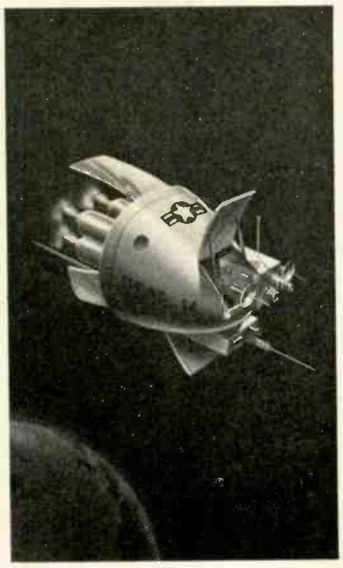

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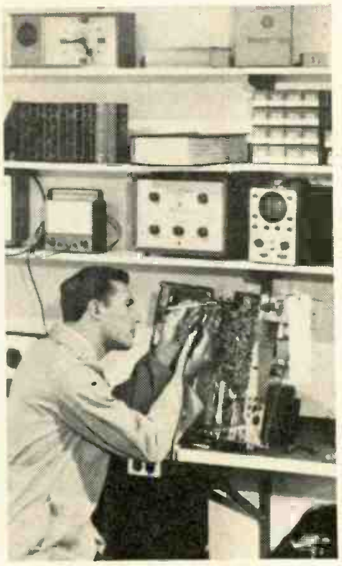

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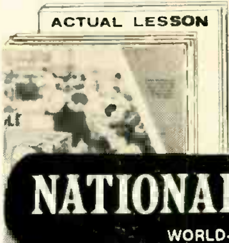

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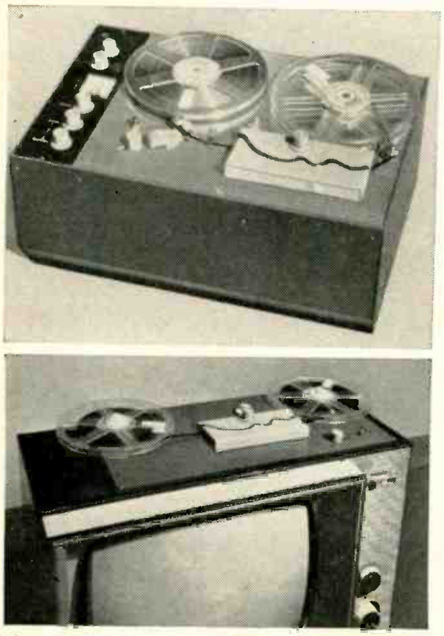
NEWS BRIEFS

New TV Tape Recorder For Less Than $200?

A new video tape recorder-playback machine that can be sold for a price within the reach of the home recording enthusiast has been announced by a British firm appropriately called Telcan (East Bridgford, Nottinghamshire). The machine uses ¼-inch double-track tape. An 11-inch reel of special thin tape holds ½ hour of recording.

The price of the tape (about $25 for a ½-hour record) may limit the amount of home recording. It does, however, open the door to prerecorded video tapes that could be rented out to the user as home movie films are. And, of course, the viewer may be able to record a program he might not be able to see at the time of transmission, view it, then erase the tape and reuse it as often as desired.



The video tape recorder measures 17½ x 9 x 6 inches and weighs 15 pounds. (Below) Recorder built in as part of a TV receiver.

Exact technical details are lacking, but the developers say that Telcan takes the signal from the TV set's detector, amplifies it and assembles it in a form that can be recorded on the tape by a special transducer mechanism. "The same transducer, which has no moving parts, reconverts the signal on the tape on replay into electrical impulses which are assembled by the following circuitry into a normal TV signal, which is then applied to the grid of the video output tube in the TV set."

The tape moves past the heads at 120 inches (10 feet) per second. System bandwidth is listed as 2 mc and resolution 300 lines. Signal-to-noise ratio is 28 db on the video and 40 db on the sound track. The recorder is compatible with 405-, 525-, and 625-line systems.

Although Telcan describes the equipment as "available" at 59 guineas (about $175) technical journalists who have seen the equipment at work are said to feel that it needs further refinement before it can become a successful commercial device. They pointed out, however, that irrespective of its state of refinement, any machine selling under $200 that could produce a usable picture represents a tremendously important forward step in the art.

Schools Get 31 Channels

FCC has set aside 31 channels for transmitting educational programs to schools. Known as "instructional television fixed service," the new plan will allow a central transmitter to serve scattered institutions and provides licensing of facilities for transmission to schools and colleges. It could also be used to send instructions to hospitals, clinics, industries and nursing homes.

Electronic Methods Used In Optical Lens Testing

A camera lens testing method strongly reminiscent of television principles is described in a recent issue of *Camera News of West Germany*. A grating of alternate black and white lines is imaged through the lens. This image is scanned by a narrow slit which moves across the lines in such a way that it sees first a white, then a black, line. A photocell picks up the light and actuates an amplifier. If the image is good, the difference in brightness between black and white lines will be great, and relatively strong alternating current will be generated in the photocell output. If the contrast or definition between black and white becomes poorer, the photocell output goes down.

The equipment is embodied in a fully automatic electronic instrument, using amplifiers and indicating results on a meter and with red and green lights. The equipment has been thoroughly proved out, one instrument having been used by the Zeiss works for nearly two years, according to the report.

Rat Power Runs Radios

Scientists in the General Electric Valley Forge laboratory have been running small radio transmitters with power drawn from the body of living rats. Biologist John J. Konikoff says the experiments may provide important data for medical research.

Two electrodes, one of platinum and one of stainless steel, are placed in the rat's body in two different areas. Connecting a lead to the two electrodes, scientists found a small current flowing through the wire.

Electronic devices like pacemakers are now run by batteries carried outside the body, and the connecting wires must pierce the skin. But this research shows that lifesaving instruments may some day run on power generated within the body.

There are no ill effects from the inert electrodes on living tissues, and rats seem to lead normal rat lives with the equipment inside them. So far, the rat transmitter has run eight consecutive hours, but researchers are sure the operation could continue for the entire lifetime of the rat.

Using rabbits and dogs, Konikoff plans to place the transmitter inside the skin along with the electrodes, to develop body-powered devices for use inside humans.

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(Continued on page 10)

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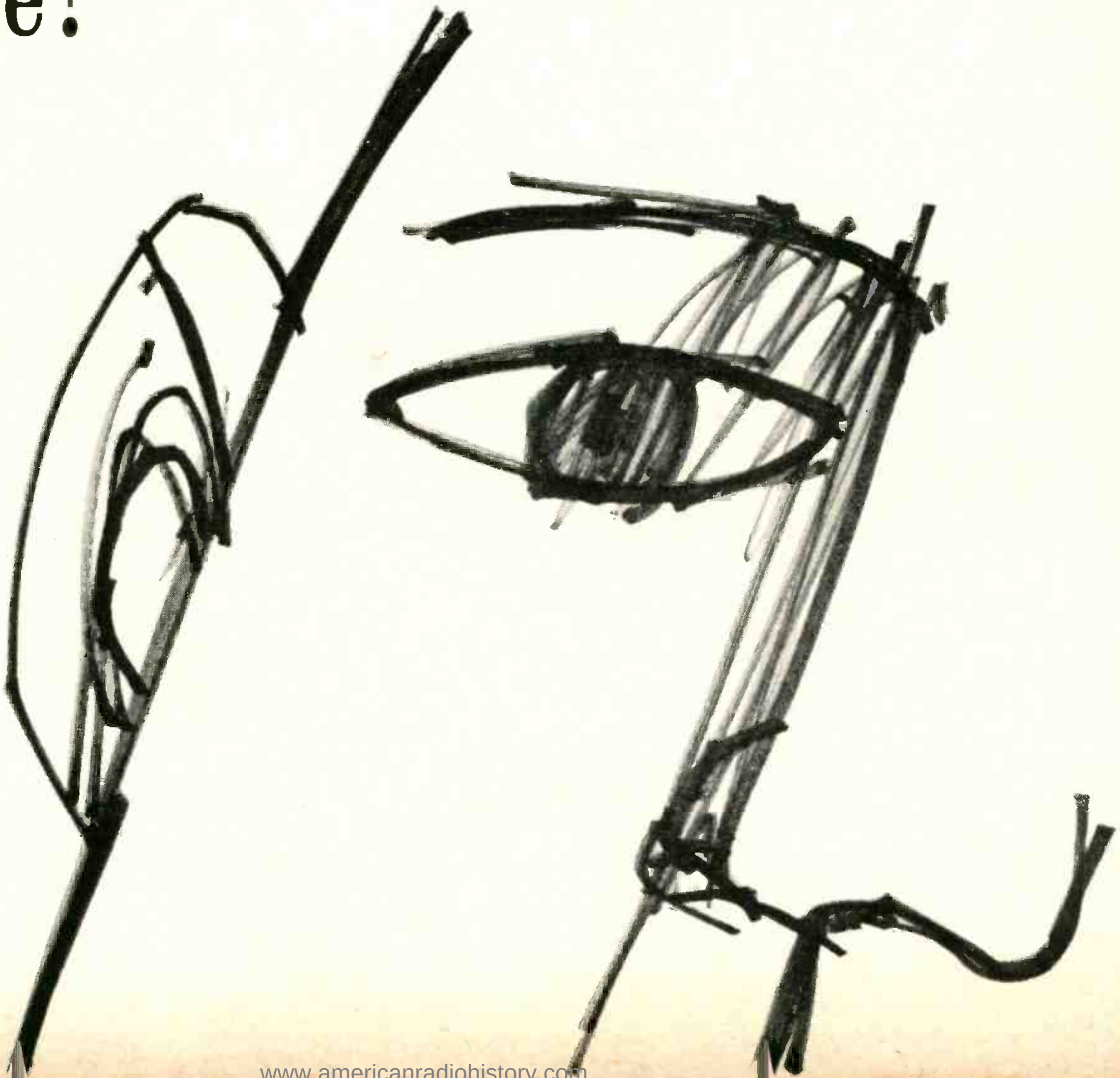

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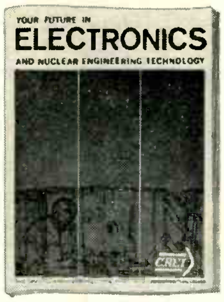

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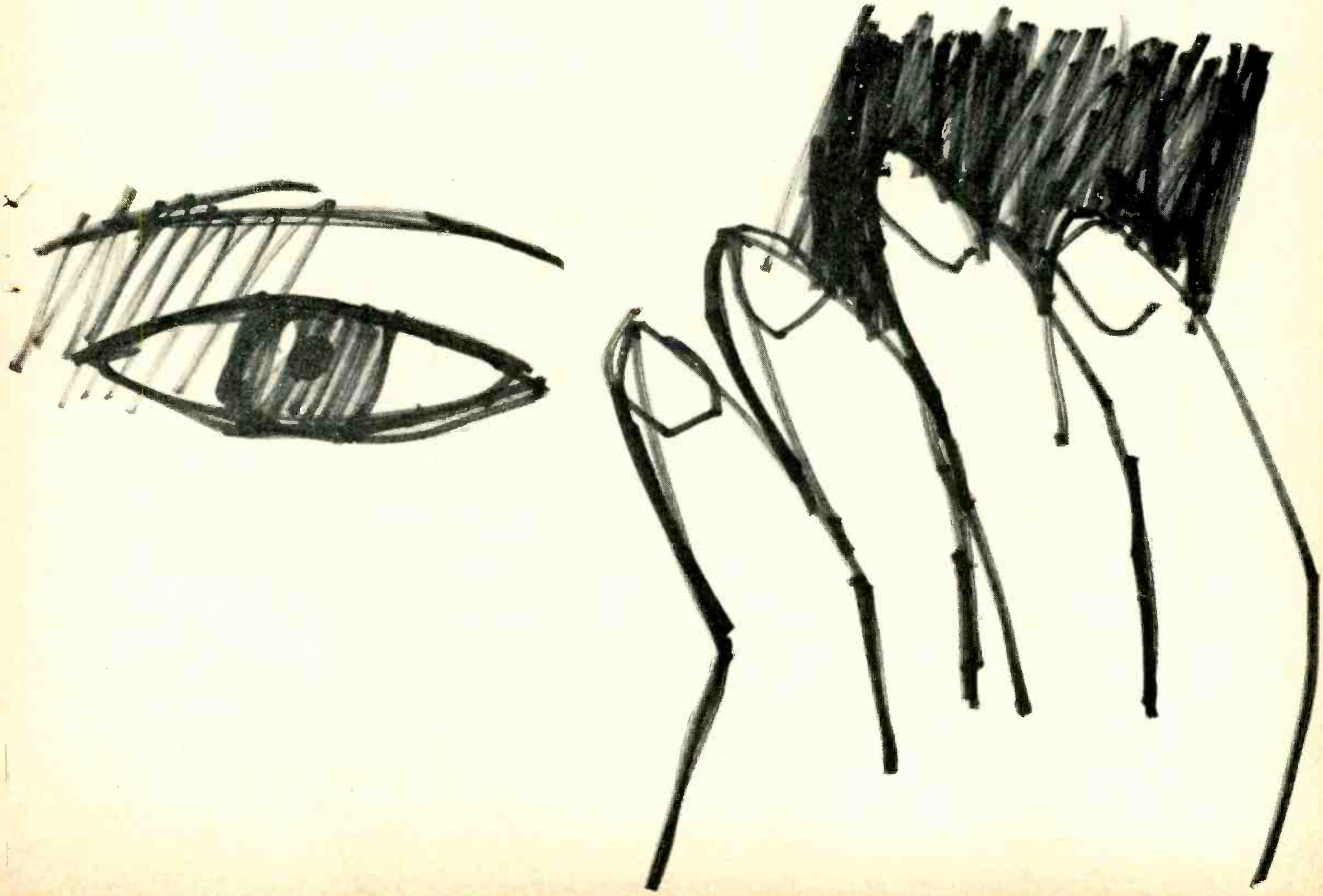
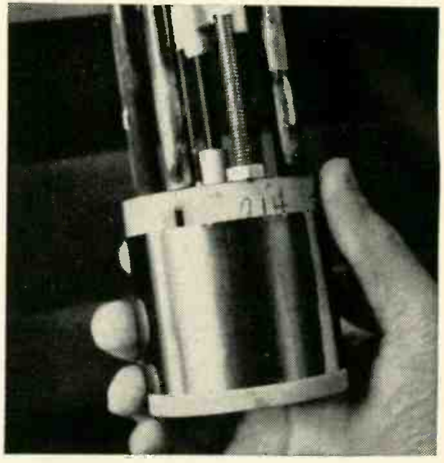


(Continued from page 6)

wound from 600 feet of niobium-tin ribbon, 1/40 inch thick and 2 inches wide. The magnet coil has an inside diameter of 1/3 inch, and an outside diameter of 2 inches. The fantastically powerful field is developed inside the 1/3-inch hollow core. The coil is maintained at 1.8° Kelvin (−456° F.). The threaded rods above the magnet are electrical connections. The other rods are used to lower it to the bottom of the Dewar flask, which keeps it refrigerated.



New Laser Material Extends Range of Injection Devices

An injection laser made of indium phosphide has been reported by scientists of International Business Machines. (Previous injection lasers were gallium arsenide.) The new laser extends the injection laser operating wavelengths farther into the infrared. Its wavelength is 9,030 Angstrom units as compared to 8,400 Angstrom units for gallium arsenide.

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Space News Broadcasts, issued in conjunction with the US National Academy of Sciences, are heard on short wave six days a week, from 0330 to 0335 GMT, on six frequencies.

Voice of America Amateur Radio Programs, written and delivered in English by Bill Leonard, W2SKE, are weekly 15-minute broadcasts devoted to ham gossip, forecasts, interviews and technical news. They are transmitted on several frequencies.

For full particulars as to stations, times and frequencies, write

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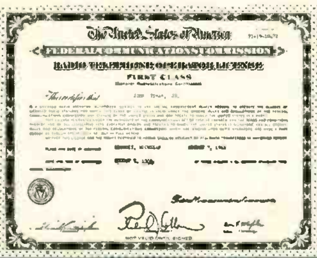

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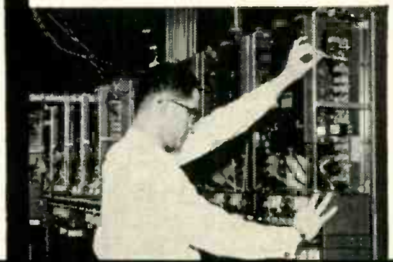

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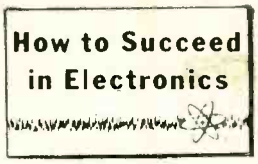

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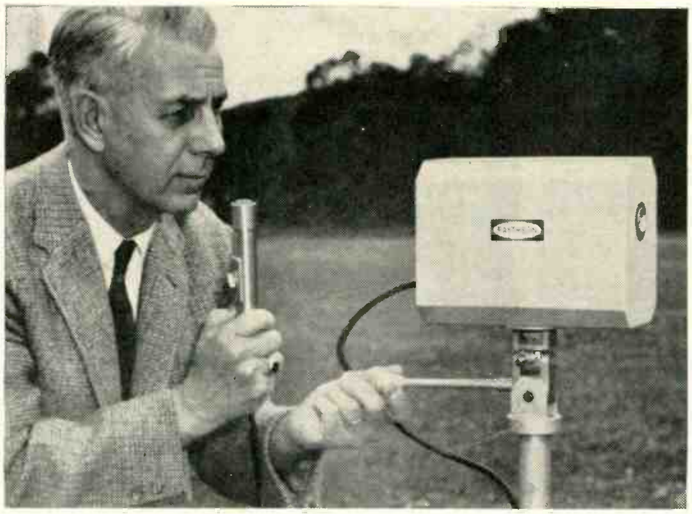
Long-Wave Laser Carries 10 Messages

A new long-wave laser, developed experimentally by Raytheon, has a range of more than a mile. Channel width is great enough to carry at least 10 voice messages. The new laser is a gas type, and operates at a previously untried wavelength of 3.5 microns. This relatively long wave makes it possible to reduce the size of the laser while increasing its range. Waves of this length are absorbed less by water vapor, carbon dioxide and other components of the air than those produced by earlier lasers. The new laser uses a mixture of neon and xenon gases.



The new experimental long-wave laser.

While there are many possible applications for the new short-range communications device, one that immediately suggests itself is short-range military communications. This laser can be easily carried by one soldier, and can be used from a foxhole by adding a periscope.

Brief Briefs

No radios—transistor or otherwise—or other electronic devices may be played on Baltimore, Md., buses, the City Council has ruled.

Denver's pay-TV is due to start Oct. 3 on KCTO-TV. FCC's original starting date, July 3, was altered at the request of Channel 2 Corp., the station owners.

Direct broadcast from a communications satellite to home TV sets will be a fact within 12 to 20 years, says a high NASA official.

Two Cleveland translators, Channels 81 and 83, will repeat signals of Midwest airborne ETV transmitters above Montpelier, Ind., to give adequate reception in Cleveland.

TV's educational programs on mental illness, says Dr. T. Glyne Williams, Maryland assistant mental health commissioner, have shown viewers that mental illness is "as curable as ulcers and no more shameful." Because of the shows, he says, 16.7% more patients are being admitted to Maryland mental hospitals during the early stages of illness.

FM Stereo programming began Aug. 1 on ABC's WABC-FM, New York City. It is the first FM stereo station to broadcast from the antenna atop the Empire State Building.

Laguna Indians of Albuquerque, N. M., have turned their talents from handicrafts to electronic components. A shipment of crystal filters, produced by the Indians with the cooperation of the Bureau of Indian Affairs, was sent to Burnell & Co., of Pelham, N.Y. The firm plans a 40,000-square-foot, $400,000 plant in the pueblo, using Indian labor.

Frank E. Smolek, national service director of Zenith Sales Corp., died July 7 in Oak Park, Ill. He joined Zenith in 1928, had held his present post since 1932, and was credited with service policies which won the backing of the independent service technician.

CALENDAR OF EVENTS

International Telemetering Conference, Sept. 23–27; Hilton Hotel, London.

Canadian Electronics Conference, Sept. 30–Oct. 2; Exhibition Park, Toronto, Canada.

Ninth National Communications Symposium (IEEE), Oct. 7–9; Hotel Utica, Utica, N.Y.

International Fair of Modern Electronics, Oct. 12–20; Ljubljana, Yugoslavia.

15th Annual Fall Convention and Exhibit, Audio Engineering Society, Oct. 14–18; Barbizon-Plaza Hotel, New York City.

1963 National Electronics Conference, Oct. 28–30; McCormick Place, Chicago.

1963 (Canadian) High Fidelity Music Show, Oct. 30–Nov. 2; Park Plaza Hotel, Montreal.

9th Annual Conference on Magnetism and Magnetic Materials, Nov. 12–15; Chalfonte-Haddon Hall, Atlantic City, N.J.

39th Annual Convention, National Association of Educational Broadcasters (NAEB), Nov. 17–20; Milwaukee, Wis.

16th Annual Conference on Engineering in Medicine and Biology, Nov. 18–20; Lord Baltimore Hotel, Baltimore, Md.

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- Textile Engineering Technology
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- Wool Manufacturing

TRAFFIC
- Motor Traffic Management
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TV-RADIO-ELECTRONICS
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- Electronic Fundamentals (Programmed)
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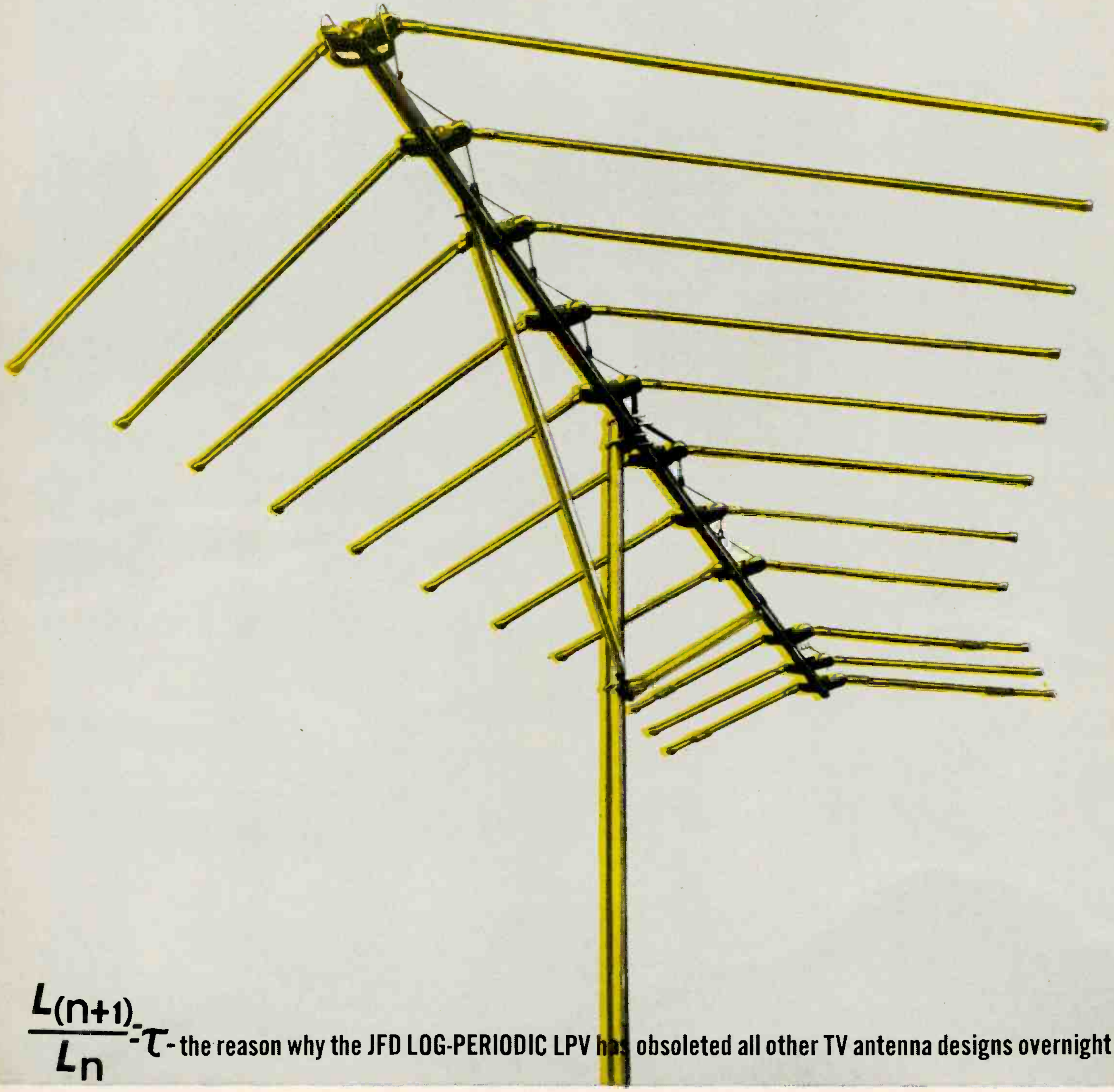

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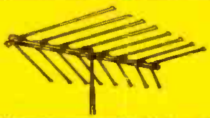

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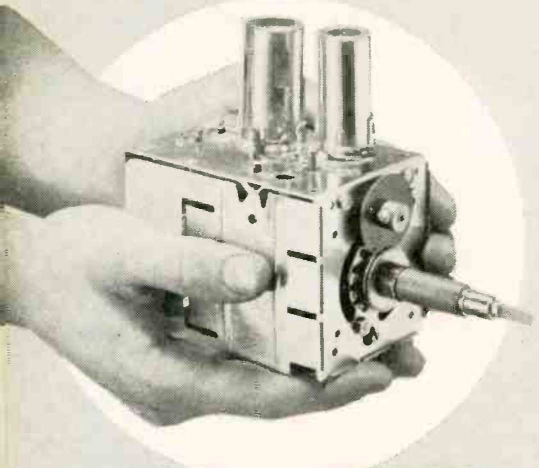


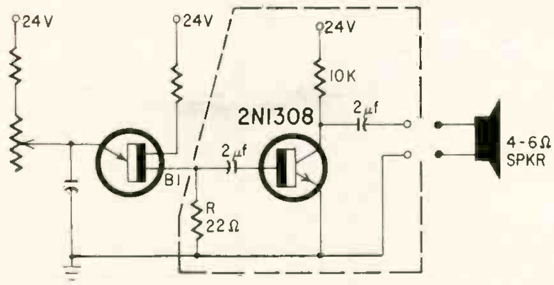
Correspondence

Metronome Amplifier

Dear Editor:

Regarding "Build a Unijunction Metronome," July, page 40: here's a cheap amplifier that works well and gives better than double output. The diagram shows the circuit. R replaces the speaker or headphone load in base 1 of the unijunction.

George W. Blankenship, W5CGZ
Austin, Tex.

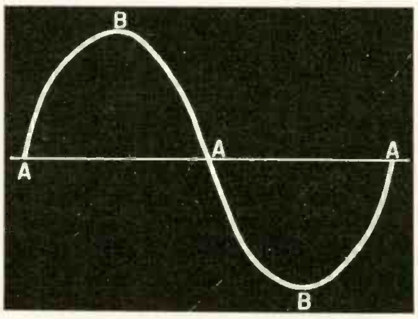


The Why and How of Transients

Dear Editor:

In "Watch Out for Transients" by E. H. Leftwich (April, page 28), the explanation of what happened in the transformer was not clear to me, nor, I presume, to Mr. Leftwich.

Transformer voltage and core flux are related by $E = N(d\phi/dt) \times 10^{-8}$, where N is the number of turns, and $d\phi/dt$ is the time rate of change of flux. In other words, voltage is proportional to rate of core-flux change.



Now look at the sine wave in the diagram. The core flux rises from zero to maximum (A to B) in .004166 second (for 60 cycles). If Mr. Leftwich had managed to switch his transformer on at A, he might have saved his instruments. But the probability of that is small, and he likely switched into the wave part way toward B, which means the core flux went from zero to maximum in a very few microseconds. That is, in the equation above, dt was a very small number, making E very large; or, the rate of change of flux was high, making the voltage high. (We depend on this principle for auto ignition and TV high voltage.)

Since the volt-ampere capacity of a transformer is related to its core size, any high-*voltage* pulse is accompanied by low current output. When a transformer is heavily loaded to near its maximum volt-ampere capacity, the load current prevents high-voltage transients.

But whenever a transformer is lightly loaded by high-impedance, voltage-operated devices, such as Mr. Leftwich's unfortunate meters, that is the time to "watch out for transients."

H. B. Conant
Conant Laboratories
Lincoln, Neb.

Nomo Error

Dear Editor:

There is an error in the Cathode Feedback Nomo on page 23 of your July issue. The graduations on the RL/RK scale are all marked one unit too small. Thus, for example, the point marked 20 should really be 21.

Albert Meyer
Supervisory Research Engineer
D. H. Baldwin Co.
Cincinnati, Ohio

TV Flicker

Dear Editor:

In the Service Clinic for July 1963, you printed an inquiry from Iceland regarding a "flickering" TV picture (page 56).

To those of us in the export trade this is quite familiar: it's called "nonsynchronous" reception and is common in areas served by a US-standards TV transmitter but which have 50-cycle power. This occurs in US bases in Europe, and in other places—Mexico City, Teheran, Bangkok and others.

The flicker, as Mr. Darr said, *is* due to interaction between the 50-cycle power and 60-cycle scanning rate. In most cases, increasing the filtering helps. Sometimes, connecting a capacitor of 0.5 to 3 or 4 μf across the filter choke to resonate it at 50 cycles does the trick.

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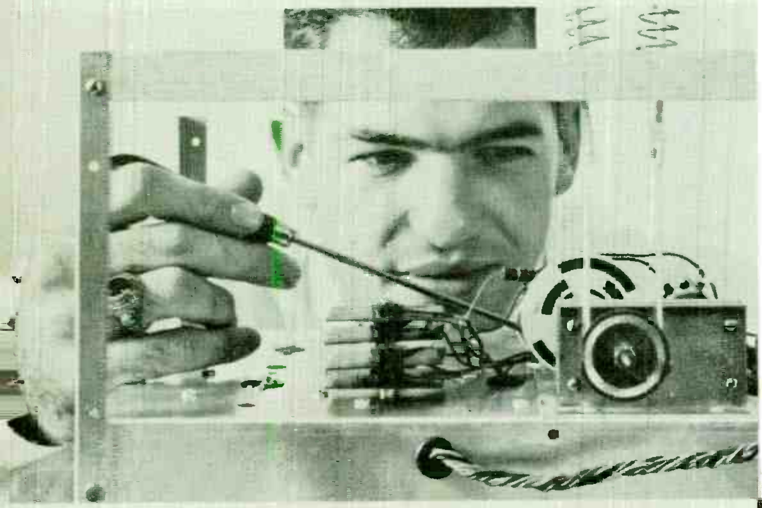

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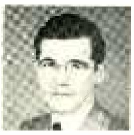

"THE FINEST JOB I EVER HAD" is what Thomas Bilak, Jr., RFD 2, Cayuga, N. Y., says of his position with the G. E. Advanced Electronics Center at Cornell University. He writes, "Thanks to NRI, I have a job which I enjoy and which also pays well."

HAS SERVICE BUSINESS OF HIS OWN. Don House, 3012 2nd Place, Lubbock, Texas, went into his own full-time business six months after finishing the NRI Radio-TV Servicing course. "It makes my family of six a good living," he states. "We repair any TV or Radio. I would not take anything for my training with NRI. I think it is the finest."

MARINE RADIO OPERATOR is the job of E. P. Searcy, Jr., 1916 Fern St., New Orleans, La. He works for Alcoa Steamship Company, has also worked as a TV transmitter engineer and holds FCC Radio-Telephone License. He says, "I can recommend NRI very highly."

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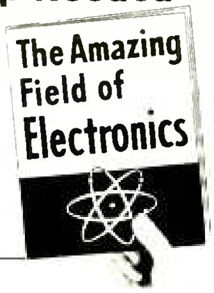

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But even if filtering is sufficient, heater-cathode leakage in vertical and horizontal output tubes or a 50-cycle field from the power transformer can cause the trouble. The remedies are to replace tubes, move the transformer or shield it magnetically. Using a transformer with a copper band around it also helps.

Still other sources of trouble are in common heater wiring, ground connections ("ground loops"), etc. But these are less common.

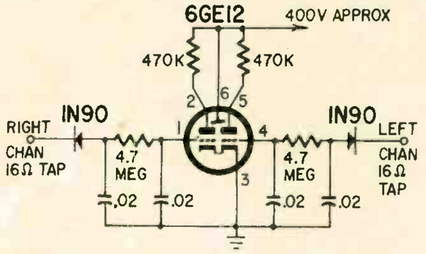
R. DEL RIEGO

Service Manager
Philco International Div.
Philadelphia, Pa.

Another Stereo Balance Indicator

Dear Editor:

A similar circuit to "Stereo Balance Indicator" (July, page 29) has been used by Clairtone Sound Corp., Ltd., with a 6GE12, another dual indicator tube. The schematic shows the essential details. There are no calibration pots in this version, which is meant to be used across voice-coil windings.



In the original equipment, it is used with push-pull 7189's with about 400 volts dc on their plates. I do not know whether a lower-powered system would drive the indicators fully.

J. D. GOOD

Richmond, Hill, Ont.

Notes on Diode Tricks

Dear Editor:

Mr. Geisler's article ("New Tricks with Diodes," July, page 36) was very useful. But the circuits have been used in carrier telephony, etc., for many years.

Some of the results may be difficult to get in practice unless you use matched diodes and carefully balanced, shielded transformers. Except at very low frequencies, stray capacitances will throw the circuits out of balance unless there is compensation.

One method, which doesn't require center-tapped windings, is to use potentiometers across the windings as adjustable center taps, with trimmers from each side to center (Fig. 1). Another, good with split windings, is to use the pot between the two halves (Fig. 2). Either method reduces efficiency but can give perfect balance.

With these adjustments and with shielded bridge transformers (General Radio 578 series or Leeds & Northrup) perfect balance is easy. With trimmers alone, you can balance for one frequency, but not for another very different one.

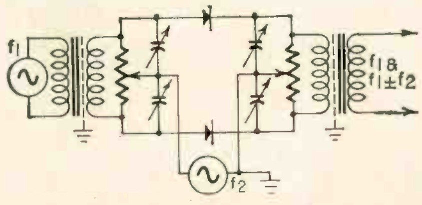


Fig.1

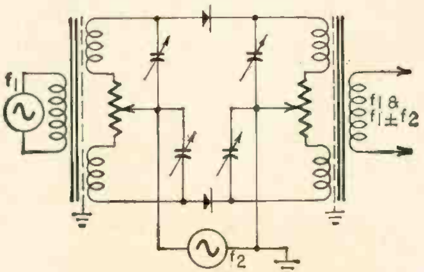


Fig.2

As Mr. Geisler states, filtering out one sideband gives "nice, clean SSB for modulating a ham transmitter." This is a standard method but takes an expensive filter because the sidebands differ so little in frequency. Another way is to use *two* ring modulators with both inputs to one of them 90° out of phase with the inputs to the other. This cancels one sideband. Circuits for this have been published and are manufactured commercially (see the *ARRL Handbook*, Bell Labs publications and a special SSB issue of *Proceedings of the IRE*, December, 1956).

The difference between the waveshapes of the article's Fig. 4 and Fig. 2-b may not be clear from the small sketches. In AM the modulation envelope is alternately concave and convex but, with DSB and no carrier, it is everywhere convex and (for sine-wave modulation) consists of two sine waves centered on axis and crossing at their zeros.

A. H. TAYLOR

Read Island, B. C.

We Missed One

Dear Editor:

In "Is That Pic Tube Really Gone?" (July, page 26) were listed all the manufacturers of cathode-ray tube checkers and rejuvenators.

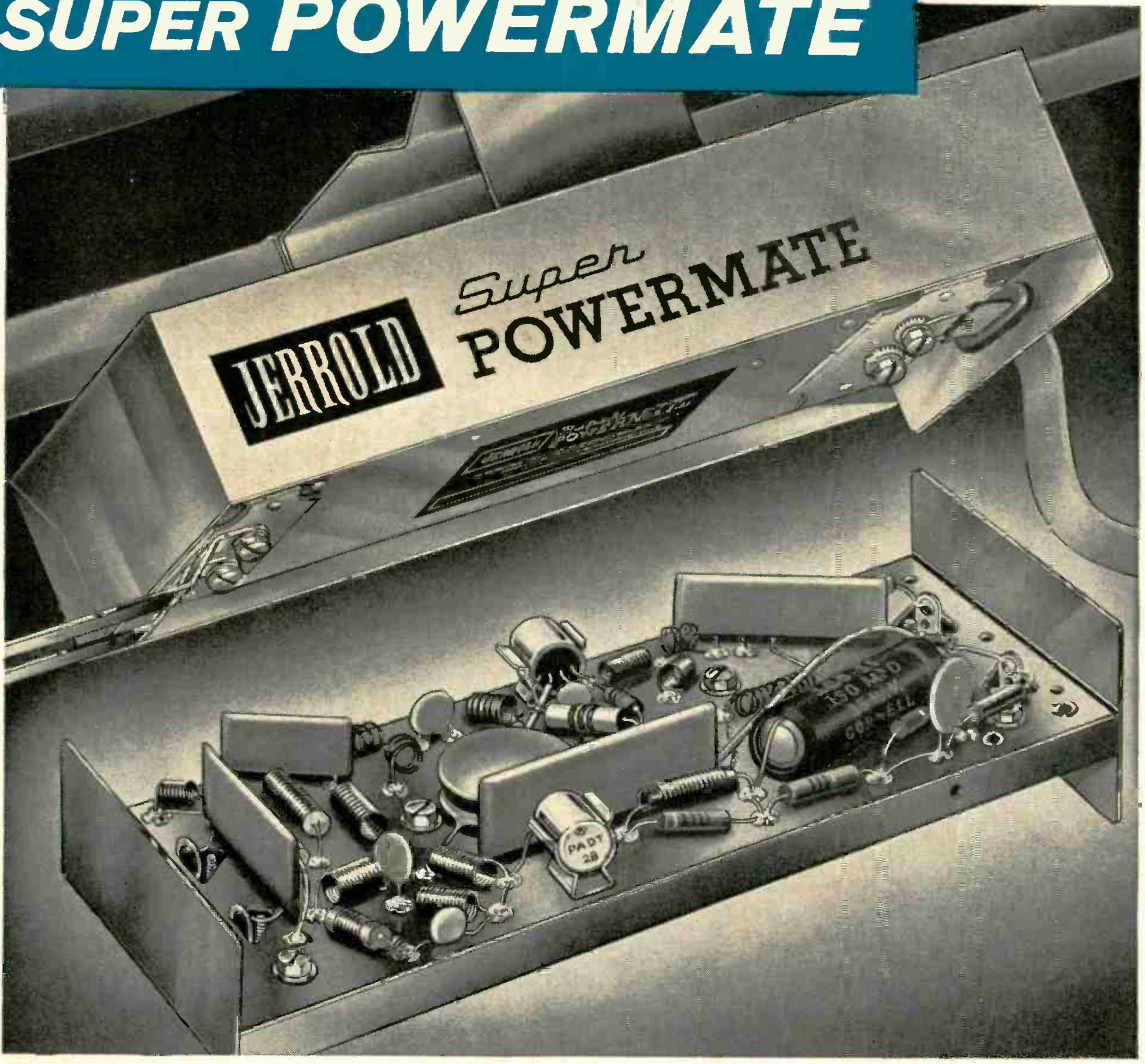
We also make this kind of equipment, and we now have on the market a rejuvenator and checker that we feel is far superior to any other product. The trade name is Simco. It has been on the market for the past 6 months.

LAWRENCE HUNT

President
Standard Instrument Mfg. Co.
Englewood, Colo.

[Apologies. The article had been in our hands for more than six months before publication. It is more than possible that other excellent instruments were also omitted from the list.—*Editor*]

NEW TWIN-TRANSISTOR SUPER POWERMATE



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Servicemen and the public long wanted it, but were told they couldn't have it—a transistorized TV antenna preamplifier with the overload capacity to handle local signals without sacrificing the gain that brings in distant stations.

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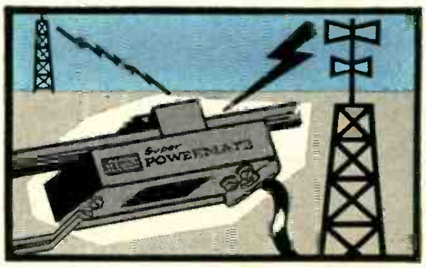

GAIN to reach far-distant stations, OVERLOAD capability to prevent local-signal interference.

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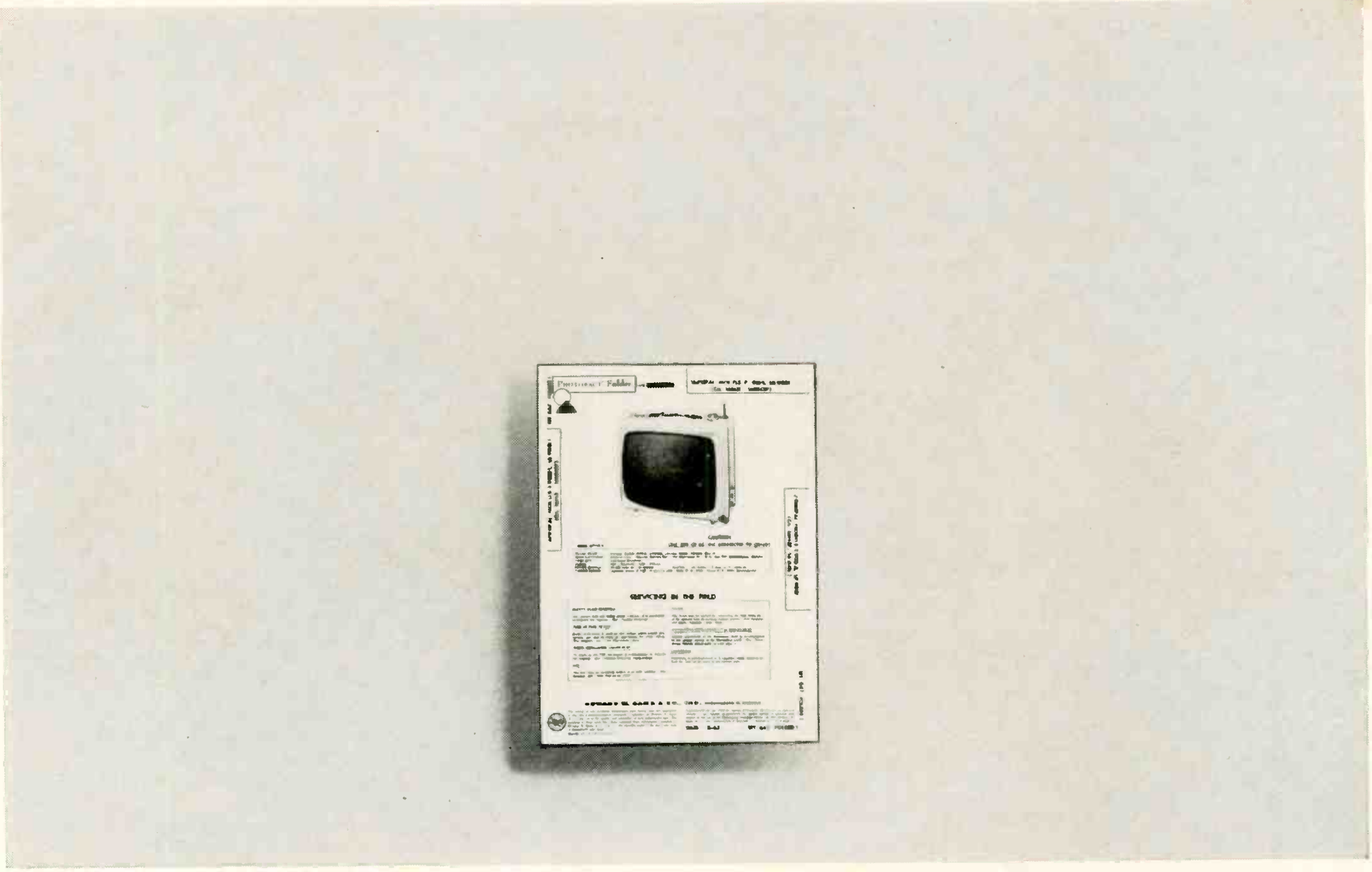

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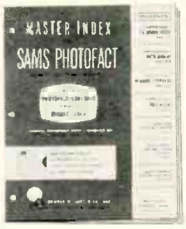

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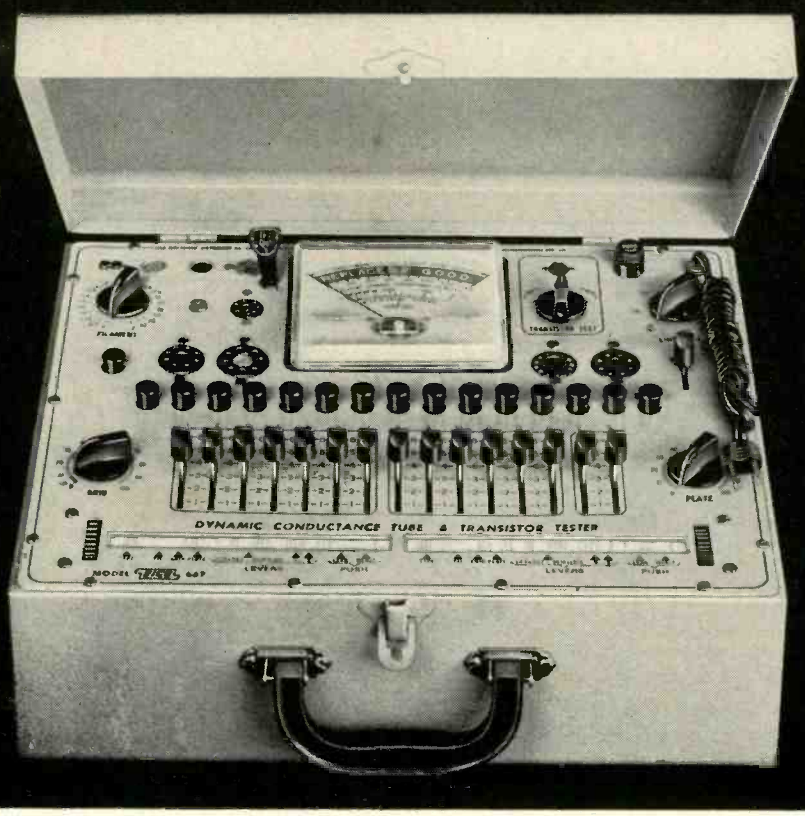

EICO 667

dynamic conductance tube and transistor tester

The EICO 667 will earn money for you by catching the bad tubes an emission tester would miss. The 667 combines a mutual conductance test with a peak emission test to give a single reading of tube quality. Bad transistors can be spotted easily. Gain and leakage tests find the defective ones.

TESTS ALMOST EVERY DOMESTIC OR FOREIGN RECEIVING TUBE MADE. The EICO 667 checks 5 and 7-pin Nuvistors; 9-pin Novars; 12-pin Compactrons; 7, 9 and the new 10-pin miniatures; 5, 6, 7 and 8-pin subminiatures; octals and loctals. It will also check many low-power transmitting and special purpose tubes, voltage regulators, cold-cathode regulators, electron ray indicators, and ballast tubes. And by inserting pilot lamps into the special output in the center of the Novar socket you get an instant good-bad test of these lamps.

TESTS MADE UNDER ACTUAL TUBE OPERATING CONDITIONS. When one section of a multi-purpose tube is being tested, all sections are drawing their full rated current. Pentodes are tested as pentodes rather than combining all the elements for a simple emission check. Leakage between tube elements is read directly on a 4½" meter in ohms.

EICO 667 NEVER WILL BE OUTDATED. A new rollchart is prepared periodically. Data on one or two tubes, can be added by unsnapping the windows over the chart.

TRANSISTORS CHECKED IN TWO STEPS. First for leakage, then for Beta or current amplification factor. Both are read directly off the meter dial, and both n-p-n and p-n-p transistors can be checked.

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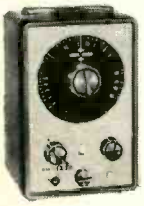

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Radio-Electronics
Hugo Gernsback, Editor-in-Chief

ELECTRONIC WEATHER CONTROL

...We Now Have the Technical Means to Modify the Weather...

IT WAS Charles Dudley Warner (and not Mark Twain) who first observed: "People are always talking about the weather, but no one does anything about it!" True in his day, and true today. But it probably will not be true at the turn of the next century, A.D. 2000.

The key, as we see it, is a combination of meteorology and electronics. But first let us look at the problem.

Scientists are in full accord that the sun, our titanic atomic furnace, 92 million miles distant, is the supreme and chief source of all weather. Its huge caloric output varies little over the ages and may, for all practical purposes, be called constant in its radiant heating power. Its energy is so great that *on each square mile of our earth we receive over 4½ million horsepower of actual energy*. A good percentage of this energy is lost—radiated back into space by reflection. Much more energy is lost by the heated earth at night when the sun is below the horizon.

Our largest heat reservoirs are the atmosphere and the oceans, but on account of the seasons, the total amount of solar energy received at any given point on earth varies constantly. Meteorology is not yet an exact enough science to cope with this variability, which is further complicated by the earth's daily rotation and seasonal inclination of its axis toward and away from the sun—its chief heat source. This is also the reason for the great variability of the weather—to an extent. Admittedly, this outline is an oversimplification of the problem, but for our purpose quite adequate. (There are other lesser factors that influence weather: internal heat of the earth, the polar icecaps, glaciation of high peaks—the Himalayas, the Swiss Alps, etc., man-made vitiation of the atmosphere by hydrocarbons, etc.)

It probably will be impossible for many thousands of years for man to influence either the rotation of the earth on its axis or change its seasons. Nor would this be advisable, even if it could be accomplished. Such a change would certainly aggravate acutely the weather problem.

But suppose we could *equalize* or modify solar radiation received by the earth to a certain degree. Suppose we could partly light the dark side of the earth with the sun's radiant energy *every day, during all seasons*. In other words, a sort of perpetual "day" for much of the habitable world. This we can do in the foreseeable future if the world governments are willing to pay the considerable price—which in the end may be very low, if one figures the huge benefits that will accrue to humanity.

The answer to the problem is the *Oberth spatial mirror*. Prof. Hermann Oberth, the great mathematician and physicist, in the early Twenties published his epochal book, *Wege Zur Raumschiffahrt* (Ways and Means to Space Navigation).*

In this classic book, Professor Oberth laid the entire groundwork for our present-day space navigation as well as all pertaining mathematics. Not only did he develop the proto-principles of modern space ships, but he was also the inventor of the World War II German V1 and V2 rockets.

More important was his brilliant conception of the gravitating space mirror, also called a *spatial mirror*. When he designed it in the mid-Twenties, 20 years before the atom bomb, the space mirror became widely known as the world's most frightful potential weapon.

Assembled in space, the lightweight mirror was to be about 60 miles in diameter, constructed of paper-thin squares of sodium, a white silvery metal of high reflecting power. These squares were to be mounted on a light metal frame network. All the metal squares would be hinged individually so they could be focused by electric motors in any desired direction.

The spatial mirror, gravitating between 400 and 700 miles above the earth, would make one complete revolution around the earth in about 1¾ hours. As a purely military weapon, Oberth wanted to use it as a gigantic burning glass to destroy cities, cause cyclones and hurricanes and destroy armies in the field by literally burning them alive.

It was also Oberth's idea to have a resident (military) crew on the mirror to guide it for observation and for eventual offensive purposes. But since the advent of the A- and H-bombs, the space mirror as a war weapon has become obsolete.

Yet for purely peaceful uses and particularly for meteorological reasons, to *regulate* the earth's weather, the spatial mirror now appears an ideal instrument that is certain to come into its own in the not-too-distant future.

To be fully effective, the space mirror will probably be much larger than the original Oberth concept, probably over 100 miles in diameter.

It will also be unmanned, electronically operated by radio impulses from earth. The electric power to focus the individual facets made of paper-thin chrome sheets will come from solar semiconductor batteries, which will operate continuously because the mirror will *always* be in full sunlight.

To be fully effective, we must use a plurality of mirrors, say eight to ten (or perhaps more). Because the mirrors are constantly moving around the earth, they cannot all illuminate the night side of the globe (at the same time), which is their prime purpose. Hence more mirrors are needed to illuminate the dark side.

The space mirrors always turn their face, the "mirror" side, toward the dark side of the earth which they illuminate; their own dark side is turned to the sun when they are over the sunny side of the earth.

The entire philosophy of the space-mirror meteorology is based on the concept that, for the maximum climatic efficiency, man requires but one season—eternal spring, or if you wish, eternal autumn. No destructive frosts, no hurricanes, no tornados, no heavy winter-long snows, no months-long glaciation. The result—blooming deserts, more abundant crops, more food for more people.

Here are a few technical details in this rather sketchy

(Continued on page 74)

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*Published in 1925 by Verlag von R. Oldenbourg, Munich and Berlin.

kill that mobile noise!

By D. A. DUDLEY

Valuable tips on noise suppression for car-borne CB, ham, FM radios

WITH THE EVER-INCREASING USE OF TWO-way—especially CB—radio in motor vehicles of all kinds, users are finding out that mobile noise often prevents effective communication. Particularly in low-power CB work, motor, generator and tire noise can make a tremendous difference in useful operating range.

The generator, sparkplugs and wiring harness, the voltage regulator, coil, distributor points, condenser and gages are the chief contributors to motor noise.

Sparkplug and wiring harness noise is a machine-gunlike popping sound that varies with motor speed. In tracking it down, be sure the sparkplugs are clean, properly gapped and, of course, of the type recommended by the manufacturer. Check the sparkplug leads for continuity. In newer vehicles, the manufacturer has usually installed radio-resistance wiring. Its resistance should be about 10,000 ohms. If a lead opens, the spark has to jump the gap, causing noise. The ends of the leads should be recrimped or, better still, soldered for positive contact. Make sure the holes in the distributor cap are cleaned out before the leads are pushed all the way down in their sockets.

In the distributor, check or replace the points and condenser to prevent them from contributing noise.

Ignition noise

This is the noise caused by actual firing of the spark plugs. It is generally suppressed by resistive sparkplugs, radio-resistance wiring, or both (Fig. 1). When both are used, the reduced voltage may cause the motor to idle roughly. A 5,000-ohm resistor can be connected right at the sparkplug in series with the plug leads, but radio-resistance wiring is superior. A 10,000-ohm suppressor can be installed in series with the distributor center lead. Install a 0.1-μf coaxial capacitor (Sprague No. 48P9) in series with the terminal marked BAT, located on the coil, if previous methods have not been successful.

[This is a coaxial feedthrough capacitor. "In series" here means that the inner element (of practically zero dc resistance) is connected in series with the lead to be bypassed, and the outer element is grounded. The *capacitance* is actually in *shunt* with the lead, not in series.—*Editor*]

What now? In occasional stubborn cases, we have to try other means to combat noises. (And believe me, "combat" is what you're engaged in!)

If some old coaxial cable is handy, try slipping the outer shield off. This shielding can now be used as a shield for the sparkplug lead. If you push the sparkplug lead through the side of the shielding about 5 or 6 inches before the end, you can use the free end of the shielding as a ground. Connect it to a bolt on the motor. Belden makes shield braid (type 8663 or similar) for bonding or shielding.

If sparkplug leads happen to be of a length that resonates at the receiver frequency, shortening will cut radiation and reduce noise. Rerouting wires that come too close to the sparkplug leads has also helped. Any lead at a potential higher than common ground can cause interference by radiation or by capacitive coupling to other leads. Shielding on those leads will sometimes help in eliminating such interference.

Generator noise

Generator noise is identified by a high-pitched whine that varies with the speed of the motor. To verify, get the car moving, turn off the ignition switch and push in the clutch. The noise will appear when the clutch is engaged and disappear when the clutch is pushed in. Make certain the brushes are in good condition. Then install a 0.5-μf capacitor (Sprague No. 48P18) in series with the armature lead (Fig. 2). Leads should be as short as possible. Mount the capacitor directly on the generator. In most cases, this cures the generator whine.

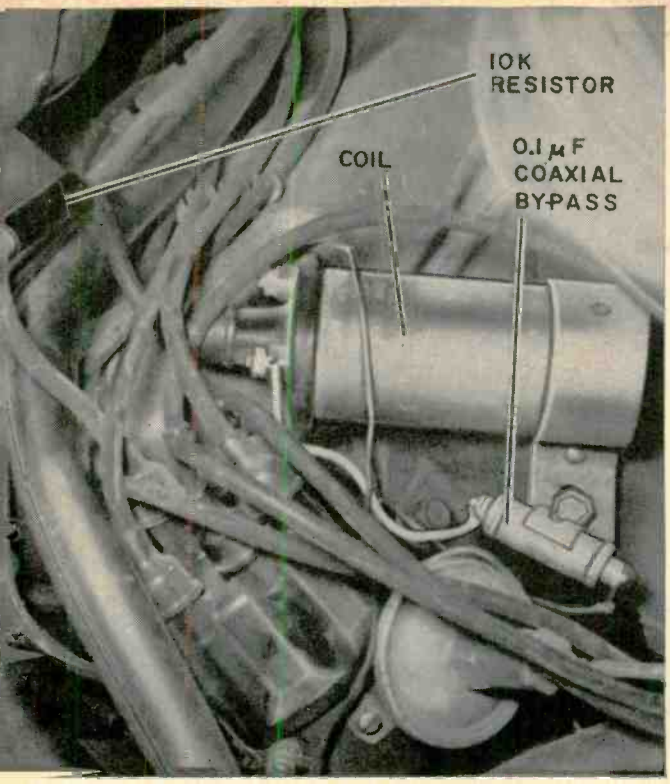
If the trouble persists, connect 0.5-μf capacitors in series with the ARM and BAT terminals on the regulator. Some technicians use a parallel-resonant trap tuned to the receiver frequency, in series with the armature lead. Install the unit as close to the generator as possible. If you wish to make your own tuned circuit, make the coil of wire heavy enough to carry the generator current. The coil should have as low a resistance as possible. No. 10 wire is good.

Noise caused by the voltage regulator is a rubbing or a rasping sound. It can be suppressed by installing a 3.3-ohm resistor in series with a .002-μf capacitor. Connect this from the FLD terminal on the voltage regulator. Do not connect a capacitor directly from field to ground—it may damage the regulator.

Other noises

Interference developed by gages, wheels and tires is most difficult to identify. When in doubt, bypass all gages right at the terminals with a large capacitor—about 0.1 to 0.5 μf. The best way to determine which one is the troublemaker is to disconnect them one at a time. The gas gage should be bypassed right at the tank. In extreme cases, bypassing the dome light will help.

Wheel static noise can be identified by applying the brakes when the car is in motion. If the noise in the receiver disappears, install grounding springs. They can be purchased at auto and electronic parts and stores. Anti-static powder in tires will suppress any tire static (usually more noticeable at 30 mph and



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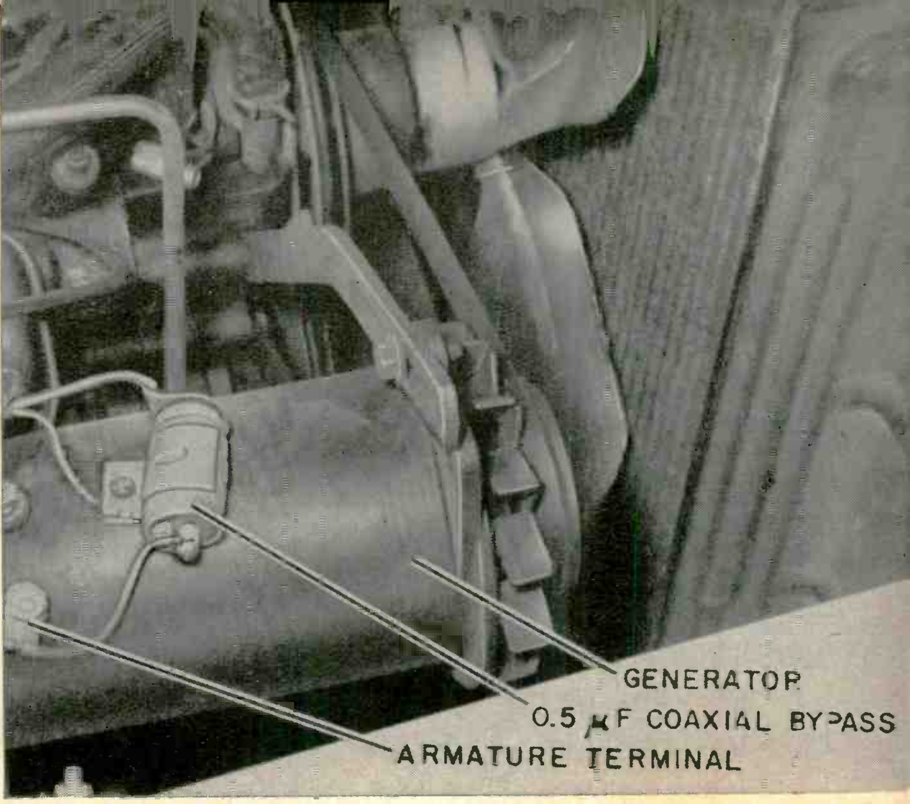
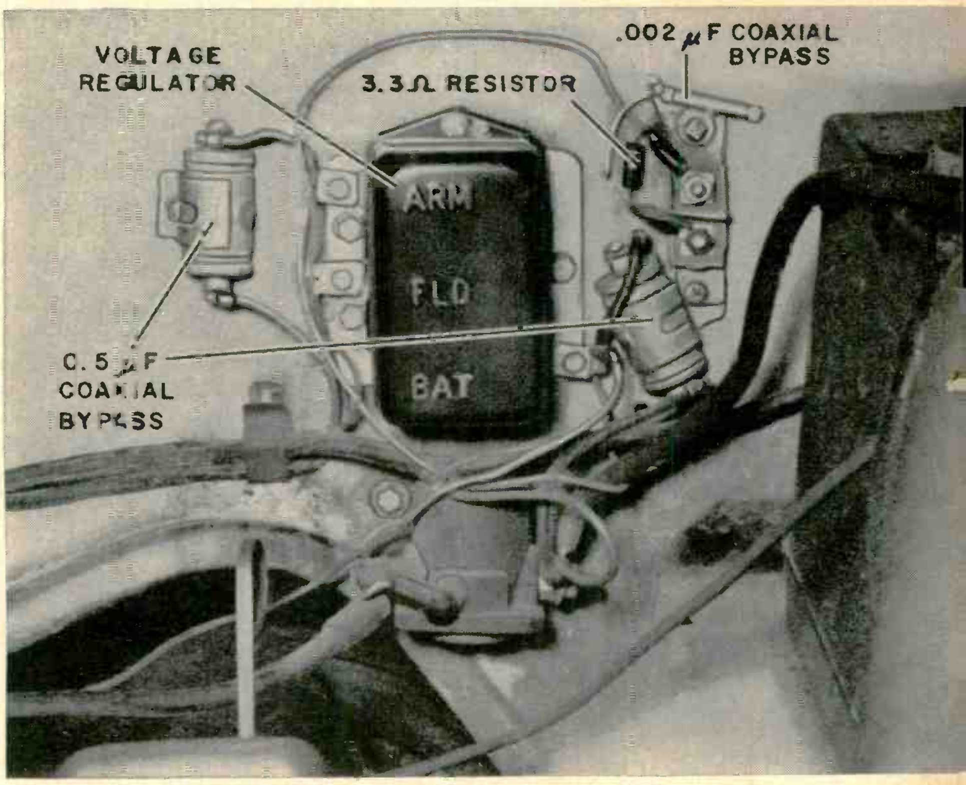


2

1/*Ignition suppression is the first step. Bypass and resistive suppressor help.*

2/*Coaxial capacitor in armature lead shuts up the generator.*

3/*If noise persists, bypass the regulator, too, but watch the field terminal—don't connect a capacitor directly to it.*



3

up). There is a high-pitched whine heard in the receiver when driving at high speeds on dry pavement. Commercial antennas have a plastic ball on top to discharge this velocity static slowly, so that it cannot be heard in the receiver. If you have this trouble, a piece of plastic tubing can be cemented at the antenna tip.

Bonding

Bonding is an important item in tracking down motor noise caused by the sparkplugs or generator. Bonding is tying all parts together at common ground potential. Connect heavy copper bonds from all four corners of the motor to the frame of the automobile. Check that the ground strap from the battery has not developed any resistance. In some tough problems, run a copper strap

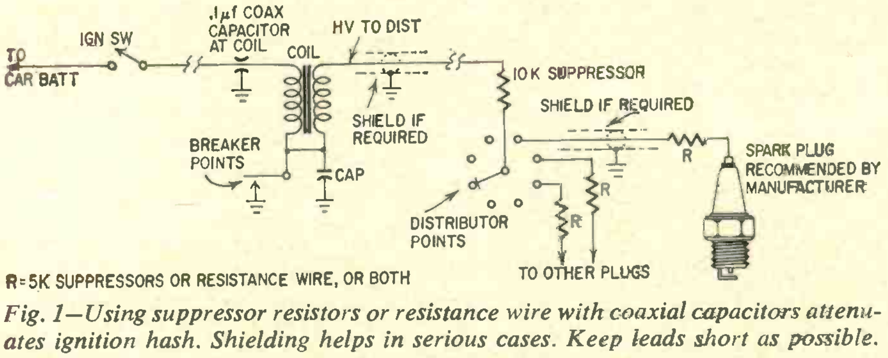


Fig. 1—Using suppressor resistors or resistance wire with coaxial capacitors attenuates ignition hash. Shielding helps in serious cases. Keep leads short as possible.

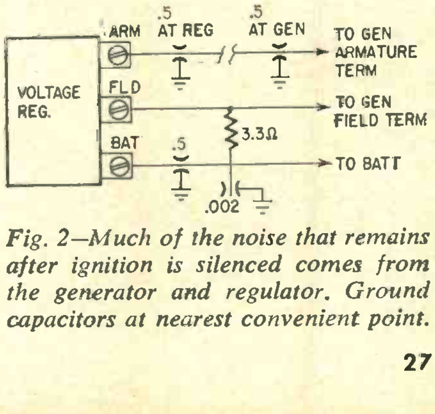


Fig. 2—Much of the noise that remains after ignition is silenced comes from the generator and regulator. Ground capacitors at nearest convenient point.

as a common ground from the voltage regulator and generator to the motor. Install bonding at both hood hinges and place a flexible piece of tin at the other end as a hood wiper. This will do much to keep the noise under the hood and out of the receiver.

The tail pipe is usually suspended from rubber supports. To keep it from acting as an antenna, bond it at intervals. Even putting a bond on the steering wheel helps in some cases. Be sure there is a good ground at both ends of the coax antenna lead. Some cars have undercoating or rust or dirt on the fender at the antenna. Be sure the fender is clean and, if convenient, run a bonding strap from it to the frame of the car. In the initial installation of the antenna, a place of minimum motor noise can be determined. Placing the antenna on the top of the car will generally improve performance. The roof then acts as a good ground plane and gives a nondirectional pattern.

I have mentioned coaxial capacitors. These should not be replaced by the paper bypass variety. Although more expensive, coaxial capacitors are considerably more effective at higher frequencies.

By metering the receiver and keeping the motor at the same rpm, you can determine how effective you have been in eliminating noise. This is helpful when you have more than one source of motor noise to contend with. The meter reading will decrease as motor noise is suppressed. Also radiating a signal on the receiver frequency will aid in determining what type of noise is being intercepted in the receiver, and if any improvement is being made.

In an FM receiver, a balance point for impulse noise is reached at some point in alignment. At this point, the motor noise will be reduced. Tune the i.f. coils for minimum motor noise, being careful not to detune the receiver. And be sure that your receiver is in good operating condition, of course. In some cases, a defective tube may show up as an increase in motor noise rather than a decrease in signal level. It is also advantageous to run the receiver direct from the battery. The battery then acts as a large capacitor, bypassing noise impulses to ground. END

INVENTORS OF RADIO

Alexander Stepanovitch Popoff

By DEXTER S. BARTLETT

ALEXANDER S. POPOFF HAS BECOME A controversial subject of late years. The Russians claim him as the sole inventor of wireless; yet he is apparently totally ignored by the Marconi adherents. The truth, as is often the case, seems to be somewhere between. His contributions may not have been epoch-forming, but are well worth mentioning for the record. He definitely was first to make practical use of a wireless device and the first to utilize an antenna. (Loomis and Edison had previously used antennas in experiments.) He made Branly's coherer a success with his decoherer and he was one of the first to have his equipment used in saving lives at sea.

Alexander Stepanovitch Popoff (or Popov) was born in Perm, in the Ural mountains of Russia, on March 16, 1859. At the age of 17 he entered the University of Sciences and in 1883 became professor at the Marine Academy at Kronstadt. It was there that he did most of his scientific work. He died at St. Petersburg (Leningrad) in January 1906.

After hearing of the discoveries of Roentgen and Crookes, he made up a series of tubes for investigating X-rays on fluorescent materials. He also heard of the experiments of Hertz and Branly and began his many wireless experiments at the Kronstadt Naval Yard.

As early as 1895, Professor Popoff communicated to the Physico-Chemical Society of St. Petersburg the details of a device employed by him for graphically registering atmospheric disturbances with an iron-filing coherer, introduced between an antenna or "exploring rod" and ground. A relay and tapper (decoherer) were also employed, the former operating a 12-hour recorder. With this arrangement, he detected thunderstorms at a distance of 20 miles.

Although Hughes and Lodge had used thumpers for decoherers, it remained for Popoff to make Branly's coherer usable by brilliantly hooking his bell tapper in the receiver relay circuit and thereby decohering after each received signal.

In May 1895, using his thunderstorm detector, along with an Hertz oscillator, he worked a distance of 1,000 meters. According to Sir Oliver Lodge, he had no thought of wireless telegraphy, but the experiment was for scientific purposes. Nevertheless, by Dec. 5, 1895, Popoff expressed confidence that he could establish a wireless telegraph system if he could perfect a more powerful transmitter.

On March 24, 1896, he and his assistant, Rybkine, gave a demonstration at St. Petersburg University, transmitting Morse signals between two buildings 250 meters apart and recording them on tape. This radio program—the first in the world, and taped, too—comprised only two words: "Henri Hertz."

In March 1897, he established a station at Kronstadt, and equipped the cruiser Africa with his apparatus. As the story of Popoff's record goes, in 1899 wireless communication was established between the battleship Admiral Aprasin and the coast, a distance of 45 miles. In 1900, a wireless dispatch from St. Petersburg, using Popoff's apparatus, was flashed to the icebreaker Ermak in the Baltic, instructing the crew to rescue a group of fishermen stranded on floating ice in the Gulf of Finland, possibly the first time wireless was used to save lives at sea.

In 1897, during experiments aimed at organizing radio communications within the Baltic fleet, Popoff is claimed by the Russian author P. Kolessov to have discovered the reflection of electromagnetic waves by naval units. More than 40 years later this discovery was to serve as a basis for radar.

A year later the Russian Army used Popoff's equipment and in 1903 the Ministry of Postal-Telegraph opened its first commercial wireless service. In 1901 he became professor at the St. Petersburg Electro-Technical Institute, but still found time to work on developing wireless telegraphy on board units of the Russian fleet.

Undoubtedly Popoff has considerable justification in his claim for firsts in wireless telegraphy as his dates are mostly contemporary with Marconi. But being a basic scientist, Popoff is said to have refused to take out patents on his wireless system, contending that the discoveries should benefit the scientific world at large. END

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SERVICING SOUND MOVIE PROJECTORS

First of three articles: How they work, how to thread, adjust and disassemble them.

By JACK DARR
SERVICE EDITOR

HAVE YOU EVER STOPPED FOR A MOMENT to think how many organizations depend on movies for education or entertainment? Visit any school, church or television station and you're sure to find at least one 16-mm sound film projector. Many larger schools have a whole fleet of them, run by an audio-visual aids staff or club. And quite a few individuals own sound projectors, too. Someone's got to service them!

Repairing movie projectors is not difficult, and can be profitable. Most of a projector is, of course, optical-mechanical. But rarely will you find any mechanisms that you might not also run into in TV tuners, tuning drives or record changers. And, since we're talking about talkies, a large part of the machine is, in fact, electronic.

Basic 16-mm sound projector

Each unit includes a movie projector: projection lamp, lenses and a driving mechanism, with reels to feed the film and take it up after showing. The sound is on a *sound track* on the edge of the film. This passes over the *sound head* after it goes by the shutter. An *exciter lamp* throws a beam of light through the track, which is focused on a photocell. The resulting light variations are converted into electrical variations, and amplified by a conventional audio amplifier. Fig. 1 shows the major parts of a typical unit.

Sequence of operation

The sequence of operations is always the same, although there are normal differences between makes. The film comes from the *feed reel,* passes over *idler rollers* (not driven) to keep it in the right path, and *driving sprockets,* provided with teeth which engage the holes in the edge of the film. (All 16-mm sound film has holes on only one side, whereas 35-mm film, as used in theaters, has holes on both sides.) The drive sprockets are always fitted with some kind of spring-loaded latch which holds the film in place on the sprocket, but allows it to slide easily.

The film travels past the shutter, where it is projected onto the screen, then over the sound head, over more idlers, then to the *takeup reel,* which winds it up again. After showing, the film is rewound on the feed reel for the next showing. The reels are both mounted on cast-iron arms, which fasten to the heavy "blimp" cases in which projector and amplifier are mounted. They are driven by coiled spring-steel belts.

The sound for a given frame is always ahead of the picture. Why? Look at Fig. 1. The frame being shown is at the shutter, while the *sound* for that frame is just running past the sound head, several frames in advance! So, we must always thread up the machine so that there is the same number of frames between shutter and sound head. This is the purpose of the lower "loop" seen below the shutter. By adjusting the amount of "slack" in this loop, we can make the sound come out in exact synchronism with the picture. Too much loop, and the sound will be late; the character's lips will move, and the words will come out quite a bit later! It takes only a couple of frames to make a very perceptible difference.

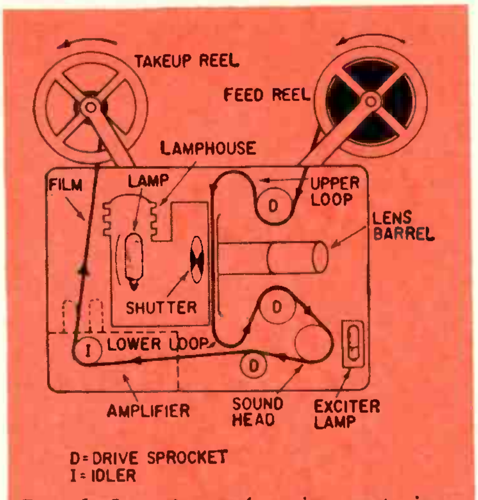


Fig. 1—Locations of major parts in a typical projector.

In most machines, you'll find *guide lines,* made of metal ridges, on the face of the housing, to show you the correct film path. This information is always given in the instruction book. If the book is missing, you'll have to figure it out for yourself. The lower loop is usually about "two fingers": make up the loop, then insert the tips of two fingers between the bottom of the pressure foot and the drive sprocket. This can be checked very quickly as soon as the machine starts! This is important only in films showing people talking. In technical films or documentaries, where you can't see the speaker, it isn't too critical.

The loops

We've mentioned the lower loop. The upper is equally important. The film in these machines does not travel smoothly down past the shutter. It travels in jerks, due to the peculiar method of projection used.

In a theater projector, the film is pulled past the shutter by sprocket rollers and travels at a constant speed. The light is interrupted by a shutter, which closes as the interval between frames passes the *gate* (the vertical blanking bar!). In small projectors, however, the film is jerked down by a pair of metal teeth during one of the intervals while the shutter is closed. A special

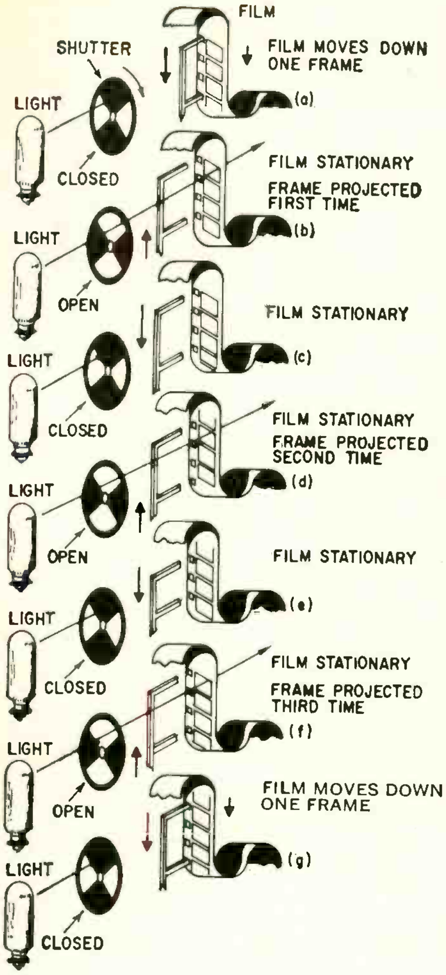


Fig. 2—"Pulldown" action cycle in 16-mm projector film gate.

cam inside the machine causes these teeth to pull the film down on every *fourth* opening of the shutter. Each frame of film is actually projected on the screen *three* times! This is done to avoid flicker on the smaller film.

From Fig. 2, you can see this action. The *pulldown teeth* are mounted in a slide, inside the film gate. A specially shaped cam causes the teeth to move *out* through slots, engage the sprocket holes in the film, and pull it down exactly one frame. The shutter is *closed* at all times while the film is *moving* (a). On the next shutter closing, the teeth pull down again, but this time they're retracted so that they do not engage the holes (c). The shutter opens (b), and one frame is projected on the screen.

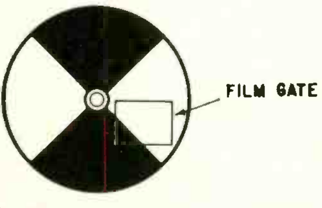


Fig. 3—Shutter of projector is actually a disc, not a flat plate. Its rotation is synchronized with the pulldown mechanism.

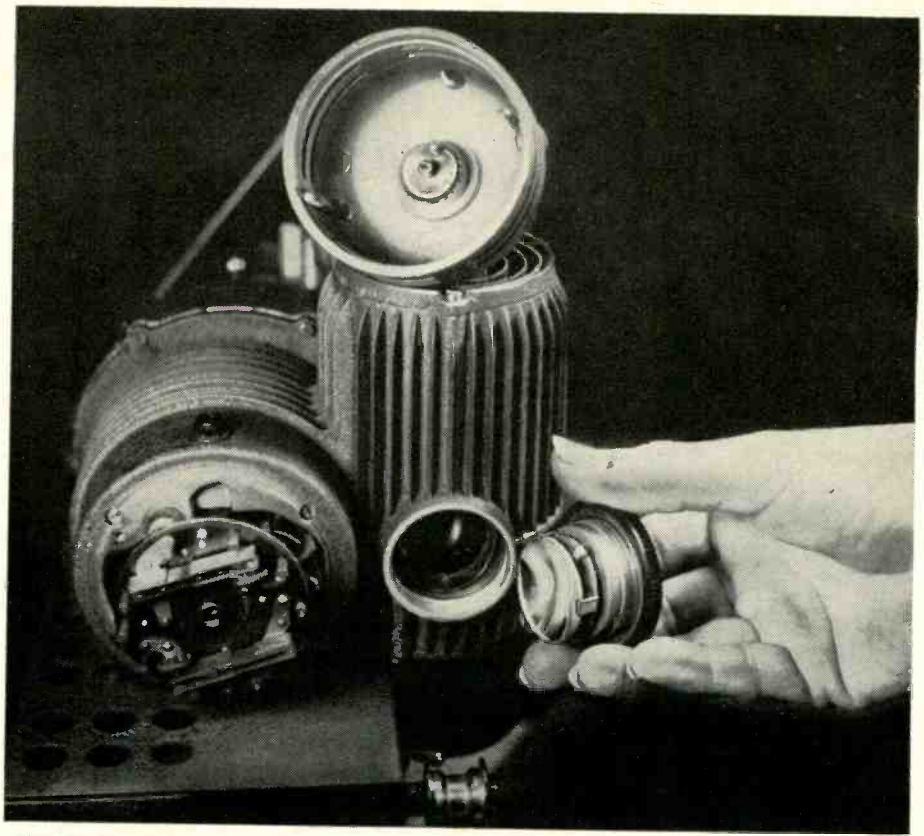


Fig. 4—Rear view of projector motor (left in photo) shows speed controller. Hand is holding parabolic reflector used behind projection lamp. It screws into hole nearby in lamphouse.

On the next two cycles (c–d; e–f) the same action is repeated. The teeth are driven up and down in synchronism with the *shutter*, but the cam keeps them retracted. So, each frame of the film is shown three times. On the fourth cycle (g), the cam pushes the teeth out again, they engage the film and pull the next frame down before the gate. The shutter is a disc (Fig. 3) with wedge-shaped slots in it.

In the 16-mm projectors used for TV films, there is a different cycle of projection. To make the frames come out "even" with the frame scanning rate, the projector shows one frame twice, then the next frame three times, then twice, and so on. This peculiar transport rate makes the frames come out even with the 60-cycle vertical scanning rate, and eliminates the flicker. (They were quite a while working that out, though!)

Now, you can see why the loops! They act as "shock absorbers" to take up the jerking motion of the film, and allow it to be drawn at a steady speed over the sound head. You can imagine what the sound would be like if this intermittent motion were used there!

Speed control

In sound projectors, film speed is very important. It must be exactly right, or we get the familiar wow and "funny sound" we'd get if a phonograph turntable was running at the wrong speed! So, a controller is used on the motor (Fig. 4). This is a centrifugal speed control similar to those used on electric mixers, etc. The end bell of the motor is the object lying on top of the lamp housing. The disc in its center engages the controller, and is used to drive a pulley for running the rear belt.

Many projectors provide dual-speed operation: 24 frames per second for sound, and 16 for silent films. The speed is changed by switching a resistor in series with the controller.

The optical system

The light from the projection lamp must be concentrated into a beam. Projectors like this use a system of reflectors and condenser lenses, as shown in Fig. 5. The parabolic reflector behind the lamp can be seen in the hand in Fig. 4. This

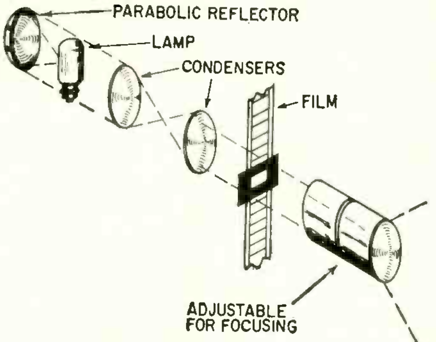


Fig. 5—Typical optical system. Some machines use fewer lenses, but idea is the same.

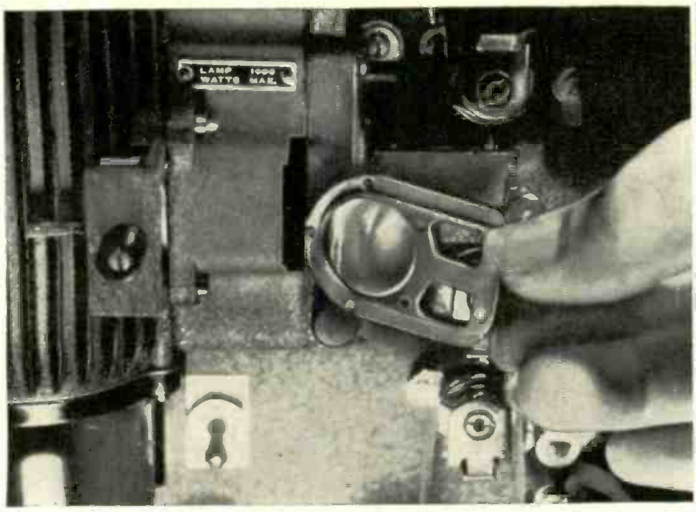


Fig. 6—Closeup of condenser lens, removable for cleaning. Other one is still inside, about 1 inch left of slot.

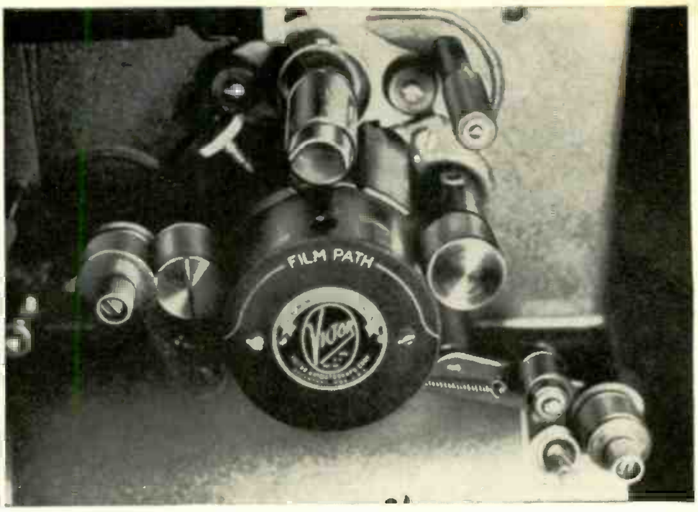


Fig. 7—Sound-head assembly.

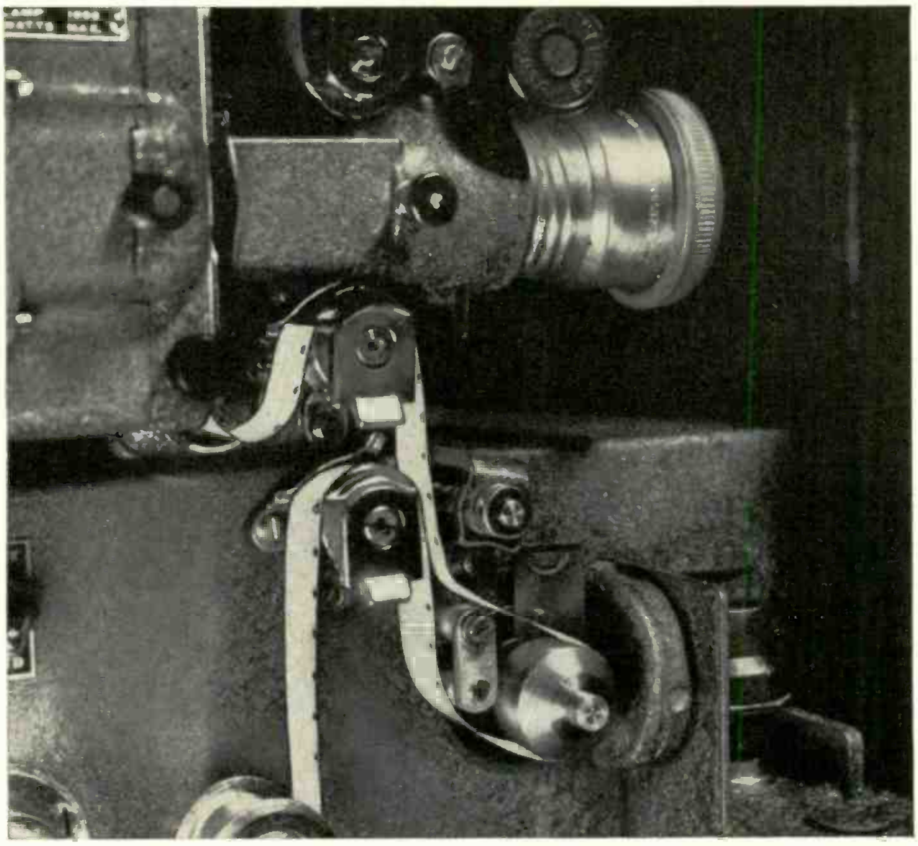


Fig. 8—Another sound-head assembly. Note shielded exciter lamp, lower right, and spring-loaded idlers between sprockets. They keep film tension constant.

reflector screws into the back of the lamp housing and can be removed for cleaning.

Two more lenses are used between the lamp and the film gate. These are also removable, as seen in Fig. 6. In the front of the gate, the projection lenses are mounted in a removable barrel. (This assembly can be seen in Fig. 1.) These outer lenses are used for focusing the light on the screen by moving the lens barrel back and forth in its holder. A locking screw is provided on all machines to keep the vibration of the motor from jiggling the lens out of focus.

The sound head

The sound head assembly of the projectors consists of an exciter lamp, a phototube and some method of moving the film past a very tiny slot, so that the light will pass through the sound track and fall on the phototube. A typical assembly is seen in Fig. 7. The exciter lamp here is inside the center housing. The hole can be seen on top, just above the words FILM PATH. The photocell is above this. In operation, of course, a lightproof shield is placed over this lamp. This is usually of metal, to prevent stray hum pickup, since this is always a high-impedance circuit.

The two drive sprockets are shown in Fig. 7, with the two spring-loaded rollers that hold the film in place, the idlers. This machine uses idlers on spring-loaded arms. The one at left is in place; the one at right open, ready to accept the film.

Fig. 8 shows the same assembly on a different machine. Here, the exciter lamp is behind the partition, at the right. The lens and slot are in the partition, and the roller in the center holds a mirror. This is set to reflect the light beam onto the phototube, which is mounted on the amplifier chassis itself, inside the projector base.

The one most important thing about the sound head is that the film must be kept at exactly the right tension as it passes over it. Notice the elaborate arrangement of drive sprockets and spring-loaded idlers used on both machines. The film must be held down very snugly against the sound head. If it is too loose, you'll get a sort of "monkey-chatter" effect, like a phonograph with a *very* bad needle and record at the same time! If you hear this kind of sound, look at the sound head to see that the drives haven't "jumped a frame" on the sprocket holes, or done something else that would allow the film to become too loose.

Next month, a look at the drive clutch and "safety shield", among other things. You'll find that threading and running are pretty much the same in all projectors, regardless of make and model. We won't get to the simpler electronics end until the third and final part, but then—making minor mechanical repairs on projectors can be a profitable venture, and will win you customers!

TO BE CONTINUED

TRANSISTOR POWER AMPLIFIER CIRCUIT DIRECTORY

By LEONARD E. GEISLER*

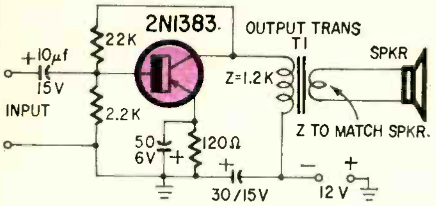
10 transistor circuits for the technician and experimenter

The experienced technician and the novice experimenter will appreciate having a variety of diagrams of common and not-so-common audio output circuits gathered together for swift comparison and evaluation. The 10 circuits here may help you build, service or design efficient, high-quality transistor output stages.

All parts values have been proved in actual lab or production-line models, so the prospective builder can be sure that all these circuits will work.

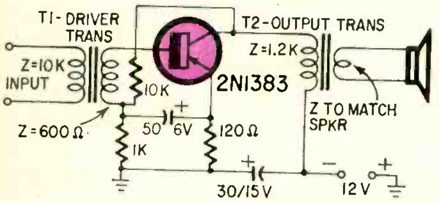
If you choose to substitute other transistors for those shown, be sure to use equivalent types. Practically no "fudging" of resistor values will be found necessary if interchangeable types are selected. The output transformers shown are representative types. No attempt to select particular types by part number has been made.

1. Probably the simplest "standard" transistor power amplifier. Gain, using the transistor listed, is a minimum of 30 db. Power consumption is high, whether the stage is idling or working at rated output. Distortion about 4 to 6%.



1

2. Increase the gain to over 33 db by adding the input impedance matching transformer to the circuit of **1.** Because of lower resistance in the bias network, battery current may increase by 1 ma or more. Returning the emitter bypass capacitor to the bottom end of T1's secondary improves gain, tone quality and ac stability. Distortion of the stage at full rated output is from 3% to 5%, depending upon the quality of transformers used.



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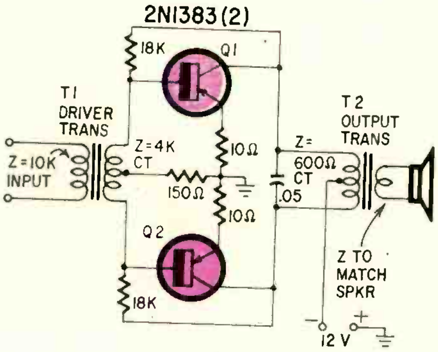
3. The transistor portable manufacturer's old standby! This familiar circuit, excavated from its well-worn rut, has been included as the prime example of bad design.



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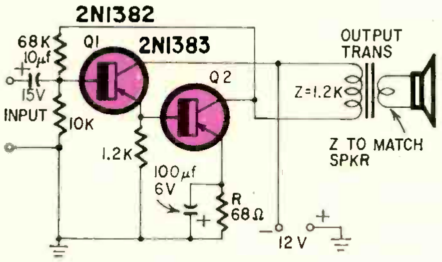
This circuit goes easy on the battery, but rarely can good fidelity be obtained for low cost. The amplifier takes up a lot of space and the coupling transformers add weight. Use of this circuit in a set supposedly designed for *minimum* size and weight is hard to understand.

4. Perfect impedance matching to the output transistor is provided by this circuit. Its input impedance is also high. This reduces loading on the signal source. Circuit gain is equal to or better than that of **2.** By increasing R's resistance, it is possible to operate the output transistor class AB with a slight loss in fidelity but at a greater battery drain efficiency. The large amount of negative feedback from Q1's unbypassed emitter resistor almost completely cancels distortion in the driver, so the amplifier's output is very clean-sounding, even at the overload point.



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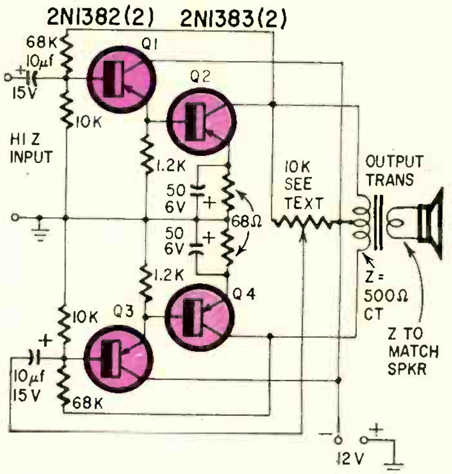
5. Two circuits of 4 wired in push-pull, double our class-A power output, nearly triple class-AB power, and cut distortion almost in half, too.

In class A, this configuration easily delivers a clean 100 mw or more output, and in AB, up to 300 mw of clean audio. The 10,000-ohm pot across the upper half of the output transformer winding adjusts the amplitude and ac balance of the "other half" of the audio signal fed to Q3. This is a "set-and-forget" control.

By substituting suitable high-power transistors for Q2 and Q4, any power output may be obtained. Of course, the output transformer must be selected to match the transistors used.



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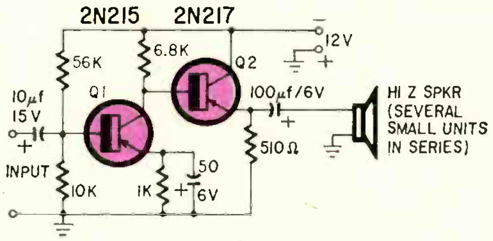
6. Q1's output impedance is matched to Q2's input by rearranging the wiring of 4 somewhat. This is a nearly perfect match and practically no power is lost. Phase shift is negligible, also.

As Q2's output is 600 ohms or less, it is possible to drive several low-impedance speakers wired in series, with great efficiency. The distortion of



6

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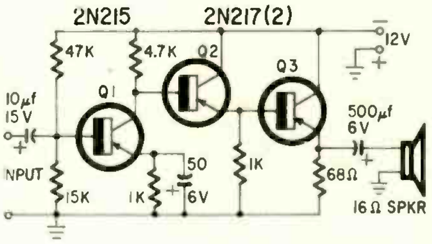
*Applications engineer, Apollo Electrical Industries, Tokyo, Japan.

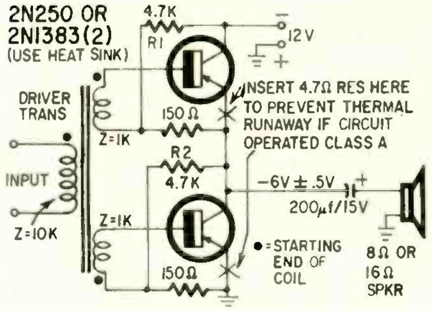
this circuit is less than 4% at full output (just barely clipping). Maximum gain is about 50 db from input to output. We have done away with the input and output matching transformers completely. If ordinary transistors are used and carefully juggled about, gains from 39 to 65 db are possible. This circuit can be made into a push-pull stage if you exercise your imagination and ingenuity. (See 5 for inspiration!)

7. Another version of 6. It has lower distortion than the other circuit, and very low output impedance. It can drive a low-impedance voice coil (16 ohms or less) through the large electrolytic dc blocking capacitor.



7

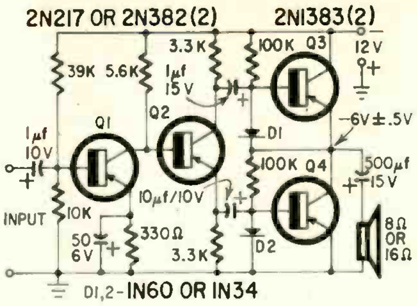
8. An efficient, low-distortion OTL (*O*utput *T*ransformer*Less*) amplifier combines the low output impedance of the emitter follower and the power gain of the common emitter. It also eliminates the objectionable feature of the circuit of 3—power limitation imposed by excessive back emf of the pulsed output transformer. The circuit is biased for class AB2 with the resistor values shown and may be operated straight class-A by decreasing the values of R1 and R2 by about 1,000 ohms so about 10-ma static collector current will flow in the circuit. (I feel that no useful purpose is served by increasing bias to class A. However, it is mentioned so the experimenter may make an exact measurement of the power output, if desired.)



8

If class-A operation is desired, it is recommended that two small resistors—about 4.7 ohms each—be inserted in the emitter lead returns to prevent thermal runaway.

9. This is nearly the end—the split load phase inverter. Not as efficient as the coupling transformer of 8, but its ac balance is excellent and automatic. Impedance matching between the phase splitter and output transistors is very close, with the two diodes acting as switches to improve overall operation further. The diodes short out excessive positive ac signal swing, which might damage the output transistors base-emitter junctions.



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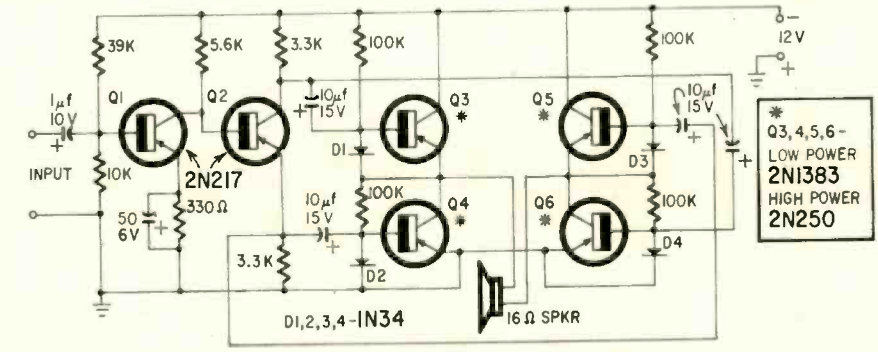
Transistors Q1 and Q2 are direct-coupled to eliminate parts and unwanted phase shifts. All four transistors are well matched to each other, the two output transistors operating either emitter follower or common collector. Q3 is the emitter follower, Q4 is the common collector transistor.

This type of amplifier is often shown with a matched complementary pair (n-p-n and p-n-p "mirror image" transistors) working as drivers for the output. Since well matched complementary transistors are not always available, I prefer the circuit shown here. A low-power version of this amplifier will take up about the same cubic volume as an ordinary output transformer.

10. Bridge type OTL amplifier. It has eight times the power output of the circuit of 3. If properly constructed, it will have less than 1% total distortion. The circuit works like the one in 9 except that the extra two transistors are connected to the opposite phase output of Q2. No direct current flows through the voice coil if the four output transistors are well matched. Thus we eliminate the output coupling capacitor. Total ac voltage across the voice coil will be nearly twice the battery supply on peaks. Both this circuit and the previous one are far more efficient than any other shown here.



10

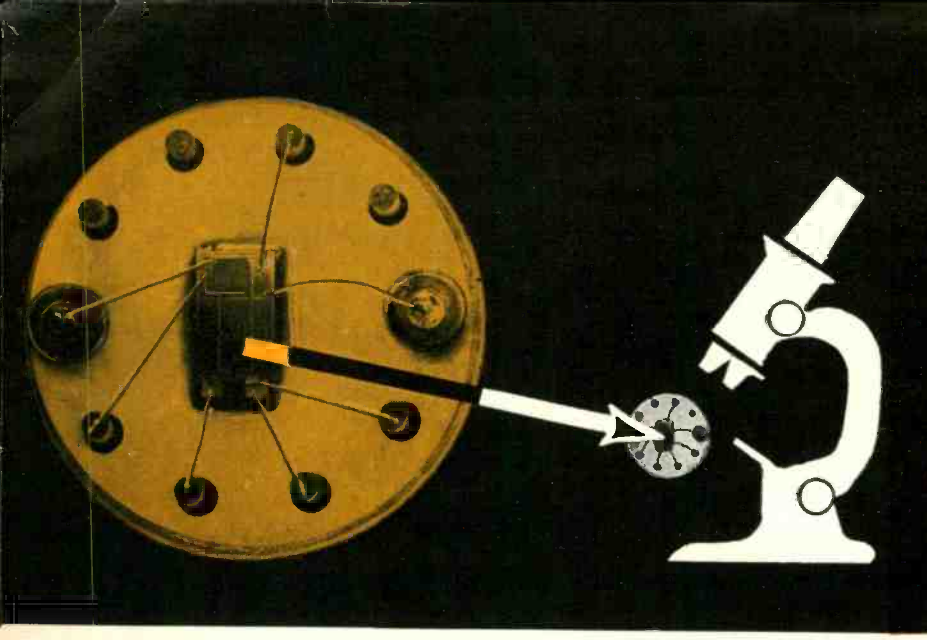
In conclusion, I want to thank the many transistor manufacturers for their kindness in supplying application notes gratis. Mr. John Palmer was kind enough to assist us in developing the circuit of 5 as shown. END

ELECTRONIC WEATHER BUREAU. The photo shows a new telemetering system (black box on tripod brace) that relays complex meteorological information from a remote weather station (top of tripod).

Called *Teladvisor* by its maker, Berkeley Instruments, the system eliminates electrical analog-to-digital converters by digitizing standard sensing instruments directly.

Mechanical dial instruments are "read" by a digitizer that scans the dial with moving lamp and photocell, and the device records or telemeters five weather variables from the unattended station.

The transducer readings are monitored and error-checked by a single central logic card. Readout is not in arbitrary units, but in conventional ones associated with each quantity (degrees, pounds per square inch, etc.)



the WHAT and WHY of INTEGRATED CIRCUITRY

Cover Story

A report on the science of vanishing electronics

By **LOTHAR STERN***

SCIENTISTS IN VIRTUALLY EVERY FIELD are striving for bigger accomplishments and larger end-products. In electronics, the best brains are going in the opposite direction. Today the emphasis is on smallness—almost to the vanishing point. The results already achieved have caused more excitement and anticipation than any development since the invention of the transistor. A new electronic technology is born—*integrated circuits*.

A multistage amplifier, a complete flip-flop, an elaborate computer gate, all so tiny that their individual structures can be seen only under the microscope, will be the basic tools of the electronic technician. Every phase of the industry, from engineering to servicing, from equipment production to product marketing, will feel the impact. The concept of integrated circuits heralds the beginning of a new era in the electronics art.

What are integrated circuits?

Even the electronics industry itself has not yet agreed on a precise definition. But a semblance of order was brought into the confusion last January. The EIA (Electronics Industry Association) proposed a definition that has at least tentative approval from a large number of manufacturers.

"Integrated circuits," proposes the EIA, "are the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit."

Electronically, integrated circuits are not radically different from those in common use. They still consist of separate component parts—transistors, diodes, resistors and capacitors—interconnected to form a working whole. Physically, there is no comparison. Unlike conventional circuits, whose component parts are separately manufactured and individually packaged, integrated circuit parts are all fashioned simultaneously and with identical processes. All are deposited on or within a tiny "chip" of silicon no thicker than a page of this publication and only a few tens of thousandths of an inch square. And, in the completed circuit, these parts are neither separable nor repairable.

Why integrated circuits?

Integrated circuits are of major importance to the electronics industry because of their technological and economic advantages.

Small size and weight are the most obvious. Capable of being compressed into a minute volume, they are the answer to many space-age and military electronics problems. Present methods of packaging are designed more for standardization than for minimized dimensions, yet are flexible enough to meet almost any need.

Size and weight reducing capabilities are the most obvious integrated-circuit features, but by no means the most important. At least as vital is the increase in equipment reliability. Separate interconnecting wires and their solder connections are replaced with vapor-deposited metallization patterns. This promises to eliminate a major source of equipment trouble. Use of high-reliability semiconductor devices and manufacturing processes is expected to improve systems reliability further.

Finally, since a complete circuit now becomes the basic building block of electronic equipment, the number of actual parts is sharply reduced, extending the life of a complex system.

But perhaps the most important overall advantage of integrated circuits is the prospect of cost reduction. This is due not only to the small cost of the actual materials required, but also to the labor and equipment savings of the manufacturing processes.

How are they made?

Integrated circuits do not really represent a *revolution* in the state of the art. Rather, they are an evolution—the extension of manufacturing techniques used in transistor manufacture for over a decade. Like transistors, they have their beginning in *crystal growing* furnaces, like that in the cover picture, where from a melt of semiconductor material a tiny seed of silicon slowly emerges as a rod of single-crystal material. This material is relatively pure, but does contain a small number of deliberately introduced p-type impurities.

This crystal is then sliced into paper-thin wafers (approximately 1 inch in diameter and .006 inch thick). Each of these serves as a base, or substrate, for dozens or even hundreds of complete identical circuits, depending upon the complexity of the circuit structure and the values desired.

(Since the substrate represents a large portion of the total material employed for such circuits, obviously the material cost of a circuit borders on the negligible. The greatest single item of hardware cost in the entire circuit is that of the header, or package, in which the circuit "chip" will be eventually mounted to permit interconnection with other circuits in a more complex system. The cost of the integrated-circuit package is not appreciably greater than that of a conventional package housing a single, ordinary transistor. And, since the actual manufacture of a wafer of integrated circuits takes only one process step more than the fabrication of a transistor wafer, it is expected that, eventually, the cost of a complete integrated circuit should be little greater than that of a single transistor today.)

Actually, the basic wafer does little more than give mechanical rigidity to the integrated circuit. The parts themselves are all diffused into a microscopically thin n-type semiconductor layer

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*Manager, Technical Information Center, Motorola Semiconductor Products.

epitaxially grown (Fig. 1) on top of the basic substrate.

The concept of integrated-circuit "parts" demands some explanation. An integrated-circuit resistor, for example, is merely a tiny area on the epitaxial layer which has been impregnated with a precisely controlled impurity of the opposite polarity (Fig. 2). The actual resistance of this area is determined by its dimensions as well as the resistivity of the semiconductor material diffused into the region. Typical resistance values range from about 10 to approximately 100,000 ohms.

Capacitors for integrated circuits (Fig. 3) are also made by diffusing one type of semiconductor material into an opposite polarity type. But, whereas resistors have two interconnecting points at opposite ends of the same material, one end of the capacitor may be the substrate itself; the other is the opposite-polarity material diffused into the substrate. Thus, a capacitor may be essentially an n-p or p-n junction which, in effect, is a junction diode.

There is very little difference between a diode and a diffused capacitor except in the way they are used. It is well known that any reverse-biased diode exhibits a capacitance effect. To use a diode as a capacitor, it is necessary only to keep it reverse-biased under all circuit operating conditions. Capacitance values available by this method depend upon the size of the diffused area. Practical values range from 1 to 1,000 picofarads.

Transistors for integrated circuits can be made in the conventional manner. Transistors require three material layers, diodes and capacitors require two, and resistors only one. It should be obvious, therefore, that all diodes, capacitors and resistors can be made at the same time a transistor is manufactured.

Limitations

Progress made in integrated-circuit technology over the past couple of years has far outstripped even the most optimistic predictions. Yet everyone connected with the field will readily admit that this is just the beginning. True, a number of devices are in production and are actually being designed into equipment. But the scope of the art—the number of types of circuits being produced—is still limited.

Integrated-circuit production is largely confined to digital (switching) circuits for the computer industry. The reason is both technical and economic. Not only are digital circuits much simpler and less critical than linear (amplifier) circuits, the required parts and parts values for digital circuits are far more compatible with the present state of the integrated-circuit art.

For example, in today's technology, practical values of inductance with reasonably high Q's are still impractical in integrated circuitry. This automatically eliminates all forms of fully integrated tuned amplifiers. Moreover, capacitance values above .001 μf require too much space to be placed on a single chip with other "parts". Therefore, low-frequency amplifiers with R-C coupling and large bypasses cannot at present be made as fully integrated devices. And the number of parasitic parameters (stray intercomponent coupling) associated with integrated circuits is greater and more troublesome than in conventional wired circuits.

Hybrid devices

All these factors can be and are being circumvented by *hybrid* devices: integrated circuits that can be combined with unencapsulated microminiature *discrete* components, all in the same package. Also, considerable study of unique circuit designs that may eliminate the need for inductances (R-C filters, etc.) and large capacitance values (active capacitance-multiplier circuits) is in progress. Results to date are, however, far from competitive with standard circuit elements.

Hybrid circuitry is a flexible technique for obtaining many of integrated-circuit advantages without being critically dependent on technological and economic factors. Sometimes called multiple-chip circuits, hybrid circuits consist of a number of silicon substrates, each containing one or more integrated-

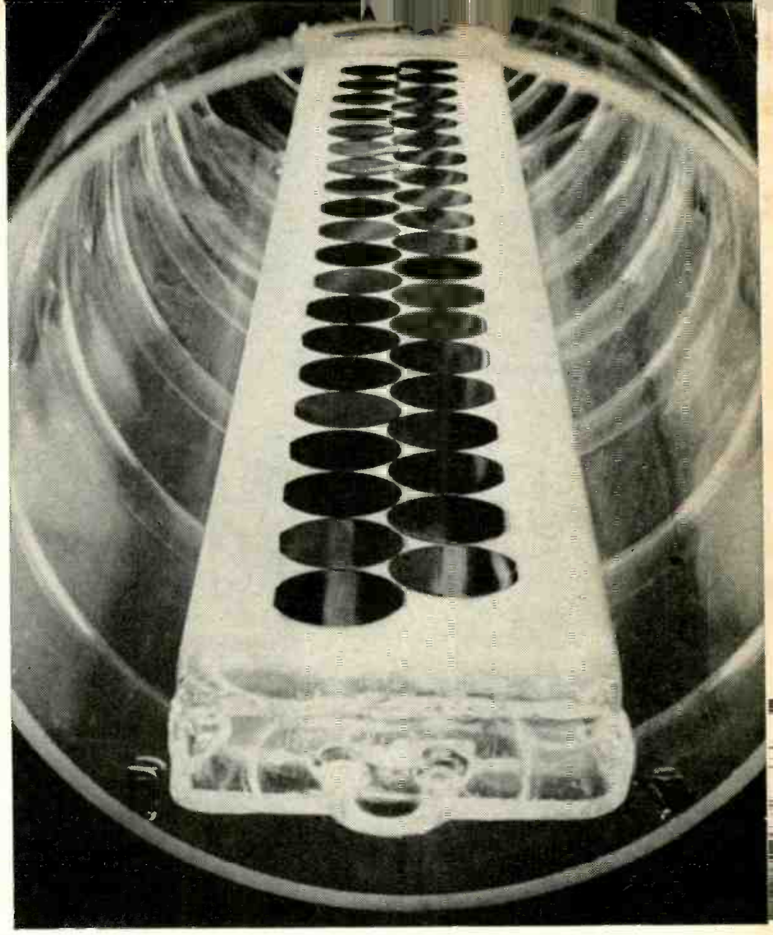


Fig. 1—Crystal layers are grown on the basic substrate in rf furnaces like this. Gases are flowed over the induction-heated semi-conductor wafers in the quartz tube to produce the desired epitaxial surface layer.

Motorola photos

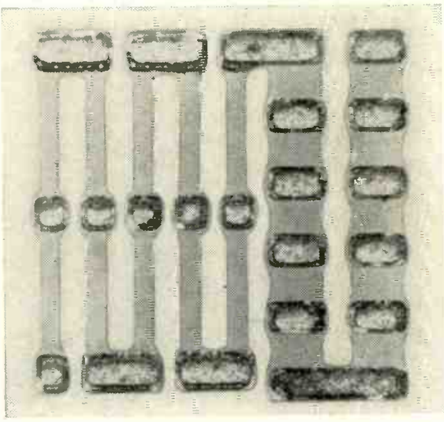


Fig. 2—Integrated-circuit tapped resistors. Metallized "islands" provide 10% and 1% resistance increments.

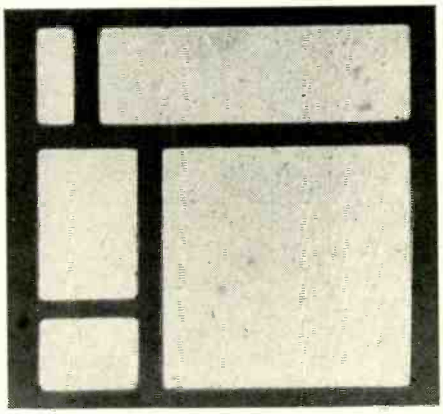


Fig. 3—Integrated capacitors. The binary pattern here contains 5 capacitors of 1, 2, 4, 8 and 16 units of area.

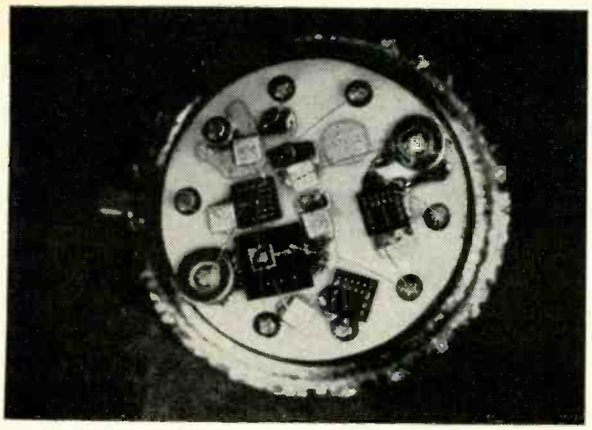


Fig. 4 — Hybrid integrated circuit. This one includes a multistage dc amplifier, with special, separate R and C components, and is mounted in the same type of package that houses a completely integrated circuit.

circuit parts. These chips are then mounted on a ceramic substrate and interconnected in a manner similar to conventional circuits.

Hybrid circuits are often combined with discrete microminiature inductors, crystal filters and other nonintegral parts. They are, therefore, highly versatile and, due to low design costs, can be adopted for custom-built and linear circuits in small quantities.

The flexibility of hybrid circuits is illustrated by a typical hybrid audio amplifier (Fig. 4). The individually mounted parts are interconnected either by separate wire bonds or by a metallization pattern. One "chip" contains a number of parts—in this case a Darlington-connected multistage dc amplifier. *For hybrid circuits, therefore, it is practical to make and stock a variety of commonly used "partial" integrated circuits and combine these with compatible parts to complete the final function.*

Hybrid circuits can be mounted in the same packages as single-block integrated circuits, and are completely compatible. Since the design cycle for hybrid circuits is short, such devices can be used as an interim stage in the manufacture of integrated-circuit equipment. For example, early equipment models may be made with hybrid modules while fully integrated circuits are in the development stage. In subsequent models, fully integrated modules can replace the hybrid circuits on a 1-for-1 basis, without changing either the appearance or performance of the system.

New circuit design principles

Integrated circuits mean a change in circuit design concepts. Just as transistors demanded a departure from vacuum-tube design principles, so integrated circuits require a new approach for best performance.

In conventional circuits, the active components (transistors and diodes) are normally far more expensive than passive ones (resistors, capacitors, etc.). With integrated circuits the opposite is often the case. In addition, an increase in the number of components to produce a given circuit function often results in little or no increase in cost. It may be convenient to use a greater number of stages to do a given job more reliably, rather than drive each stage to its maximum ratings.

The circuit designer, however, will be faced with the problem of which and how many stages and components are to be placed in a single integrated-circuit package. A particular "chip" size will hold only a certain number of components—often determined by component values. The designer may elect to place more than one chip in a package, thus reducing interconnection costs and increasing replacement cost. He may specify a larger "chip" to mount more components, but in doing so he reduces circuit yield and increases costs. He will have to circumvent inductors in his circuit design, and perhaps substitute active circuitry for large-value capacitors. He will have to design circuits within the limits of available integrated parts values and cannot rely on very close resistor and capacitor tolerances. Finally, he must be acquainted with the various parasitics in integrated-circuit fabrication and learn either to compensate for them or to use them in his circuit design.

But he will be starting on the ground floor. Today, the bulk of accumulated integrated-circuit knowledge is stored largely within the confines of semiconductor device manufacturers and those equipment companies who have set up close working relationships with the semiconductor concerns. For most working engineers, the design of integrated circuits requires a learning process similar to that involved in the changeover from tubes to transistors.

Although integrated circuits are being built in production quantities and are already designed into some equipment, even the most knowledgeable integrated-circuit engineer will admit that we have just scratched the surface of this new technology. But, if the progress made in the past year is any indication, acceptance of integrated circuits will be more rapid than that of any other major development in the history of this fast-moving industry. END

This is the first of a series of articles on integrated circuits. The second will describe and explain the thin-film type of circuitry.

Reverse voltage protection for transistors

WHEN THE SUPPLY VOLTAGE TO A TRANSISTOR circuit is reversed, the characteristics of some or all of the semiconductors are likely to be changed—seldom for the better. Because a reversed battery may do several hundred dollars worth of damage to a complex transistor assembly, and may cause delays of up to a month while new transistors are procured and installed, some sort of reverse-voltage protection is desirable.

Simplest protector is a diode connected in series with one supply lead. With this arrangement, the assembly will work when the battery polarity is correct, and it will not work if the battery is reversed. This protects the assembly against battery reversal. However, in practice, many assemblies are rejected as inoperative when the real and only trouble was that the battery was connected backward.

Much more satisfactory is a suitably polarized bridge rectifier connected between the power input terminals and the transistor load (Fig. 1). With this arrangement, the circuit will work, independent of battery polarity. This circuit works well, but technicians using such circuits are likely to disregard polarity completely, with unhappy effects on other unprotected equipment.

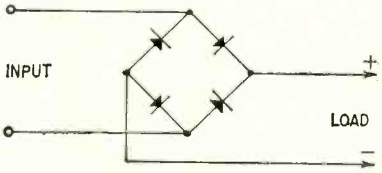


Fig.1

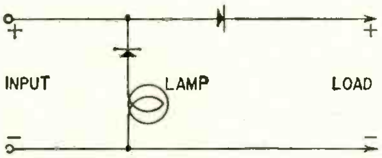


Fig.2

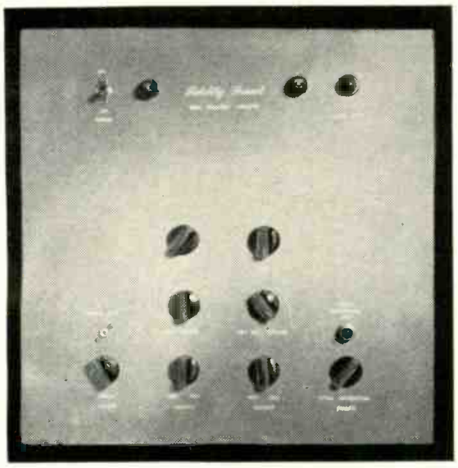
The most satisfactory device tried so far is shown in Fig. 2. Here, a series diode protects the load against reversed voltage, while a lamp in series with a suitably polarized diode lights when the supply polarity is wrong. If the supply packs enough power, a loud buzzer, adjusted for a Bronx cheer tone, can be used in place of the lamp.

When the supply voltage to the transistor assembly is critical, the battery voltage must be increased slightly to compensate for the slight drop in the series diode or diodes. With silicon diodes, whose current rating is in the same order of magnitude as the actual load, the drop per diode will be roughly 1.5 volts.—*Ronald L. Ives*

By **WAYNE LEMONS**

CUSTOM BUILT CHURCH AMPLIFIER

This high-quality, high-versatility piece of equipment can meet many PA needs



Panel of the completed amplifier. Stock decals were used to label the controls.

WE BUILT THIS AMPLIFIER BECAUSE WE couldn't buy anything quite like what we needed, at a price we could afford. What evolved is a versatile system that fits not only our needs, but looks as though it might serve other churches as well—and perhaps schools, too.

One peculiarity of this amplifier is its shape. We wanted it built into a wall, something that couldn't be done with commercially available amplifiers. We needed independent volume control of the main auditorium speakers and the "cry room" (nursery) speaker. T- or L-pads would have wasted a lot of power and created matching problems. Finally we also wanted controllable earphone output for hard-of-hearing churchgoers.

Figs. 1 and 2 show the results. Earphones and cry-room speaker share one channel, since both are wanted simultaneously all during services. All input sources are common to both channels. The auditorium speakers are driven from a higher-powered amplifier with its own volume control.

What? No power transformer?

At first gasp, this seems like a horrible thing to do to a church. Actually, it's a safety factor! The amplifier is mounted inside the wall, in a grounded metal box, and is connected to the power line through a polarized plug that is inaccessible once it has been polarized correctly (chassis to grounded side of line, of course). There is no chance of shock. Also, since the chassis is tied firmly to earth ground through power wiring, hum and instability are reduced. Turn all volume controls up full, even *without* input sources connected, and you hear nothing but tube hiss!

If you want to use this amplifier for portable PA work, use the alternate (transformer) power supply in Fig. 3.

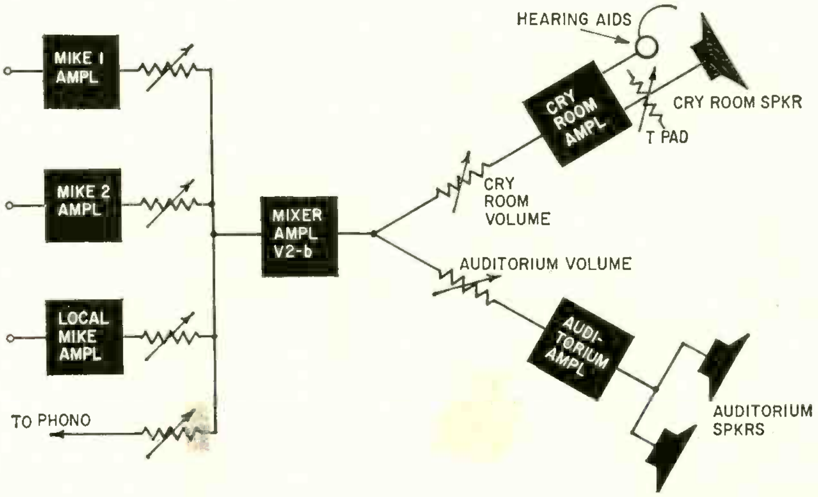
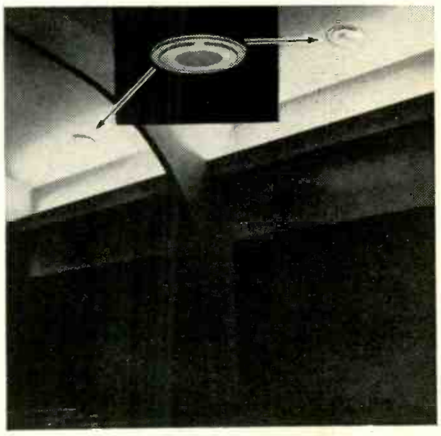


Fig. 1—Four mixable input sources feed a common mixer amplifier and two power channels.



Ceiling speakers are installed in church where this amplifier is used.

(We strongly recommend permanently connecting the chassis to a water pipe or earth ground. This will blow the fuse and eliminate the shock hazard if the polarity of the supply line should be reversed through a wiring error. If the additional ground is omitted, reversal of line polarity may raise the microphone cases and hearing aids to line potential, thus presenting a serious shock hazard.

Do not, under any circumstances, use the transformerless version of this amplifier as a portable unit.—*Editor*)

You might also (second gasp) notice that there is no fancy voltage feedback. We relied only on simple unbypassed-cathode-resistor current feedback, which presents not the slightest chance of peaks or instability. Top-quality output transformers are expensive and bulky, yet without them, most

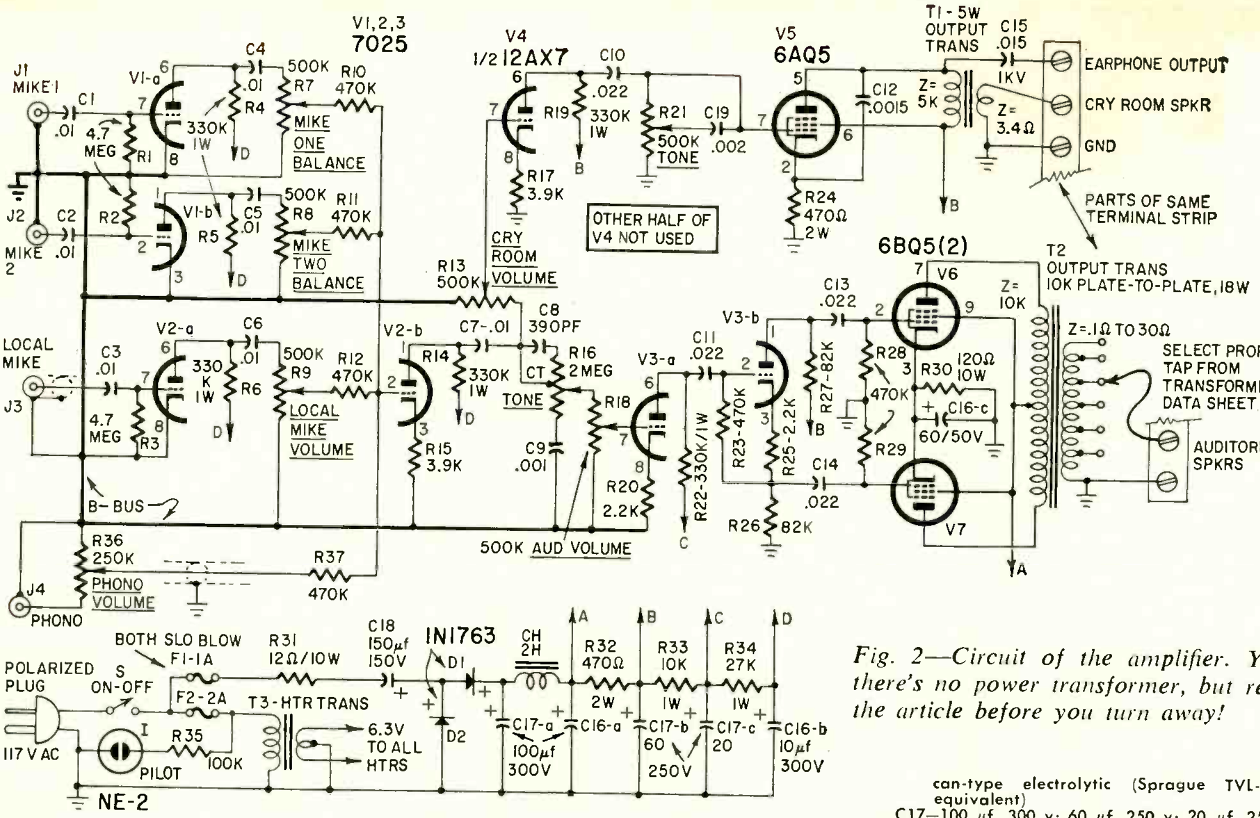


Fig. 2—Circuit of the amplifier. Yes, there's no power transformer, but read the article before you turn away!

R1, R2, R3—4.7 megohms
R4, R5, R6, R14, R19, R22—330,000 ohms, 1 watt
R7, R8, R9, R13, R18, R21—pot, 500,000 ohms, audio taper
R10, R11, R12, R23, R28, R29, R37—470,000 ohms
R15, R17—3,900 ohms
R16—pot, 2 megohms, center-tapped, linear or audio taper
R20, R25—2,200 ohms
R24, R32—470 ohms, 2 watts
R26, R27—82,000 ohms
R30—120 ohms, 10 watt, wirewound
R31—12 ohms, 10 watt, wirewound
R33—10,000 ohms, 1 watt
R34—27,000 ohms, 1 watt
R35—100,000 ohms
R36—pot, 250,000 ohms, audio taper
All resistors ½ watt, 10% unless otherwise noted
C1, C2, C3, C4, C5, C6, C7—.01 μf
C8—390 pf
C9—.001 μf
C10, C11, C13, C14—.022 μf
C12—.0015 μf
C15—.015 μf, 1,000 volts
C16—100 μf, 300 v; 10 μf, 300 v and 60 μf, 50 v can-type electrolytic (Sprague TVL-3574 or equivalent)
C17—100 μf, 300 v; 60 μf, 250 v; 20 μf, 250 v can-type electrolytic (Mallory FP335 or equivalent)
C18—150 μf, 150v tubular electrolytic (Sprague TVA-1422 or equivalent)
C19—.002 μf
CH—2-henry, 200-ma filter choke (Thordarson 26C43 or equivalent)
D1, D2—1N1763 (RCA)
F1—1-amp slow-blow fuse
F2—2-amp slow-blow fuse
I—NE-2
J1, J2, J3, J4—phono jacks
S—spst toggle switch
T1—Output transformer, 5,000 ohms to 3.4-ohm voice coil, 5 watts (Thordarson 24S51 or equivalent)
T2—Output transformer, universal, 18 watts (Thordarson 26S46 or equivalent)
T3—Filament transformer, 6.3 vct, 3 amperes
V1, V2, V3—7025
V4—12AX7
V5—6AQ5
V6, V7—6BQ5
Chassis, 10 x 5 x 3 inches
Polarized ac line plug
Tube sockets and miscellaneous hardware.

attempts at long-loop voltage feedback are doomed—they can actually make an amplifier less listenable. For the occasional amplifier builder, we feel that simple current feedback is the best approach. This amplifier *sounds* good, and that, after all, is the final test.

The auditorium amplifier uses a universal output transformer to simplify matching to various speaker loads.

The nursery-earphone amplifier uses a single 6AQ5 with a receiver type output transformer. Its "listenability" is excellent. High-impedance earphones and lorgnettes are fed through a capacitor from the 6AQ5 plate. This channel normally runs "wide open", since the phones and cry-room speaker have individual volume controls.

Grid leak bias is used for the mike preamps. It's simple and inexpensive, and reduces heater-cathode leakage hum.

The power supply is a fuse-protected half-wave voltage doubler. The two 500-ma silicon rectifiers are very cheap and run cool.

A center-tapped filament transformer supplies heater voltage. It, too, is fused. If a center-tapped transformer is unavailable, use an untapped one and connect a 200-ohm pot across the secondary, grounding the arm to some convenient point. Adjust the pot for minimum hum.

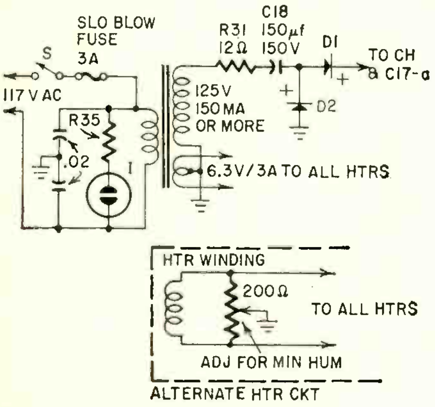
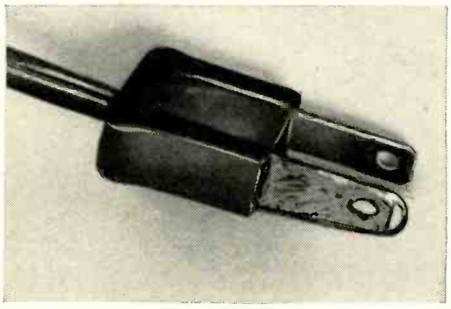


Fig. 3—Alternate power supply for a portable, or wherever a completely enclosed installation is not convenient.

Construction

Because of the amplifier's peculiar shape (it's only 4 inches deep), a few special techniques are very helpful in building it efficiently. Since all the parts are mounted around what would normally be the sides, or skirts, of the chassis, laying the chassis top-side down as usual would make wiring very inconvenient. We drilled two holes in what would normally be the top surface of the chassis, and mounted the chassis with that surface flat against the front apron of the bench, using one woodscrew through each hole. The parts along the lower side of the chassis were now at hip height and could be wired easily. To get at the other sides, remove one



Handy trick for making polarized plug—solder paperclip over one prong. That prong goes to ground side of line. This plug fits modern wall receptacle. You can buy polarized plugs from most big electrical supply houses.

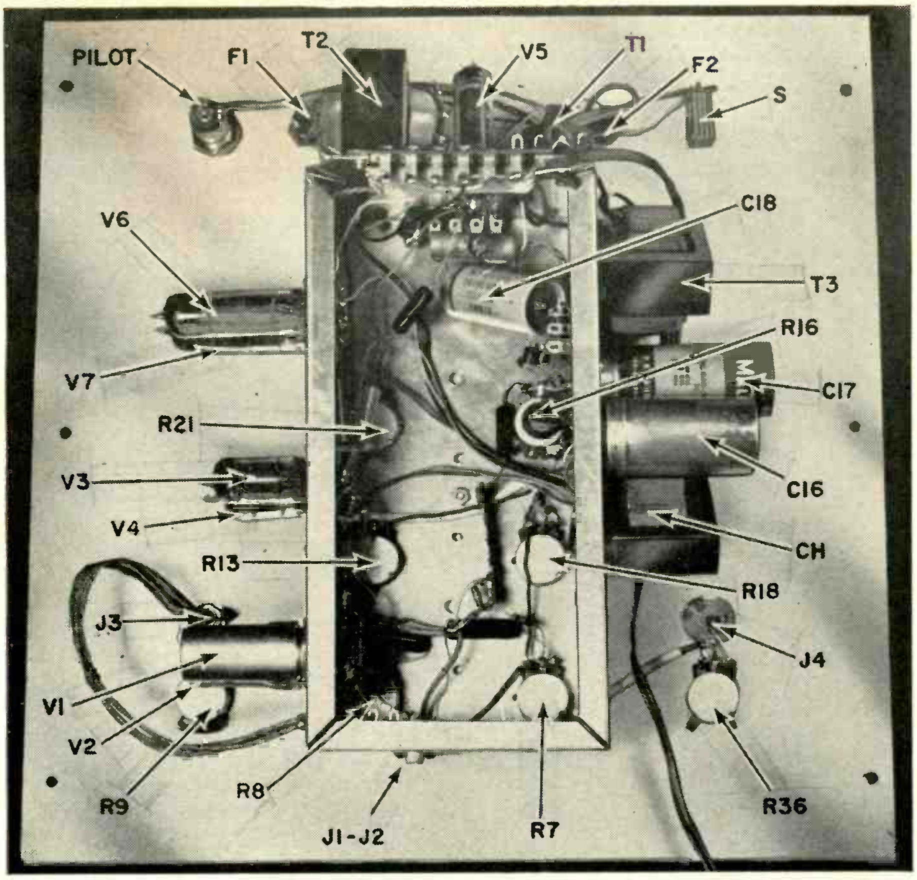
woodscrew and rotate the chassis around the other one. The two holes will not be seen in the finished unit.

It's wise to adopt a few tricks that will keep hum to a minimum. First, make all ground connections to a heavy bus bar (No. 8 copper or heavier) grounded to the chassis *only* at the input jacks. Exception: make power supply grounds to a common point on the chassis, but *not* through the bus bar.

Twist heater leads together tightly. If a single heater lead must run for several inches near any low-level stage, wrap a coil of light hookup wire around it as a shield and ground at one end.

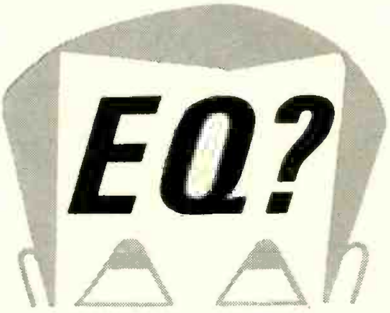
The panel is 14 x 16 inches, which was the space between two adjacent wall studs where it was to be installed. The edges of the panel overlap the studs slightly, so that they can be fastened against the studs with woodscrews. Chassis and panel are held together by the nuts on the control bushings.

The amplifier is really very easy to build, and its design allows changes to fit a different situation. As shown here, its volume is more than enough for a congregation of 500 (using the speaker installation shown in the head photo), and drowns out half a dozen squalling babies in the cry room! END



Rear view. Connections to jacks and terminal strips permit removal for servicing.

WHAT'S YOUR EQ?



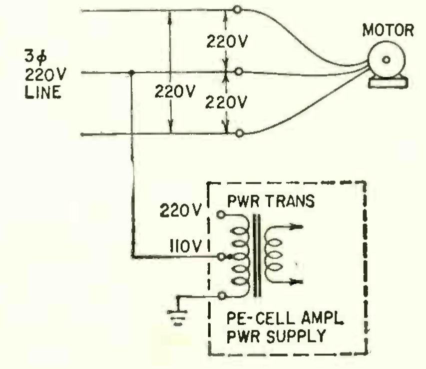
Three puzzlers for the student, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer!) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.

Answers to this month's puzzles are on page 72.

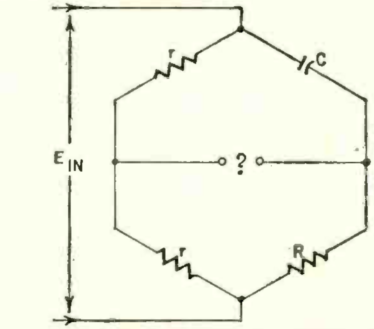
Power Supply Puzzler

The photocell controller for a factory conveyor refused to work after reinstallation in a new spot. It was supposed to stop the conveyor motor when a box broke the beam. A 3-phase 220-volt line supplied power to the motor. The power transformer of the photocell relay control amplifier, a standard 110–220-volt tapped transformer, was connected between the center leg of the 220-volt line and ground. The transformer overheated and resistors burned up. When the tap was moved to 220 volts, the amplifier still refused to work.



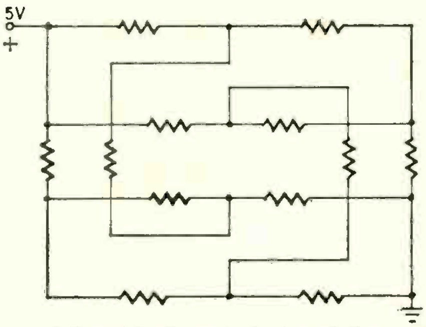
The complete system was taken to the shop. There, it worked perfectly on both 110- and 220-volt supply, yet it refused to work on the machine. What's the matter? Possible hint for solution: "Industrial Electrician" employed by local factory was kid who acutally didn't know what three-phase current is. Argued for three days, despite actual demonstrations on nearby power supply. He got the motor to work by following wire colors, but couldn't get the photocell amplifier to work at all.—*J. J. Darr*

Output Voltage

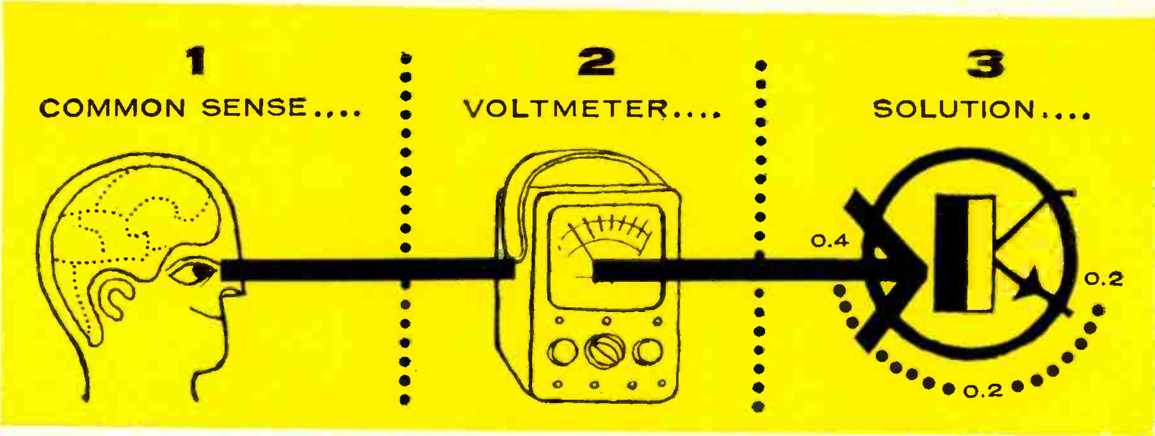


What is the output voltage across the bridge? Can you prove it mathematically?—*Cameron McCulloch*

Double Grid



All resistors are equal and the total current is 1 ampere. What is the value of each resistor?—*Kendall Collins*



Test transistors IN-CIRCUIT

Nothing to build, no special equipment —just a voltmeter and common sense!

by **GLEN McKINNEY**

ONE OF THE MOST TIME-CONSUMING jobs in transistor radio servicing is trying to find a bad transistor. It takes time to unsolder the transistor; it can be damaged by heat or accidental breaking of a lead, and putting it back in the circuit takes more time.

Many transistor checkers can determine the condition of a transistor out of circuit; a few can test it while still hooked up. However, there are ways to check a transistor in the circuit without a tester of any kind.

How to go about it

The two most common failures are opens and shorts. A reliable method for checking an open transistor is to measure the voltage drops across resistors connected to the different elements. Refer to Fig. 1, and let's see how to check for an open transistor.

If we disconnect R1, the only current through R2 will be the emitter–base current of the transistor. If the *base* is open, no current at all will flow through R2. Measured from ground with a vtvm, its voltage will be the same at both ends. Should the *emitter* open, conduction would cease completely, and no voltage drops would be measured across R2, R3 or R4. If the *collector* opens, there will be no drop across R4. There will, however, still be some drop across R2 and R3. If the collector is open, the drop across R2 will go up, and that across R3, down.

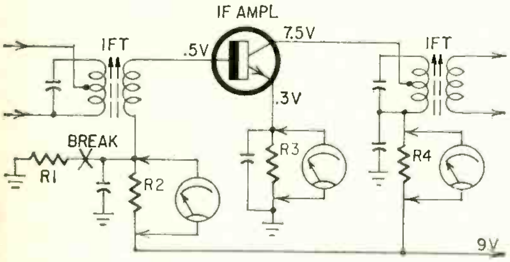


Fig. 1—A typical transistor i.f. stage. Once all passive components check good, voltages across R2, R3 and R4 can be used to diagnose transistor condition.

Shorted transistors

In an emitter-to-base short, no voltage will be developed across R4 in Fig. 1, because the forward bias is shorted out, reducing collector current to zero. In a short between emitter and collector, larger than normal voltage drops will be measured across R3 and R4, because of increased transistor conduction. The remaining short possibility is between collector and base. This trouble would be indicated by a radical decrease in voltage across R2 and an increase across R3 and R4. A voltage check on the collector and base (measured from ground) is a quick way to spot a collector–base short. Because of the high external resistance in the base circuit, this voltage will read about the same for the collector and base, depending on the degree of the internal short.

Gain

With one of the resistors in the collector or emitter circuit (R3 or R4), the transistor gain may be determined (qualitatively). First measure the voltage across this resistor (in this case, R4). Then short between emitter and base. The voltage across R4 should drop to zero, or very nearly so, because this removes the forward bias and no current flows in the collector circuit. If the voltage across R4 does not fall to practically zero, the transistor is defective. This is an indication of the transistor's ability to control current in the collector circuit. The more nearly the voltage across R4 approaches zero, with emitter shorted to base, the *better* the transistor. Bear in mind that, when we speak of voltage across the resistor, we mean the voltage measured from one end of the resistor to the other—not necessarily from ground to the ends of the resistor.

Another fairly accurate check for current gain is to measure the emitter voltage (the voltage across R3 in Fig.

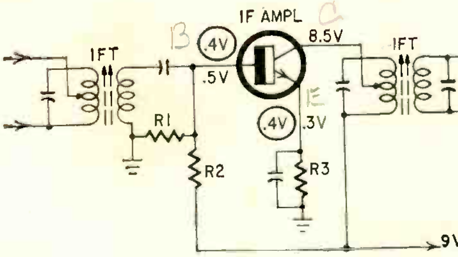


Fig. 2—Another representative circuit. Abnormal voltages are circled. With those voltages, transistor is unbiased and will not amplify. Often, juggling bias-resistor values will put the weak transistor back on the job.

1). Then parallel bias resistor R2 with one of the same size (which halves the resistance), and measure the emitter voltage again. If the transistor is good, the emitter voltage should about double, to read approximately 0.6 volt. The higher this emitter voltage rises (with the bias resistor halved), the *better* the transistor.

By paralleling R2 with a resistor of exactly the same size, the voltage on the base about doubles, causing the transistor to conduct more heavily. R3 now carries this additional current and shows a larger voltage drop—in this case 0.6 volt instead of the normal 0.3 volt.

Other methods

Signal tracing or signal substitution may be useful in isolating a bad transistor. Inject an appropriate signal first at the collector, then at the base, working from the output stage back. Each good transistor should exhibit gain when a signal is applied to the collector and then to the base. A stage that does not contribute gain indicates a defective transistor. Of course this applies only when all other parts check good.

Another method we have used in the audio section with a great deal of success is to use a voltmeter on the ac scale. If the radio is weak in the output section and you wish to check the audio stages for gain, simply switch the voltmeter to a low ac range and tune the receiver to a strong local station. Hook the common lead of the meter to ground, then clip the hot lead to the collector of the output transistor, and note the meter swing with modulation. Carefully observe the peaks. Then move the test lead to the base of the output transistor, and again note the peak amplitude. There should be a decided decrease in the meter reading if the transistor is good.

The driver and first audio transistors may be checked in the same manner if the ac voltmeter is sensitive enough. Use a .05-μf capacitor in the hot lead of the ac meter as a precaution against disturbing transistor bias while making these measurements. A more reliable check is to use a modulated signal generator, since the readings will be constant rather than fluctuating. But with a bit of experience the station signal can be used to good advantage.

A kind of cure

Another practical situation occurs frequently in actual transistor radio servicing. Let's take a typical transistor amplifier stage (Fig. 2). Bear in mind that this example holds true whether we are dealing with rf, i.f. or audio transistor circuitry.

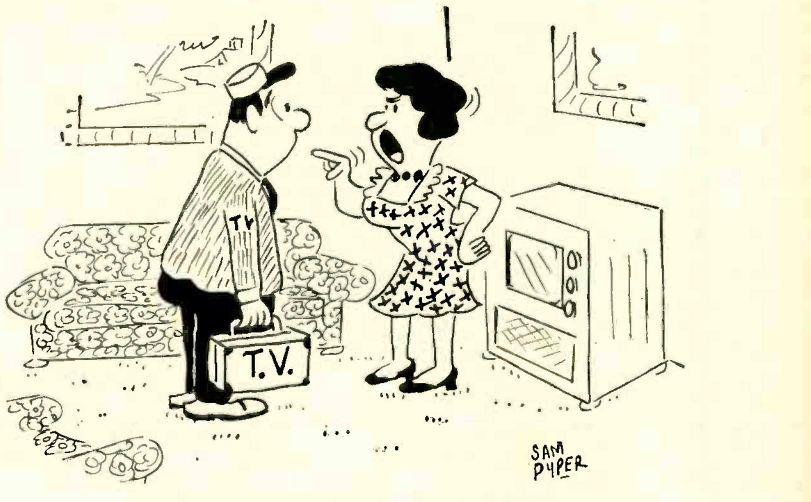
In Fig. 2, we have a transistor circuit with the correct voltage: emitter 0.3, base 0.5 and collector 8.5 volts. With this voltage relationship, the transistor is properly biased, and will amplify. Suppose that for some reason the voltages measure as indicated by the circled voltages, or perhaps the base might read even slightly less than the emitter. This circuit might still pass a signal, but only by "brute force"—the stage could not amplify under these conditions. After you've checked R1, R2 and R3, and found them OK, the situation begins to become a bit baffling. Why are the voltages incorrect if the resistors are OK and the supply voltage is normal? You might begin to suspect the transistor, but the voltage discrepancy is so slight that you can't be sure, and you might again start looking for circuit troubles. There are two checks you can make to verify the transistor's condition.

First, transistors tend to shift their characteristics before they become completely shorted. In cases like the one in Fig. 2, this is probably what has happened. By lowering the value of R3 we can pull the emitter voltage back down to its normal value of 0.3 volt, leaving the base with a slightly higher potential than the emitter and giving the transistor its forward bias again.

Second, by paralleling R2 with another resistor we could bring the base voltage *up* sufficiently to restore forward biasing and put the transistor back in operation. When dealing with good transistors, these two resistors (R2 and R3) have a decided effect on base and emitter voltages, and establish the operating point of the transistor.

Now let's see what will happen if the transistor has developed enough of a short to impair its operation. If we bridge R2 and R3, we will not get the voltage difference of 0.2 volt between emitter and base. Rather, when we lower R3 to reduce the emitter voltage, the base voltage also falls and will stay about the same as the emitter. Or if we parallel R2 with another resistor to raise the base voltage above the emitter, we find that the emitter will also rise, maintaining about the same ratio as we started out with. If you cannot reach the correct emitter–base voltage by these two operations, the transistor must be replaced.

However, if the transistor's characteristics have changed only slightly, we may be able to restore the necessary forward bias to put the transistor back in operation again, even though the base–emitter voltages may not be exactly what they were originally. If we can get, say, 0.4 volt on the base and 0.2 on the emitter, or 0.6 on the base and 0.4 volt on the emitter, the transistor might operate again. We have found many cases like this where normal operation was restored without replacing the transistor. A new transistor should be installed when possible, but this is a helpful hint when no replacement is on hand, or for a foreign make for which there is no American equivalent. END



"And fix it right this time! I don't want to be calling you back in 5 or 6 years!"

Conclusion: FM troubleshooting and alignment

By PHILIP R. POWELL*

SERVICING 1963 DELCO AM-FM AUTO RADIOS

LAST MONTH WE GOT ACQUAINTED WITH the circuitry of the Delco AM-FM set and learned some general troubleshooting techniques, which we applied in checking out the AM and portions of the radio common to AM and FM.

AM troubleshooting checks out most of the stages. If the FM section of the radio does not function but AM does, the ratio detector, fourth i.f., converter and rf stages for FM are likely suspects. (The first, second and third i.f. stages also work on AM. If there is an FM defect in one of these stages, it will probably be in a defective i.f. coil, located later during alignment.)

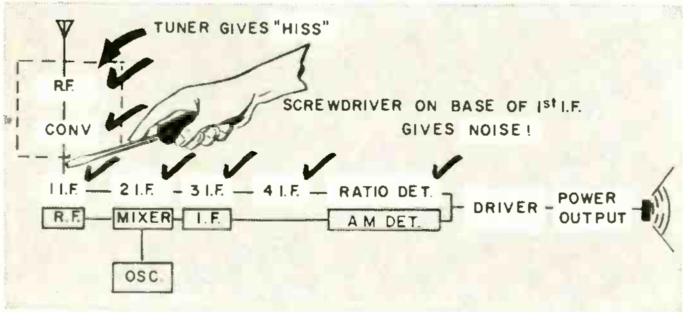


Fig. 1 — Most of the possibilities have been eliminated in AM checks. Screwdriver test pinpoints FM trouble.

The FM front end is largely responsible for the loud hiss in the speaker. If the front end is dead, the four i.f. stages will produce a weak hiss in the speaker. Noise level should increase when the blade of a screwdriver touches the base of the first FM i.f. transistor (Fig. 1). Place your finger on the blade when making this check.

If there is no noise or the screwdriver has no effect, the ratio detector or fourth i.f. should be suspected.

Ratio detector and i. f.

With a dc voltmeter connected as shown in Fig. 2, reading should be zero volts, with no station. This zero reading indicates that the ratio detector is balanced and will not distort the audio. If an unbalance shows (either positive or negative) distortion will result.

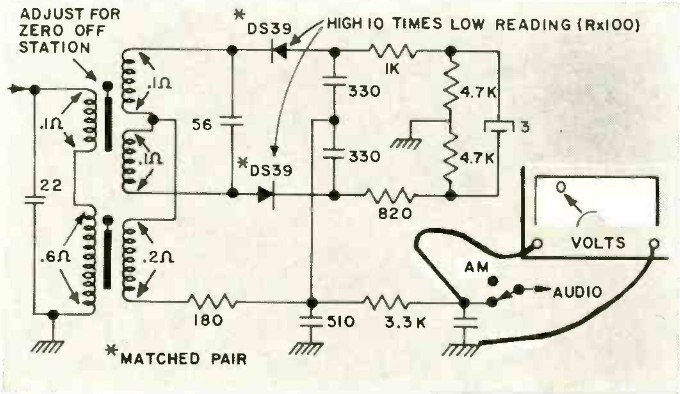


Fig. 2 — Balanced ratio detector will show zero volts dc on audio line with no station tuned in.

Adjust the blue slug on the ratio transformer for a zero reading, with no input signal. (Noise must be present for this adjustment.) Failure to obtain zero indicates an unbalance in the circuit. Check the ratio transformer windings with an ohmmeter to determine if they are at fault. The matched-pair diodes should also be checked (on the R × 100 scale of an ohmmeter). The high reading should be at least 10 times the low reading, and the low reading should be under 500 ohms.

The fourth FM i.f. stage is checked the same way as AM: conduction, bias, diodes (Fig. 3).

Normal conduction for this stage is shown by 1.2 volts across the emitter resistor, with a forward bias of 0.2 volt.

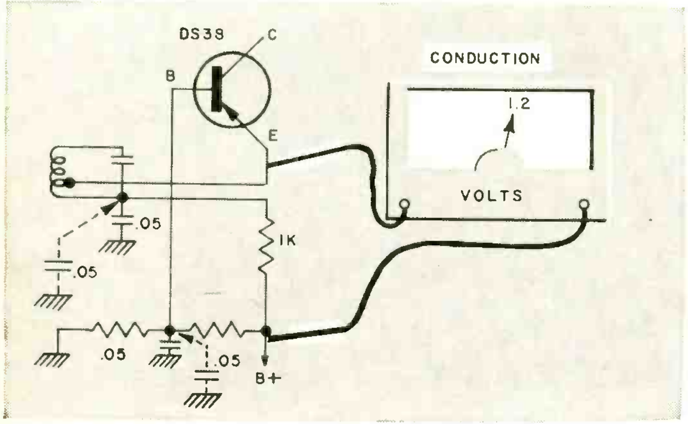


Fig. 3—FM fourth i.f. check follows AM procedure.

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*Delco Radio Div., General Motors Corp., Kokomo, Ind.

The in-circuit diode readings produce a high reading five times the low reading. The low reading should be under 500 ohms on the R × 100 range of most meters.

The two .05-μf capacitors can be checked by bridging them with good ones.

FM front end

Check the "Z+" voltage first (Fig. 4). (It does not have to be exactly 7.5 volts.) The purpose of the Zener diode is to regulate the voltage. If the voltage reading obtained is within 10%, and it does not vary more than 0.1 volt with an input change of 11 to 15 volts, the Z+ system is functioning properly.

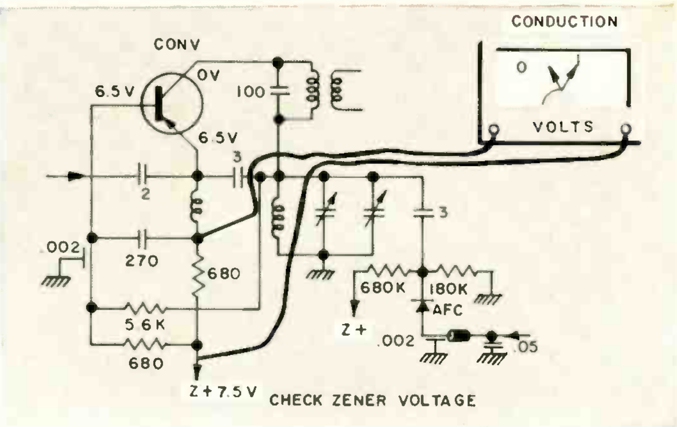


Fig. 4—Checks on FM front end ("tuner") include Zener voltage, bias and diodes.

The normal conduction reading for this stage is 1 volt. This reading drops slightly as the oscillator is tuned. This change in conduction is a good test for oscillation. The positive probe is placed on Z+, and the negative probe goes to the emitter or the top of the 680-ohm resistor. (The top of the 680-ohm resistor is physically more convenient to reach.)

Note that the base and emitter voltages indicate no bias on this stage. This is true at one spot on the dial, but as frequency varies, bias will appear. A shift in the bias voltage also proves that the stage is oscillating.

Since this transistor is in a socket, it can be removed and checked. The afc diode can be checked with an ohmmeter in the circuit. A low reading under 1,000 ohms and a high reading of approximately 100,000 ohms is normal.

The conduction reading for the rf stage should be 0.5 volt (Fig. 5). The negative meter lead is placed on the emitter and the positive lead on the Z+ line. The bias is 0.2 volt, and the transistor can be checked out of the circuit by unplugging it.

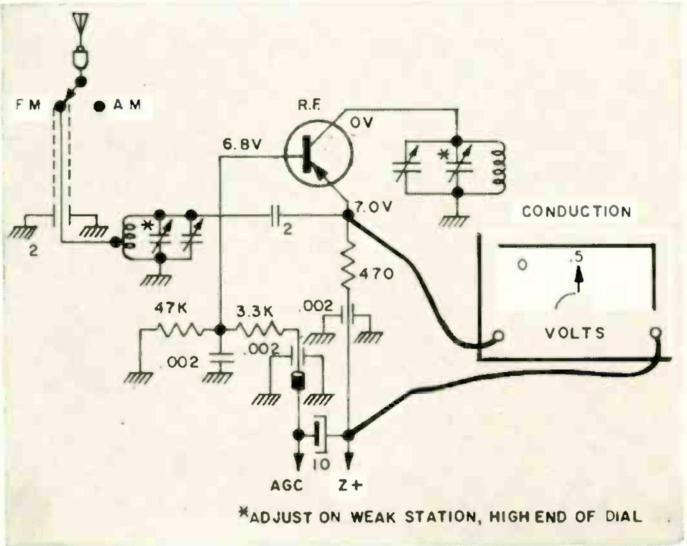


Fig. 5—FM rf stage checks. Again, emitter resistor drop indicates current flow.

Since conduction of this stage depends on the FM agc circuit, check the agc diodes with an ohmmeter if the transistor is conducting too heavily.

Avoid FM tuner adjustments unless you definitely suspect the tuner has been tampered with. These adjustments are very critical.

FM alignment

To align the FM i.f. stages:

1. Connect a dc voltmeter as shown (Fig. 6) to orange wire on the AM-FM bandswitch.

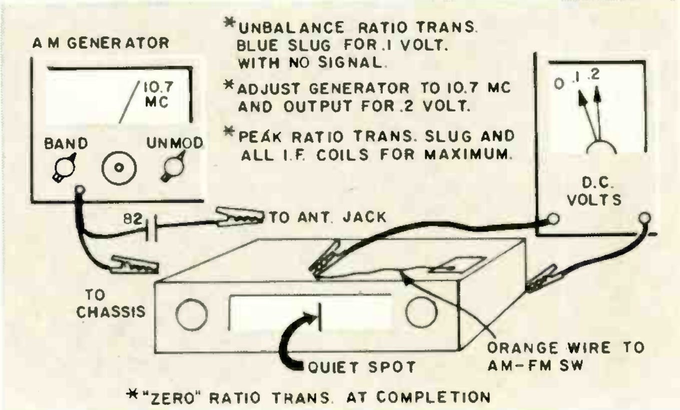


Fig. 6—Alignment is extremely simple and needs no special equipment.

2. With the antenna unplugged, turn the blue slug in the radio detector transformer to obtain 0.1 volt.

3. Connect a 10.7-mc unmodulated generator to the antenna jack through the 82-pf capacitor. (If any squeals are heard, tune the radio to a quiet spot.)

4. Adjust the generator output to obtain 0.2 volt on the meter.

5. Adjust the pink slug in the ratio detector transformer and all FM i.f. coils to maximum (use a plastic alignment tool).

6. Turn off the generator and trim the blue slug in the ratio detector transformer for zero meter reading again.

Summary

Important points to remember when troubleshooting the Delco AM-FM set are:

Listen on both bands. If trouble affects both AM *and* FM reception, troubleshoot on AM. If FM only is bad, check the ratio detector, fourth i.f. and FM front end.

Look the set and circuit board over carefully for obvious defects. Isolate stages by "thump" testing (DS-501) and with a noise generator on AM.

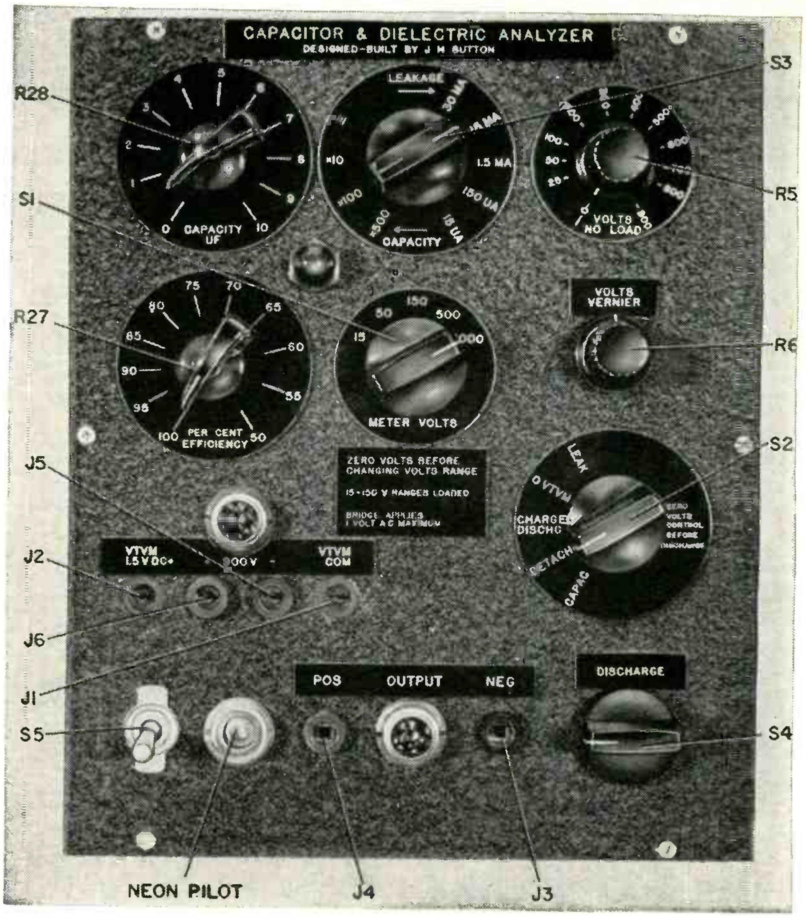
Check conduction, bias and diodes (in that order) in suspected stage or stages.

If all voltages are normal, *check capacitors and tuned circuits.* END

CAPACITOR and DIELECTRIC ANALYZER

Build a useful addition to your shelf of test equipment

By JOSEPH H. SUTTON



The analyzer panel. The LEAKAGE *pilot is at the bottom center,* TEST *pilot is just above J5 and J6 and the* CAPACITY *pilot is centered below S3 and R28.*

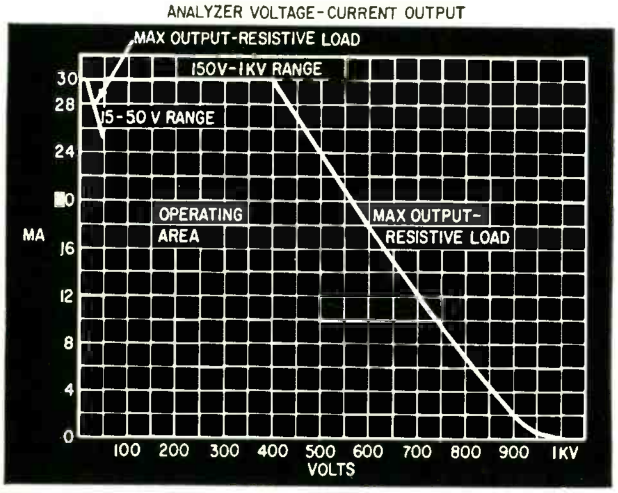


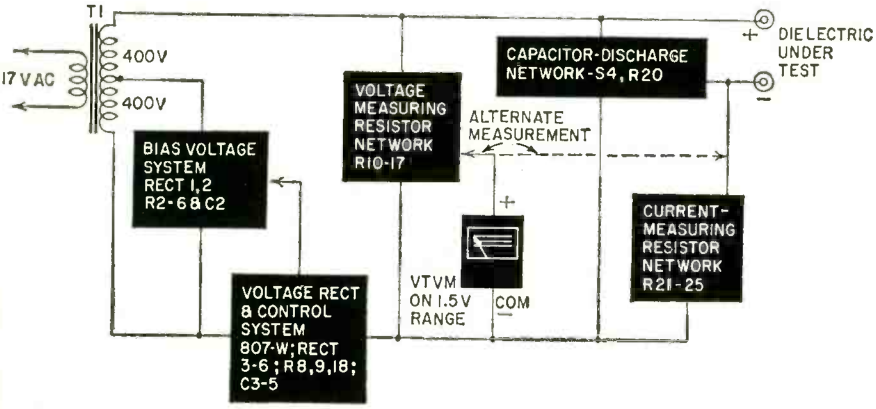
Fig. 1—Graph shows the voltage-current curve for the analyzer. It shows what is applied to the item being tested.

Fig. 2—Block diagram of the analyzer.

This instrument measures dielectric leakage through capacitors, switches, sockets, rectifiers, diodes, etc. Leakage range is from 0.2 μa to 30 ma at voltages from 1 to almost 1,000 (Fig. 1). Capacitance and efficiency of electrolytics are measured on a 1-volt ac bridge, thus permitting an undamaging test of electrolytics rated 6 volts dc or higher.

The circuits for leakage and for capacitance are not electrically connected, so you can build either circuit as a separate unit. Fig. 2 is a block diagram of the leakage tester, Fig. 3 a simplified schematic of the bridge.

Since dielectrics can short during test, both the power supply and the leakage milli- and microammeter will absorb a full short without damage. For the meter you will use your vtvm. Do-



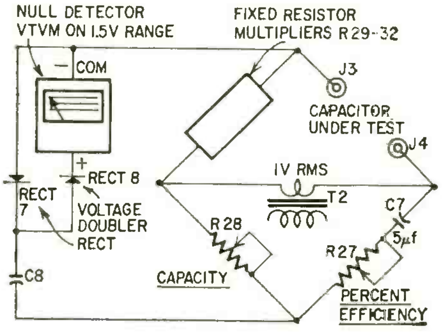


Fig. 3—Basic diagram of the capacitance bridge.

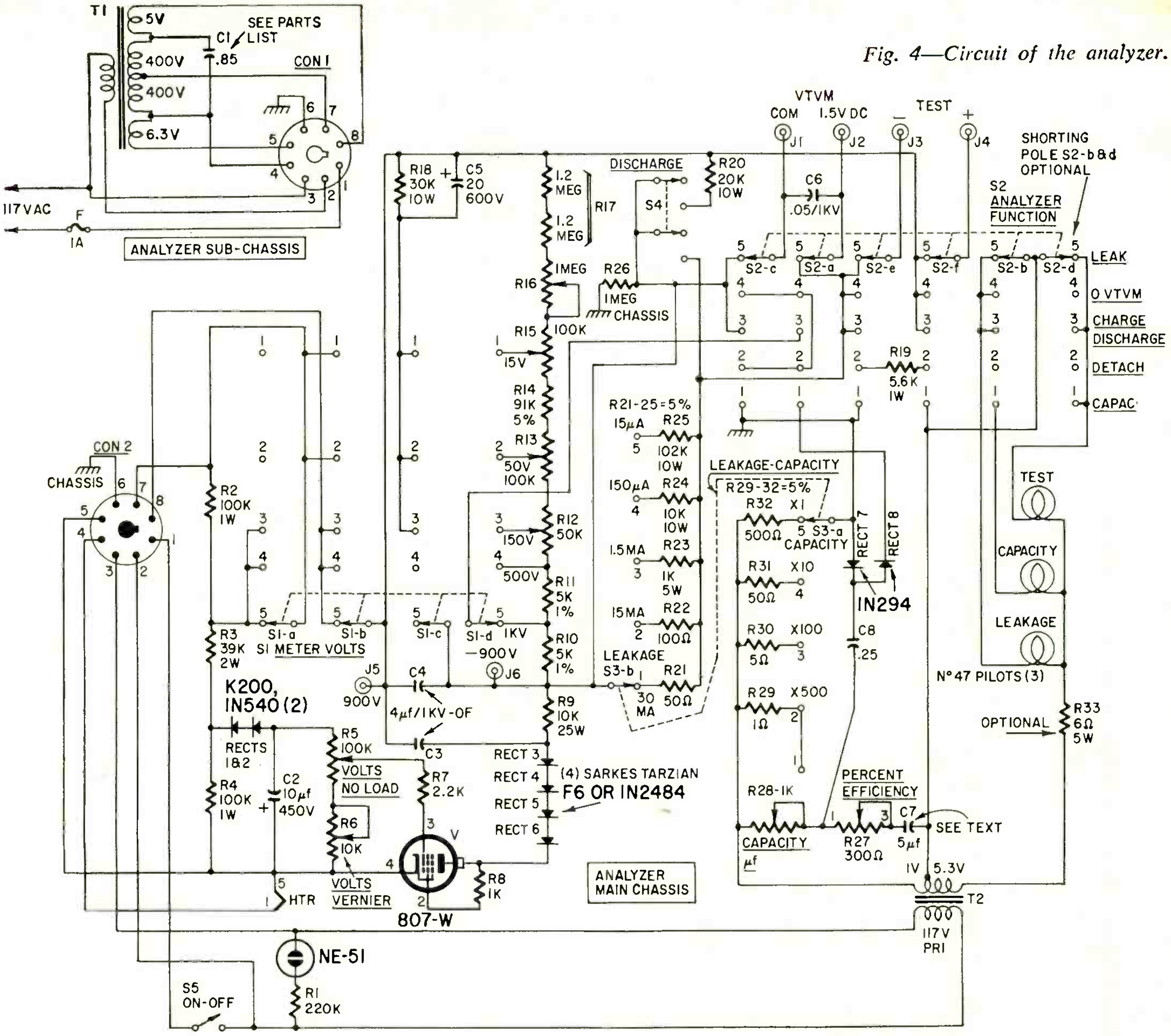


Fig. 4—Circuit of the analyzer.

ing so minimizes cost, simplifies construction and speeds use of the analyzer (if your vtvm is already warm on the bench).

Want to build one?

Parts layout is not critical. The bridge (Fig. 3) exhibits no residual capacitance. The chassis is separated from the high-voltage supply by 1 megohm (R26) to prevent shock (Fig. 4). Some newer vtvm's include this protection too, but if your vtvm's common jack is connected to chassis, the vtvm must not touch the analyzer chassis.

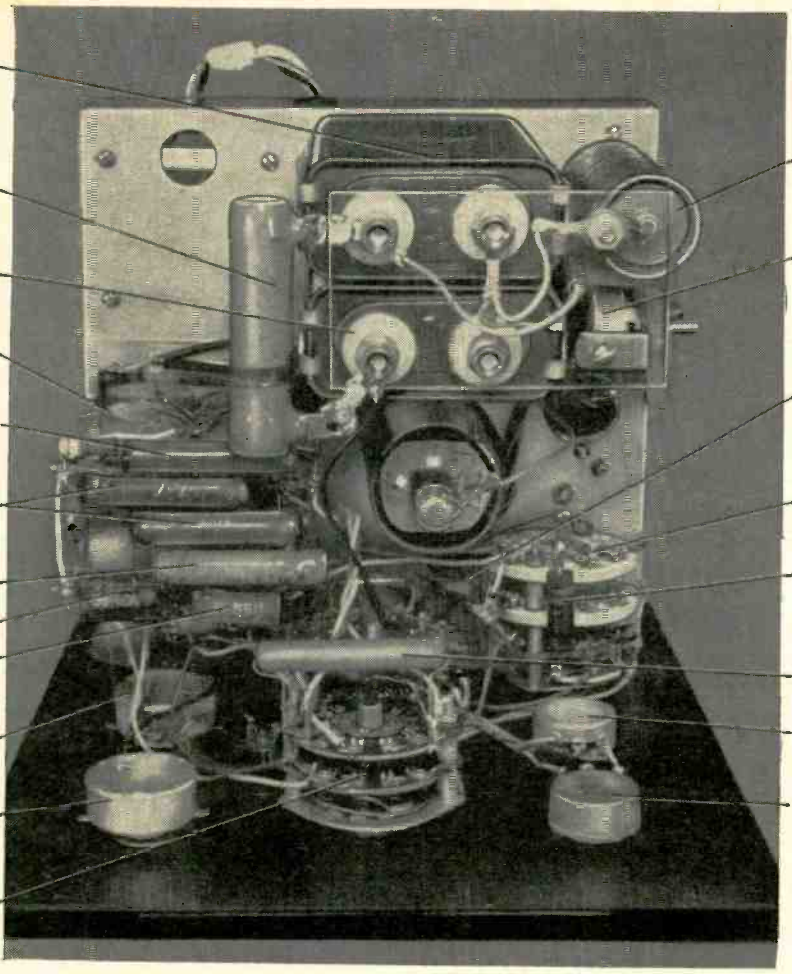
The FUNCTION switch (S2) is assembled from wafer and index components, as specified in the parts list.

High-voltage components are mounted under the main chassis on terminal strips raised from the chassis floor by ceramic cones. This adds insulation and frees the chassis floor for mounting other parts.

Attach potentiometers R5 and R6 to the panel through fiber shoulder washers for added insulation. Jacks must have zero leakage at 1,000 volts (see parts list).

A subchassis holds constant-voltage transformer T1. Connection to the

R1—220,000 ohms
R2, R4—100,000 ohms, 1 watt
R3—39,000 ohms, 2 watts
R5, R13, R15—pot, 100,000 ohms, carbon
R6—pot, 10,000 ohms, carbon
R7—2,200 ohms
R8—1,000 ohms
R9—10,000 ohms, 25 watts, wirewound
R10, R11—5,000 ohms, 1%
R12—pot, 50,000 ohms, carbon
R14—91,000 ohms, 5%
R16—pot, 1 megohm, carbon
R17—2.4 megohms (two 1.2-megohm resistors in series)
R18—30,000 ohms, 10 watts, wirewound
R19—5,600 ohms, 1 watt
R20—20,000 ohms, 10 watts, wirewound
R21—51 ohms, 5% (selected 51-ohm res.)
R22—100 ohms, 5%
R23—1,000 ohms, 5 watts, 5%, wirewound
R24—10,000 ohms, 10 watts, 5%, wirewound
R25—100,000 ohms, 10 watts, 5%, wirewound
R26—1 megohm
R27—pot, 300 ohms 5%, wirewound (Centralab WW301 or equivalent)
R28—pot, 1,000 ohms, 5%, wirewound (Centralab WW102 or equivalent)
R29—1 ohm, 1 watt, 5%
R30—5.1 ohms, 5%
R31—50 ohms, 5% (selected 51-ohm res.)
R32—510 ohms, 5%
R33—6 ohms, 5 watts, wirewound (optional)
All resistors ½-watt 10% unless noted
C1—0.85 μf (furnished with T1, Sola 7106)
C2—10 μf, 450 volts, electrolytic
C3, C4—4 μf, 1,000 volts, oil-filled
C5—20 μf, 600 volts, electrolytic
C6—.05 μf, 1,000 volts
C7—5 μf (see text)
C8—0.25 μf, 100 volts
F—1 amp
RECT 1, RECT 2—silicon rectifiers, 260 volts, 200 ma (Sarkes Tarzian K-200, IN540 or equivalent)
RECT 3, RECT 4, RECT 5, RECT 6—silicon rectifiers, 600 piv, 750 ma (1N2484, Sarkes Tarzian F6 or equivalent)
RECT 7, RECT 8— IN294
S1—4-pole 5-position nonshorting rotary (Centralab PA-1013 or equivalent)
S2—6-pole 5-position rotary made up of one Centralab PA-4 wafer, one Centralab PA-5 wafer, one Centralab PA-300 index
S3—2-pole 5-position shorting rotary (Centralab PA-1002 or equivalent)
S4—2-pole 2-position spring-return switch (Centralab 1464 or equivalent)
S5—spst toggle
T1—constant-voltage transformer (Sola 7106 or equivalent)
T2—6.3-volt unshielded filament transformer, 750 ma or more (modified, see text)
V—807-W
J1, J2, J5, J6—jacks, zero leakage at 1000 volts (Amphenol sockets 78-1P or equal)
J3, J4—jacks, zero leakage at 1,000 volts (Amphenol sockets 78-1M or equal)
Panel-lamp sockets (4)
NE-51 neon lamp (1)
No. 47 lamps (3)
Cabinet—10 x 8 x 7 inches
Chassis—7 x 7 x 2 inches
Chassis—4 x 6 x 2 inches
Miscellaneous hardware



(Above) Parts layout inside the case. (Below) Under the chassis. Note how many of the smaller components are mounted on terminal strips.

main chassis is through an octal socket, plug and a cable made from No. 24 stranded hookup wire in assorted colors. (Photo shows 11-pin socket, but octal will be sufficient.)

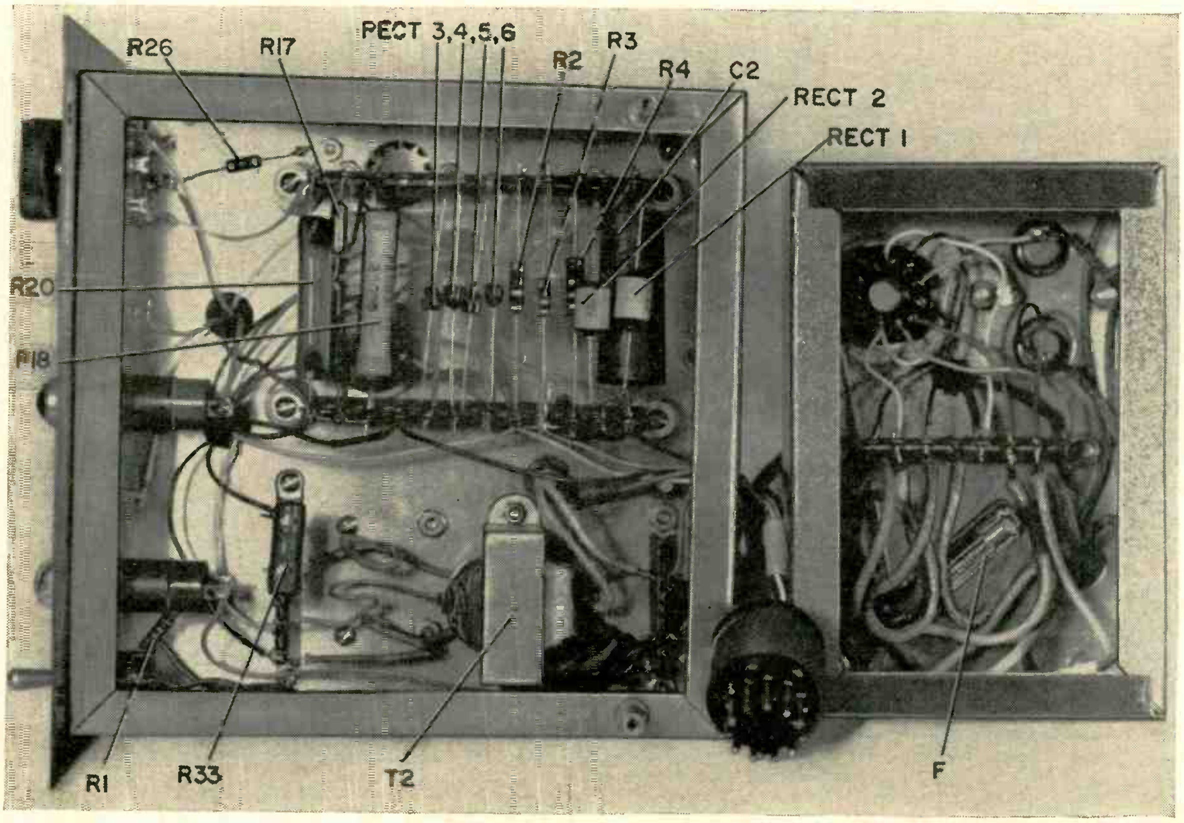
The full brunt of high-voltage rectification falls on the series silicon diodes (RECT 3 through RECT 6), while the tube (an 807) is for voltage control only. This control is smooth at all outputs, down to and including 1 volt.

For all tests, set your vtvm to its 1.5-volt dc range. The voltage-dividing resistors R10 to R17 are calculated for an 11-megohm input vtvm. To simplify voltage calibration, carbon pots are used for R12, R13, R15 and R16. First adjust R16 for the 1,000- and 500-volt ranges. Then adjust the remaining pots in any order.

Convenience extras

The vtvm prods (⅜-inch diameter) fit into sockets recessed so that only about 1 inch of prod protrudes from the panel. With this design, prods mate with the sockets "hole-in-one" fashion every time; no fumbling. The socket guides are polystyrene tubing ⅝ inch OD, ½ inch ID, 3¼ inches long. Sockets (Amphenol 78-1P) are ½ inch OD and fit snugly into the tubing. Of course, if your vtvm probe is a combination dc–ac type, or heavier than normal, you will have to modify the design.

Extra tip jacks across the high-voltage supply let you observe voltage and leakage simultaneously. Read volts on your vom's 1,000-volt range. (Photo shows 900-volt limit on these jacks.



This limit is in error due to circuit design change.)

The suggested main chassis will protrude from the back of the suggested cabinet about ⅛ inch. Correct for this by cementing strips of ⅛ inch pressed wood to the back cover. Then fasten the back cover to chassis with self-tapping screws, providing added chassis support.

Panel markings are machine-engraved on 1/16-inch "insulating" bakelite. You can do as well with decals.

Check leakage

1. Set METER switch (S1) correctly.

2. Set LEAKAGE switch (S3) to 30 ma.

3. Set VOLTS control (R5) to zero.

4. Set FUNCTION switch (S2) to DETACH.

5. Connect TEST terminals J3 (negative) and J4 (positive) to capacitor or other dielectric under test.

6. Turn FUNCTION switch (S2) to CHARGE–DISCHARGE.

7. Adjust VOLTS controls (R5, R6), observing voltage on vtvm.

8. Turn FUNCTION switch (S2) to LEAKAGE position.

9. Turn LEAKAGE switch (S3) so vtvm reads upscale as desired.

10. Return FUNCTION switch (S2) to CHARGE–DISCHARGE position. Repeat steps **7** to **10** as desired. (NOTE: the 0 VTVM position is only for convenient check of vtvm zero set.)

11. Return VOLTS control (R5) to zero.

12. Depress DISCHARGE switch (S4) until vtvm reads 50 volts or less. *This discharge step is absolutely necessary to prevent burnup of* FUNCTION *switch.*

13. Turn FUNCTION switch (S2) to DETACH. At DETACH position, all panel lights are out except main pilot (NE-51).

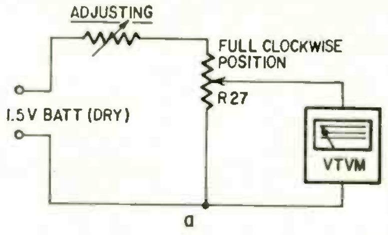
Circuit tolerance for capacitor (or other dielectric) leakage depends on the application. Some circuits cannot tolerate any leakage; others a lot.

Normally, dielectric leakage decreases with the length of voltage application. This decrease is dramatic in electrolytic capacitors (after the voltage has become steady), and is also noticed in large paper or plastic units.

Long-idle or little-used electrolytics may need re-forming for 10 minutes or more. After discharge and rest for a few minutes, if initial leakage is still high, reject the capacitor.

Intermittent capacitors tend to have a jerky leakage. Rising leakage is sure sign of incipient short. Under a short, the analyzer voltage will not rise appreciably from zero except on the 15-μa and 150-μa leakage ranges.

Semiconductor diode and rectifier leakage often decreases with increasing inverse voltage. A unit testing poor on the ohmmeter may be superior under rated or applied inverse voltage. Leakage ratings for most semi-conductors are given in manufacturer's manuals. Selenium rectifier leakage usually is not given, but should not be a large percentage of rated forward current.



Efficiency	vtvm voltage	Efficiency	vtvm voltage
50%	1.50	80%	0.53
55	1.31	85	0.39
60	1.14	90	0.26
65	0.97	95	0.13
70	0.82	100	0.00
75	0.67		

b

Fig. 5—Calibration circuit (a) and efficiency vs vtvm reading (b) for setting up R27.

Leakage from terminal to terminal of phenolic switches and sockets is usually appreciable. Steatite or ceramic units should show no leakage at the maximum voltage output of this analyzer.

Check capacitance

1. Set FUNCTION switch (S2) to DETACH.

2. Set CAPACITY switch (S3) to proper range.

3. Connect TEST terminals J3 (negative) and J4 (positive) to capacitor. Observe polarity here only as a matter of habit.

4. Turn FUNCTION switch (S2) to CAPAC.

5. Rotate CAPACITY pot (R28) and EFFICIENCY pot (R27) successively for null on vtvm. At null, read R28, R27 dials.

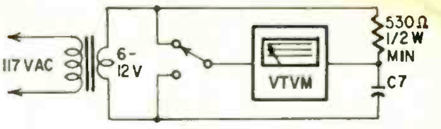


Fig. 6—Circuit for calibrating C7.

6. Return FUNCTION switch (S2) to DETACH.

Percent efficiency replaces the conventional term power factor. Efficiency emphasizes the capacitor's work rather than loss. The two terms are related as follows:

Efficiency (%) = 1 – loss (power factor) × 100. R27's dial is calibrated accordingly.

Calibrate the capacitance section

To calibrate R27 for percent efficiency use the Fig. 5-a circuit:

1. Set R27 fully clockwise.

2. Turn the adjusting pot (say 20 ohms) for 1.5 volts full scale on your vtvm.

3. Divide the voltage as per the data in Fig 5-b.

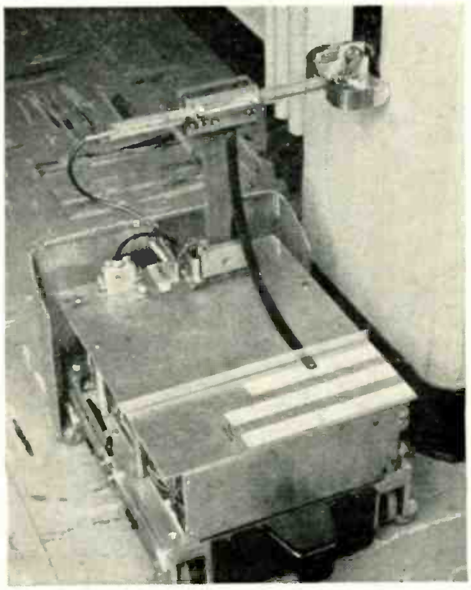
Use the same circuit, but a 50-ohm adjusting pot and your vtvm scale, to divide R28 (CAPACITY–μF) into 10 *equal* parts.

My standard capacitor (C7, 5μf) is built up from four 1-μf capacitors and one 0.25-μf unit. Your assemblage may be different. To get the correct assembly, set up an open switch bridge as in Fig. 6. Parallel capacitors until the vtvm indicates the same voltage across C7 as across the 530 ohms. This method is very accurate.

To tap the 6-volt transformer at 1 volt, needle-probe visible windings. Under the desired wire, slip a piece of fish or insulating paper and solder a tap.

Now put the unit to work. It will pay you handsome rent for its bench space. **END**

MOBILE AUTOMATON FEEDS ITSELF—with electricity. An attempt at making a neuronlike electrical network *do* something, the automaton navigates around the corridors of the Applied Physics Lab at Johns Hopkins University, where it was born. The network consists of about 60 identical *nor*-gates connected, much as in an animal nervous system, to provide a particular behavior pattern. The automaton manages to avoid obstacles, and, when its battery gets weak, it heads for the nearest wall outlet to recharge itself!



MORE TALK POWER FOR YOUR CB RIG

Higher average modulation means greater range—legally

By ROBERT F. SCOTT
Technical Editor

DO YOU WANT YOUR CB TRANSCEIVER TO be more effective for contacts with the mobile units in the dead spots and fringes of your service area? If so, one of the accessory speech clippers or compressors is for you.

For a given rf carrier level, the readability of a radiotelephone signal depends on the average percentage of modulation. When it is low, readability drops off much more rapidly with distance than when it is high.

Take a look at the speech waveform in Fig. 1-a. The scale on the left represents modulation percentage, and the one on the right is voltage input to a given stage in a speech amplifier. You'll see that when a transmitter is adjusted for 100% modulation on the occasional loud sound or syllable, the average modulation produced by the weaker sounds is around 25%. It may seem obvious that all you have to do to increase the average percentage of modulation is to turn up the audio gain, use a mike with higher output or talk louder.

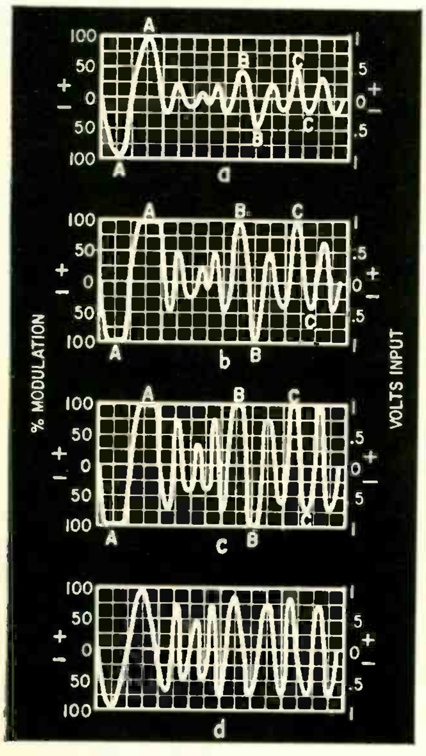


Fig. 1—What clipping and compression do to speech waveform. a—Highest peak determines maximum level, causing all lower peaks to modulate well under 100%. Full transmitter power isn't being used. b—Clipping sharply at 1-volt level allows doubling amplitude of rest of signal without overmodulation. c—Tripling original amplitude (in 1-a) still won't overmodulate, but weaker sounds modulate fully or nearly so. Transmitter power is being utilized more effectively. d — Compressed, rather than clipped, wave. Note absence of "sharp-edged," highly distorted peaks.

But this doesn't work out because the loudest passages will overmodulate the transmitter. Overmodulation distorts the modulation envelope and develops audio harmonics which modulate the carrier and produce sidebands that fall outside the normal channel. These distorted spurious sidebands are called "splatter."

To raise the average level of modulation without *over*modulating, you must limit modulation on peaks to 100% while increasing the amplitude of the weaker sounds. In Fig. 1-a, we see that a 1-volt input (signal A-A) produces 100% modulation while the average signal level is around 0.25 volt.

In Fig. 1-b, the signal level fed to the speech amplifier has been doubled. Syllable A–A has been clipped or limited at 1 volt. B–B now produces 100% modulation on positive and negative peaks. C–C develops 100% modulation positive peaks and 50% on the negative. Here, the average percentage of modulation is around 50.

In Fig. 1-c we have the same speech pattern as in Fig. 1-a with all amplitudes tripled. Now, the signal peaks are clipped at A–A, B–B and the positive half-cycle of C. Note how the average percentage of modulation has increased. You cannot overmodulate because the clipper sets the maximum signal output regardless of the amount of signal fed into it.

A clipped audio signal has high-amplitude, high-order harmonics and produces splatter just like overmodulation. We use a low-pass filter to prevent the useless high-frequency byproducts of the clipper from modulating the carrier.

The filter has comparatively little attenuation around 2,000 cycles but cuts off all frequencies above about 3,000 cycles.

Speech compression

Speech compression is a form of audio automatic voltage control that follows the average amplitude of the speech waveform. Weak sounds are am-

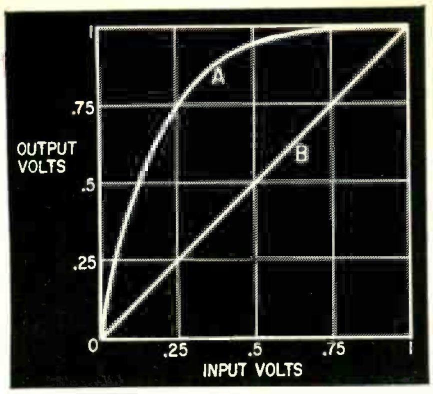


Fig. 2—Gain of compressor amplifier (curve A) levels off at high amplitudes; Ordinary amplifier (B) is more or less linear up to overload point.

plified much more than in a constant-gain amplifier, while the louder sounds get little or no amplification. Fig. 2 compares the output of a speech or volume compressor (curve A) with that of a conventional constant-gain amplifier (curve B).

In a speech compressor, we rectify and filter a portion of the modulator's audio output and use it as a variable negative bias on the compressor stage. Fig. 1-d shows our typical audio wave-of modulation for various speech levels form (Fig. 1-a) after passing through a speech compressor with the gain curve (A) in Fig. 2.

We've seen how we can use clippers and compressors to raise the average modulation level. Now, let's take a look at some typical circuits.

Executive speech clipper

International Crystal Manufacturing Co.'s model 150-203 Executive speech clipper/filter amplifier connects between the mike jack on the transmitter and the microphone, and is designed to operate from 12 to 15 volts ac or dc. Once it has been set up for your transmitter or transceiver, it automatically maintains a high percentage of modulation for various speech levels at distances ranging from 1 inch to several feet from the mike.

Input and output impedances are 100,000 ohms. The time constants of the R-C coupling networks are set to attenuate frequencies below 100 cycles to eliminate hum and other low frequencies not needed for communication. Frequencies above around 2,000 cycles are attenuated. They are not needed for communication and tend to cause needless interference and overly broad signals.

With clipping, the response at the 3-db points is 500–2,200 cycles; 380–2,500 cycles 6 db down and 230–3,800 cycles at 20 db.

The circuit of the model 150-203 is shown in Fig. 3. Three 12AF6's are operated with low bias, plate and screen voltages so they are driven to saturation on peaks. (Plate-current saturation produces a flat-topped wave similar to that produced by some square-wave generators and diode clippers.) The low-pass filter (L1, C9, C10 and C11) removes the high-order harmonics generated by clipping.

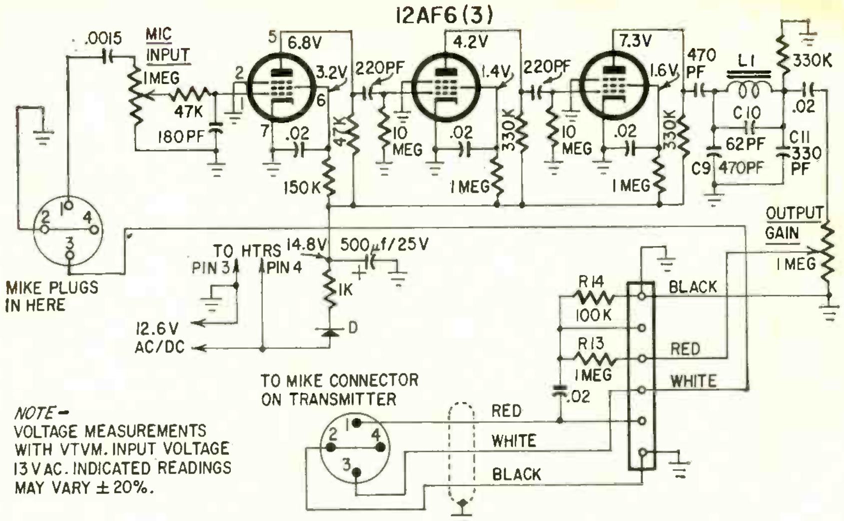


Fig. 3—Circuitry of International Crystal Executive speech clipper/filter amplifier (photo below). Sharp filter removes harmonics created in clipping process.

When the unit is operated from an ac power source, diode D rectifies the voltage for the plate and screen supply. Power drain is 450 ma with 13 volts dc input.

An attenuator pad consisting of R13 and R14 reduces the maximum output available from around 2 volts to 0.15. It is wired into the circuit when the clipper is used with a transmitter or transceiver designed for a low-output mike. To bypass the pad, transfer the RED lead from the end of R13 to the lead to the junction of R13 and R14.

The Sampson power modulator.

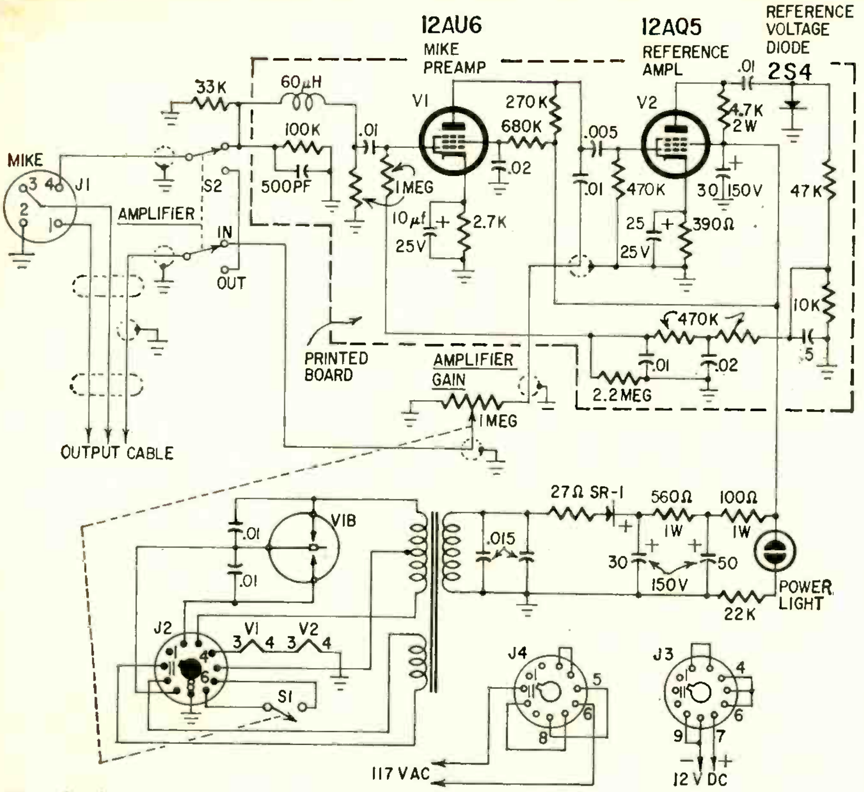


Fig. 4—A compressor type accessory, Sampson power modulator rectifies amplified speech signal, biases preamp accordingly to limit gain on loud signals.

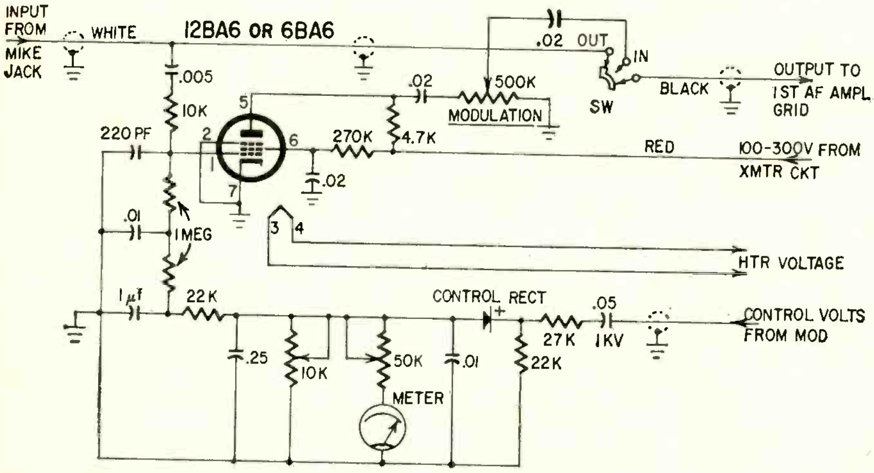


Fig. 5—"SpeakEasy" (below), another type of compressor, incorporates modulation percentage meter. High-level control signal comes from CB set's modulator.

Sampson Power Modulator

This instrument, made by the Sampson Co.'s Communications Equipment Division, operates as a volume compressor. It has a two-way power supply for either 12-volt dc or 117-volt ac operation.

The signal from the microphone is amplified by the 12AU6 (Fig. 4) and fed simultaneously to the grid of the 12AQ5 and to the transmitter's speech amplifier via the AMPLIFIER GAIN control. The 12AQ5's output is rectified and filtered to produce a variable negative grid bias for the 12AU6. The filter network is arranged so the 12AU6 operates with high gain for weak sounds and low gain for loud sounds. The gain curve of the 12AU6 looks like curve A in Fig. 2.

SpeakEasy

A product of Communications, Inc., this unit is also a volume compressor. Its signal circuits are connected in series between the transmitter's mike jack and the grid of the first af amplifier. Heater and B-plus operating voltages are tapped off the transmitter's power supply.

The SpeakEasy's circuit operation (Fig. 5) is like that of the Power Modulator. Feedback or control voltage is tapped off the high side of the modulation transformer's secondary or the modulator plate when Heising modulation is used. The modulator's output is sampled, rectified and filtered to supply a variable negative bias voltage proportional to modulation level. A meter, calibrated in modulation percentage, measures the bias voltage.

The SpeakEasy comes with internal controls preset for the average CB unit. To operate, throw the switch to OUT and whistle or hum a steady tone loud enough to swing the meter to 100%. Holding the same tone level, switch the SpeakEasy into the circuit and adjust the MODULATION control so the meter again reads 100%. Hold the tone and switch the unit in and out several times. The meter should hold at 100%. As a check, switch the compressor out of the circuit and whistle or hum softly to modulate the rig at 20%. Hold the tone level and switch the unit back into the circuit. The meter should now indicate a modulation level about twice as high.

If the SpeakEasy circuit needs adjusting, feed a 2-kc signal from a signal generator into the mike input and adjust the generator's output level for 100% modulation as indicated on a scope. Switch the compressor out of the circuit and adjust the 10,000-ohm potentiometer for −4.5 volts at the junction of the two 1-megohm grid resistors. Attenuate the generator's output 50% (6 db) and adjust the 50,000-ohm control so the meter reads 100%. END

by Jack Darr
Service Editor

Service clinic

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envlope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 11, N.Y.

THERE'S A LITTLE CONFUSION IN THE audio field—a confusion which I shared for quite a while! This concerns methods of shipping audio *power* from place to place. From bitter experience, I picked up a few pointers, and you may be able to use them. We're not speaking of home sound work but of industrial sound jobs—factories, etc., where we need high levels, and the sound must be sent from the amplifier over great distances. Anything over 200 feet will be considered as a "great distance" from now on.

We can move audio power in two ways—*voltage* and *current*. All small installations use current. In a home hi-fi system, for example, if we send 10 watts of power through a 16-ohm line, we're carrying a high *current* and hardly any voltage. Why? To develop 10 watts of *power* across a 16-ohm speaker, we have to cause a heavy *current* to flow through it: I^2R. Because of the low impedance of the speaker voice coil, we won't develop much voltage drop, nor will we lose too much in the lines, because they're so short.

If we're sending 10 watts of audio out to several speakers in a factory building, several hundred feet from the amplifier, we'd better use a different method. Short-run speaker wiring uses the common No. 20 solid-copper "bell wire." Twenty feet of this isn't much. However, if we hang 250 feet of it on the output of an amplifier, we've got something else!

Each 250 feet of this wire has a resistance of 5.07 ohms; No. 20 solid will carry 1.46 amperes. If we put two 16-ohm speakers in parallel at the far end of our line, we'd be losing nearly half of our total audio power in the wire (5 ohms of wire, 8 ohms of speaker)!

So, we use the same method the power company does. To get large amounts of power across great distances, they step up the *voltage*. This lets them use much smaller currents to get the same amount of *power* (voltage times current) at the far end of the wire. Much smaller wire can be used, which is a big saving. Fig. 1 shows what this might look like in sound work. Fig. 1-a is a typical home sound installation, with the maximum exaggerated a little. Fig. 1-b shows the same 100-watt output into the load (which would be several speakers, though only one is shown here), but now we need only carry 1 ampere in the wire because we have stepped the voltage up. Of course, this requires matching transformers at each speaker, to get our audio power back into the high-current – low-voltage shape the speakers need. If we had 100-ohm speakers, we could dispense with transformers!

Now, how can we do this? Simple. Most PA amplifiers are built with just such installations in mind. Older PA rigs had a "500-ohm line" output; 500-ohm matching transformers were used at each speaker. By raising the impedance of the line, we raised the voltage and lowered the *current*, as we've been saying. To divide the output in such a system, we combine speaker matching transformers, just like hooking resistors in parallel. Four 2,000-ohm transformers in parallel give us a total impedance of 500 ohms. The total sound power here is divided equally between the four speakers.

Later amplifiers use a system with different names, but working on exactly the same principle. You'll find this marked "70.7-volt line" or even "100-volt line." For those who, like myself, have been mystified by this, it means that this is the rms ac voltage that you'll read across the (properly matched) line *when the amplifier is putting out full rated power.*

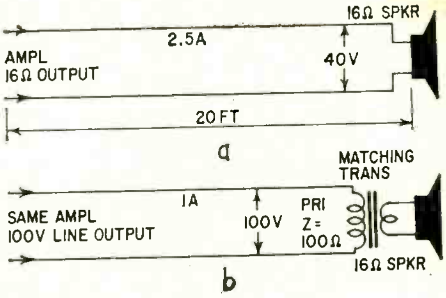


Fig. 1—The same audio power (minus transformer loss) arrives at the speaker in both (a) and (b). But by using a higher impedance line, there is 1/10 as much current in the line, and only 1/100 as much power loss.

This system permits changing speaker output powers a lot easier than the old system. In fact, it's exactly like the old system, but the transformers are marked differently! By changing the tapping of the output transformers at the speakers, you can take off any amount of audio power up to the amplifier's maximum output, and still keep your line matched to the amplifier for maximum power transfer (which is, after all, the idea of impedance matching!).

You get a lot of this, especially in factory sound work (background and paging systems, for instance). One speaker may be high in the ceiling of a noisy room, needing about 10 watts of power to be heard at all. Another might be on a wall of the coffee shop, where ½-watt of power is plenty. By changing taps on the transformers, you can adjust the sound level in each speaker to whatever you want. The instructions for doing this will be packed with each transformer, so there's no need to go into details here.

So, to save yourself a lot of trouble and, above all, from having to take down an undersized speaker line scattered over thousands of feet of factory to put up the right-sized one, remember the two ways of shipping audio power from here to there, and use the right one in the right place.

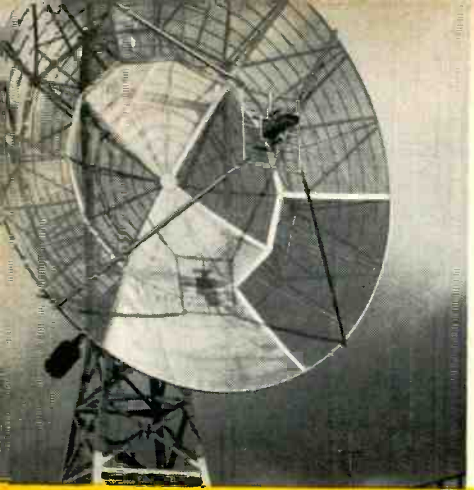
Brightness on RCA KCS-127

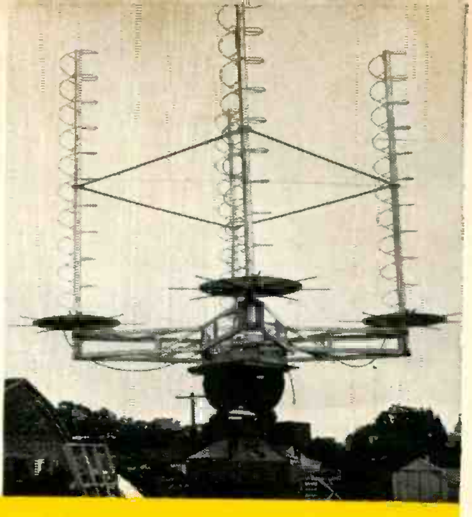
What circuit change would have to be made to increase the brightness control range on an RCA KCS-127?
—C. K. P., Fanwood, N. J.

I'm just a little bit lost here. Do you mean that you do not have normal control of the brightness? There should be enough range to go from a complete blackout to a washout. Normal range should vary the picture tube cathode–grid voltage from 0 to about 70 volts.

This chassis uses a rather unusual retrace eliminator circuit (Fig. 2). The vertical and horizontal blanking pulses are both fed from the same

(Continued on page 54)





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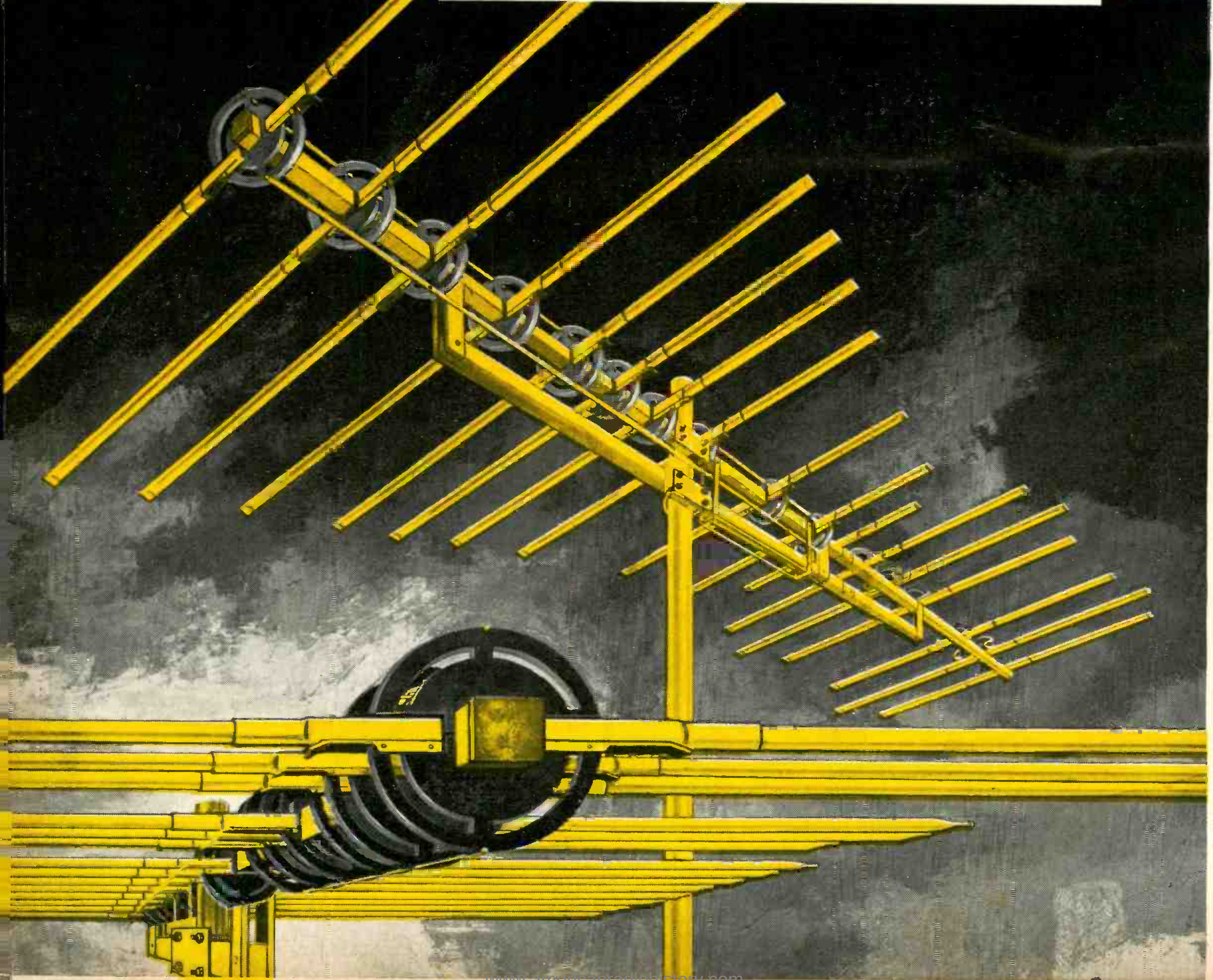

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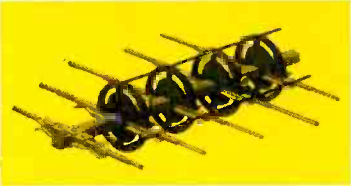

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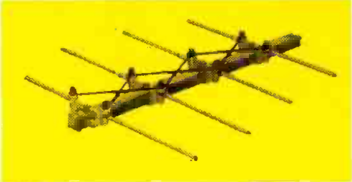

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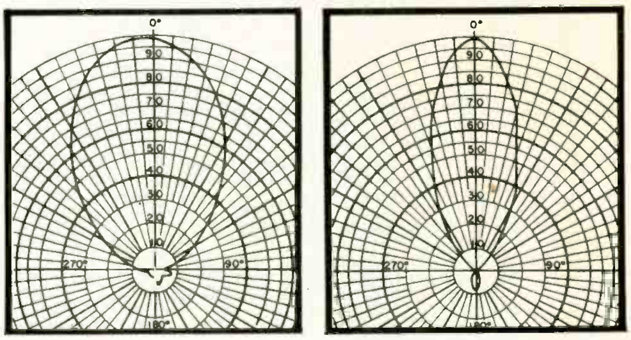

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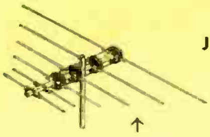

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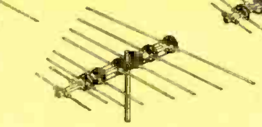

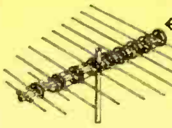

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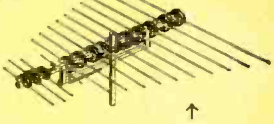

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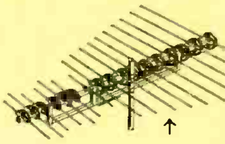

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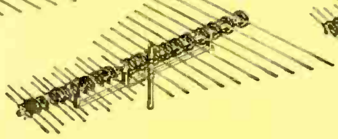

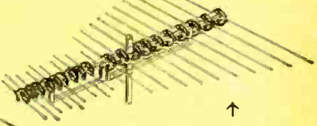

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(Continued from page 51)

source; the vertical pulse is picked up from the bottom of the vertical output transformer. This is fed through the secondary of the width coil, bypassed by the R-C network shown, and then fed to the CRT grid. We have had a few cases of incorrect polarity on the width coil windings; this causes horizontal "shadowing". An open winding here leaves the CRT grid floating, which *would* interfere with the brightness control!

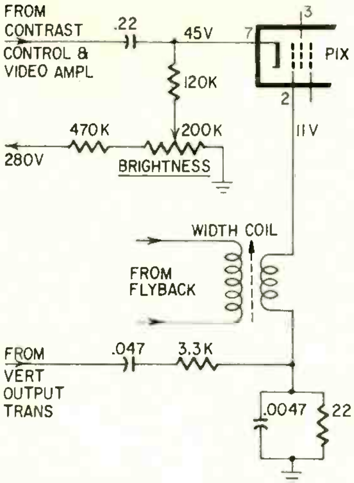

Fig. 2—Unusual retrace blanking circuit in RCA KCS-127 chassis.

Crosley horizontal instability

I'm asking for advice on a Crosley HC-21HCL TV. The trouble is horizontal instability. After the set plays for about 20 minutes, the trouble goes away. When the set cools off, trouble's back again. Any ideas?—H. C. K., North Burnaby, B. C., Canada

This trouble is likely in one of the resistors in the horizontal oscillator or horizontal afc circuits, from the "time constant" you mention. As an average, resistors seem to take about that length of time to begin to drift from heat.

I'm not speaking here of resistors which are overloaded and warm up because of *internally* generated heat, but of lightly loaded resistors which are changing value because of *external* heat, from adjacent parts, tubes, etc.

So, look for resistors in some of the frequency-determining circuits: grid resistors, plate load resistors, saw-forming network resistors, and so on. With the set cold, try applying heat with the tip of a soldering iron to each resistor. The culprit will cause the set to fall out of sync (or fall *in* sync) when heated.

Foreign radio power transformer

I have a Kaiser radio, German-made, with a burned-up power transformer. Uses European tubes and a bridge selenium rectifier. The dealer says that parts are not available for this any more. What to do?—W. B., Mundelein, Ill.

You should be able to find a replacement power transformer for this set in one of our catalogues. After all, power transformers are pretty well standardized. Also, you won't need the elaborate tapped primary winding of the original European transformer.

Add the filament currents of the tubes. If you can't find all of them in an American tube manual, get a copy of the Philips *Blue Book*, the Amperex manual, or look up US "interchangeable" types. (As a last resort, hook the tube up to a 6-volt battery and *measure* the heater current!)

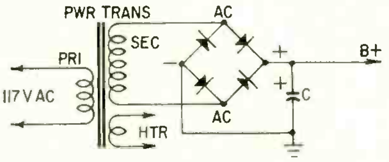

Fig. 3—Use voltage rating of C as guide to original transformer voltage. Current drain of 7-tube set will be around 150 ma.

To find the proper B-plus voltage, look at the ratings on the filter capacitors. On the diagram you sent, I note that the input filter is marked "350–385 volts". So, since the German makers of this radio were probably pretty conservative, I'd say that the original B-plus wasn't over 300 volts; probably 275 or so. (See Fig. 3.)

Look up an American radio power transformer with these specs in any one of the major transformer manufacturer's catalogues. Now all you have to worry about is the physical dimensions of the transformer; these can be measured and checked against the replacement. Don't forget to check the circuit to see what blew the original transformer!

Cable system leakage

I'd like some information about a TV community antenna system. Several of my customers are having trouble operating from antennas. This system converts all stations to low channels. I can pick up Ch. 9 on Ch. 6, by pointing my antenna at an amplifier about 50 yards away. This isn't right, is it? Aren't there standards as to the amount of permissible leakage from such systems? —H. P., Albany, Texas

Yes, indeed. The FCC will allow only a very small amount of rf leakage from community TV systems. Most systems give no trouble at all. However, there is always the possibility of leakage from a bad shielding box, etc.

If you are picking up the signal from Channel 9 on 6, this is obviously cable leakage. There is another common form, often called "cable bars". It shows up as a black or white vertical bar in the center of the TV screen, if the set is operating on an antenna. This

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is actually the horizontal blanking bar from the *same signal*. It has been delayed through 25–30 μsec by passing through several miles of coaxial cable. Since it is seen, there must be enough leakage from an amplifier to allow this. The delay causes it to move into the center of the screen. It looks like a stationary "windshield-wiper" effect.

There are two possibilities: an amplifier shielding-box is not properly grounded, has a loose cover, etc.; or one of the amplifiers is running at too high a level. If you'll advise the operator of the system of this and show his engineers the trouble, they will promptly correct it, I'm sure.

Jackson TV flyback replacement

I replaced the flyback in a Jackson model 277 TV with a G-E 77J1 I had on hand. Doesn't seem to work so well; no high voltage, etc. Any ideas?—J. C., Ridgway, Pa.

The 77J1 is not the proper replacement for this chassis. Fig. 4 shows the difference in inductance between this and the exact duplicates, such as Triad D-627, Merit HVO-46, etc.

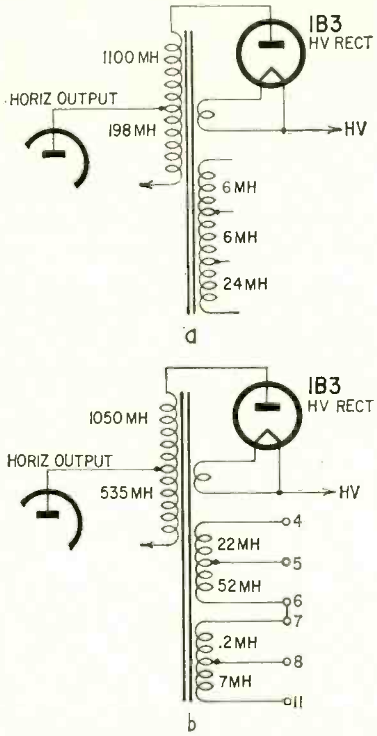


Fig. 4—Difference in G-E 77J1 (a) and exact-duplicate (b) flybacks for Jackson 277. Severe mismatch would keep set from working.

Shadow in Sylvania 1-177

If a Sylvania 1-177 TV is aligned (horizontal oscillator, that is) in accordance with the instruction in the service data, it works for about 10 minutes, or until it gets thoroughly warmed up. Then a shadow creeps in on the left edge of the screen and it falls out of sync. This set has no horizontal hold control, but I can reset the horizontal frequency slug, and pull it in again, until the temperature rises.

Out on the bench, it works longer than if I put it back in the cabinet. The voltages, etc., are all good, of course! The only thing out of the ordinary I can see is a peculiar waveform (Fig. 5) in the horizontal sawtooth.—R. P., Philadelphia, Pa.

Obviously, as you have discovered, this is thermal trouble. The key clue here is the appearance of that little "squiggle" in the middle of the sawtooth waveform. I ran into a case some years ago almost exactly like this, except that mine refused to work at all (farther along the road, as it were).

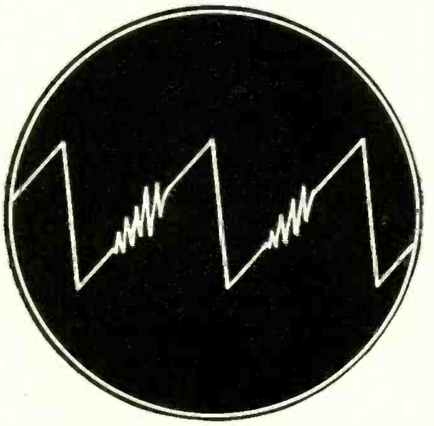


Fig. 5—Mysterious "squiggle" in horizontal oscillator waveform: power supply trouble.

This is due to feedback in the horizontal oscillator section, upsetting the horizontal oscillator frequency. The squiggle is the result of some signal from the output stage leaking back through the power supply lines. From the time constant of the trouble, I'd say it was a bad electrolytic capacitor in one of the voltage supply circuits to the oscillator. Wait until the trouble shows up, then check all voltage feed points with a scope and low-capacitance probe. You'll probably find lots of "hash" on these lines, which should be completely free of any ripple at any frequency.

If you have one of those "capacitor-shunt" testers, this is a good place for it. If not, bridge or test *all* electrolytics even remotely associated with this circuit, and you'll find it. Don't overlook any of them. I found one only a week or so ago, the only trouble was a severe horizontal instability!

Flyback dc resistance

I've replaced the flyback in a Coronado TVI-9330. Resistances were identical to those on the schematic. Now I haven't got enough width. Can you explain this?—H. H., No. Hollywood, Calif.

The dc resistance of flyback windings should never be used in selecting a replacement! If you cannot locate the exact replacement, or enough information about the old flyback, use the *inductance* value, never the dc resistance.

Dc resistance of windings *is* valuable when checking an *original* flyback against the schematic. Low or high readings could mean shorted turns or corrosion inside of windings, etc.

Your trouble here probably comes from a lack of drive signal on the horizontal output tube. Or, check the screen voltage on the 6CD6. You can increase this slightly to get more width, as long as you do not exceed the 160-ma rating of the 6CD6.

Grunow power transformer

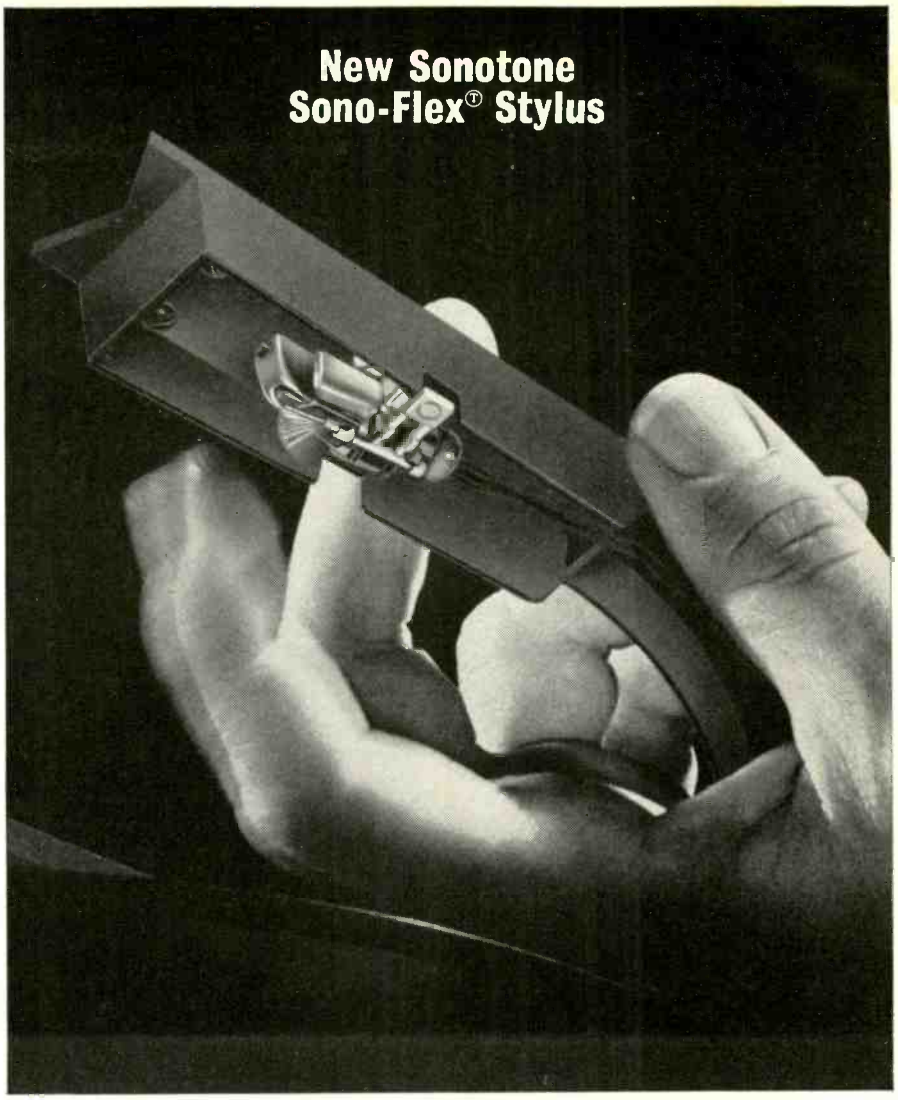
Did you ever hear of a Grunow radio? I've a model 588 that lights up, no sound. If I leave it on, the power transformer gets hot, and there's a frying sound inside of it. If it's gone, where can I get a replacement?—A. S., Miami, Fla.

Heavens, yes! The Grunow was one of the best sets built by one of the designers of the *original* Majestic radios. You'll find the schematic on this in Rider's *Perpetual Troubleshooter's Manual*, Vol. 9, listed under "General Household Utilities."

Replacement power transformers for this should be simple to get. Any standard transformer with the right rating should do. Look up the articles, "The Old Timer Helps Replace a Power Transformer" in the December '61 and January '62 issues of RADIO-ELECTRONICS; all of the details are there. Disconnect all loads, even the pilot lights, and cook this transformer for a while to see if it has an *internal* short. A wattmeter will tell you immediately if the "bare transformer" draws any current at all. If it does, it's shorted; replace it immediately. END

Radio-TV Complaints Down 12%

The Better Business Bureau reports that in the year ending May 31, 12% fewer complaints against radio and television sales and service firms have been processed than in the previous years. Radio and TV still top the list of complaints, however, with 555 being recorded by the BBB. Apparel was second with 430, home improvements 402, appliance sales and service 385, and furniture 335. The complaints included sales as well as service, and the BBB noted that "there has been considerable improvement in the use of fictitious comparative prices by local advertisers."



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85
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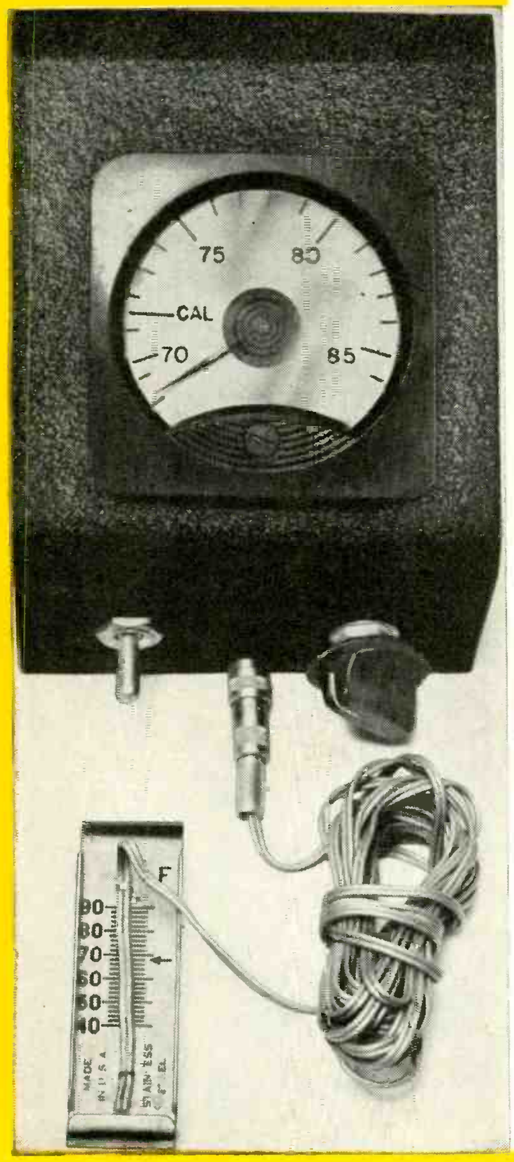
PICTURE TUBE

By TONY KARP

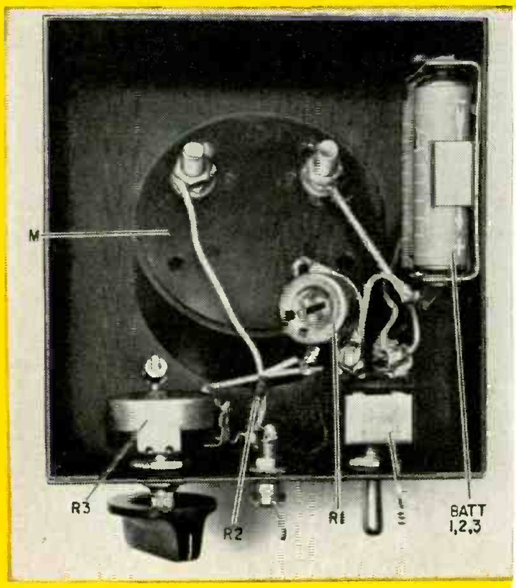
electronic darkroom thermometer

Simple photo accessory pays off in better prints



The thermometer. Case can be put up on wall or shelf. Thermistor itself is hidden under curved lip of old thermometer plate.

Half an hour should be enough to do this bit of wiring.



A GOOD THERMOMETER IS A MUST FOR any darkroom. The ideal is to have a large scale, the correct range for photography (65°–85°F) and high accuracy. By using a thermistor as the temperature-sensing element, you can build an electronic thermometer with all these features.

The thermometer has two basic parts: a Glennite 31TD2 thermistor on a probe cable, and a case holding the meter, batteries, etc. For convenience, the case can be on a shelf or mounted on the wall, where it will be easy to read and out of harm's way.

The circuit is simple. The 31TD2 thermistor is in series with a 200-μa meter and a 2.8-volt source (two mercury cells). The thermistor has a resistance of about 1,000 ohms at room temperature. R3 and BATT 3 apply a reverse current to the meter, allowing it to be zeroed in the correct temperature range. Setting S to CALIBRATE substitutes R1 and R2 for the thermistor, allowing the meter to be set to the desired temperature. By using a selector switch and several different resistances for R1 and R2, the meter can be made to cover a number of ranges. Mercury batteries are used for their accuracy and long life. As S is a center-off switch, no on–off switch is needed.

No unusual construction is involved in the thermometer. The photograph shows the general parts layout. Any suitable case can be used to hold the meter and other parts. The three mercury batteries are mounted in a single holder. Larger mercury batteries such as the Mallory RM-42 are good if the unit is to be used for continuous duty. R1 can be an inexpensive rheostat such as the Mallory FL-500 and can be mounted by soldering one of its terminals directly to S. If you are going to mark calibrations directly on the meter scale, the meter should not be mounted into the case until that has been done. You can connect it into the circuit with a pair of long leads. On my thermometer, I substituted a blank scale for the regular meter scale and marked the calibrations on the glass face of the meter.

The probe

Constructing the probe is a little more complicated. The thermistor and its connections must be waterproof, since some photographic chemicals conduct electricity and would throw off the accuracy of the meter. Take a piece of plastic-insulated twin-conductor *stranded* wire and cut it so that a short length of bare wire is exposed. Hold the wire and push back the insulation until about an inch of bare wire is exposed. Cut three or four strands from each conductor and then push back the insulation so that it covers the wire again. Now you have sort of a home-made socket for the thermistor. Cut the thermistor's leads to about ¾-inch and push them gently into the two-conductor wire. Coat the thermistor and the first inch of wire with two coats of clear nail polish. The probe can be mounted on the stainless steel plate from a small glass thermometer, as shown in the photograph. Put the batteries in the holder, and the thermometer is ready to be calibrated.

Calibration

The electronic thermometer will be only as accurate as the thermometer against which it is calibrated. The one I used was a Kodak Perfectemp, reading from 50° to 100°F in 1° graduations.

Place both thermometers in a graduate filled with water at about 75°F. Put S to the READ position and adjust R3 so the meter reads about half-scale. By adding hot or cold water to the graduate, you can check the range that your thermometer covers. If either end of the scale is too high or too low, adjust R3 until the meter covers the correct range. Once this has been done, leave R3 at its setting until the meter has been calibrated.

Add enough cold water to the graduate to bring the meter down to the low end of the scale. Stir the water thoroughly and give both thermometers a chance to reach the same temperature

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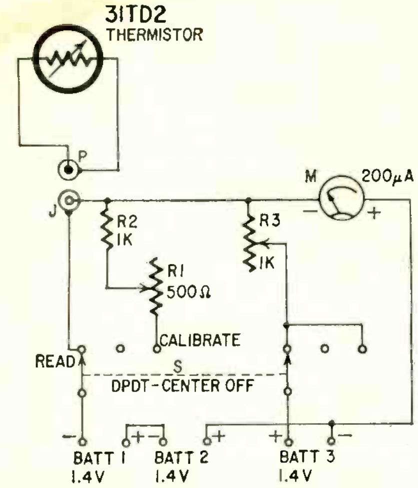


J—miniature mike connector (chassis-mounting male)
M—meter, 200 μa full scale
P—cable connector to fit J
R1—pot or rheostat, 500 ohms (Mallory FL-500 or similar)
R2—1,000 ohms, ½ watt
R3—pot or rheostat, 1,000 ohms, wirewound
S—switch, dpdt, center-off (Lafayette SW-19 or SW-27)
Batt 1, 2, 3—1.4-v mercury batteries (Mallory ZM-9 or equivalent)
Thermistor — Glennite 31TD2 (available from Milgray Electronics, 160 Varick St., New York 13, N. Y. Minimum order $5.
Case, 3-cell battery holder, double-conductor cable for probe, connectors for probe cable
Miscellaneous hardware

Circuit of thermometer. Thermistor is at end of 6-foot cable.

before reading them. Check the calibration thermometer to find the exact low-end reading and mark this temperature on the meter.

Pour enough hot water into the graduate to raise the temperature exactly 1°. Mark the meter at this point. Continue raising the temperature 1° at a time, marking the meter until the entire scale has been covered. Be careful not to change the setting of R3 during calibration.

Once the entire range has been calibrated, put S in the CALIBRATE position. Make a mark somewhere on the scale and adjust R1 until the meter pointer is at the mark. Use a drop of nail polish to lock R1 at that point. When using the thermometer, put S in the CALIBRATE position and use R3 to adjust the needle to the calibration mark. This does the same thing as zeroing an ohmmeter — compensates for falling battery voltage. Put S to the READ position, and the thermometer is ready for use. END

[The author reports that if the Glenite 31TD2 is not readily available and you can tolerate a longer time constant, substitute a Veco 28D3 and make the following changes in the circuit:

Delete BATT 2. Change R2 to 330 ohms. Change R3 to 500 ohms and add a 330-ohm ½-watt resistor between its arm and the switch.

You can use any meter from 200-μa to 1 ma full scale. A 1-ma meter gives a temperature span of about 30° and a 500-μa meter has a range of about 15°. You can use a 200-μa meter with an adjustable shunt to give the temperature range that you need.

You must encapsulate the Veco 28D3 to make it moisture-proof. Mix a small amount of epoxy cement in a paper cup. Heat it in hot water until it softens and then dip the thermistor and about a half inch of the lead. Drip dry. This leaves a very thin protective coating. *—Editor*]

By F. ADAMEK, Jr.

Audio Booster for Transistor Radios

And this little amplifier has a host of other uses

THIS CIRCUIT REQUIRES NO TRANSFORMERS and uses conventional p-n-p transistors. A somewhat better circuit is possible with a p-n-p–n-p-n (complementary) output, but n-p-n transistors are expensive. Output with 2N256A's is about 1 watt.

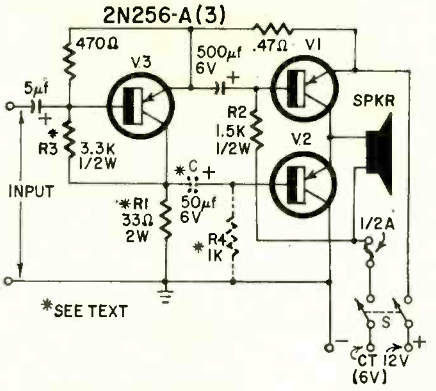
The output is push-pull, with each half having its own voltage supply but a common load (the speaker). The push-pull output is driven by an unbalanced phase splitter. The unbalance is necessary because the output stage is unbalanced. V2 has a common-collector configuration with a corresponding power gain. V1 is a common emitter which has a different power gain.

Coupling may be direct to save components. If higher stability is desired, R-C coupling (shown by the dotted lines and components) may be used. All the capacitors shown are two to five times bigger than they need be, to insure good bass response.

Because of the large variations in transistor parameters, the values given in the circuit are only nominal. It is necessary for the builder to optimize the values for the transistors and speaker he wants to use. So he should not feel limited to the use of 2N256A's only; I chose them because they could be obtained for $1.00 each. Several outlets advertise power transistors at less than this price in the latest issues of RADIO-ELECTRONICS. Any of those with a beta higher than about 30 and maximum collector ratings of 2 amperes will do. They do not have to be matched.

Once the transistors are chosen, they must be mounted on a metal chassis with an effective radiating surface of about 20 square inches, or more. V1 and V3 require anodized aluminum insulators coated with silicone grease to insulate them electrically from the chassis. V2 may be mounted directly on the chassis since its case (the collector) is connected to ground (chassis). Next the components whose values are given in the circuit may be wired.

For the next steps, a scope and 400-cycle signal generator are required, along with a dc ammeter and an ac volt-



meter. Connect C as shown and start off with the nominal values given for the rest of the components. Variable resistors would be convenient. Now adjust R4 so that there is zero dc in the speaker coil with no signal at input. Next apply a sine wave at the input. A direct current will again appear in the speaker coil. Now R3 and R1 must be adjusted so that it is possible to get symmetrical clipping at the voice coil. For some value of R1, the dc in the voice coil will be very small and the ac voltages across the collector-emitter terminals will be equal in V1 and V2: the output will have been balanced.

If you want to leave in the R4-C coupling, the next step is to adjust R2 and R4 for a collector current in either transistor of about 400 ma and 0 ma in the speaker voice coil. To get direct coupling, remove C and R4 and connect V3's collector to V2's base. Now R3 and R2 must be adjusted so that clipping is symmetrical while the direct current in the speaker remains close to zero. It will be found that it is impossible to remove all traces of dc for all signal levels because of the nonlinearity of the transistors. However, about 50 to 100 ma may be tolerated, depending on the speaker used.

Note that, unless the transistors used are very good, the speaker impedance should be more than 4 ohms for good results. While making the dc measurements it is advisable to replace the speaker with a coil of similar dc resistance. The high current which may be encountered balancing might damage the speaker cone. The ac readings should be made with the speaker connected.

The power supply used was a 12-volt car battery with a tap at 6 volts. The tap was obtained by drilling a small hole ¼ inch deep into the lead bar under the tar. A self-tapping screw was then inserted.

I am using this amplifier as a booster for a tiny pocket radio. The radio's output is low and it distorts with appreciable volume (which is required in a noisy automobile such as mine). By connecting the booster to the earphone jack on the radio, good volume and surprising quality can be obtained. Being very small, the radio may be hung behind the rear-view mirror where it can readily pick up signals without an external aerial.

If the amplifier is to be used in a car, check the polarity of the ground. Some cars have a positive ground. Also be very careful that your speaker does not have one end of the voice coil connected to its frame. This could result in speaker damage and a fuse burnout if the speaker frame touches the car. END

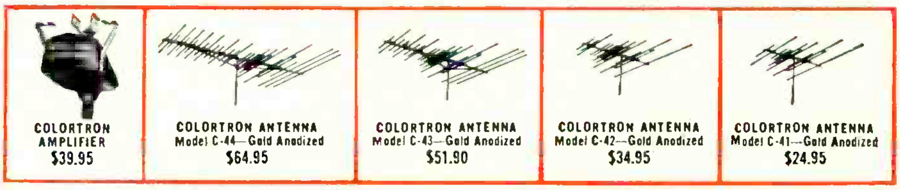
Proposed German Color TV Improves on American

Telefunken has proposed a color TV system based on the American NTSC, with some improvements. The new system would be called "PAL," and was developed by Walter Bruch in the research laboratories of Telefunken in Hanover. According to Telefunken, PAL (Phase Alternation Line) will combine the best features of the NTSC system with freedom from phase distortion along the transmission path, without deviating too much in principle from NTSC.

It will be insensitive to band limitations (single-sideband distortion). Transmission of hue is faultless and obviates the necessity for manual readjustment of the receiver. Reproduction of color pictures is said to be better than with NTSC.

In phase alternation line, the color carrier is shifted 180 degrees from line to line. This causes color impurities (caused by phase distortions during transmission) to appear complementary from one line to the next. Because the scanning lines are so close together, the eye "averages" the error and perceives approximately the correct color.

A delay line is used for that purpose, and delays the signal one line—approximately 64 μsec. In areas where phase distortion is not large, a simplified system omitting the delay line can be designed, permitting the construction of cheaper receivers.



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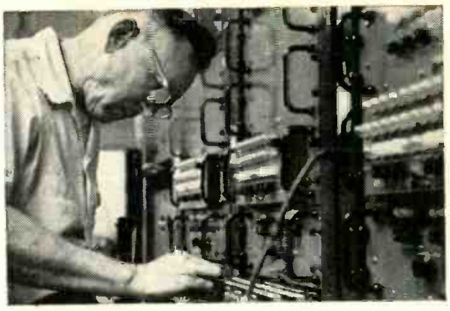

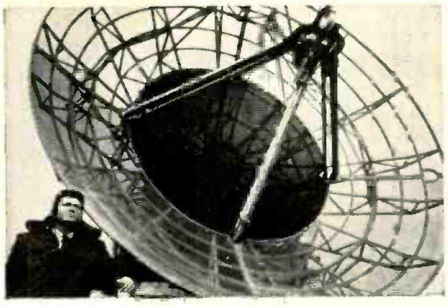

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equipment report

Ac/Dc/Audio Vtvm/Wattmeter

(Radio Shack "Realistic")

and

"Add-A-Tester" Milliohmmeter

(Simpson 657)

SERVICING HIGH-FIDELITY SYSTEMS HAS become an almost everyday part of a technician's business. Nevertheless, few shops do enough of this type of servicing to justify a large investment in specialized audio instruments. This Radio Shack vtvm offers an economical way of getting some of the basic instrumentation at a small additional cost over that for the normal service type vtvm.

This instrument provides the usual ac-dc vtvm ranges: ac and dc volts from 1.5 to 1,500 full scale, and ohms from 10 ohms to 1 megohm midscale. Voltages down to less than 100 mv, and ohms from less than 1 to about 1,000 megohms can be measured on these normal ranges.

But there are some refinements not found in most vtvm's (Fig. 1). The power supply is stabilized with three NE-2 neon lamps in series. Once the tubes are aged, zero drift is considerably less than in the usual vtvm. There is a 2× scale multiplier on the dc voltage ranges to take full advantage of the greater accuracy near full scale. The reading on the normal voltage scales is mentally multiplied by 2.

The instrument has three separate inputs selected by a switch: one for dc volts through a shielded cable and a microphone type connector; one for ac volts and ohms through a pin jack and ordinary test leads, and a third for auxiliary probes through another microphone type connector. All use a common ground through a separate lead with an alligator clip, which can be replaced with a normal test lead when a clip would be awkward. The input selector switch has a position that shorts the input so the meter can be zeroed without shorting the test leads.

A high-voltage probe which extends the range to 30 kv and an rf probe useful to 250 mc are available as accessories. Since the instrument has the standard 11 megohm input, any of the standard specialized probes intended for an 11 megohm input can also be used.

On the ac ranges there are scales for reading peak-to-peak as well as rms values. There is also a db scale.

The instrument offers higher accuracy than most because there are no fewer than six calibration pots for the various functions and ranges. In the voltage dividers, 1% resistors are used. If accurate standards are available, accuracy can be kept within the 2% accuracy of the meter itself plus the 1% of the divider.

In addition to these normal vtvm functions, this instrument has a high-gain preamplifier, using a 6AU6 pentode, to provide two audio millivolt ranges: 15 and 150 mv full scale. Voltages as low as 100 to 200 μv can be read. Outputs of microphones and phono pickups can be measured directly, and low-level audio and signal tracing is easier.

Measuring amplifier power output provides a good way of testing some performance characteristics and of showing improvement produced by balancing, bias adjustment, tube changes, etc. Audio output power can be measured up to 15 watts on a 16-ohm load, 30 watts on an 8-ohm load and 60 watts on a 4-ohm load. The instrument *does not* contain load resistors. External ones must be used. A 15-ohm adjustable wirewound resistor with two sliders, one set for 8 ohms and the other for 4 ohms, is useful.

The instrument includes a current transformer for reading either current drain (up to 5 amps) or the wattage (up to 1.5 kw) of any device plugged into an ac receptacle on the front panel.

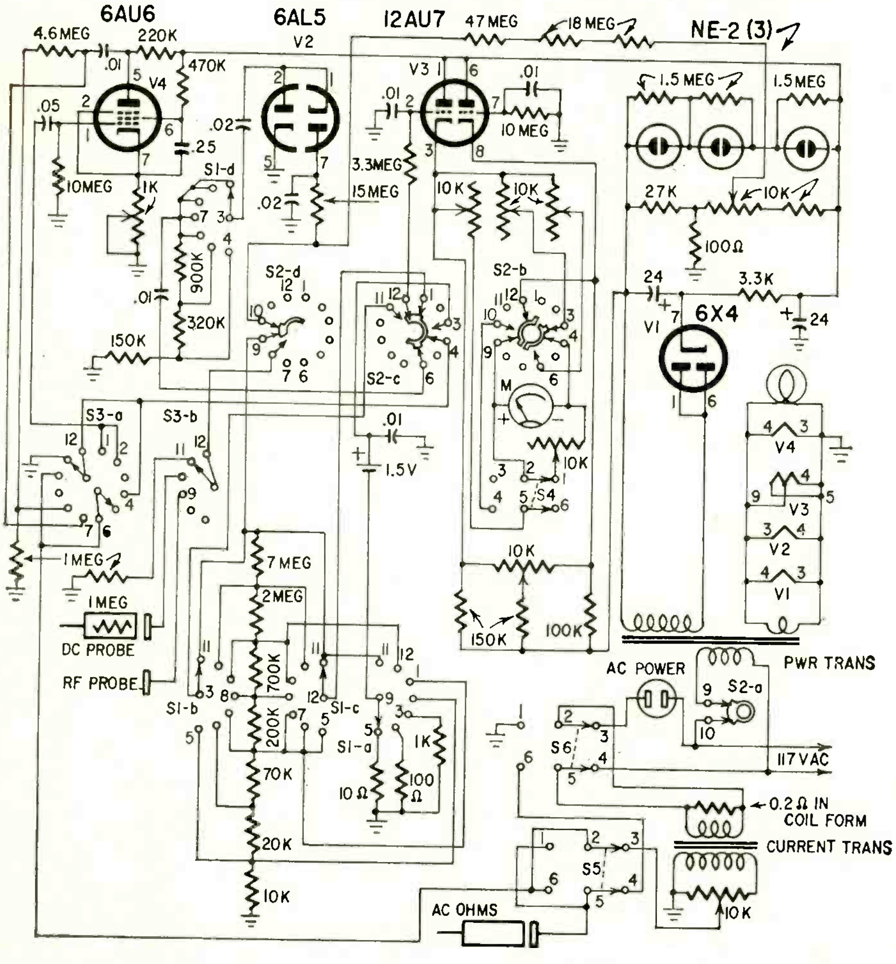

Fig. 1—Circuit is basically standard ac-dc vtvm, with audio preamp (V4) and current and power measuring circuits added. Neon lamps in power supply help stabilize voltage.

Specifications

Dc volts: 0 to 1.5/5/15/50/150/500/1,500 volts
  Input resistance 11 megohms all ranges
  Accuracy 3% of full scale
Ac volts: low (rms) 0 to 15/150 mv
  low (peak-to-peak) 0 to 40/400 mv
  standard (rms) same as dc
  standard (peak to peak) 0 to 4/14/40/140/400/1,400/4,000 volts
Db: −20 to +40 (3 ranges)
  Response flat to 2 mc
  Accuracy 5% of full scale
Ac amperes: 0 to .15/.5/1.5/5 amps
  Accuracy 5% of full scale
Ac watts: 0 to 1,600 w
  Accuracy 5% of full scale
Audio watts: 0–15 w across 16 ohms
  0–30 w across 8 ohms
  0–60 w across 4 ohms
  Accuracy 5% of full scale
Ohms: R× 1/10/100/1,000/10k/100k/1 megohm
  Accuracy 3% of full scale
Meter movement: 400 μa
Tubes: 6AU6, 12AU7, 6AL5, 6X4
Dimensions: 11 x 8 x 6 inches
Weight: 5 lb

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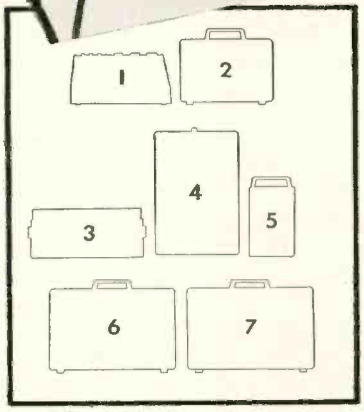

Complete lab above consists of:
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Several probes can be connected at once and chosen by the probe switch, topmost knob.

Power consumption checks often provide useful clues to equipment faults.

Naturally, the unit is more complex and will take more time to assemble than the typical kit type vtvm. But it is still fairly easy to put together. The instruction manual is clear, and the assembly and wiring steps have been well thought out. Calibration is possible with a dry cell, and voltages available from the power line, although it can be calibrated more accurately with accurately calibrated standards. On the test model I got accuracies well within 3%.

Although about twice as big as the common ac–dc vtvm, the Realistic Dual is light and portable. It is probably most useful as a bench instrument.

At $45 in kit form and $70 wired, this instrument represents an unusually high value in all-around utility, and should be of interest to serious audiophiles as well as professional technicians.—*Joseph Marshall*

Simpson Model 657 Milliohmmeter

HAVE YOU EVER TRIED TO MEASURE THE resistance of a high-current meter shunt, a switch or relay contact resistance or a high-wattage heating element with your ohmmeter? If so, you know just how difficult it is. Simpson Electric Co. has just introduced the model 657 milliohmmeter that makes measuring resistances as low as 1/100 of an ohm as simple as checking 50,000 ohms with an ordinary multimeter.

The 657 is Simpson's latest addition to the Add-A-Tester series of adapters designed to be used with the model 260 and 270 multimeters. (Seven other adapters for these multimeters were described in the article "Test Adapters" in the July 1960 issue.) It measures resistances from .010 to 1.0 ohm in four ranges. You won't find a conventional ohmmeter that can measure such low resistances accurately. The average ohmmeter usually reads 10 ohms at center scale; few read below 5. Even with a 2-ohm center, a reading 0.1 ohm would be within about the first 2% of the scale arc—a very poor spot for precision readings. Look at your ohmmeter.

The 657 milliohmmeter adapter plugs into four jacks on 260 multimeter. New multimeter case with 50–μa jack on side is part of 402 case kit.

Even the laboratory type Wheatstone bridge does not fare well for measurements of less than 1 ohm. Its accuracy is affected by lead resistance and contact resistance at the binding posts. The 657 milliohmmeter is the field or service-bench supplement to the laboratory Kelvin bridge normally used below 1 ohm for:

- Measuring lead and contact resistance in automotive lighting and ignition wiring.
- Measuring winding, coil and yoke resistance in servicing and manufacture.
- Checking armature and field windings and brush contact resistance in motors and generators.
- Calibrating meter shunts.
- Measuring switch, relay and connector contact resistance.
- Checking grounding and bonding connections in automotive, computer and radio installations.

How it works

The milliohmmeter operates by comparing the resistance of the unknown element with an internal standard. (The unknown is equal to or less than the standard selected by the range switch.) The unknown and standard resistors are connected in series with a heavy-duty 1.5-volt battery (see Fig. 2). The meter is first switched across the standard resistance R_{std} and the calibrate control adjusted for full-scale deflection. This fixes the current through the unknown. When the switch is thrown to READ, the resistance of the unknown is read on a dc scale of the multimeter.

Each of the two internally connected test leads is a two-conductor type with the individual leads terminating in insulated contacts in the jaws of the alligator clip. Thus, each alligator clip has two contacts. These are marked A and B in Fig. 2. Battery current flows through the "B" contacts; the "A" contacts are used for measurement only. The low contact resistance of the switch and the "A" side of the clips does not introduce an error because of the high input resistance of the transistor differential dc amplifier. The contact resistance of the "B" contacts does not enter into the measurements because the voltage across the resistor to be measured does not include the voltage drop across these contact resistances.

The differential dc amplifier is simply a transistor version of the dual-triode amplifier in a vtvm, with the 50-μa meter movement in the 260 or 270 connected between the collectors of the 2N591 silicon transistors. The amplifier uses a 9-volt battery.

Using the 657 with your meter

There are three versions of the 260. The series I, identified by its flat, square-cornered panel, is an early version that cannot be used with the 657 and other accessories in the Add-A-Tester line. The series II has a raised panel with rounded corners, a 100-μa range and pin jacks for the test leads. The series III is similar and is easily recognized by its banana jacks and 50-μa range.

Adapter cases are available for series II and III 260's and 270's produced before June 1959. The 401 case kit is an optional accessory for the 270 and series III 260. It consists of a new case that permits latching the 657 securely to the multimeter. The 402 case kit is required for series II 260's. It contains a new case, four pin plugs to replace the banana plugs on the 657 and parts needed to add the 50-μa range needed for most of the Add-A-Testers. The photo shows a series II in the new modified case. Note the 50-μa jack on the side.—*Robert F. Scott*

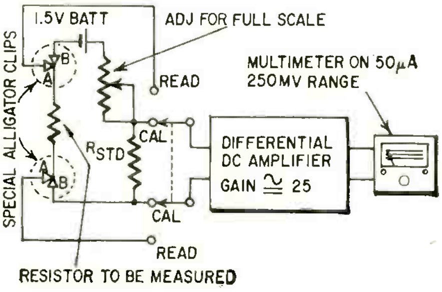
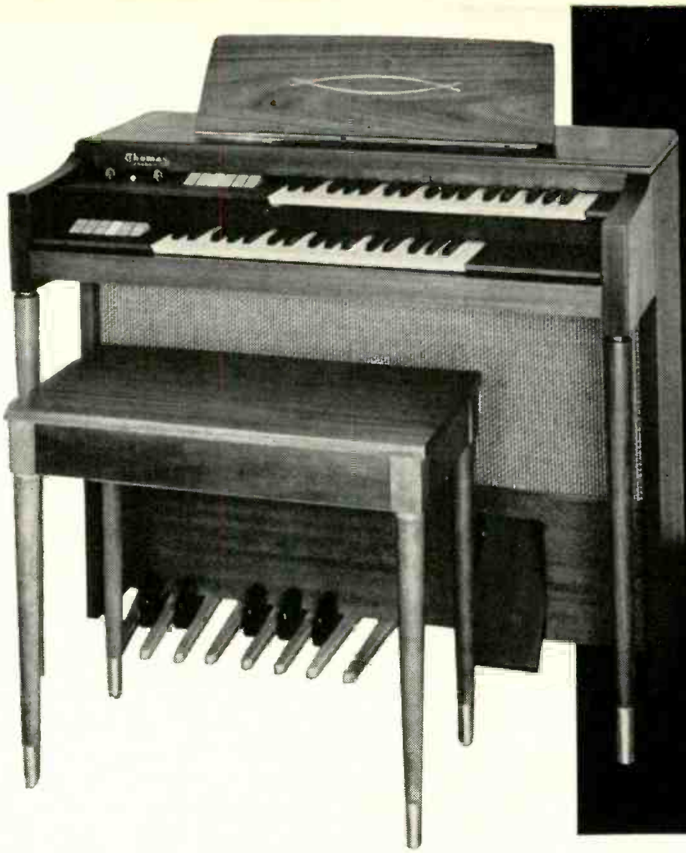


Fig. 2—Basic circuitry of milliohmmeter. Special two-contact clips eliminate errors from contact and lead resistance.



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What's Your Eq?

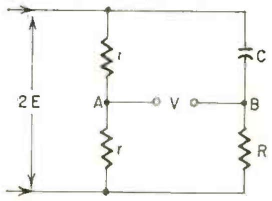
These are the answers.
Puzzles on page 39.

Power supply puzzler

Wrong *primary power supply!* You can *not* get "110 volts" or "220 volts", single-phase, by tapping into a *three-phase* 220-volt supply line! The voltage read between the center leg and ground actually comes out something like 165 volts or more, depending upon how good the ground is! This is due to the waveform of the voltage; the actual average voltage between any wire and earth ground is far above a single-phase average! Came out something like 165 or 175 volts, which, of course, burned up resistors in the photocell amplifier. Solution: run a single-phase 110-volt line from a nearby lighting circuit to the amplifier, which then worked perfectly.

Output Voltage

The ratio of output voltage (as measured with a vtvm) to input voltage is always ½—for *any* frequency including dc, *any* value of C or *any* value of R! The only requirement is that the two resistors marked r be equal.



Proof? Here goes. (See the diagram.) For convenience, let's call the input voltage 2E (we can call it anything we like, after all). Since r = r, the voltage at A (V_A) must be ½(2E), or just E. By the same voltage-divider reasoning, the voltage at B (V_B) will be

$$V_B = 2E\left(\frac{R}{R - jX_C}\right),$$

where jX_C is C's reactance. Now we know V_A and V_B (at least in symbols). The output voltage V must be the difference between them: $V = V_A - V_B$. Substituting our expressions for V_A and V_B, we get

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$$V = 2E\left(\frac{R}{R - jX_C}\right) - E$$

$$= \left(\frac{2R}{R - jX_C} - 1\right)E$$

$$= \left(\frac{2R - R + jX_C}{R - jX_C}\right)E$$

$$= \left(\frac{R + jX_C}{R - jX_C}\right)E$$

But the absolute value (magnitude) of the expression in parentheses is just 1 (unity), hence $V = E$, or exactly half the input. Note that the proof contains no f's or omegas—the voltage does not depend on frequency—and also that the R's and X's drop out. Thus the solution holds, as we said, for any value of f, C or R.

Note on "Fussy Fuses"

Several readers have written about the item "Fussy Fuses," which appeared on page 43 of the August issue. In the main, writers stated that differences in resistance of the various fuses would cause the current to divide unevenly, and that, though they might blow in the same order, the combination would carry considerably more current than suggested by Mr. Stumph.

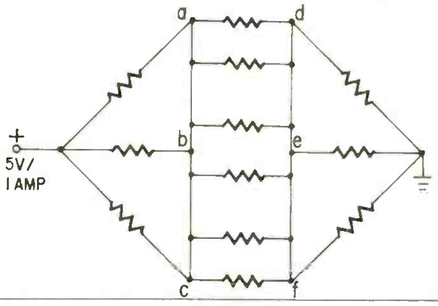
We had thought of that one, too, and had queried the author. He made a number of measurements on fuses and reported the resistance so low that it would presumably not affect the results.

One reader, however, made a brilliant suggestion, which we followed—that we hook up a few fuses in parallel, in series with a flat iron or a hot-plate load. We did just that, using 1-and 2-amp fuses in parallel. With the help of a Variac, it was found that before the 1-ampere fuse blew, the 2-ampere fuse was usually red hot. Obviously the two-fuse combination was carrying considerably more than 2 amperes.

A brief article, "Some Notes On Fuse Resistance," will go further into this question in an early issue.—*Editor*

Double Grid

This is simply the old cube circuit, presented in an unconventional way. Each resistor is 6 ohms. An equivalent circuit is shown for convenience in analyzing the cube circuit. The voltages at a, b and c are identical, as are those at d, e and f. Therefore, they can be shown connected together for purposes of calculation. Then, if the effective resistance of the circuit is 5 ohms (5 volts/1 amp) the value of any one resistor in the circuit can be found:



R = 1 network resistor
$5\text{ ohms} = \frac{1}{3}R + \frac{1}{6}R + \frac{1}{3}R$
$5\text{ ohms} = \frac{5}{6}R$
$R = 6\text{ ohms.}$

END

◆

50 Years Ago

In Gernsback Publications

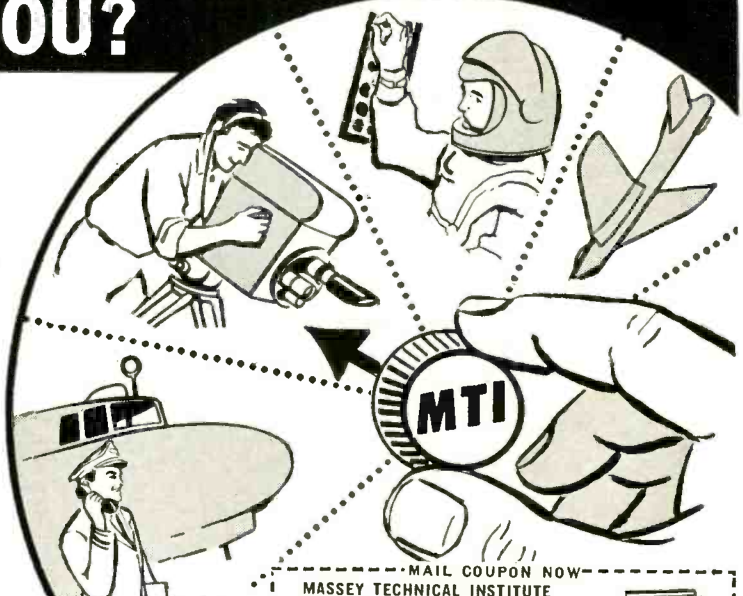
HUGO GERNSBACK, *Founder*

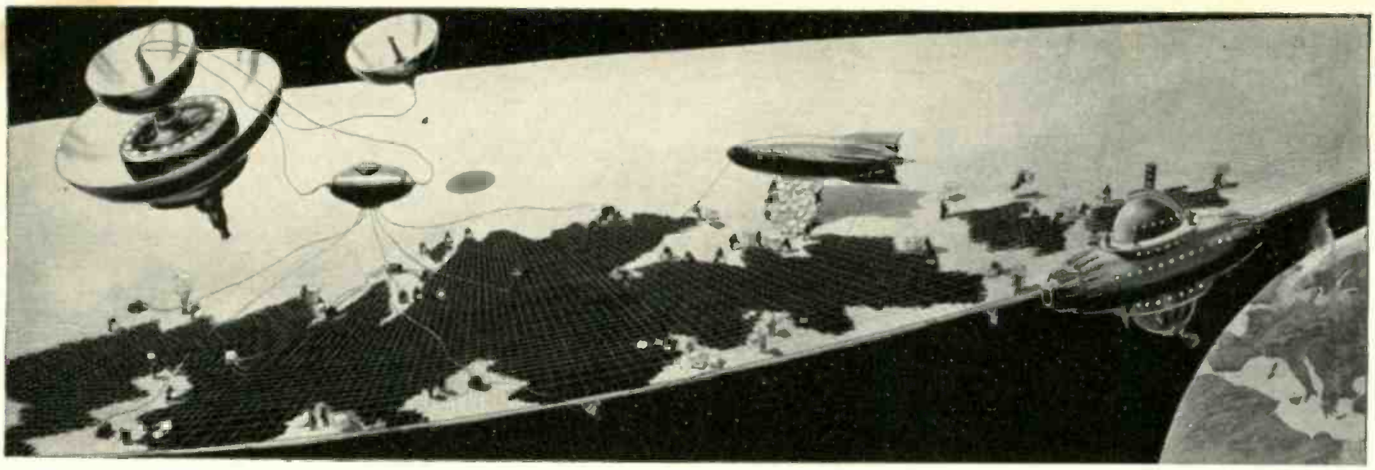
Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics and the Electrical Experimenter on file for interested readers.

In October, 1913, Electrical Experimenter

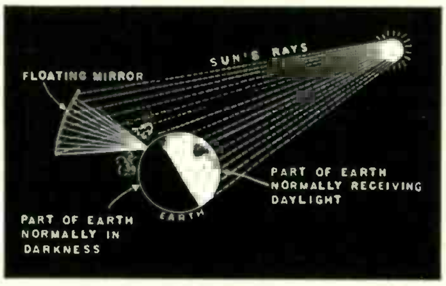
How to Build a Magnetic Hysteresis Detector, by H. Winfield Secor.
The Radio Detectometer.
The Poulsen Motor Tikker.
Music by Wireless Now.
Wire Fence Aerials.
Audion Detectors.



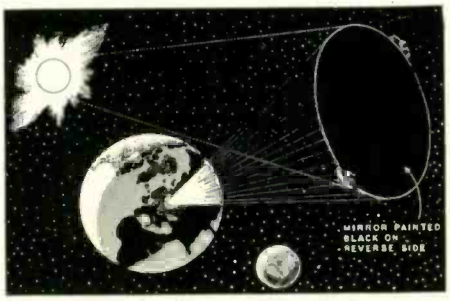


Illustrations by Frank Paul

The Oberth Space Mirror, under construction, as it would appear approximately 700 miles above the Earth. The three objects at left are the solar energy plant which furnishes power for the workers, as well as heat and light. Matter being weightless here, everything not rigidly attached floats off into space. Directly above we see a Space Rocket unloading chromium sheets which become the mirror's facets. The mirror measures some 100 miles in diameter. To the right is the Observatory Rocket, which also houses the workers. At lower right is the earth as it appears from 700 miles up. The sun is overhead.



This shows how the Spatial Mirror operates. The solar energy is caught by the mirror, then is concentrated on the dark side of the earth. For clarity's sake only one of more than 8 to 10 mirrors is shown. The mirrors' rays concentrate chiefly on the upper part of the atmosphere. The reflected energy of the mirrors is unimaginably large.



Another view showing only one of 8 to 10 space mirrors as they gravitate around the earth, as does the moon, below. Once in position the mirrors function continuously, except during the rare occasions when the earth eclipses the sun. Mirrors usually will be focused on the upper atmosphere.

(Continued from page 25)

account of the idea—many books can and probably will be written on it.

1. It is *not* the sole purpose of the mirrors to illuminate the dark side of the earth. At best, with all mirrors working at maximum illumination, the night side will be in a constant twilight.

2. The chief purpose of the mirrors is to heat the two subpolar regions sufficiently to keep the so-called temperate zones free from frost, deep snow and ice. No attempt would be made to melt the polar caps. (That would raise the level of the oceans more than 100 feet and put all the world's coastal cities under water.)

3. The solar mirrors would seldom concentrate their heat on the earth itself. *The mirrors would chiefly heat the atmosphere at the stratosphere level and above.* It is here weather is created and air currents are generated, the so-called jet currents that vastly influence our weather. It will be one of the tasks of the space mirrors to *regulate* these air currents for full efficiency.

4. Most important, just where, geographically, are the mirrors to concentrate their maximum heat for full efficiency? These regions will change from day to day, depending upon the seasons. Hence a global meteorological network must continuously feed such information to the mirrors' central headquarters.

5. This vastly detailed global weather information is then fed into special electronic computers and the result is then transmitted to the individual mirrors which now will concentrate their energy on the exact regions and atmospheric altitudes for the exact period required.

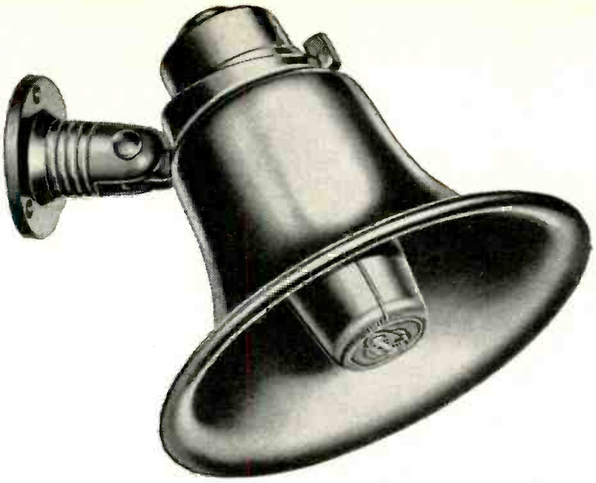
The above outline gives only an incomplete idea how the weather on our planet can be *regulated* in the future.

6. It must be realized that here we have to do with extremely vast cosmic forces running into many billions of horsepower an hour. Hence we must understand that even with all solar mirrors working at full efficiency, the climatic changes will be very slow and gradual. *It will not be perpetual spring all over the world immediately.*

It will take a number of years to derive the full benefit of our vast expenditures, which will run into many billions. But in the end it will be cheap and very much worth while.

—H. G.

"On the contrary, we have a very large tube inventory. However..."



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U-29

our policy on freebies

By ART MARGOLIS

WHEN MRS. ARMOZEEN CALLS AND SAYS, "Your man was here a few days ago and the TV is out again," you brace yourself. She always adds, "And you know, it's the same trouble."

If a customer ever said, "It's a different trouble", I'd award her a prize.

Naturally they try to pin the TV seizure on you so they can exercise the guarantee you give with every repair. Of course, they want the recall to be a freebie. How do you handle the price aspect of recalls? Do you insist on sticking to the letter of your guarantee and demand full compensation no matter what? Or do you give in easily and give away parts and labor to avoid any hard feelings? Here is our usual procedure on the three types of situations the recalls fall into.

The free call

Our guarantee is the usual one advocated by most bonding companies and associations. Generally stated, we guarantee our work. This includes all parts we install and any labor needed to reinstall any of these parts should they become defective during the next 90 days. This time length can be extended or shortened for specific parts such as picture tubes, etc.

Actually, this guarantee is only as good or bad as the service operator who gives it and the customer who accepts it. Each service job must be handled individually. The 90-day guarantee simply gives us a general framework within which to operate.

In many situations, logic, justice and sticking to your guns must yield to a businesslike approach. Whether you are entitled to money or not, it's sometimes best to waive the loot and be a graceful sport.

Like a 24-inch Philco that I serviced recently. In the house, the customer, an avid TV viewer, said "Do whatever you have to, just fix the set so it will play like it used to."

It had agc trouble. Tubes didn't help, so I pulled it for bench work. On the bench, with our good antenna, local stations were washed out and distant stations were coming in a little better than they normally do. The local-distance switch was inoperative.

I hooked my high-impedance bias box into the grid circuit of the first i.f. The condition cleared. Local channels came in once more and distant channels lost their extra gain. That meant the trouble was in the agc line, since the bias box substituted for the agc circuit.

Voltages are so tiny in the agc line and the number of components so few, I began statically testing each component. It didn't take long. An 8.2-megohm resistor coming out of the switch read wide open (Fig. 1). A nearby 6.8-megohm resistor read 300 megs. I replaced the two offenders and the agc condition cleared.

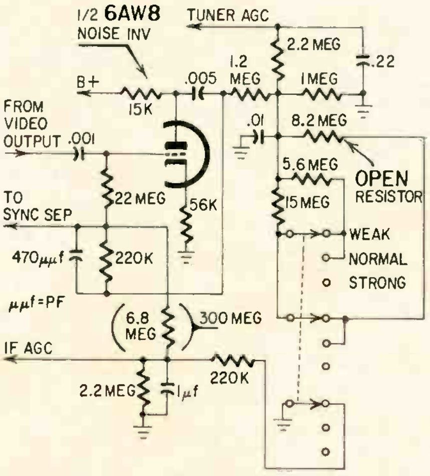

Fig. 1—Agc condition was caused when the high-value resistors in series with the LOCAL-DISTANCE (WEAK-NORMAL-STRONG) *switch increased drastically in value.*

The TV checked out otherwise, and it was returned to the customer with regular shop charges.

I didn't hear from the set owner for about a week. Then he called, "Art, the TV is doing the same thing."

I made the call myself. The symptoms were vertical foldover and occasional vertical roll. I checked the vertical tubes by replacement. The new ones didn't help a bit. I thought about the set's circuit. It was still fresh in my mind. It struck me that the vertical output tube's −10-volt bias came from a tap onto the horizontal output tube's −35 volts. A gassy horizontal output tube in this wild circuit could reduce the −35 volts and, by remote control, reduce the vertical output bias. I replaced the 6CD6 horizontal output amplifier. The vertical fold disappeared as the vertical tube stopped overdriving from the lack of bias.

The set owner said as nicely as he could, "Guess you didn't do too good a job in the shop. Guess you're gonna charge me some more money."

"No, sir," I replied, "the trouble was another tube conking out. We can't predict when tubes are going to blow. However, there is no additional charge. Hope your TV gives you good service now." I packed up and left without any additional fanfare.

If I had said it was different trouble and meant more money, it would have been hard for the customer to swallow. Since I said different trouble,

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How can we give away a tube and service charge? Our regular shop charges include enough to take care of one service charge plus one tube on every shop repair. It's easy to do a freebie when you've been paid in advance.

Charging for parts

While it's nice to act the philanthropist, you can't do very much of it in business. If the part is relatively inexpensive, you can include it in your apparent guarantee philanthropy. However, more expensive parts cannot be given away.

Fortunately, people do not object too strenuously when you charge for a part, as long as you give your labor away. Within the framework of your guarantee, you specifically state free replacement of any parts you replace. If you can definitely show that you have had to replace another component during a recall, most times customers will be agreeable and pay for it. This can cover you on a recall if you handle it properly.

A case in point was a 23-inch Silvertone that had developed noise on all channels. There was some audio, but it was almost drowned out by the racket of the intercarrier buzzing. Fine tuning did no good whatsoever.

I fed a 400-cycle note onto the plate of the audio detector, a 4DT6 sharp-cutoff pentode. The note came out of the speaker clear as a bell. That cleared the stages past the detector.

The sharp cutoff characteristics of the tube help limit any AM noise that might be in the sound i.f. carrier. The loud intercarrier buzz was a tipoff to insufficient limiting and poor detection.

I took voltage readings on the 4DT6. All were good. I took resistance readings. When I read the continuity from pin 7, the suppressor, to the bottom of the quadrature coil there was none (Fig. 2). The coil was open. I removed it and examined it closely under a magnifying glass. On one end the dope had dried up and the coil form had swelled. The wire had parted at this point. A drop of solder cured all. The coil was reinstalled, the audio sounded healthy and the TV was delivered.

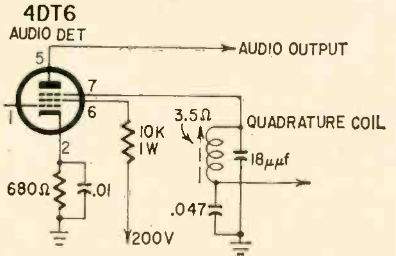

Fig. 2—One end of the quadrature coil opened and messed up limiting detecting action of 4DT6 audio detector.

No more was heard for about a week. Then the customer called, "It's the same thing." I took the house call. I turned on the set. The audio was perfect. I asked, "What's the trouble?"

"Wait a few minutes. You'll see."

I waited, then it happened. The picture developed white vertical lines, each about an inch thick. A severe case of yoke ringing. I jumped the horizontal windings individually and entirely with different small capacitors; no use.

She said, "This has been happening off and on for a year. I thought you fixed it."

I asked, "Did you mention it to me when I took the TV to the shop?"

She answered, "I don't remember, but you should have fixed it."

I said, "I'll tell you what I can do, I'll purchase a new yoke for you and I won't charge you for my labor to install it. All you'll have to pay for is the yoke itself. You'll end up paying exactly what you would have if we had replaced the yoke in the shop. No more."

She agreed easily. Most reasonable people will. It was a plug-in yoke, easy to install, and the profit I made between the net price and list covered the cost of the recall. The call wasn't a loser.

When to charge all over

While charging for parts can help cover costs in calls that occur during guarantee periods, you'd go broke on the less expensive items. There are some situations where a compelete new service fee is indicated.

You can prepare in advance for such eventualities if you let the customer know exactly what was done to their set on the initial call. In fact, go out of your way to explain the original repair. One such call I had was on a 24-inch Emerson. The complaint was vertical roll after about 10 minutes. Since tubes didn't help, I pulled it to the shop.

On the bench, after the condition started, I examined the vertical blanking bar. The sync pulses were blacker than the darkest picture element. That meant sync input was good and the trouble was in the sync or sweep circuits.

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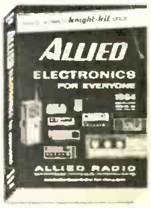

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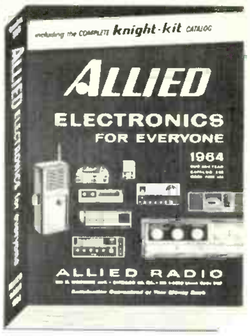

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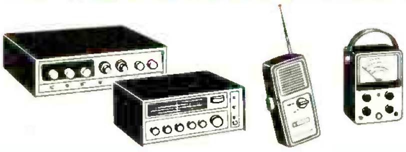

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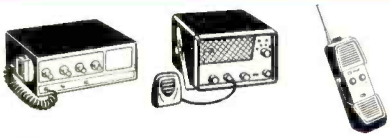

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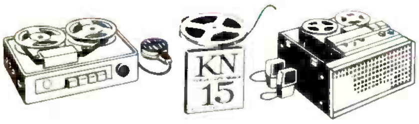

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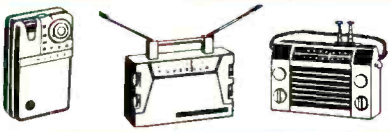

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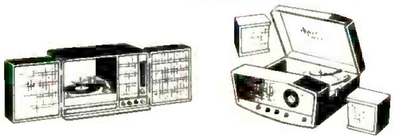

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I ran some voltage tests on the sync separator. There was supposed to be 50 volts on the plate of the 5U8. As the seizure occurred, the 50 volts gradually dropped to 10. I crossed over the 27,000-ohm plate load resistor. There was 125 volts on the other side, as it should be. I checked the far side of the coupling-blocking capacitor leading to the sync amplifier. It was near zero volts at that point so the capacitor didn't seem to be leaking. That left the load resistor. I felt it. It was a bit too warm. With the TV still on, I snipped off the B-plus end of the resistor and measured its resistance quickly. It read 500,000 ohms instead of 27,000 ohms (Fig. 3). That was it. The resistor was replaced, the TV checked out. I delivered it.

During delivery one point was made. I said, "Do you remember the trouble?"

She said, "I think so."

I said, "The picture was rolling. Now look. The vertical hold control works like a charm."

She tried the vertical hold and said, "Oh yeah, it's real good."

Two weeks later she exercised her guarantee. I went to the house and examined the latest trouble. The fuse resistor was open. I measured the silicon rectifiers. One had a dead short. I said, "You have an entirely different trouble."

She answered. "Yeah, I know, it's not the vertical hold knob this time."

I replaced both rectifiers just to be sure and the fuse resistor. I wrote up the bill and, to ease the pain a bit, said, "Now you have two 90-day guarantees. One on each job."

I don't have to tell you what would have happened if we didn't make the point of the vertical hold. The customer would honestly have believed it was the same thing.

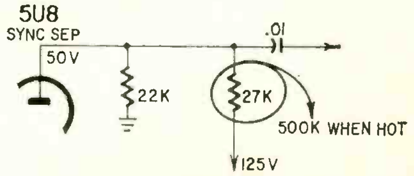
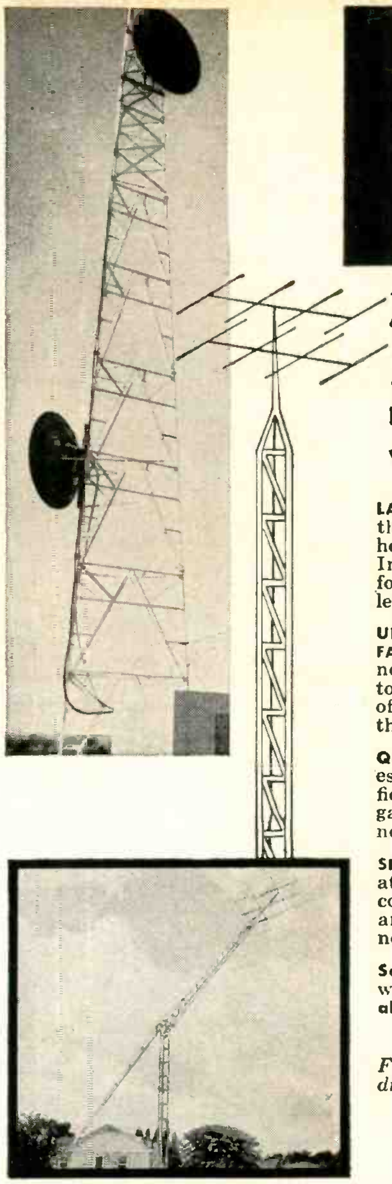


Fig. 3—The 27,000-ohm plate resistor would go up in value after the set was on for about 10 minutes.

To sum it all up, our policy on freebies is to play each job by ear and obtain as much money as we are entitled to without jeopardizing our hard-earned customers. A bit of customer psychology must be used, and a freebie reserve charge included in your service fees is mandatory. You can run some recalls as complete freebies, charge only for parts on other recalls and be able to recharge on the third type. Each particular job and customer is individual. It hurts sometimes, but pattern your policy around that old cliché, "you can't win an argument with a customer." END



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NICKEL CADMIUM RECHARGEABLE BATTERIES. 10-page brochure discusses voltage stability, discharge rate, recycling, temperature, mechanical stress, other characteristics. Illustrated by graphs and 18 photos.—**Sylvania Electric Products Inc.,** 730 3rd Ave., New York 17, N. Y.

TELSTAR II. 72-page, illustrated color reprint of April 1963 issue of Bell Labs Record. Contains 10 semi-technical articles about engineering of project, communications equipment, Andover ground station, satellite launch operations.—**Telstar Record,** Bell Telephone Labs, 463 West St., New York 14, N. Y.

TAPE HEADS described in 4-page leaflet. Full description, specs, cross-reference table for record/play, record and erase heads.—**The Nortronics Co., Inc.,** 8101 10th Ave. N., Minneapolis 27, Minn.

UHF CONVERTERS described in 2-page, illustrated spec sheet. Photos, operational features, specs on manufacturer's two models.—**Standard Kollsman Industries Inc.,** 2085 N. Hawthorne Ave., Melrose Park, Ill.

APPLICATION NOTES. Noise and gain of the RCA-8056 Nuvistor triode at 200 mc, 4 pages, *Note AN-195;* new high-gain tubes for i.f. amplifier and limiter stages of FM tuners. 6 pages, *Note AN-197;* temperature ratings and thermal considerations for Nuvistor tubes, 4 pages, *Note AN-196.* —**RCA,** Electron Tube Div., Harrison, N. J.

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CERAMIC CAPACITOR CHART. 17 x 22-inch wall chart shows 20 ceramic capacitor types. Line drawings, dimensions, form factors. Capacitance values, voltage, operating temperature, dissipation factor, insulation resistance. Applications, construction details.—**Cornell-Dubilier Electronics,** Div. Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

ELECTRONIC WIRE shown in 28-page 1963 *Catalog 863.* Complete specs. detailed line drawings approximately 70 types.—**Belden Mfg. Co.,** 415 S. Kilpatrick, Chicago 44, Ill.

MAGNETIC TAPE for instrumentation application. Illustrated 10-page booklet gives complete description of manufacturer's tape line. Sections on tape selection. accessories.—**Ampex Corp.,** Mail Stop 24-1, 934 Charter St., Redwood City, Calif.

LOUDSPEAKERS shown in illustrated *Data Sheet 170.* 24 Viking models, 3–12 inches, including 10 new oval models. Lists magnet weight. impedance, power wattage output, voice-coil diameter, dimensions and list price.—**Jensen Mfg. Co.,** 6601 S. Laramie Ave., Chicago 38, Ill.

PORTABLE TAPE RECORDER shown in 4-page foldup leaflet. Photos, description, full specs on new Sony model 801-A and accessories.—**Superscope Inc.,** Dept. 1A, Sun Valley, Calif.

SOUND, 20-page "how-to" manual, describes amplifiers and systems for industrial applications, outlines selection considerations. Sound system design chart shows required audio power for specific applications. Technical data and photos of manufacturer's CA and Troubador series transistorized PA amplifiers.—**Harman-Kardon Inc.,** 55 Ames Court, Plainview, N. Y.

MODULAR CABINET RACKS, CONSOLES described in illustrated 44-page *Catalog 63.* Contains engineering drawings, specs, descriptions. Illustrations show how units can be used singly or in assemblies.—**Par-Metal Products Corp.,** 32-62 49 St., Long Island City 3, N. Y.

CAPSULE THERMISTOR COURSE NO. 2. Educational data sheet details resistance–temperature, voltage–current, current–time characteristics. —**Fenwal Electronics Inc.,** Sales Engineering Dept., 63 Fountain St., Framingham, Mass.

REPLACEMENT TRANSFORMERS, COILS. 1,500 types for TV, radio, hi-fi, stereo, shown in 48-page *Catalog 1-1063 1963/64.* Instructions for selection of transformers, schematics of manufacturer's coil products, output transformer chart. Lists 260 home entertainment tubes, with transformer for use with each.—**Stancor Electronics Inc.,** 3501 W. Addison St., Chicago 18, Ill.

FLEXIBLE NEEDLE REFERENCE GUIDE, *No. SAH-71.* Foldup chart lists 1,400 phono models now in use in which new flexible needle may be installed.—**Sonotone Corp.,** Elmsford, N. Y.

POWER FOR TELEMETRY. 4-page, illustrated brochure gives characteristics and recommendations on use of modules for L and S bands. Describes cavity amplifier modules powered by grid-type power tubes in cascade.—**Eitel-McCullough Inc.,** 301 Industrial Way, San Carlos, Calif.

BARRY'S GREEN SHEET No. 11. Illustrated 1964 catalog offers new and surplus tubes, semiconductors, transformers, chokes, meters, test equipment, industrial supplies.—**Barry Electronics Corp.,** 512 Broadway, New York 12, N. Y.

PORTABLE INDICATING INSTRUMENTS shown in 4-page illustrated *Technical Bulletin 99-352.* Photos and specs, two series ac and dc instruments with taut-band suspension.—**Westinghouse Scientific Equipment Dept.,** PO Box 868, Pittsburgh 30, Pa.

FREQUENCY CONTROL HANDBOOK. 44-page catalog has illustrated design parameters. Describes crystals, 400 cps–100 mc; filters, center frequency 1 kc–20 mc; frequency sources 1 cycle–250 mc.—**Hill Electronics Inc.,** Mechanicsburg, Pa.

REED RELAYS. 16-page *Catalog B* describes and pictures 12 custom types, with photos and full specs. Types include basic, pulse, crosspoint, latch, logic and infinite margin reed relays.—**Struthers-Dunn Inc.,** Pitman, N. J.

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SILICON TRANSISTOR GUIDE. 2-page data sheet lists silicon planar "leaf" n-p-n transistors, silicon diffused mesa power transistors by type number, with electrical characteristics and case type.—R. R. Meijer, **Bendix Semiconductor Div.,** South St., Holmdel, N. J.

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A new phase inverter-output tube makes this amplifier possible. Built by a member of the RADIO-ELECTRONICS staff, it offers an honest 10 watts per channel at a very modest cost.

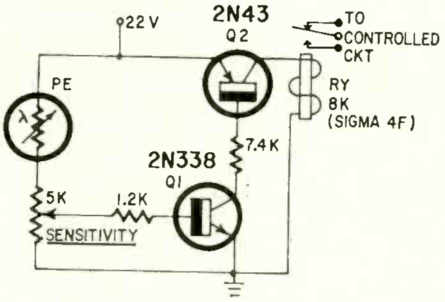
NOVEMBER ISSUE (ON SALE OCTOBER 17)

noteworthy Circuits

Photoelectric Relay

This sensitive photocell amplifier trips a relay on small increases in light intensity. A flashlight beam directed at the photocell in a normally lighted room will trigger the relay at a distance of 35 feet. In pitch darkness, the relay can be operated at 60 feet.

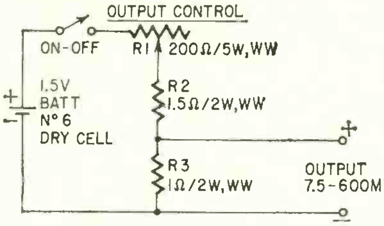
The photocell is a Polaris Maj-I type photoresistor (Lafayette Radio Electronics catalog No. MS-791). When light falls on the cell, its resistance decreases and raises the base voltage on Q1. Q1's conduction increases and forces more base current into Q2. This increased base current is amplified by the current gain of the stage and forced to flow through a sensitive relay which pulls in at less than 2 ma.



The transistors specified are rather expensive. Other types can be used but Q1 should be a low-leakage (I_{CBO}) type.—*Phillip Cutler*

Tunnel-Diode Supply

A well regulated, low-resistance dc bias supply is required when testing tunnel diodes. This is especially true when they are tested as amplifiers; an unstable supply can result in no amplification at all. Many suitable supplies have been described, most of them employing some form of electronic voltage regulation, but a complicated circuit is not necessary if the output resistance is made low



enough to "stiffen" the supply.

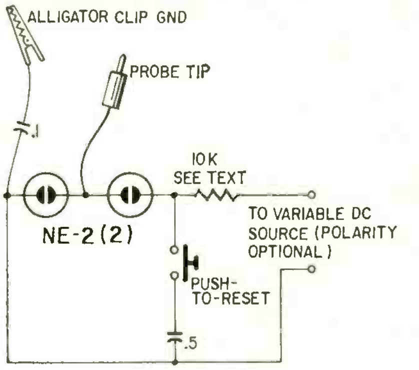
The diagram shows the simple circuit of a stiffened supply. The output resistance, determined by R3, is 1 ohm. R1 varies the output voltage between 7.5 and 600 millivolts dc. This voltage range will accommodate all commercially available tunnel diodes.

Since the current through the resistor string is high (0.6 amp at 600 mv output, the price paid for the low-resistance output), a large-sized 1.5-volt cell is required. I use a No. 6 cell.

The 5-watt wirewound pot, a Centralab WW-201, is of volume-control size (1⅛ inches in diameter) and provides smooth control of the output voltage. Limiting resistor R2 prevents accidentally applying the full 1.5 volts to the diode when R1 is at its lowest resistance setting.—*Rufus P. Turner*

Novel Capacitance Probe

Stray capacitance is very often an unnoticed problem until after an experimental circuit is completed and found to be unstable or even inoperable. The trouble is usually distributed capacitance of only a few picofarads. Only the more expensive bridges detect, much less measure, such low capacitances. Uhf and CB experimenters must rely on experience and simply guess at such things as the maximum length of those "short as possible" leads, how much a tube shield will affect circuit performance, and other sometimes all-important "intangibles."



But for little more than the price of two NE-2's, many of the pitfalls of unwanted capacitance can be pin-pointed, regardless of whether the circuit in question is working or still in the design stage. The uncomplicated circuit shown in the diagram may be built into a clear plastic probe and used to indicate and indirectly measure extremely small capacitances. As long as the distance from the probe tip to the neon bulbs is kept to an inch or so, physical arrangement is completely flexible. Some experimenters may wish to make the reset circuit a part of the power supply. The only rigid requirement is that the probe body be transparent so that the glow of the bulbs may be seen!

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Operation is simple. The series-connected NE-2 lamps are biased just below their firing potential by an external power supply. When a small capacitor is suddenly shunted across one of the lamps, which is what happens when the probe tip is touched to a capacitance relative to the ground lead, the gas in the other lamp ionizes slightly as this "capacitor" charges. Taking advantage of the increased conduction this ionization has produced, the first lamp is able to ionize also. The result, in effect, is an ionic avalanche which ends with both lamps totally ionized and glowing brightly. The amount of capacitance needed to trigger this indication is determined mainly by the voltage applied across the lamps. Sensitivity is surprising, and detection of capacitances down to 3 pf is not unusual.

The probe is reset by either turning off the power or by shunting the lamps with a large capacitance to drop their supply voltage below the cutoff point. The 0.5-μf capacitor protects the indicators in case the probe tip should be accidentally shorted to ground. Trial-and-error calibration of the probe with different applied voltages and standard capacitances will enable the experimenter to "measure" stray capacitance with reasonable accuracy. No fancy power supply is required. Most any source of B-plus, adjustable by a 100,000-ohm pot connected as a voltage divider, will serve the meager (about 0.3 ma) requirements of this electronic nuisance-spotter. The range of voltages depends on the characteristics of the individual NE-2's. A variable source of about 110 to 150 should be adequate. The value of the series resistor should be chosen so the indicator lamps go out when the RESET button is pressed.—
Maurice E. Scherer, Jr. END

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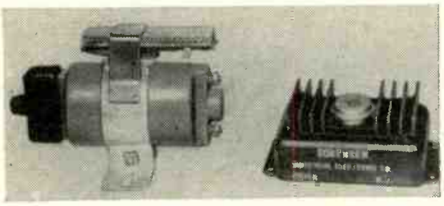

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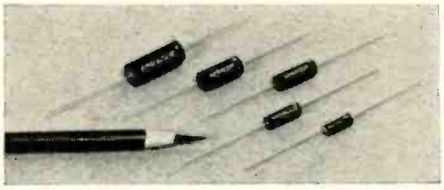

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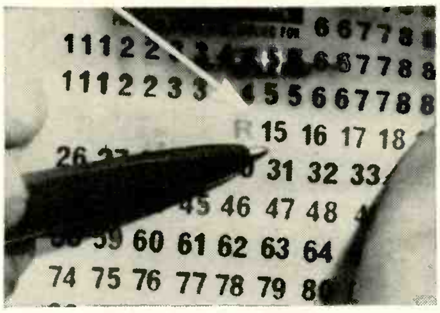

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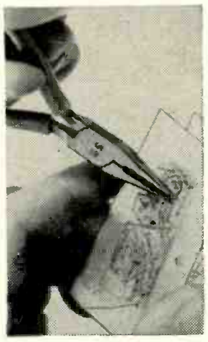

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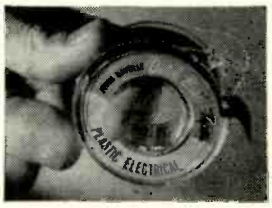
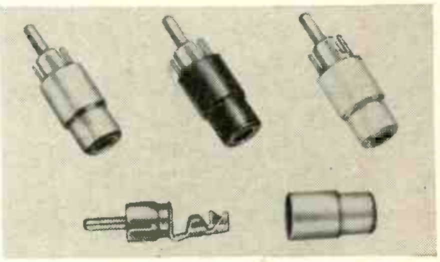


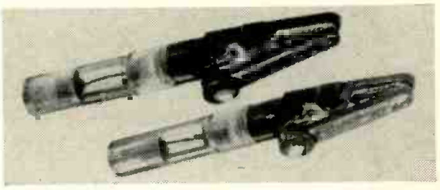
SOLDERLESS TERMINALS and connectors, *Pre-Vue Pak.* 100 popular types available packaged in quantities from 15 to 45.—**Waldom Electronics,** 4625 W. 53 St., Chicago 32, Ill.

PHONO PLUGS, *Series 3508.* Positive cable clamp minimizes shorts due to pulling and twisting strain on soldered contacts. Snap-on plastic handles. For 2-circuit applications—hi-fi, stereo equipment, record players, FM-AM tuners, etc. **Switchcraft,** 5555 N. Elston Ave., Chicago 30.



BULL DRIVERS, BIG SHORTIES. Plastic *Comfordome* handles break- and shock-proof. Blades of chrome vanadium steel, polished nickel-chrome finish. 7 bull-driver models, square blades, various sizes; 6, round blades; 1, Phillips blade. *Big Shorties* square blades. ¼- and 5/16-inch.—**Vaco Products Co.,** 317 E. Ontario St., Chicago 11, Ill.

FUSED TEST CLIP, *model 1410F Safe-T-Klip.* 2 insulated alligator clips with fuse housing for type AGX or other fuse measuring ¼ x 1 in. Any-length test leads may be connected to clips. Clear plastic holder permits visual check for blown fuse. 100% Nylon-insulated, safe operation to 600 volts.—**Industrial Devices Inc.,** Edgewater, N. J.



CB VIBRATORS. Large contact points; heavy-duty lead wires; gold-anodized, serrated can. To replace all popular models.—**Vokar Products Inc.,** 149 E. Hoover St., Ann Arbor, Mich.

IN-CIRCUIT TRANSISTOR/DIODE TESTER, *model 3.* Portable. Measures true small-signal

ac gain at 1kc. Dc continuously variable to 1,000 ma. In-circuit measurements of saturation voltage of transistors, and forward voltage drop of diodes and rectifiers. Gate signal for testing silicon-controlled rectifiers in circuit. Ac gain, current leakage and saturation voltage measured out of circuit. Accuracy 3% out of circuit, 5% in any circuit 20 ohms or more.—**Test Equipment Corp.**, P.O. Box 22042, Houston 27, Tex.

VHF–AM MONITOR RECEIVER, *model AMR52-X*. For 100–150-mc band. Single or multi-channel. Front-panel controls: volume and squelch,

power switch, channel selector (optional). Standard models for 117-volt, ac operation. On special order, receivers with 6- or 12-volt transistor type dc power supplies.—**Hammarlund Mfg. Co.,** 53 W. 23 St., New York 10, N. Y.

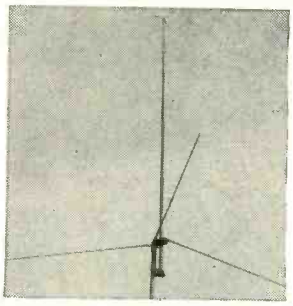
UHF 2-WAY MOBILE RADIO, *type M-845-A*. Single control head: speaker, operating controls, transistorized power supply and standby power-saving switch. 25 watts, operates in 450–470-mc band. Mounted in trunk, under dash, or other location. For 12-volt operation.—**Du Mont**

Labs, Communication Dept., Div. Fairchild Camera & Instrument Corp., Clifton, N. J.

ONE-BAND SSB TRANSCEIVER, *Kit model HW-12*. For 80-meter amateur band, mobile or fixed-station operation. Heavy-duty circuit board, 1-piece steel chassis, gimbal bracket for under-dash mounting. Low-frequency vfo, automatic

level control, large vernier tuning dial with 6 inches bandspread, tuning meter, crystal filter ssb generator. Provision for use with linear amplifier and plug-in 100 kc crystal calibrator. 14-tube heterodyne circuit, 45-db carrier suppression, 200 watts.—**Heath Co.,** Benton Harbor, Mich.

COLINEAR CB ANTENNA, *CLR II*. 8-db omnidirectional gain. 3.4-db omnidirectional gain in measured field-strength intensity. Radiator 19 ft. 10 in., electrically extended to ⅝ wavelength.



Full ¼ wavelength horizontal radials. ⅝ wavelength radiator working against ¼ wavelength ground plane system extends range. Built-in static arrester, 6 db gain in signal-to-noise ratio. Moisture-proof solid-state matcher swr less than 1.2:1. 52-ohm coax cable connector recessed and embedded in moisture-safe housing.—**Hy-Gain Antenna Products Corp.,** 1135 N. 22 St., Lincoln, Neb.

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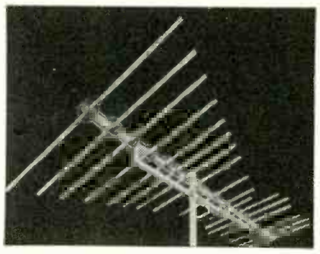

tenna-mounted preamp (gain to 28 db); 3 FM antennas with gain to 12 db.—**Jerrold-Taco,** 15th & Lehigh Ave., Philadelphia 32, Pa.

8-TURN HELICAL ANTENNA, *model G-1453*, for telemetry. 6-foot-diameter ground

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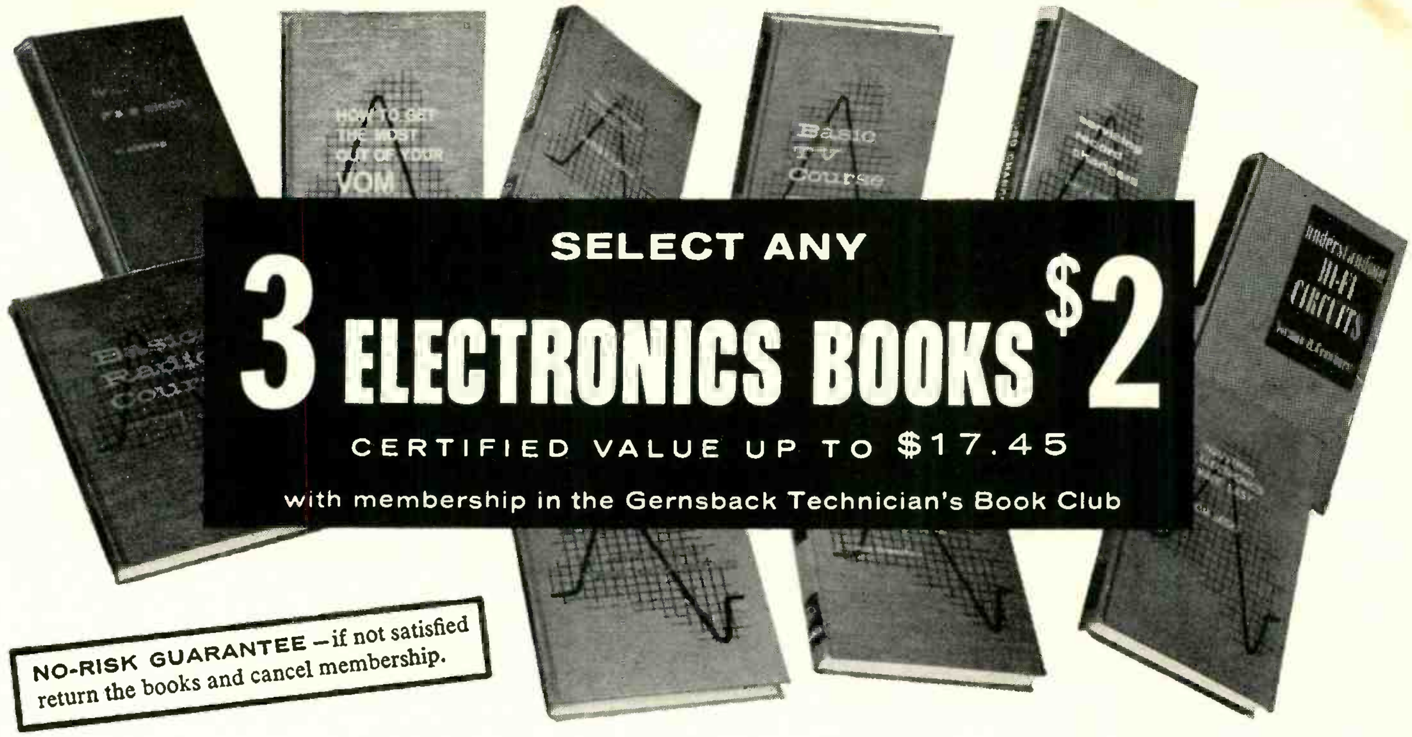

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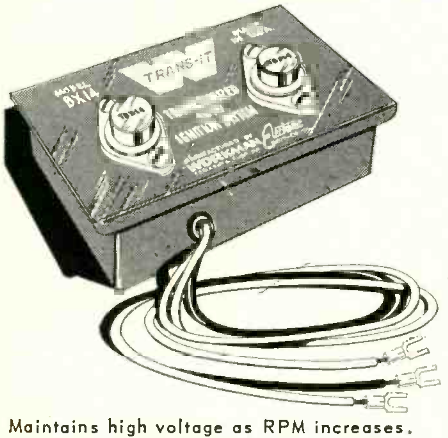
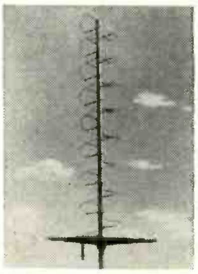
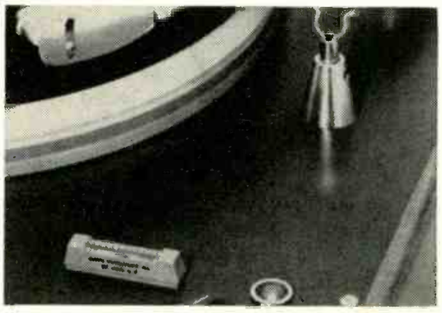


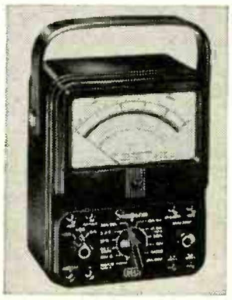
plane, polarized in right circular mode. Gain 13 db nominal at center frequency. 2-piece circular ground plane of aluminum sheet .062-inch thick with reinforcing ribs supporting radial arms. Arms ¾-inch OD aluminum tubing, extend 8 in. from 56-in. diameter circular disk. Overall diameter of ground plane with radials, 72 in. Radiating helix of ⅜-inch aluminum tubing supported from 3½-in. aluminum shaft by fibrous glass insulators.—**TACO, Technical Appliance Corp.,** Sherburne, N. Y.



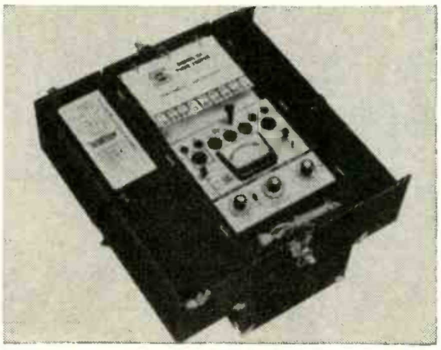
MINIATURE ELAPSED-TIME METER, *Curtis 500 Indachron.* Measures hours of wear on stylus, tape recording heads, preamps, amplifiers, etc. Electrochemical meter element with traveling electrolyte gap. Plug-in indicator and separate molded Zener diode power supply regulate and rectify 115 vac. Elapsed time read directly from calibration marks. Standard scales 500, 600, 1,000 hours, all with 3% accuracy. Under-panel space requirements to mount power supply and socket plate, 0.40 x 1.5 x 0.50 in.—**Curtis Instruments Inc.,** 351 Lexington Ave., Mt. Kisco, N. Y.



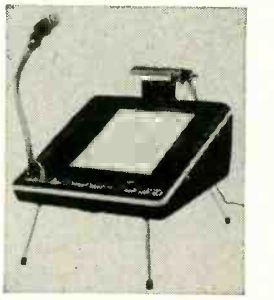
VOM, *model 261.* Accuracy 1½% dc, 3% ac. Self-shielded annular ring meter movement. Spring-backed jewels. Mirror scale with knife-edge pointer eliminates parallax. Diode overload protection prevents movement burnout on 200,000% overload.—**Simpson Electric Co.,** 5200 W. Kinzie St., Chicago 44, Ill.



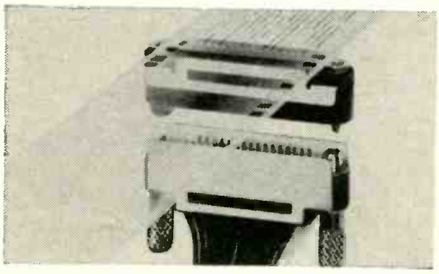
TUBE TESTER/TOTER, *Caddy Pack.* Storage sections holds more than 200 tubes. Test section meter reads grid emission, common leakage and short faults in one step. Indicates filament continuity and open elements plus cathode emission. Grid circuit and tube merit test scales show tube faults on single, burnout-proof meter.—**Seco Electronics Inc.,** Dept. 164, 1201 So. Clover Dr., Minneapolis 20, Minn.



ROVING ROSTRUM, *Ampli-Vox.* Portable, battery-powered, self-contained sound system doubles as lectern. 25 watts audio power, runs on flashlight batteries. Low-impedance omnidirectional dynamic mike, 2 full-fidelity speakers (1 in reading table, 1 in cover). Anti-feedback speaker housing. Inputs for mike and auxiliary equipment, two outputs for speakers or other equipment. 22 lbs. —**Perma-Power Co.,** 5740 N. Tripp Ave., Chicago 46, Ill.

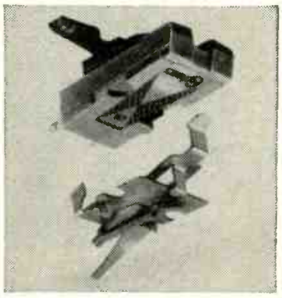


MULTI-TRACK HEAD, *Pinlite.* 16 to 32 light sources per inch of film width. Compact readout device can be used with perforated cards or tapes, photosensitive films, other optical sensing devices. Voltage requirements 1½ volts max. Number of tracks on head variable; head may be arranged like highly dense matrix with up to 240 individual light sources per square inch. Lamps have built-in lens effect. Heads usable with 35-mm or other standard film.—**Pinlite Div.,** Kay Electric Co., Pine Brook, N. J.



TURNTABLE/AUTOMATIC CHANGER, *model TD-224 Masterpiece.* Built-in continuous record-cleaning device, illuminated stroboscope visible through playing cycle. Plays records individually, record feed-in arm changes records automatically. No record stacking.—**Elpa Marketing Industries Inc.,** Thorens Div., New Hyde Park, N. Y.

PHONO CARTRIDGE, *model U-11R Soft Touch.* Lifts stylus automatically if abnormal pressure is applied to tone arm; brings soft plastic guard nib into position between cartridge and record so stylus cannot contact record until abnormal pressure is removed. Frequency response 20–



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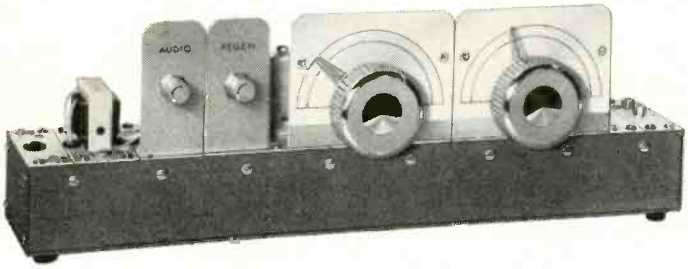

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This new line of International receiver kits cover a wide range of amateur, citizens band and special frequencies. Designed for AM, CW, or SSB reception, this basic receiver using a superheterodyne circuit* with regenerative second detector may be expanded to a more elaborate receiver by the addition of other Add-On-Circuits. Sensitivity usable to below 10 microvolts for voice and 1 microvolt for code. Nuvistor rf amplifier, mixer, oscillator, I.F. transformer, detector/1st audio, and power audio amplifier. Tube lineup: 6DS4 nuvistor, 6BE6, 6U8, 6AQ5.

Receiver kit includes 4" speaker and power supply.

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AOR-43	6 mc — 18 mc	62.50
AOR-44	80 meter/40 meter	62.50
AOR-45	15 meter/10 meter	62.50
AOR-46	6 meter	66.50
AOR-47	2 meter	66.50
AOR-48	Citizens 27 mc	62.50

*AOR-41 uses a tuned rf circuit with 6BA6

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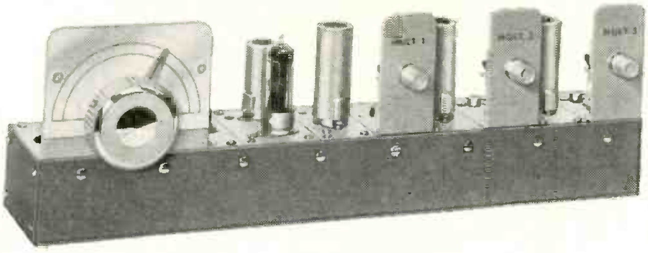

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The International AOF series of variable frequency oscillator kits is available in three versions. For example, the AOF-91 kit is a complete driver unit to be used with 6 meter and 2 meter transmitters. Approximately .5 watt of power is available on both bands. Tube lineup: 6BH6 oscillator, OB-2 voltage regulator, 12BY7 buffer-amplifier/multiplier.

Kit	Frequency	Price
AOF-89	VFO 8 mc — 9 mc and buffer	**$22.00**
AOF-90	VFO 8 mc — 9 mc plus buffer multiplier and 6 meter output	**29.00**
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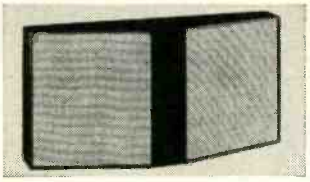
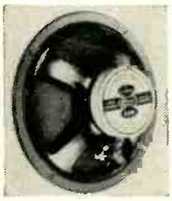
CERAMIC HEADPHONES. Frequency response 50–10,000 cycles. Moisture- and heat-resistant piezoelectric elements. Impedance 50,000 ohms at 1,000 cycles. "Blanket" and "donut" earcushions available.—**Clevite Corp.**, Piezoelectric Div., 232 Forbes Rd., Bedford, Ohio.

WALL-MOUNTED SPEAKER SYSTEM, *model TP88.* Tapered face for wide-angle dispersion in long, narrow rooms. 4 inches deep in center. 15 watts peak audio power. Two 8-inch speakers prewired to screw type terminal board. Mounting hardware. Overall 10 x 20 in.—**Utah Electronics Corp.**, 1124 E. Franklin St., Huntington, Ind.

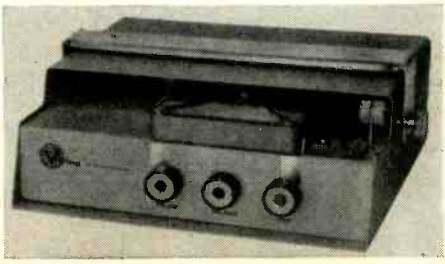


8-INCH FULL-RANGE SPEAKER, *Castle Bell model S-548.* Ceramic magnet, double-wound voice coil. Flexedge cone, exponential high-frequency whizzer. Response 30–15,000 cycles. Power rating 12 watts. Impedance 8 ohms.—**Olson Electronics Inc.**, 260 S. Forge St., Akron 8, Ohio.



3-WAY SPEAKER KIT, *KS-2 Stratakit.* 12-inch free-piston woofer, half-roll cotton surround, 6-lb magnet structure. Free-air resonance 25 cycles. 5-inch mid-range, butyl-coated surround, sealed off in back. 3-inch cone type tweeter, hemispherical dome bonded to 1-inch voice coil with 2-lb magnet structure. 3-way inductance–capacitance crossover network at 1,200 and 2,800 cycles. Continuously variable tweeter level control. —**Fisher Radio Corp.**, 21-21 44th Dr., Long Island City 1, N. Y.

TAPE CARTRIDGE PLAYER, *Auto-Tape 500.* Solid-state amplifier, 2 watts per channel,



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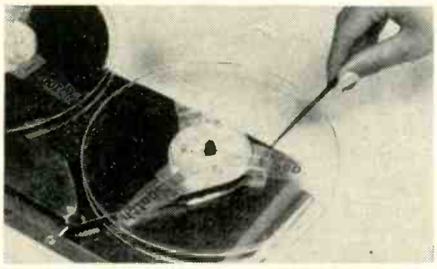
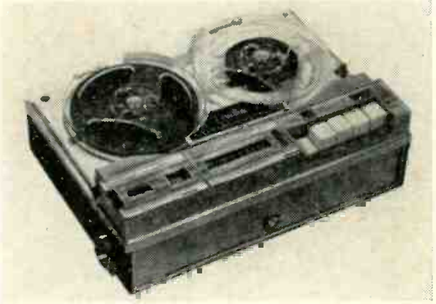
cartridge deck. Operates from 12-vdc power source. Accepts all Viking cartridges with prerecorded quarter-track stereo programs for 3¾-ips playback. Response 60–10,000 cycles, ±3 db. Amplifier has 10 transistors. Speaker output impedance 3–4 ohms. Distortion 2%, flutter and wow 0.3%. Signal-to-noise ratio 50 db. Power requirements 11–14.5 vdc, 1 amp. max. negative ground.—**Viking of Minneapolis Inc.**, 9600 Aldrich Ave. So., Minneapolis, Minn.

SELF-THREADING TAPE REEL. Threaded by laying tape between flanges near hub. Tape winds and unwinds automatically. Solid-flange reels with footed plastic snap-closure collar; reel and collar self-storing. Pressure-sensitive adhesive write-on labels for reel and collar. "Scotch" brand tape, No. 290-36, in 3,600-foot lengths on 7-inch reel.—**3M Co.**, 2501 Hudson Rd., Saint Paul 19, Minn.

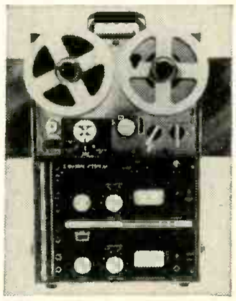


PORTABLE TAPE RECORDER, *Korting TR 2000*. Duplicates original tapes without second recorder. 4-track transistorized hi-fi model with stereo head outputs. Low-impedance dynamic mike; mono record–play patch cord; takeup reel. 7½, 3¾ ips. 4-track record/playback, sound-on-sound dubbing, hysteresis motor. Other models available.—**Matthew Stuart & Co. Inc.**, 156 5th Ave., New York 10, N. Y.

PORTABLE TAPE RECORDER / RADIO, *model 400 Cosmopolitan*. 1⅞, 3¾ ips. Four 1.5-volt flashlight batteries, external ac. Transistorized. Record–playback, erase heads. Arbitrary counter, dual meter to monitor audio level and show condition of batteries. 5-inch reels. Under 10 lb.—**American Concertone Inc.**, Div. Astro-Science Corp., 9449 W. Jefferson Blvd., Culver City, Calif.



WIDE-RANGE TAPE RECORDER, *Crossfield 770*. 7½, 3¾, 1⅞ ips. Crossfield head records new higher octave. Separate recording and biasing heads eliminate erasure of higher frequencies. Gap width 40 millionths of an inch. 2-speed, electrically switched, heavy-duty hysteresis synchronous motor. Blower ventilation system: automatic shutoff switch selector.—**Roberts Electronics Inc.**, 5978 Bowcroft St., Los Angeles 16, Calif.



All specifications from manufacturer's data.

10-WATT STEREO AMPLIFIER, *model LA-214*. Self-contained, ac-operated amplifier for stereo or mono inputs from record players, changers, tuners and stereo tape players. Music power output 5 watts per channel, 10 watts mono. Response 50–20,000 cycles ±1 db at 1 watt. IM distortion 3% at full output. Hum and noise 58 db below full output. Front-panel controls: 4-position mode selector, 3-position program selector, separate concentric bass, treble and volume controls for each channel, ac on–off switch, rumble filter on–off switch, speakers/phones switch and stereo headphones jack. Rear panel: speaker impedance switch (8 or 16 ohms), speaker phase switch, hum adjust, ac convenience outlet. 105–125 volts.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y. END

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RADIO-ELECTRONICS MARKET CENTER
on Page 109

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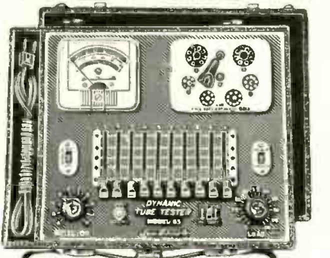

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6A8
6AB4
6AC7
6AG5
6AL5
6AN8
6AQ5
6AS5
6AT6
6AT8
6AU4
6AU5
6AU6
6AV6
6AW8
6AX4
6BA6
6BC5
6BD6
6BG6
6BH6
6BJ6
6BL7
6BN4
6BN6
6BQ6
6BZ6
6C4
6CB6
6CD6
6CF6
6CG7
6CG8
6CM7
6CZ5
6D6
6DA4
6DE6
6DQ6
6EM5
6F6
6SH7
6SJ7
6SK7
6SL7
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6SO7
6SR7
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6J5
6J6
6K7
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6Q7
6S4
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6SC7
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6W6
6X4
6X5
7A7
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12AF6
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12AX7
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12BD6
12BE6
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12BH7
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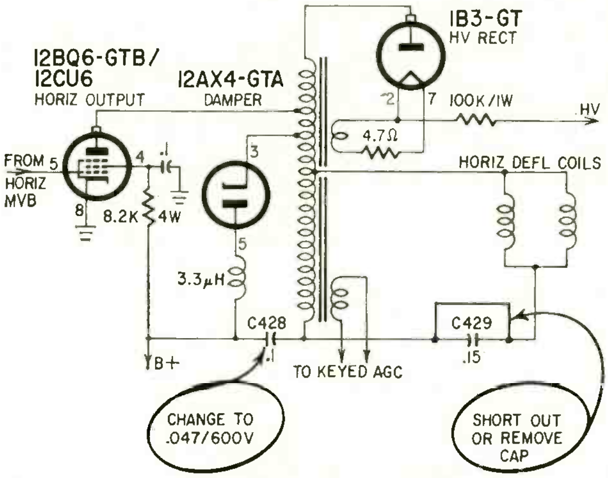
TECHNOTES

Westinghouse V-2342 Chassis

For parasitic oscillations in horizontal output circuit of Westinghouse chassis V-2342 (RADIO-ELECTRONICS, July 1957, p. 58), Westinghouse Supplement No. 1 to V-2342 and V-2343 chassis Service Manual recommends shorting out C429 (or removing it completely) and changing C428 to .047 μf, 600 volts. This also applies to chassis V-2316 and V-2317, and others using the same horizontal output circuit. These changes were made later in factory production.



I have seen several cases of this trouble, and in every one, making these changes produced a complete cure. The first case I had, though, was a real puzzler until I wrote to the distributor's service manager.—*W. J. Stiles*

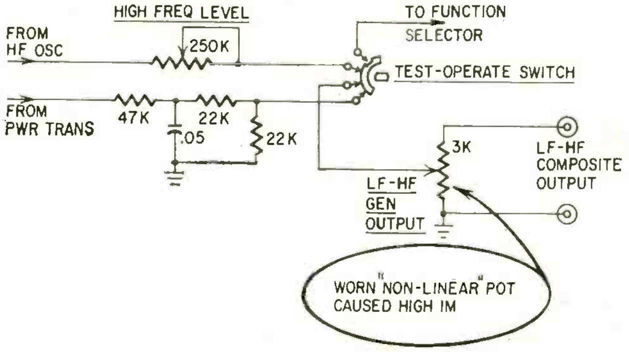
Unstable Horizontal Sync

In any of the older Motorolas (and some other makes, too) with the horizontal oscillator near the rear of the chassis and the horizontal hold pot on the front panel, unstable sync can be a problem. Replace the long unshielded grid lead from the tube to the pot with a shielded wire. Ground the shield, of course.—*W. G. Eslick*

Heath AA-1 Audio Analyzer

One of these was found to have about 15% intermodulation distortion all by itself, with no amplifier between generator and analyzer portions!

The trouble was caused by the 3,000-ohm pot that con-



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trols the composite output level. The wiper was making poor contact with the worn element, and the resulting nonlinearity caused intermodulation before the test signal even left the generator.

Replacing the pot brought the residual IM back down to under 0.1%. Incidentally, you can check residual IM simply by jumping the red IN and OUT terminals on the AA-1 and running through the test procedure as though you were checking an amplifier.—*P. E. Sutheim*

Hotpoint 14S201 ("Q" line); GE 14T007 through 14T020

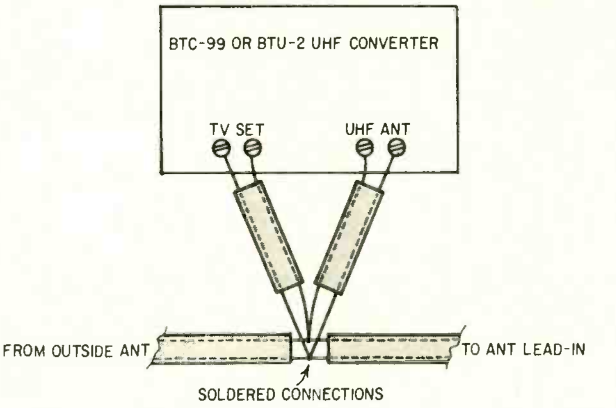
Buzz in sound with volume control counterclockwise: reroute wire from 5T8 toward the top and down to the output tube.

Sync troubles (pulling): tubes and phase diodes OK. Monitor with scope (sweep set to 30 or 60 cycles) the 200- and 60-μf sections of C402 (sections A and B). One of them may have developed an open or intermittent, putting sync pulses on the B-plus line.—*W. G. Eslick*

$15 Answer to the Translator

Since translator stations are low-power units covering a limited area, many TV sets will be repaired outside the normal reception area. This requires a uhf signal for sound alignment and tuner test. An effective answer wherever channel 4, 5 or 6 is available is the Blonder-Tongue converter BTC-99 or BTU-2 (available at most parts houses) and the simple hookup described.

Connect two pieces of 300-ohm ribbon line (as short as convenient) to the terminals marked TV SET and UHF ANT.



Take the free ends, wrap them together and connect them to your antenna lead-in. This sounds odd, but the vhf signal will enter the terminals marked TV SET, enter the crystal section, mix with the oscillator output and give excellent uhf signals within two channels of the converter dial setting.

Note that the desired signal has the sound on the proper side, and that good picture quality appears only where it should. Also, the entire uhf band is at your fingertips.—*Owen Harrison.*

Zenith Transoceanic Portable

A Zenith Transoceanic portable was brought into the shop with the complaint that it operated only during the daytime. A check with a variable voltage transformer showed that the receiver would not function on less than 115 vac. All tubes checked out well on an emission type tube checker.

On a hunch, the 1LA6 converter was replaced, and the set worked normally. Apparently the lower line voltage at night decreased the filament voltage enough to cause the old converter to quit oscillating. Installing a new tube solved the problem.

This type of complaint has been encountered several times since in other three-way portables, and the solution was identical.—*Joseph E. Fleagle*

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The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore, you will construct radio circuits, perform jobs and conduct experiments to illustrate the principles which you learn.

You begin by examining the various radio parts included in the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set, you will enjoy listening to regular broadcast stations, learn theory, practice testing and troubleshooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are 25 Receiver, Transmitter, Code Oscillator, Signal Tracer, Signal Injector, Square Wave Generator and Amplifier circuits. These are genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current. In addition you construct battery-operated transistor circuits.

In order to provide a thorough, well-integrated and easily-learned radio course, the "Edu-Kit" includes practical work as well as theory; troubleshooting in addition to construction; training for all, whether your purpose in learning radio be for hobby, business or job; progressively-arranged material, ranging from simple circuits to well-advanced topics in Hi-Fi and TV. Your studies will be further aided by Quiz materials and our well-known FREE Consultation Service.

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You will receive all parts and instructions necessary to build 25 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, diodes, transistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hookup wire, solder, selenium rectifiers, volume controls, switches, knobs, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to the F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, and a High Fidelity Guide and Quiz Book. Everything is yours to keep.

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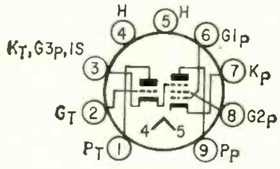
New Semiconductors and Tubes

6LC8, 8LC8

New miniature triode-pentodes, these RCA tubes are made for sync-separator and noise-immune, gated agc applications in both color and black-and-white TV sets.

They are similar to the 6KA8 and 8KA8, but have separate cathodes for each unit and internal connections between pentode grid No. 3, the triode cathode and the internal shield.



6LC8,8LC8

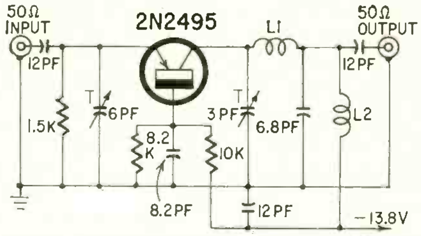
The pentode section can provide a high inverted-noise output from grid No. 2 for use in canceling the positive-going noise pulses at the triode grid. The pentode plate can withstand maximum peak positive pulse plate voltages to 600.

Both new types feature controlled warmup time and the RCA dark heater.

2N2495

This is a germanium p-n-p transistor designed for use as an rf amplifier at frequencies up to 470 mc, making it ideal for TV and communications receivers. Amperex, the manufacturer, also suggests it for TV boosters, as an ultra-low-noise i.f. amplifier, and as a uhf—vhf mixer.

Its 200-mc power gain is 15.5 db, and feedback capacitance only 0.7 pf. It has a 1-kc beta of 70 and a gain-bandwidth product of 300 mc.



L1 - 1 TURN N°18 SILVERED COPPER WIRE, 3/8" DIA
L2 - 13 TURNS N° 22 ENAM COPPER ON A 10MEG, 1/2 WATT VITROHM RES

Amperex has designed a converter using the 2N2495 to operate at 465 mc with a sensitivity of 0.65 μv for a signal-to-noise ratio of 12 db. The rf stage of the front end is shown in the schematic.

The company has several reports available free to persons writing on company letterhead: the *S-105*, describing

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	1B3	.79		6AW8	.90		6SA7GT	.99		12CX6	.54
	1DN5	.55		6AX4	.66		6SH7	1.02		12D4	.69
	1G3	.79		6AX5	.74		6SJ7	.88		12DE8	.83
	1J3	.79		6BA6	.50		6SK7GT	.95		12DL8	.88
	1K3	.79		6BC5	.61		6SL7GT	.84		12DQ6	1.04
	1R5	.77		6BC8	1.04		6SN7	.65		12DS7	.84
	1S5	.75		6BE6	.55		6SQ7GT	.94		12DT5	.76
	1T4	.72		6BF5	.90		6T4	.99		12DT7	.79
	1U5	.65		6BF6	.44		6T8	.85		12DT8	.78
	1X2B	.82		6BG6	1.70		6U8	.83		12DW8	.89
	2AF4	.96		6BH8	.98		6V6GT	.54		12DZ6	.62
	3AL5	.46		6BJ6	.65		6W4	.61		12ED5	.62
	3AU6	.54		6BJ7	.79		6W6	.71		12EG6	.62
	3AV6	.42		6BK7	.85		6X4	.41		12EK6	.62
	3BC5	.63		6BL7	1.09		6X8	.80		12EL6	.50
	3BN6	.75		6BN6	.74		7A8	.68		12EZ6	.57
	3BU8	.78		6BQ6	1.12		7AU7	.65		12F8	.66
	3BY6	.58		6BQ7	1.00		7EY6	.75		12FA6	.79
	3BZ6	.56		6BU8	.70		7Y4	.69		12FM6	.S0
	3CB6	.56		6BX7	1.11		8AU8	.90		12FR8	.97
	3CS6	.58		6BZ6	.55		8AW8	.93		12FX8	.90
	3DG4	.85		6BZ7	1.03		8BQ5	.60		12GC6	1.06
	3DK6	.60		6C4	.45		8CG7	.63		12J8	.84
	3DT6	.54		6CB6	.55		8CM7	.70		12K5	.7S
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	3Q4	.63		6CG7	.61		8CS7	.74		12SF7	.69
	3S4	.75		6CG8	.80		8EB8	.94		12SK7GT	.95
	3V4	.63		6CL8	.79		8FQ7	.56		12SL7	.80
	4BQ7	1.01		6CM7	.69		9CL8	.79		12SN7	.67
	4CS6	.61		6CN7	.70		11CY7	.75		12SQ7GT	.91
	4DT6	.55		6CQ8	.92		12A4	.60		12U7	.62
	4GM6	.60		6CR6	.60		12AB5	.60		12V6	.63
	5AM8	.79		6CS6	.57		12AC6	.55		12W6	.71
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	5BQ7	1.01		6CY7	.71		12AF6	.67		18FX6	.53
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	SCL8	.76		6DG6	.62		12AL8	.95		19BG6	1.39
	5CQ8	.84		6DJ8	1.21		12AQS	.60		19EA8	.79
	5EA8	.80		6DK6	.59		12AT6	.50		19T8	.85
	5EU8	.80		6DN6	1.55		12AT7	.76		21EX6	1.49
	5J6	.72		6DQ6	1.10		12AU6	.51		25AX4	.70
	5T8	.86		6DT5	.81		12AU7	.61		25C5	.53
	5U4	.60		6DT6	.53		12AV6	.41		25CA5	.S9
	5U8	.84		6DT8	.94		12AV7	.82		25CD6	1.52
	5V6	.56		6EA8	.79		12AX4	.67		25CU6	1.11
	5X8	.82		6EB5	.73		12AX7	.63		25DN6	1.42
	5Y3	.46		6EB8	.94		12AY7	1.44		25EH5	.55
	6AB4	.46		6EM5	.77		12AZ7	.86		25L6	.57
	6AC7	.96		6EM7	.82		12B4	.68		25W4	.68
	6AF4	1.01		6EU8	.79		12BD6	.50		32ET5	.55
	6AG5	.70		6EV5	.75		12BE6	.53		35C5	.51
	6AH4	.81		6EW6	.57		12BF6	.60		35L6	.60
	6AH6	1.10		6EY6	.75		12BH7	.77		35W4	.42
	6AK5	.95		6FG7	.69		12BK5	1.00		35Z5	.60
	6AL5	.47		6FV8	.79		12BL6	.56		36AM3	.36
	6AM8	.78		6GH8	.80		12BQ6	1.16		50B5	.69
	6AQ5	.53		6GK5	.61		12BR7	.74		50C5	.53
	6AS5	.60		6GK6	.79		12BV7	.76		50EH5	.55
	6AT6	.49		6GN8	.94		12BY7	.77		50L6	.61
	6AT8	.86		6H6	.58		12BZ7	.86		70L7	.97
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☐ 50 TERMINAL STRIPS, asst. 1-to-10 lug types . . . $1
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☐ 2 CBS 35W POWER TRANSTRS, 2N1434, pnp, stud $1
☐ 10 CK722 TRANSISTORS, pnp, untested $1
☐ 15 PNP TRANSTRS, asstd. types & cases $1
☐ 15 NPN TRANSTRS, asstd. types & cases $1
☐ 4 100mc SB-100 TYPE TRANSTRS, TO1 case $1
☐ 20 TOP HAT RECTIFIERS, 750mil, untested $1
☐ 10 HIGH GAIN NPN TRANSISTORS, TO5 case . . $1
☐ HOFFMAN SOLAR SILICON CELL, ½ x 1" $1
☐ 2 AMP SCR SILICON CONTROLLED RECT stud . . $1
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☐ 3 CBS 20watt TRANSTRS, pnp, stud 2N1320 . . . . $1

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☐ 2N498	4	7.90	☐ 2N699	2**	8.50
☐ 2N656	4	7.15	☐ 2N1252	2**	6.90
☐ 2N657	4	9.00	☐ 2N1253	2**	11.95
☐ 2N696	2**	5.65	☐ 2N1613	3**	9.00
☐ 2N697	2**	6.50			

**Freq. above 100 mc

☐ 3 CBS 20watt TRANSTRS, npn, stud 2N1321 . . . . $1
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☐ 6 750 MIL 600V TOP HAT, with leads, silicon . . $1
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☐ 3 CBS 2N155 TRANSISTORS, TO3 case $1
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☐ 2 40 WATT TRANSISTORS, 2N174 type TO36 . . . $1
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☐ 10 2amp SILICON POWER STUD RECTIFIERS . . . $1
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☐ 2 'MESA' 4watt TRANSTRS, npn, silicon, TO5 . . $1
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☐ 5 10 WATT TRANSISTORS, TO3, pnp, untested . . $1
☐ 4 2N211/CK879 I.F. TRANSISTORS, pnp, TO22 . . $1

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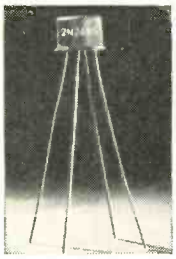
the front-end mentioned here; *S-114*, showing a 200-mc rf amplifier with a 3.9-db noise figure; *S-103*, a 170-mc mixer, and *S-106*, an FM broadcast rf amplifier.

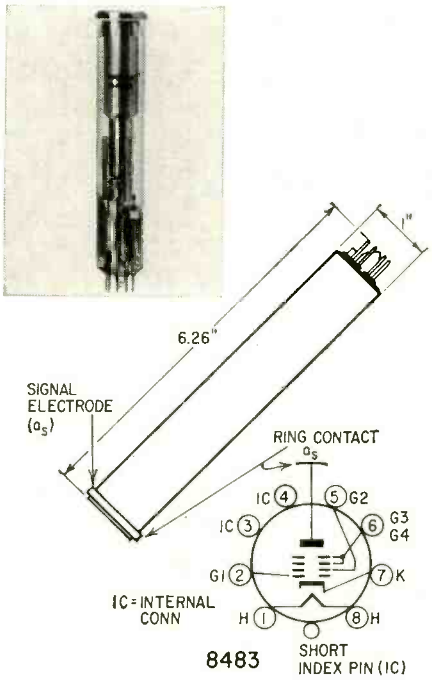


Write to Amperex Electronic Corp., Semiconductor & Receiving Tube Div., 230 Duffy Ave., Hicksville, N. Y.

8483 vidicon

Here's one that should appeal to ham and closed-circuit TV enthusiasts: a 1-inch vidicon capable of 990-line resolution, designed especially for compact, portable transistor TV cameras.

The 8483's heater draws only 90 ma at 6.3 volts—a total power consumption of 0.6 watt, keeping power drain and heat dissipation to a minimum.

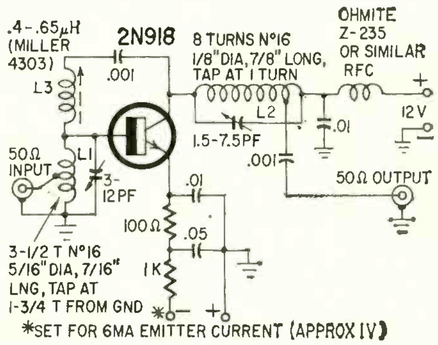


The new tube, which uses magnetic focusing and deflection, produces usable pictures with 0.1 foot-candle faceplate illumination. The average gamma is 0.6.

Because of its small size and sturdy construction, this Amperex vidicon has very good microphonic characteristics. To reduce accidents, the exhaust tip is centered at the base inside the pin circle, instead of protruding from the side as in many other such tubes.

2N918

Here is a transistor you may see a good deal more of—if its price ($13.50 in 100-up quantities) comes down. It's a silicon n-p-n passivated epitaxial transistor, designed as a low-noise rf amplifier, local oscillator up to 1,000 mc, or as i.f. or video amplifier. It provides a minimum power gain of 15 db at 200 mc, and supplies 30 mw of power output at 500 mc with 25% efficiency. Most attractive are its current gain of 50, its gain-bandwidth product of 900 mc, and its noise figure: 3 db at 60 mc.



The 2N918 comes in a TO-18 package and is made by Motorola. The diagram shows a power-gain test circuit for 200 mc, lifted from the manufacturer's data sheet. It shows one possible amplifier circuit, and may suggest others.

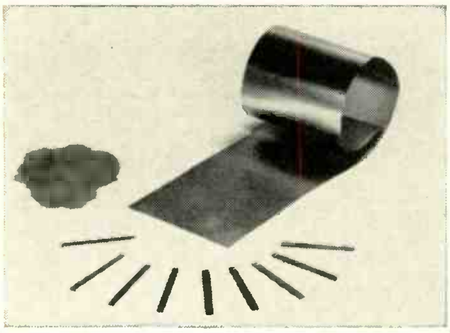
Powder-metal cathodes

Among the devices displayed at the 1963 WESCON (Western Electronics Show and Convention) were receiving tubes with new powder-metal cathodes, developed by Sylvania and General Telephone & Electronics Laboratories, Inc.

The basic material is carbonyl powder, alloyed with the necessary additives and rolled into a thin strip. The strip is then formed into cathode sleeves in much the same way as conventional nickel cathodes.

The new process prevents the contamination that occurs during the usual melting, pouring, forging and hot-rolling operations with existing alloys. It also makes fabrication of special compounds and alloys much easier.

Reduced contamination makes possible much greater reliability, as shown in a failure-rate report on the 6AF4 uhf triode. 6AF4's with ordinary cathodes have a failure rate of 13.1% per 1,000 hours; with the new cathodes, 1.5% per 1,000 hours. END



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technicians' News

California Legislature Passes License Bill

Sacramento—California has a licensing law. The act, effective Jan. 1, 1964, regulates advertising claims, work performed, estimates and charges.

Among the advertising restrictions specifically cited in the bill are "Making . . . any statement . . . which is untrue or misleading . . . ," and "Making any false promises of a character likely to influence . . . a customer to authorize the repair . . . of [a TV, radio or phono]."

All work done is to be recorded on an invoice and must describe all the work and the parts used. If any of the parts are not new, the invoice must mention that. The service dealer shall return replaced parts to the customer, except where other arrangements are necessary as part of a warranty agreement.

A service dealer may not charge for work done or parts supplied in excess of an estimate without previous consent of the customer. However, the bill makes the original estimate a voluntary, optional matter. If made, though, it must be in writing.

Repairmen Point Out Snags in California Law

The new California law regulating servicing and service advertising practices has come in for severe criticism from service companies in the state, according to *Home Furnishings Daily*.

The most vigorous complaints center around the law's provision that when companies give customers written estimates of repair charges before work is begun, actual charges may not exceed the original estimate or a revision signed by the customer.

The service operators claim that since it is impossible to make a precise estimate of repair charges, estimates will have to be inflated to cover possible unforeseen costs, creating new levels of high estimates.

"This will cause more trouble for an honest dealer than a dishonest one," said an official of Universal Television Co., Inc. Universal, he said, will refuse repair jobs where the customer demands a written estimate.

In some cases, a company may tell its customers that its written estimates are deliberately made high, but that the final bill could be lower.

Factory service operations appear to be generally opposed to the new law, but officials of these companies point out their policies forbid them to go on record as opposing legislative measures.

California's Gov. Edmund Brown emphasized that the laws are aimed at the dishonest operator only, and that there is no intent to license dealers but only to provide elementary policing and consumer protection.

New Florida Association

Miami—Delegates from Pensacola, St. Petersburg, Tampa, Fort Lauderdale and Miami met to lay groundwork for a new statewide electronic service association, to be called the Florida Electronic Service Association (FESA).

A temporary chairman was selected: A. Edward Stevens. Jack Norris was chosen as temporary secretary. Both men are from Miami. Others were appointed to divide the state into manageable districts and to investigate the problem of collecting dues.

The group discussed membership qualifications, voting rights and methods, and drew up a skeleton charter.

Moch Speaks at St. Louis

St. Louis—NATESA Executive Director Frank J. Moch addressed the 14th anniversary and installation dinner of

TESA-St. Louis in July. His talk, "Time for Reappraisals," stressed the need for a new attitude in competing with big service businesses he feels are capturing the independent trade.

The only possible path, Moch said, is *specialization*. He called for all association members to "appraise the abilities and talents of each member and then channel the various activities necessary to the conduct of a solid, growing and prosperous service business to those most capable to do them."

He cited statistics to show that there is now more than $33,000 worth of service business per man in the industry, and pointed out that only sound leadership and a team effort could revive the service trade.

Butte, Mont., ESA Elects

Butte, Mont.—The Electronic Service Association elected new officers at its annual meeting here. The organization is a recent affiliate of NATESA.

Elected were Leonard Barrough, president, replacing Patrick Gordon, who became recording secretary. Kenneth Venner was re-elected as treasurer, as was Raymond G. Tuszynski to his office of corresponding secretary.

Harry Carroll and Donald Lassila were elected trustees.

The group confirmed Mr. Tuszynski as NATESA-director reporter for the coming fiscal year, and Howard F. Neier as his alternate.

The organization reports concern over the city's licensing system, which makes it possible for incompetent persons to obtain licenses for TV service.

Article Smooths Service Customer Relations

An article in the August 1963 issue of *Redbook* could go a long way toward alleviating some perpetual gripes that all service customers have: high cost, frequent need for service, failure of "man" to arrive promptly, and others well known to service technicians.

The item, "Time-Saving, Money-Saving Advice From Your Repairman," by Rose Marie Burnley, deals specifically with home appliances (washers, refrigerators, etc.), but much of the material applies to TV as well.

It is not a one-sided article, though. Helpful as it is in making the repairman's life a little less trying, it mentions a way in which technicians could help hold up their end of diplomatic relations.

Though a repairman can't be expected to know *exactly* when he'll arrive at a job, "he should be able to narrow it down to a particular morning or afternoon," the article said—particularly if the service outfit has been told that the customer expects to stay home especially for the call. END

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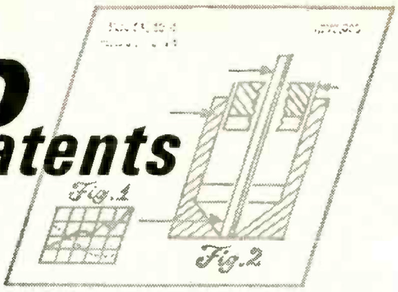


Jamming Suppressor

PATENT No. 3,015,026

Leonard Milton, Lake Success, N. Y., and Murray Gunar, Lakewood, N. J. (Milton assignor to the Filtron Co., Inc.)

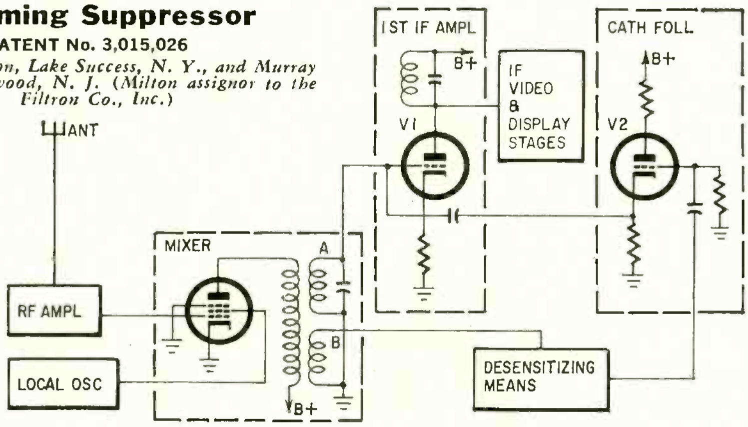


Fig.1

A radar receiver can be jammed by a strong signal that sweeps through a wide frequency spectrum. When the jammer frequency is the same as that of the receiver, it overloads the i.f. and renders it inoperative for a time.

Fig. 1 shows basic circuits of the jamming suppressor. The mixer has two secondaries: A, which feeds the i.f. as usual, and B, which has a wide-band response (Fig. 2). Hence a jamming signal, as it sweeps through the band, will cause a response in B before the radar signal does. B's signal generates a negative pulse which blocks cathode follower V2. In turn, V2 blocks i.f. amplifier V1. As soon as the jammer output from B drops to zero, V1 resumes operation.

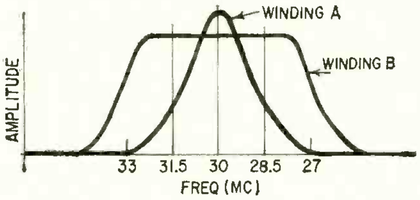


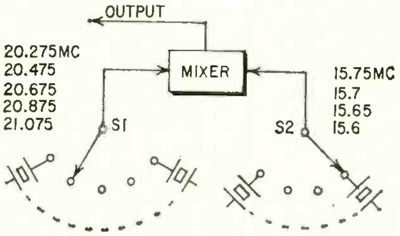
Fig.2

If V1 had been *overloaded* by the jammer, it would have taken considerably more time to return to normal.

Multi-Oscillator

PATENT No. 3,085,202

Edward Jakubowics, Fairhaven, N. J. (Assigned to USA as represented by Secretary of Army)



Many crystal frequencies can be generated by a few crystals. For each crystal selected by S1, four crystal frequencies will be available at S2, giving a total of 20 from the mixer. With the crystal frequencies shown, the output will range from 4.525 to 5.475 mc at intervals of 50 kc.

For example, when S1 selects 20.275, the mixer outputs will be: 4.525, 4.575, 4.625, 4.675. If S1 is switched to 20.475, which is 200 kc higher, the outputs will also be 200 kc higher: 4.725, 4.775, 4.825, 4.875 and so on for the others.

Only lower sidebands are used here. If the uppers are also used, the number of output frequencies is doubled. This principle, called frequency synthesis, is being used in many commercial devices (see "Frequency Synthesis Improves CB Coverage," August 1963, page 44).

Zener-Coupled Amplifier

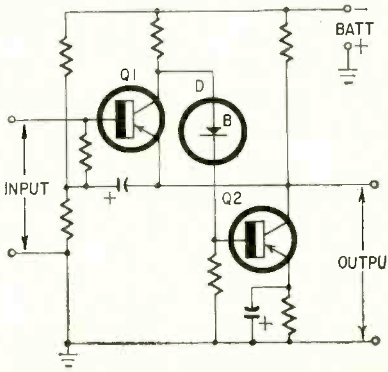
PATENT No. 3,080,528

James J. Davidson, Lawrence Township, Ind. (Assigned to RCA)

This amplifier includes several unusual features. Zener diode D couples the stages. Being reverse-biased, it isolates the stages for dc, but transmits ac. Any change at its anode (from Q1) appears without loss at its cathode (to Q2), because D maintains constant voltage *difference*. The frequency discrimination of a coupling capacitor is not present.

Q1 is an emitter follower, and its output impedance is low. The input impedance is high because the input signal is amplified by both transistors, then fed back to Q1's emitter. Output has the same phase as the signal.

Q1 and Q2 are in series for dc, so temperature affects them equally. The inventor claims efficient operation to 100°C. END



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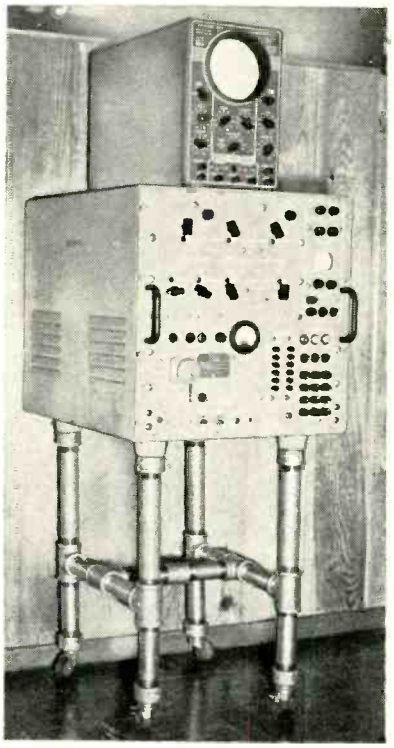

The synthesizer type frequency meter shown in the photograph measures about 19 x 19 x 25 inches and weighs a bit less than 160 pounds.

The dollies can be made from standard pipe fittings. Construction details are self-evident. Standard 1¼-inch water pipe T's, caps and various length nipples are threaded together. The top caps are drilled to pass the equipment mounting bolts and the bottom caps to mount the threaded stud casters.—*Roy E. Pafenberg*

Vom Capacitor Check

To check leaky capacitors with a vom, clip one meter lead to one end of a suspected capacitor. Switch the meter to an "ohms" range and charge the capacitor by touching the other meter lead to the remaining capacitor lead. (One end of the capacitor must be disconnected from the circuit.) Now wait half

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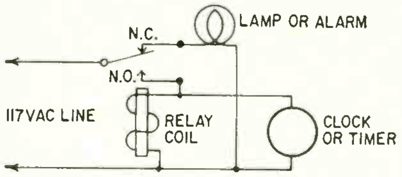
a minute or so and touch again. If the meter pointer jumps again as it did initially, the charge on the capacitor has leaked away and the capacitor is leaky. Try again to be sure.

This trick works most reliably with paper capacitors of .001 μf and more. *—Clare E. Ernst*

Relay Prevents Clock Confusion

If clocks and timers start automatically after the end of a power failure, the systems they control will be out of synchronization. This can cause considerable confusion as, for example, when school bells ring at wrong times.

This can be avoided by keeping clocks and associated timing devices turned off until they can be manually reset and started. This can be done easily with an inexpensive 117-volt spdt relay wired as shown in the diagram. To start the clock motor, depress the armature of the relay manually. (An insulated button is attached for this purpose since the armature is "hot".) This closes the circuit to the N.O. contact, to which the clock motor and the relay coil itself are connected. The relay is thus energized and the N.O. contact is kept closed. As long as the power stays on, the relay will stay closed and the clock will run. If power fails, the relay will open. A lamp or alarm of some sort connected to the N.C. contact announces there has been a power failure. The clock circuit remains open until the relay armature again is manually depressed.—*William B. Rasmussen*



Extra Eyes

When working on a midget transistor radio with subminiature components and almost invisible terminals, even a young 20-20 vision man needs optical aids of some kind. Try a binocular magnifier of the type built like an eyeshade. They come in various focal lengths, of which No. 5 seems to be the most useful. This has a magnification of 2 times which is adequate and easy to work with. A binocular magnifier allows natural use of both eyes and retains the stereoscopic effect. The work may be moved around to get the best light and viewing angle.

For a closer single-eye view, a watchmaker's loupe (with headband) is very good. A focal length of 3 inches is the best compromise between magnification and ease of handling.

But a real closeup of a cracked line in a printed circuit calls for a 10-power Coddington magnifier. This is made of a piece of glass rod with a lens on each end, giving excellent field and definition. *—Nicholas B. Cook*

Magnet Anchors Washers

In servicing record players it is sometimes necessary to remove the C-washer that holds the turntable in place. These little washers are small but ornery, and they can sail through the air with the greatest of ease to get lost somewhere. But I have learned to keep them earthbound with a small magnet held against the washer during removal. Then I leave the washer on the magnet until reassembly.—*Nicholas B. Cook*

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A largely mathematical approach, with a very simple style for an advanced work.

DIODE CIRCUITS HANDBOOK, by Rufus P. Turner. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 123 pp. Paper, $2.50*

Shows how diodes may be used in receivers and transmitters, and in control, instrument and computer circuits. Includes tunnel diodes.

MATHEMATICAL TABLES AND FORMULAS, compiled by Robert D. Carmichael and Edwin R. Smith. *Dover Publications, Inc., 180 Varick St., New York 14, N. Y. 5½ x 8½ in., 269 pp. Paper, $1.00.*

Five-decimal table of logs, circular and hyperbolic functions, roots and powers, integrals, series and formulas, arranged for ready reference.

COMPUTER CIRCUIT PROJECTS YOU CAN BUILD, by Lee Boschen. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 143 pp. Paper, $2.95*

Mechanical and electronic details for building a signal flasher, a stroboscope, tachometer, sound-operated lamps and others. Only a few of the chapters deal with computer circuitry.

PROFITABLE TELEVISION TROUBLESHOOTING (2nd Edition), by Eugene A. Anthony. *McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N.Y. 6 x 9 in., 418 pp. Cloth, $7.25*

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ELECTRONIC CIRCUITS AND INSTRUMENTATION SYSTEMS, by Jack J. Studer. *John Wiley & Sons, 605 3rd Ave., New York 16, N.Y. 6 x 9 in., 456 pp. Cloth, $10.75*

A college text that emphasizes signal transfer properties. It has 3 main parts: circuits, electronics, systems.

TECHNICAL MANUAL (12th Edition). *Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N.Y. Looseleaf, cloth binder, 4½ x 9 in. $3.00.*

Detailed data for commonly used receiving and cathode-ray tubes and photocells; condensed data for obsolete and older types. Also includes diode charts, replacements and miscellaneous data. Owners are entitled to future supplements.

ELECTRONICS MATH SIMPLIFIED (Vol. 2), by Alan Andrews. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 207 pp. Paper, $4.95*

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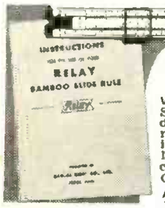

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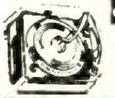

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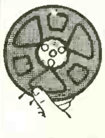

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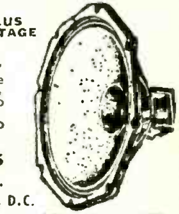

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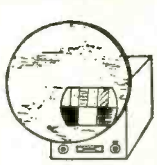

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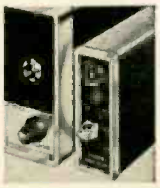

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