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NOV. 50c

Radio-Electronics

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Electronic Engine Analyzers

Expandable-Modular Concept and Easy-to-Service Features in . . .

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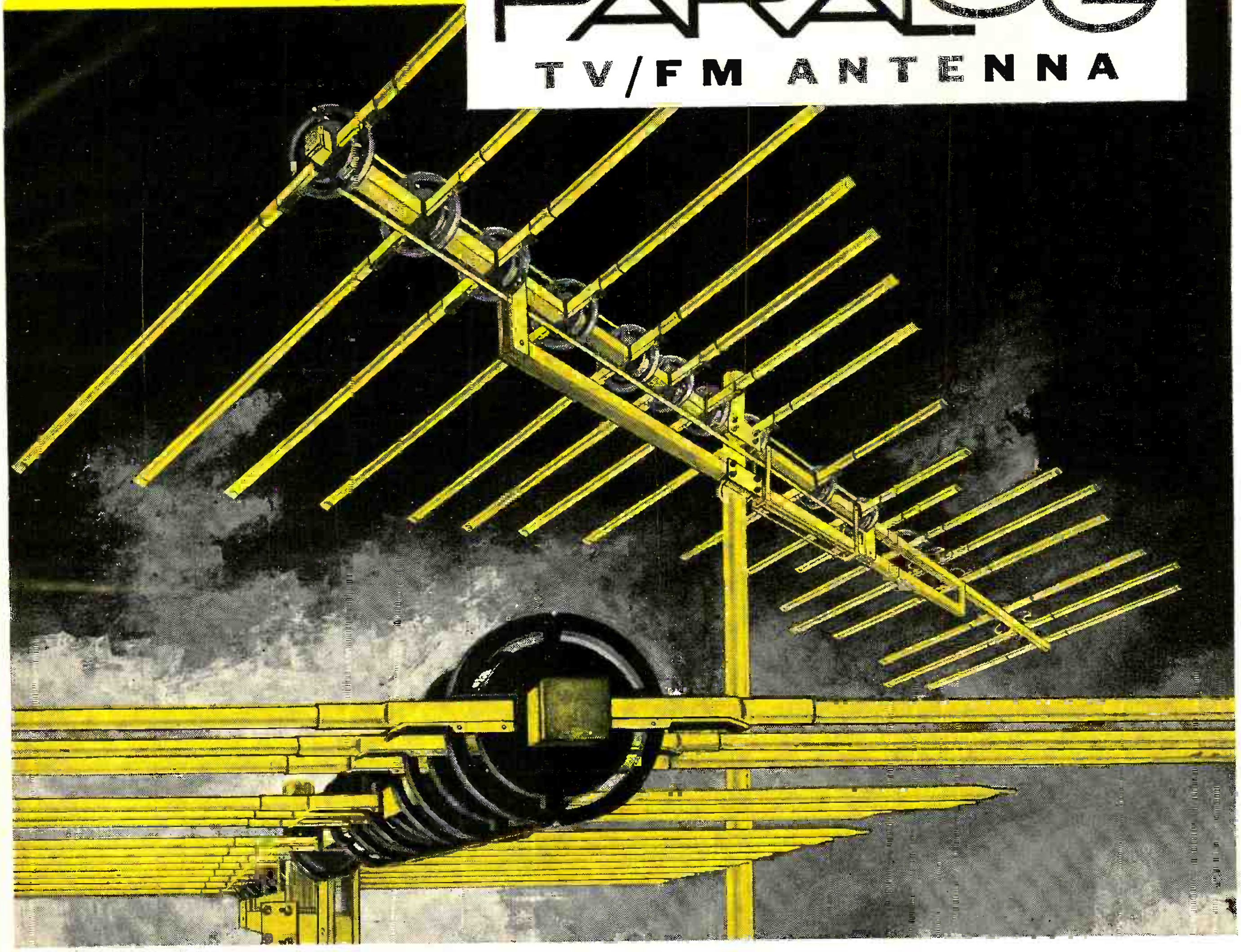

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Radio-Electronics

NOVEMBER 1963 VOL. XXXIV NO. 11

Over 55 Years of Electronic Publishing

Member, Institute of High Fidelity
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NEWS BRIEFS

New Device Makes Speech From Written Characters

Reversing the old idea of a talking-into typewriter, Melpar, Inc. has just demonstrated a working model of a system for generating speech from written patterns. The device is called EVA (electronic vocal analog) and is adapted from a somewhat similar device developed at the Royal Institute of Technology in Sweden.

One of the advantages of such a device is that it can be used on a much narrower band than an ordinary phone channel. The experimental model requires a bandwidth only about 1/30 that of a normal voice communications band. The chief use of the present model, however, is to study human speech. Learning how speech is put together could be very valuable in developing other instruments along the lines of EVA, phonetic typewriters and other speech-electronic devices.

Illegal CB Operator Faces Several Charges

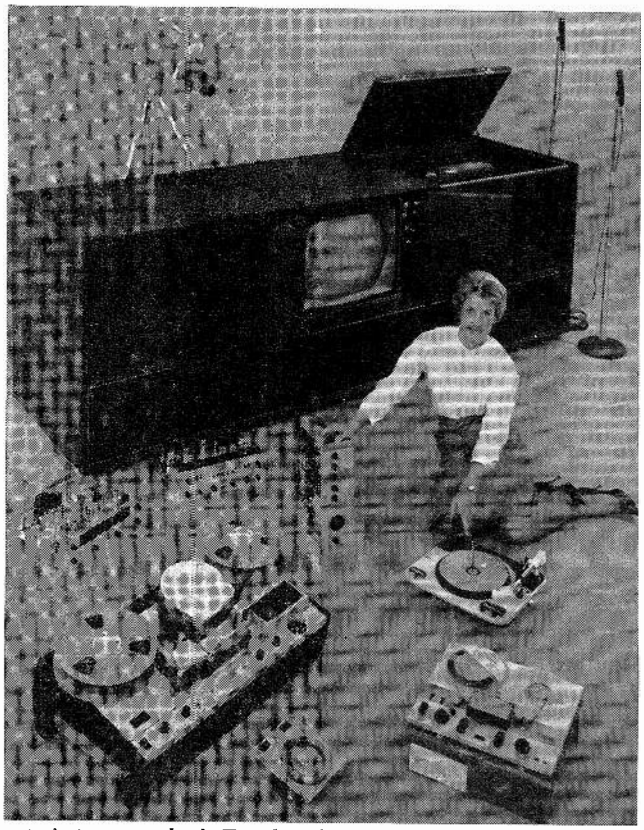
Warren J. Currence of Elkins, W. Va., was arrested last August for alleged operation of an unlicensed citizens radio station. He was held under $1,000 bond for appearance before the grand jury, and three CB transmitters were seized.

Currence had earlier been charged with using obscenity on the air, and his citizens radio license was revoked. This was the result of complaints "by hundreds of Citizens Band licensees" in central West Virginia.

If found guilty of transmitting obscenity over the citizens band, Currence is subject to a maximum penalty of $10,000 fine or not more than two years imprisonment, or both. And, if convicted of transmitting after his license had been revoked, he faces a like fine or imprisonment not exceeding one year, or both.

Transistors in Ascendant At New York Hi-Fi Show

Transistors in almost very form and in nearly every kind of circuit were the hit of the 1963 High Fidelity Music Show, held September 11–15 in New York City.



Ampex's complete home-entertainment system has: an AM-FM stereo tuner; a record changer; a stereo control-center-and-pre-amp; a 4-track tape record-playback machine; a built-in stereo speaker system; color television: video tape recorder good for 90 minutes of TV recording; a vidicon camera that can be used with the recorder or with the TV set directly; two microphones for stereo recording; and a timer to preset the video recorder to take down a program without attention, or to record one while another is being watched. Total ac-line current drain is 12 amperes!

An Ampex engineer is part of the deal for as long as it takes to supervise installation.

The show, billed by the Institute of High Fidelity, its sponsors, as "the largest to be staged by the industry", was attended by more than 25,000 persons.

Emphasis was placed this year on decorative aspects of hi-fi. Several exhibitors' rooms were sumptuously furnished to show how well a stereo system could fade into the woodwork, and there was a gallery of photographs of installations from around the country.

But among the displays of 83 manufacturers all over the world, transistor equipment was probably the most prominent. For the first time, several major manufacturers (Sherwood, Scott, Fisher and Pilot among them) exhibited all-transistor equipment.

The prize for the most expensive single piece of home entertainment equipment must surely go to Ampex for its "Signature V", a $30,000 colossus in a 9-foot long walnut cabinet which, besides the usual AM-FM stereo tuner, changer and tape recorder, contains a color television set, a video tape recorder and a self-contained TV camera. (See photo above.)

Other highlights included comparisons of live and recorded music, some of it composed especially for the show.

New TV Sees The Invisible

A detection system for the invisible fire of liquid hydrogen has been announced by General Dynamics/Astronautics. Liquid hydrogen, which supplies nearly 40% more power than conventional propellants, used to be considered too dangerous

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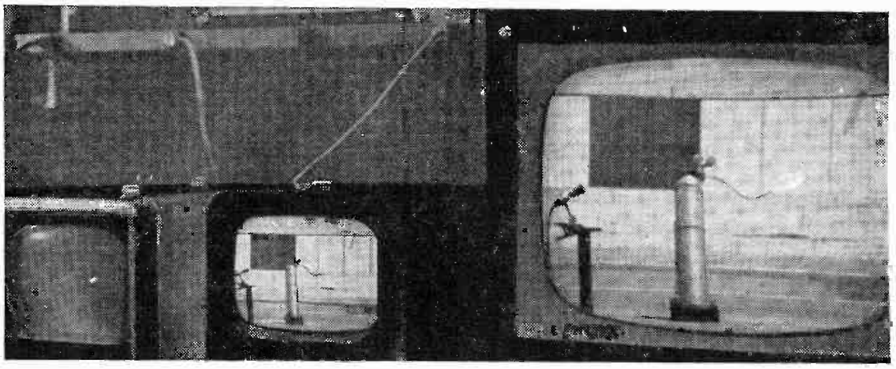

TV set at left is blank except for the small flame detected by the infrared camera. Middle picture is from standard TV camera which cannot see hydrogen flame. Two pictures are superimposed on monitor at right, which shows that a fire exists and pinpoints its location.

for rocket fuel, but it's now being used in the Centaur space vehicle, and other vehicles are being designed to use the high-energy fuel. The device that detects the invisible flame of burning hydrogen is another step toward increasing its usability.

The warning system uses a special lens which focuses infrared radiation on the vidicon tube of a TV camera. Beside the infrared camera is a standard camera, both covering the same field of view. The infrared picture, revealing the fire only, is superimposed over the scene viewed by the standard camera, displaying visually the location of the fire.

This system is expected to be used at hydrogen test facilities, around launching areas for hydrogen-fueled rockets and possibly as fire surveillance equipment aboard space vehicles.

Closed Circuit TV Adds Foreign Language Channel

TeleGuide, a closed-circuit TV system that operates in 41 hotels in New York City, has added a foreign language service. From 7:30 am to 1 am daily, half-hour films describing the attractions of New York City to the tourists are presented in French, German, Italian, Japanese, Portuguese and Spanish. The program is on Channel 13, and is sponsored by Pan American Airways.

Magnet May Become Kitchen Tool

Green tomatoes, exposed to the south pole of a large magnet, ripen several days faster than nonmagnetized tomatoes, say **Dr. A. A. Boe** and Dr. K. Salunkhe of Utah State University.

Starting with green tomatoes, they exposed one group to the south pole of a magnet. These tomatoes were almost red in 11 days, while the nonmagnetized tomatoes were barely pink.

Magnetism's effect on organic substances is not a new idea. Louis Pasteur experimented with tartaric

(Continued on page 14)

Lunar Vehicle To Precede Astronauts

The odd-shaped vehicle is an exploration vehicle, designed by the Westinghouse Defense Center to make the arrival of astronauts on the moon safer, and to make the work more useful. It would arrive before the astronauts and roam the surface of the moon to locate landing sites for manned vehicles. Stereo television cameras would scan the moon's surface and transmit images back to earth. The little wheel ahead of the vehicle detects crevices, and is also designed to collect samples of the surface for analysis.

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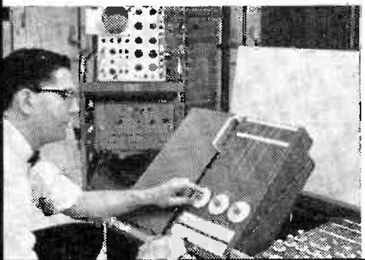

A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

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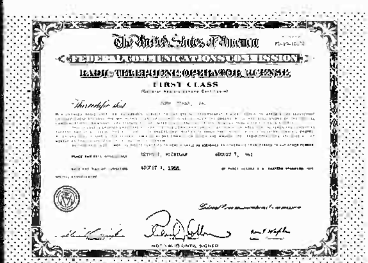
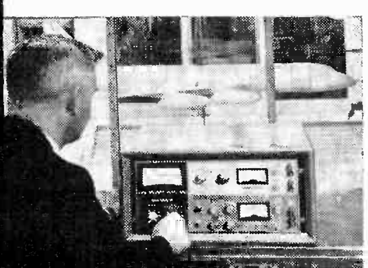


If you want a 1st Class FCC ticket quickly, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

Industrial Electronics & Automation



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

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

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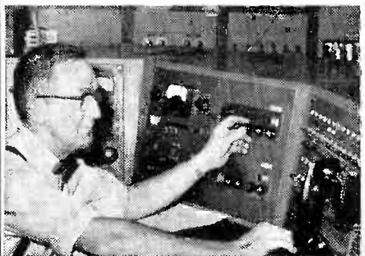

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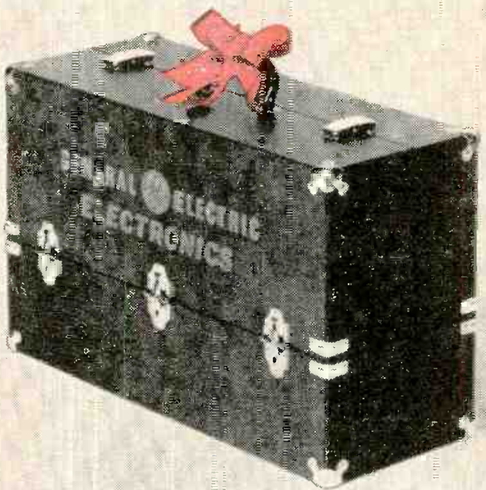
Pardon us while we change you into Santa Claus

Do your Christmas shopping early at your G-E Distributor's. He has lots of wonderful gifts that you can get with the purchase of General Electric tubes . . . gifts for your family, friends and favorite customers. And there're some you'll want for yourself . . . such as a tube caddy that looks like fine luggage. You can also get Christmas cards designed only for service dealers . . . to mail to customers and friends.

See your General Electric Distributor and start packing your bag *today*. You're going to be a sensational Santa!

Start packing your bag!

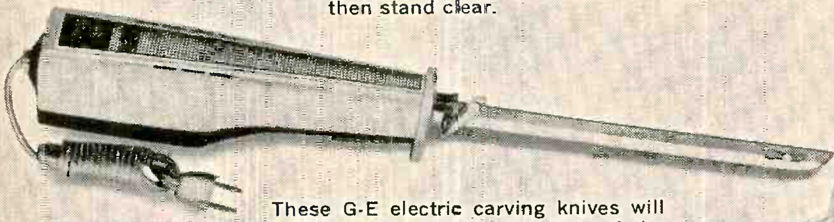
Be good to yourself this Christmas. You can get these Armor Clad® tube caddies when you purchase G-E tubes. They look like fine pieces of luggage and the special vinyl coverings are longer lasting. They are reinforced with nickel plate at all stress points.



These Kodak Flashfun camera outfits include everything that young photographers need: Hawkeye camera, film, clip-on neck strap, batteries, flash bulbs and instruction manual. They're yours when you buy G-E tubes.

Little girls will go wild over these Mattel® Sister Belle talking dolls. They're 17" tall and have a rag body and plastic head. Each one says eleven different things that little girls like to hear . . . like "Let's play house," "Give me a kiss." No batteries needed.

These Dick Tracy Power-Jet Squad Guns by Mattel® will be a hit with any boys you know. They're automatic cap-firing guns that shoot a stream of water 35 feet . . . farther than any water guns ever made. Give one to any boy and then stand clear.



These G-E electric carving knives will make a great gift for the lady of the house. They even slice through hot bread or hot meat with smooth precision. Get several from your G-E Tube distributor.

Get these Christmas cards . . . prepared especially for you. They're in color on heavy, high-gloss stock and show a cartoon of you adjusting a TV set to say "Happy Holidays." 50 cards and 50 envelopes to a box. Get yours now for early mailing.

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Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 8)

acid a century ago, concluding that the earth's magnetic field altered the arrangement of atoms in molecules.

Three years ago, magnetism was found to spur the growth of germinating seeds. This effect was named "magnetotropism." Its cause, Drs. Boe and Salunkhe suggest, is that a magnetic field quickens an enzyme system and thus respiration.

Dc Through GaAs Generates Microwaves

Microwaves can be generated by passing electric current through a block of gallium arsenide at room temperature, reports J. B. Gunn of IBM's Thomas J. Watson Research Center. The gallium arsenide maser has produced as much as ½ watt output at 1 gc, and oscillations have been produced from 0.5 to 6.5 gc.

Mr. Gunn discovered the effect while measuring the room-temperature resistivity of n-type gallium arsenide as a function of applied electric field. He found that resistivity increased abruptly at a field of about 2,000 volts/cm, and the current passing through the smaller samples began to oscillate coherently at high frequency.

The phenomenon depends to a great extent on the length of the specimen. Specimens longer than about .02 cm produce random oscillations, while the frequency of coherent oscillations in the shorter specimens is inversely proportional to their length.

Computer Makes Movies For Satellite Research

An ingenious way of visualizing the motions of an orbiting communications satellite has been worked out by Bell Labs scientists, to help in studies of such satellites. An IBM 7090 is programmed to generate a tape containing the data necessary for describing positions and attitudes of the orbiting satellite. This tape is then fed to a General Dynamics/Electronics SC 4020 recorder, which converts the digital data into line drawings on the face of a special cathode ray tube. Images on the face of the tube are photographed by a motion picture camera. The film, when projected, depicts the motion of the satellite yawing and turning over, and showed how undesired motion can be prevented by positioning the gyro stops properly.

CALENDAR OF EVENTS

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.

International Exhibition of Measurement, Control, Regulation and Automation (MESUCORA), Nov. 14–21; Paris, France.

14th National Conference on Vehicular Communications, Dec. 5–6; Adolphus Hotel, Dallas, Tex.

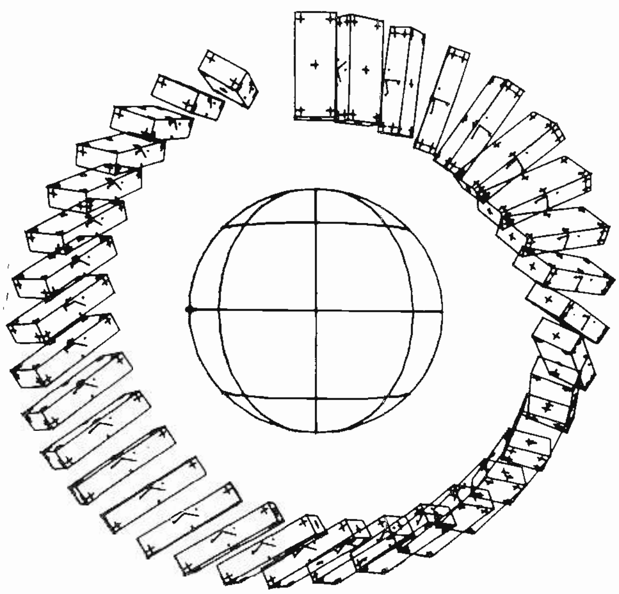
39th Annual Convention, National Association of Educational Broadcasters (NAEB), Nov. 17–20; Milwaukee, Wis.

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

Engineers Sometimes Slighted, Says NASA Spokesman

Scientists too often get credit for work done by engineers, said Dr. Hugh L. Dryden, NASA's Deputy Administrator, to the New Jersey Society of Professional Engineers.

"Engineers are only too rarely associated in the press with the great accomplishments of recent times," he said, referring to the atomic bomb, nuclear power plants and satellites,



These closely-spaced drawings of a domino-shaped box, projected rapidly one after another, produce a moving picture showing how the box would orbit in space. The figure at center represents the earth.

while "engineering has become the full and active partner of science in the exploration of this newest frontier. We must bring before the public the great engineers of our day," he concluded, "as persons identified with creative works, and the contributions of these works to human welfare."

Telcan Coming to US

Despite the skeptical response of many to *Telcan*, the prospective British video recorder, it may be introduced into this country shortly. Cinerama, Inc. has signed a contract under which it will assist in further development of the Telcan recorder in exchange for certain manufacturing and marketing rights in this and other countries.

A spokesman for Cinerama suggested that a prototype may be shown in the United States within the next six weeks and stated that the finished instrument might "be sold in every type of store now selling tape recorders and TV sets." A price of "under $200" was suggested.

Brief Briefs

A silicon-carbide injection laser that emits continuously at room temperature is reported by Tyco Laboratories of Waltham, Mass.

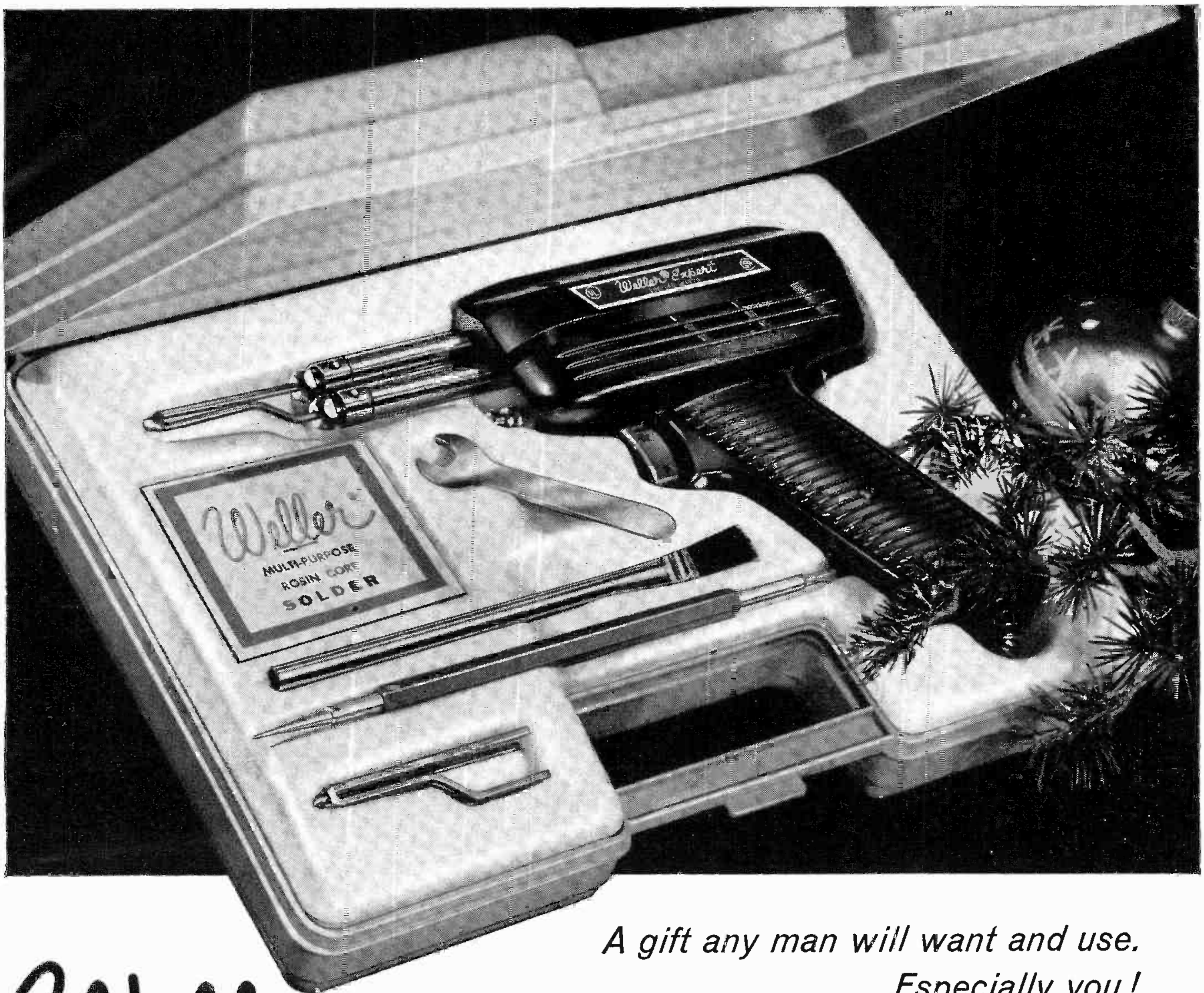
Zenith Sales Corp. reports a new 19-inch hospital TV that supplies AM and FM radio and recorded music from the hospital communications system, as well as regular TV entertainment.

By special agreement with the Laguna Indians of Central New Mexico, Burnell Co. will construct a $1,000,000 research and development firm on the Laguna reservation near Albuquerque.

RCA has announced a new computer, the 3301, with a "scratch-pad" memory operating at 250 nanoseconds, about twice as fast as any previous computer.

G-E's new junction laser operates continuously at a power output of more than 1 watt—a tenfold improvement over the output of ruby and gas lasers.

Radars for pleasure boats are taking a high place in the marine electronics market. FCC licenses for radars installed on US yachts and commercial vessels in the first quarter of 1963 jumped 47% over the same period last year. END



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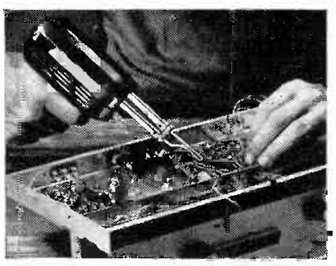
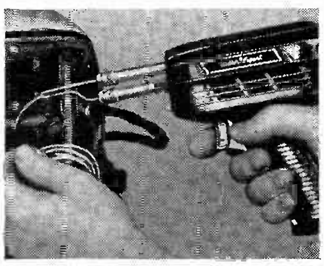
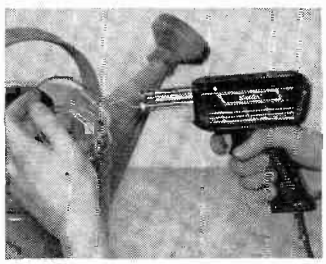


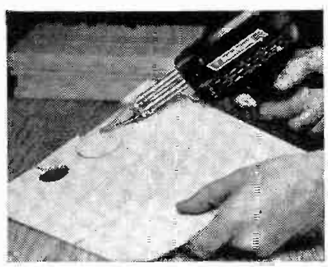
For electrical repairs



For mending metal



For many other jobs



Correspondence

Long, Fat, Fragile Shoestring

Dear Editor:

Jack Darr's "Start Service on a Shoestring" (R-E, July, p. 46) does little more than *insult* service shop owners.

The statement "Fact is, I don't know of a better business for a young feller" is a direct contradiction of statistics. Service business failures are among the highest. Insufficient capital and poor record-keeping are two prime causes. Your neophyte is starting out in a complex repair business with both those strikes against him. There was no mention of bookkeeping. Or won't he need any?

"You can use a well stocked tube caddy in place of a tube tester . . ." With today's multiplicity of tube types that caddy would need wheels!

Shop rent not being itemized implies that your man is setting up shop at home. He'd better check zoning ordinances first. He'll have to pay business rates on phone and on power, unless he has a separately metered line installed to his shop. His fire insurance may become void. If he owns his home he should take out a contractor's liability policy. Our courts keep quite busy with lawsuits.

One small item—hardly worth mentioning?—"Fuse assortment in a plastic box." That should cost no more than $25. Or will your man use the universal fuse – tinfoil? Perhaps 85% of TV troubles *are* caused by faulty tubes, but your man won't service many of these. Someone told the druggist how much money he could make selling tubes at an unrealistic markup, so he got into TV service with no investment beyond floor space.

The other 15% will surely test the "young feller's" mettle, with no spare parts and no schematics. He'll get to know his distributor quite well. At 10 cents a mile for all that driving.

"Rent, utilities, transportation and other stuff" are brushed aside as presenting "too many variables to even get a halfway useful answer . . ." The ex-Young Ham had better have such an answer or he'll quickly join a vast army of embittered part-timers.

The low-price competition of these moonlighters collecting no state sales tax, paying no county personal property tax and no Federal income tax has forced many men with 10 years' experience into other fields. The public is the loser. This constant turnover of men entering and leaving TV service serves no one except the electronics schools and test equipment manufacturers.

ELMER C. FISCHER
Fischer TV Service
Independence, Ohio

Jack Darr Replies

[Yet our readers wouldn't have felt too complimented, either, if the Old Timer had suggested that only a fool would go into—or stay in—the service business. Anyway, we gave Jack Darr a copy of Mr. Fischer's letter, and below is his reply.—*Editor*]

I fully realize the difficulties of which Mr. Fischer speaks, having had personal experience in large cities and small towns in just such projects, and having aided and abetted quite a number of young men like the XYH in similar enterprises. As for his "direct contradiction of statistics," I can't help quoting the old saw about the three kinds of lies —"Lies, dam' lies and statistics!!" The "statistics" used in the article all came from personal experience.

On his contention about "insufficient capital and record-keeping," I agree. I gave the XYH fits about that, if not in the article, at least in person! As to the omission, I can only say that there is room in a short article like this for only a few things; we hope to have another, going farther into this subject, in a forthcoming issue.

The "well-stocked tube caddy" is again personal experience, and, as stated very plainly, intended merely as a starter. By the way, if you *test* a tube, and don't have one like it, isn't it just as far back to the shop? The fuse assortment I carry, which has covered all sets for several years, cost me something like $7.50.

I would question Mr. Fischer's "statistics" once again on his *percentages* of "only a tube" jobs that are taken away by drug-store tube-testers. Around here, and in quite a few other towns I know of, it is exactly *reversed,* if not more than that! Frankly, before the DIY tube testers were born, we had the same percentage of do-it-yourselfers. Then, they came in to your shop, with all the tubes from their TV set in a paper sack, and said, "You advertised free tube testing—check these!"

Some 27 tubes later, you found a dead 5U4. As you reached up for a new one, he said, "Did you say 5U4? Let me write that down. I don't want to get the wrong one when I make out my order to Sears-Roebuck!" The drug-store has taken *that* business away from me, and I'm just about tickled to death! These are the people we'll always have with us, but once again, thank goodness, they are a very *small* percentage. (They also are

(Continued on page 24)

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TURN PAGE

Perhaps you're working in Electronics now but feel the need for an FCC License or more math . . . perhaps you're a hobbyist trying to decide between a career in Automation and one in Communications . . . perhaps you're a beginner who left school early, but you're thinking about the career possibilities of building a spare-time or full-time business of your own servicing radio and television sets. Worker, hobbyist or beginner, whatever your desire, there is training for you among the nine specialized courses NRI offers. Read the descriptions of NRI training on the other side of this page, about successes of NRI graduates, about NRI training equipment included at no extra cost. Then, cut out and mail postage-free form for FREE NRI CATALOG.

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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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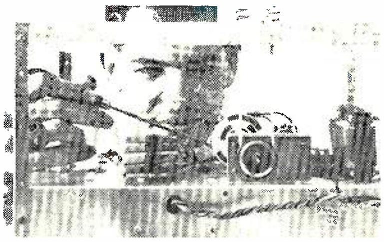

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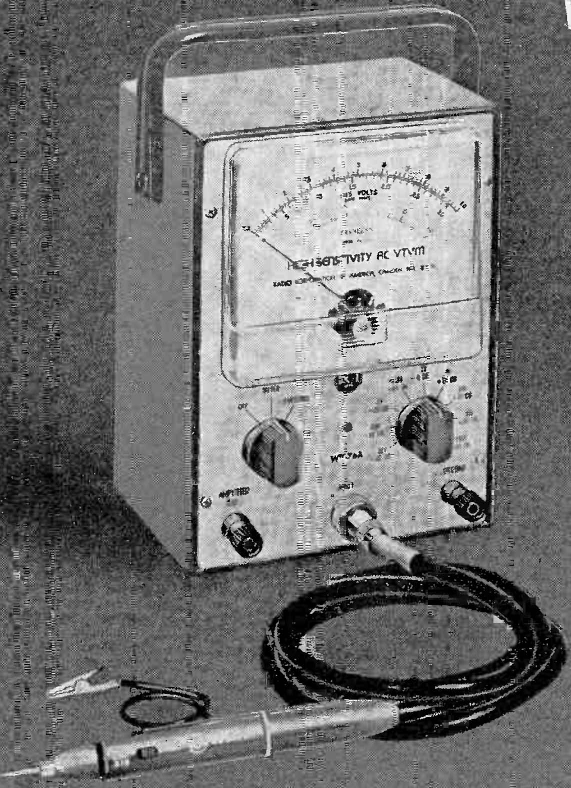

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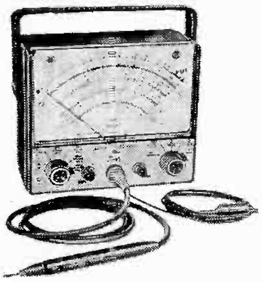

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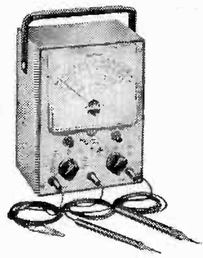
Kit: $57.95* Factory Wired: $79.50*



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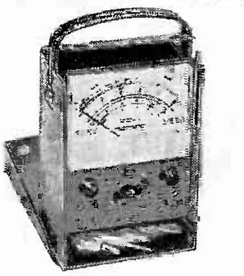
Separate 1.5-volt rms and 4-volt peak-to-peak scales for accurate low AC measurements. Measures AC and DC voltages to 1500 volts, resistances from 0.2 ohm to 1,000 megohms. Ultra-slim probes, long flexible leads.

Kit: $29.95* Factory Wired: $43.95*



RCA WV-38A (K)
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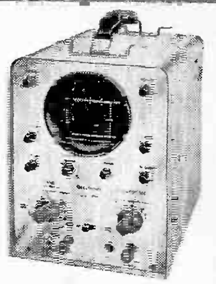

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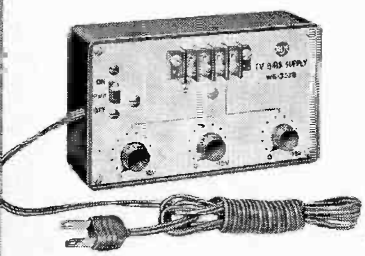

RCA WG-307B (K) TV BIAS SUPPLY KIT

Three separate DC output voltages each adjustable from 0 to 15 volts provide bias voltages for aligning RF, IF and other circuits of color and black-and-white TV receivers. **Kit: $11.95***

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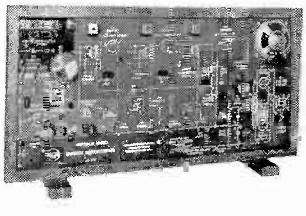

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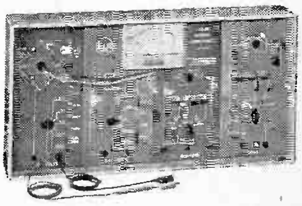

RCA WE-95A (K) VOLT-OHM-MILLIAMMETER DYNAMIC DEMONSTRATOR KIT

A functional, accurate V-O-M laid out on panel board for instruction and demonstration. Each basic circuit separately color coded. Measures AC volts, DC volts, DC current and ohms. One of the most useful test instruments in electronics. **Kit: $37.95***

*User price (optional)

RCA The Most Trusted Name in Electronics

continued from p. 18

the people who cause trouble by going to our distributors and buying parts wholesale!)

So, frankly, Mr. Fischer, I think you take entirely too dim a view of the whole situation! As I told the XYH, personally and in print, the result you get out of any endeavor of this kind depends entirely on how much of yourself you're willing to put into it; in other words, how hard you want to *WORK!* Also, if you're a poor businessman, you're going to fail, whether you're a grocer, TV technician or anything else! We're presuming that the XYH is smart enough to handle all of the other details, until proven otherwise.

Therefore, I still maintain that there is and always will be a place in our electronics industry for the individualist, *competent,* hard-working independent technician! This sounds just a little Pollyanna-ish, I know, but I still believe you'll find enough spirit left in our young men to let them make a success out of that old American dream of owning their own place!

JACK DARR

Honor Inventors

Dear Editor:

It greatly irks me and others in electronics to view the usual trash programs on TV, while those scientists and inventors who have made TV possible remain unhonored, impoverished and even driven to suicide from sheer ingratitude.

It certainly would be highly fitting if these men could occasionally be honored on a few programs. I believe that such programs could be made interesting enough to hold the average viewer's interest, thereby attracting enough sponsors to cover costs, profits and even an overdue donation for some meritorious inventors and widows, who are practically destitute.

DEXTER S. BARTLETT
Portland, Ore.

Not So Unusual, Maybe?

Dear Editor:

On page 92 of the July issue (Noteworthy Circuits) you call the power supply circuit "unusual." I patented this circuit more than 15 years ago (Patent No. 2,426,599). It has appeared in QST and various handbooks.

I admire your magazine very much and I think I've bought every issue!

E. E. COMSTOCK
Choctawhatchee Beach, Fla.

[Sorry—we didn't realize it was patented, Mr. Comstock. But the circuit is still "unusual" in that it is unfamiliar to most readers. While it may have been used in a few transmitters, a reader wouldn't know of it unless he had either built the transmitter or made a detailed study of its circuitry.—*Editor*] END

A complete tube tester that is smaller than a portable typewriter yet outperforms testers costing hundreds of dollars. A real money maker for the serviceman and a trusty companion for engineers, maintenance men and experimenters.

Even though the Mighty Mite weighs less than 8 pounds, new circuity by Sencore enables you to use a meter to check grid leakage as high as 100 megohms and gas conditions that cause as little as one half microamp of grid current to flow. Then too, it checks for emission at operating levels and shorts or leakage up to 120,000 ohms between all elements. This analytical "stethoscope" approach finds troublesome tubes even when large mutual conductance testers fail. And it does all this by merely setting four controls labeled A, B, C, & D.

Check these plus Sencore features: New, stick-proof D'Arsonval Meter will not burn out even with a shorted tube • Meter glows in dark for easy reading behind TV set. • New large Speedy Set-Up Tube Chart in cover, cuts set-up time • Rugged, all-steel carrying case and easy grip handle • Smallest complete tester made, less than one foot square. • The Mighty Mite will test every standard radio and TV tube that you encounter, nearly 2000 in all, including foreign, five star, auto radio tubes (without damage) plus the new GE Compactrons, RCA Nuvistors and Novars and Sylvania 10 pin tubes.

Mighty Mite also has larger, easy-to-read type in the set-up booklet to insure faster testing. Why don't you join the thousands of servicemen, engineers, and technicians who now own a Mighty Mite tube tester? Tube substitution is becoming impossible and costly with nearly 2000 tubes in use today. Ask your authorized Sencore Distributor for the New Improved Mighty Mite. Size: 10¼" x 9¼" x 3½". Wt. 8 lbs.

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Sencore Sam says . . "They all agree . . . the Mighty Mite is the real answer for the man on the go."

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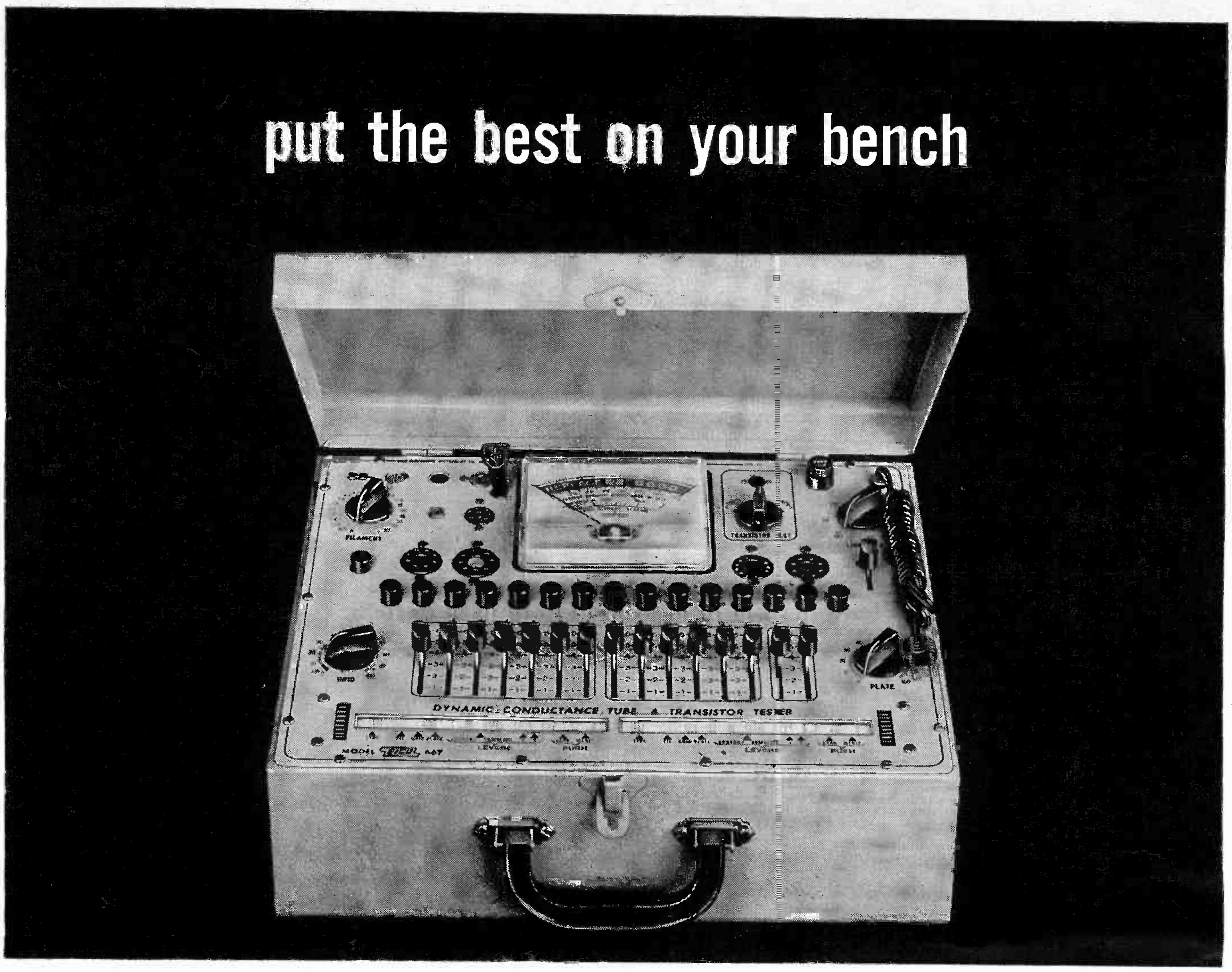

EICO 667

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.

FEATURES OF THE 667. Multi-circuit lever switch sets up plate, screen and control grid voltages rapidly. 13 pushbutton switches insert alternate tube elements for rapid leakage testing. 200-ma 4½-inch D'Arsonval meter is sensitive enough to give accurate readings even for tubes with low cathode current. 20 heater voltages cover all tube types including 300-, 450- and 600-ma series string tubes. Line voltage variations are compensated for by a line-adjust potentiometer **$79.95** kit, **$129.95** wired.

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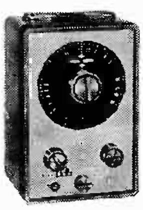

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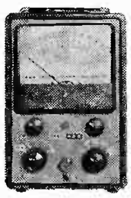

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ELECTRONIC ROBOTS

...Are Human-like Robots Possible in the Foreseeable Future?...

WE OFTEN receive letters and calls in person from well-meaning, often highly-intelligent persons who wish to get "complete" technical information on the so-called Robots. How soon will we have robots, *in human form,* that can act like humans, *think* like humans, and perform various human tasks, and that can replace humans in industry and commerce?

Before we answer, let us give a short history of *robotology,* if we can call it such, because in our technological age many pseudo-science fiction themes sound not only reasonable but eminently possible.

It was Karel Čapek, science fiction writer of Czechoslovakia, who in 1920 coined the word *Robot,* from the Slav term *robota,* "work." He wrote a play, R.U.R. ("Rossum's Universal Robots") about artificial mechanical men put into mass production. These were sold as soldiers and workers. The play then goes on to its inevitable conclusion when the robots revolt and destroy man. The word, usually mispronounced, has the accent on the first syllable: *ro*-bot.

R.U.R. was first produced in New York in 1922, and soon caught the world's attention. The term *robot* is now known all over the globe in almost every language, yet the idea of artificial perambulating men is very old, going back thousands of years, and including the Hebrew *Golem,* the *Frankenstein* monster and many others in early science fiction.

To modern man the idea of an electromechanical, or electronic, robot will not down—it sounds too plausible! Even good science fiction writers—usually non-scientific, non-technical—are caught in the robot illusion. There is not a single year during the past 25 that has not had its quota of robot short stories or books. These are *always* in human form; often they masquerade as real humans from other worlds.

Few of these pseudo-science fiction authors ever think through, or technically work out, the (at present) almost impossible task of constructing a true, thinking replica of a human. What about the power to motivate such a machine independently, without a cumbersome engine? How to electrify it without a separate power plant? Batteries, fuel cells? These are wholly impractical if the robot is to be less than 10 feet high and weigh less than a ton. Atomic energy? Completely unrealistic in the foreseeable future! Remember that a robot, to perform like a human, must have a reasonably independent power supply so that it can do every kind of labor: walk, run, climb, lift weights, etc. *This takes a good deal of energy.* Where does a human-sized robot get it? Well, at present it is not even on the horizon.

But even if that problem could be solved in 300 years, where is the brain that will make the robot think and act?

Alas, the foremost computer scientists laugh at the idea of thinking computerized robots! Listen to just a few of them:

Says Dr. Philip M. Morse, Professor of Physics and Director of the Computation Center of the Massachusetts Institute of Technology: "The present state of computer design compares to the very early automobile design of 1913."

In the 1962 meeting of the Conference on *Self-Organizing Systems* in Chicago and New York, sponsored by the Office of Naval Research and the Armour Research Foundation, the talks centered on machines, devices and systems that could "learn" from experience and conduct themselves accordingly. The main obstacle, the speakers confessed, was lack of information on how the human nervous system operates during the thinking processes. This, in their opinion, points to the long paths that lie between us and true "thinking machines."

Says Dr. Marshall C. Yovits of the Office of Naval Research: "Some of the much-publicized systems, allegedly capable of learning or recognizing, must be taken with a grain of salt!" (Refer also to our editorial, "After the Computer, What?", in the June, 1963 issue of RADIO-ELECTRONICS.)

So much for the total impracticability of the robot in human form—at least for the foreseeable future.

Man is still the most complex, the best, the most efficient and the cheapest "robot" in existence!

Yet we do have excellent working robots all around us today, *if we can forget that they are never in human form,* but come in all shapes, sizes and weights, from a mere few ounces to hundreds of tons.

Every time you dial a number, you use a fairly intelligent robot. Every time you turn on a radio, a TV set, a washing machine, a dishwasher, start an automatic elevator, you use an intelligent, yet not thinking, robot.

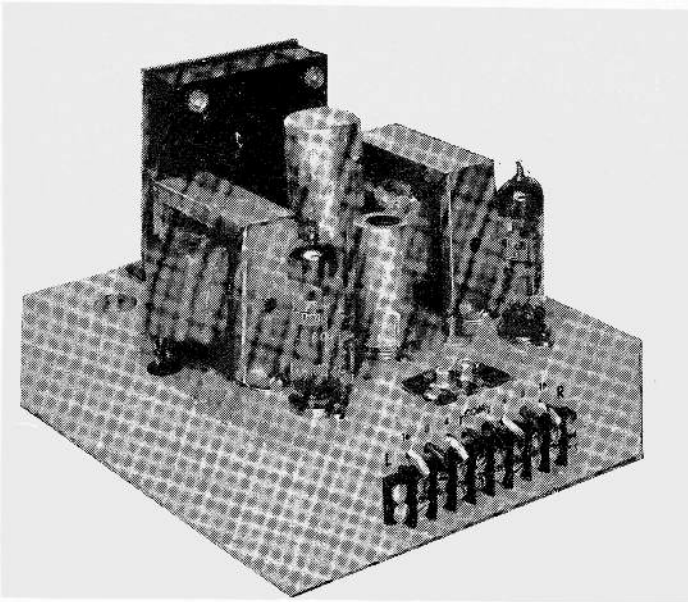
Industry uses thousands of almost-thinking robots: Automatic typesetters, billing machines, typewriters that write automatically, auto-printing machines, automatic bowling pin resetters, near-automatic assembling machines that turn out radios and automobiles, and of course, the computers we have been discussing.

There are now hundreds of almost manless plants that work automatically, turning out and packing for shipment such articles as pins, screws or stampings of every kind. We have bottling plants, even automatic gasoline refining plants that take the raw product, crack the gasoline and deliver it ready for shipment, all without human hands.

It would take a large volume to list all the automated plants in use today. This is Čapek's R.U.R. *in reverse.* Today it isn't the robots that revolt and destroy man—it is man who is beginning to revolt against the robots and their automation.

What is desperately needed now is the renaissance of man in the automation age. It will take a great deal of ingenuity to devise means and ways to reintegrate man into the new electronic-robot age.

One solution would be free Government "conversion" classes in various parts of the country to retrain persons out of work because of automation. Such individuals would be taught various trades in which there is the best possibility of employment. Such an effort would certainly pay dividends to the country and reduce unemployment. —*H.G.*



20 WATTS STEREO... 3 TUBES!

By PETER E. SUTHEIM
ASSOCIATE EDITOR

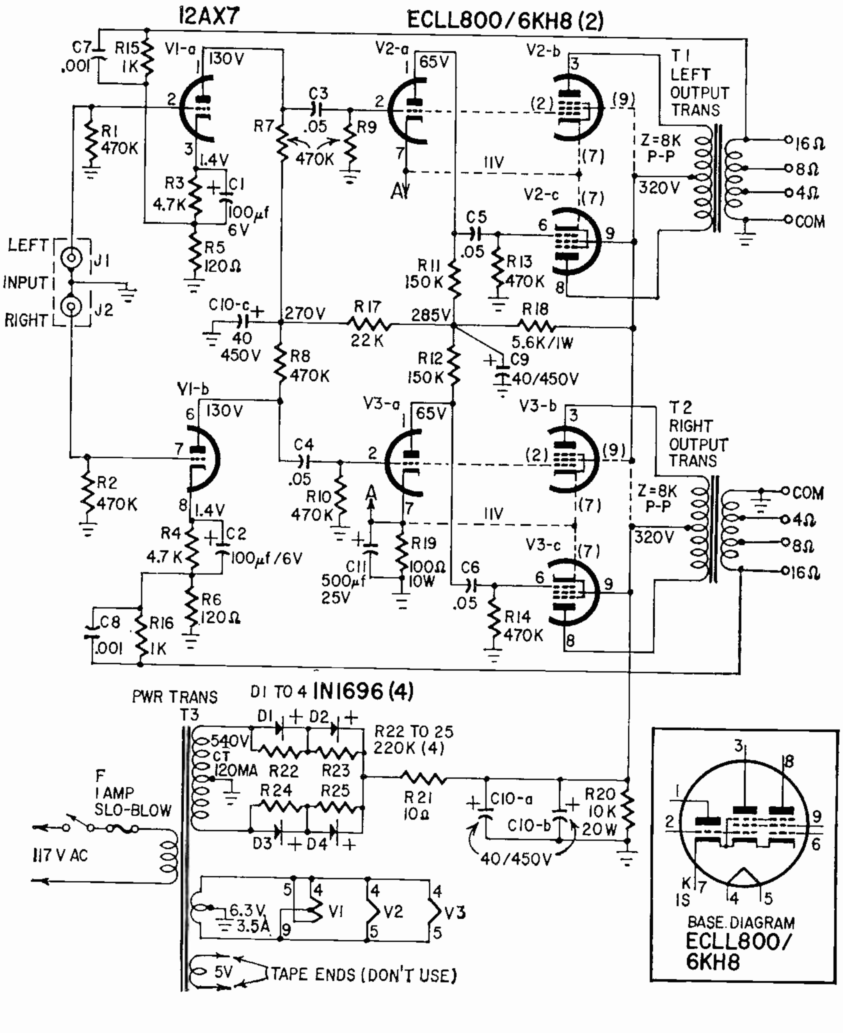
EARLY THIS YEAR, INTERNATIONAL TELEphone & Telegraph announced a remarkable new tube, made in Germany by Lorenz to be distributed here by ITT. Dubbed the ECLL800/6KH8 (!), it contains two audio power pentodes and a low-mu phase inverter triode—all in a single nine-pin miniature envelope! A look at the specification sheet for the new tube soon had me convinced that I could build a dual stereo amplifier with two ECLL800's and a single 12AX7. I tried it, and Fig. 1 and the photos show what it looks like.

The circuit

The only unusual part of the amplifier is what surrounds the new tubes. Even there, the actual circuit is probably a good 30 years old. I would have preferred a different kind of phase inverter, but the fact that several elements are connected together inside the tube limits the ways it can be used. Despite my misgivings, though, the circuit performs very well.

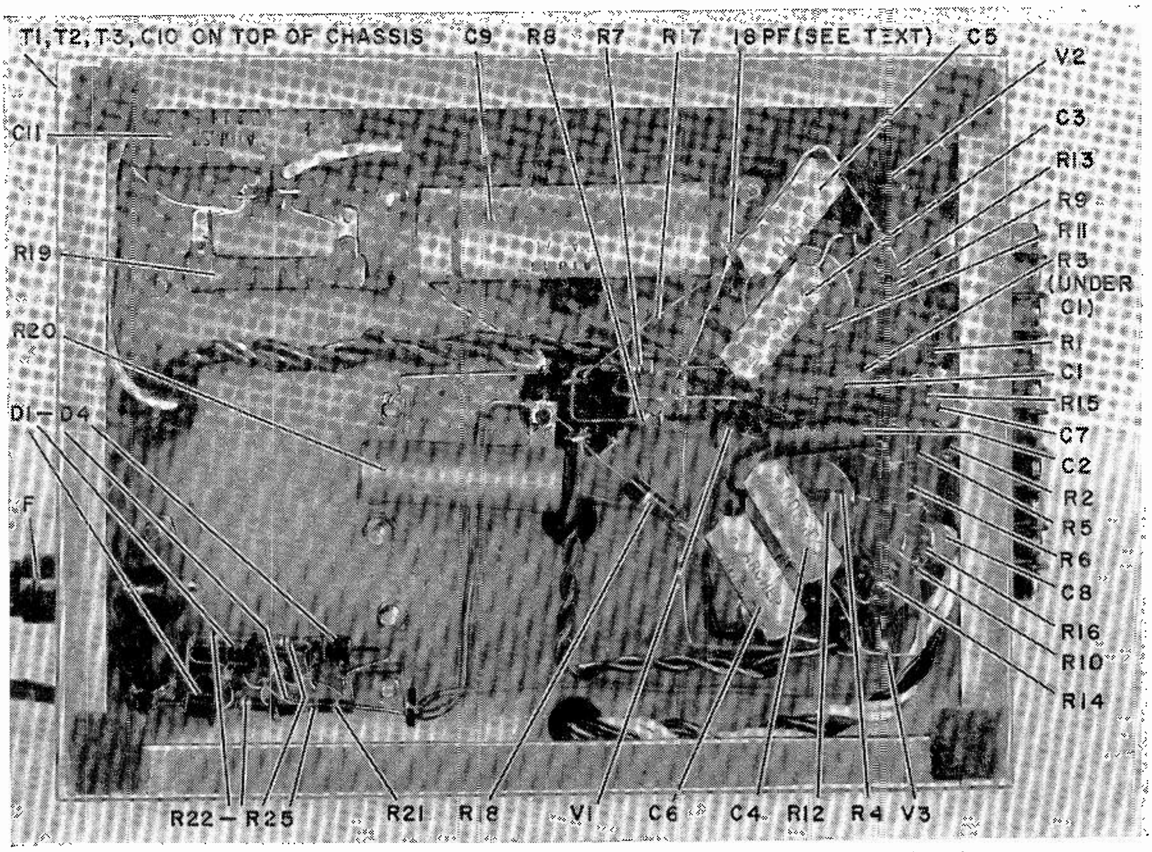
The input stage of each channel is half a 12AX7 with plate and cathode resistor values (R7, R8; R3, R4) selected for maximum gain. We'll need that gain for feedback later. To provide a point for applying negative feedback from the output transformer secondary, 120 ohms of cathode resistance (R5 and R6) is left unbypassed. This is such a small portion of the total cathode resistance that the gain of the stage (without overall feedback) is unaffected.

Since the grid of one of the power pentodes is common to the built-in phase inverter, the drive appears there, too, and then again on the phase inverter plate, delayed by 180°. Normally, this kind of phase inverter gives more gain on the inverted side than on the "straight-through" side, since there is one more stage in the inverted side. To compensate, most circuits of this kind split the grid resistor of the output tube



R1, R2, R7, R8, R9, R10, R13, R14—470,000 ohms
R3, R4—4,700 ohms
R5, R6—120 ohms
R11, R12—150,000 ohms
R15, R16—1,000 ohms
R17—22,000 ohms
R18—5,600 ohms, 1 watt
R19—100 ohms, 10 watts
R20—10,000 ohms, 20 watts
R21—10 ohms
R22, R23, R24, R25—220,000 ohms
All resistors ½-watt unless noted
C1, C2—100 µf, 6 v, electrolytic
C3, C4, C5, C6—.05 µf, 600 v, paper
C7, C8—.001 µf, 500 v, ceramic
C9—40 µf, 450 volts electrolytic
C10—40-40-40 µf, 450 volts electrolytic
C11—500 µf, 50 volts electrolytic
V1—12AX7
V2, V3—ECLL800/6KH8 (available from ITT distributors)
T1, T2—output transformer, 8,000 ohms plate-to-plate. Sec. 4, 8 and 16 ohms. 18 watts (Allied Radio Catalog No. 62 G 058)
T3—power transformer, 540 vct, 120 ma; 6.3 v, 3.5 amperes; 5-v winding not used (Allied Radio Catalog No. 61 G 466 or equivalent)
F—fuse, 1 amp, slow blow
D1, D2, D3, D4, diodes, 1N1696 or equivalent
J1, J2—dual phono jack
Chassis, 9 x 7 x 2 inches
Fuse post, terminal strip, tie points, assorted hardware

Fig. 1—Circuit of the stereo amplifier. By replacing R1 and R2 with dual 1-megohm volume control, amplifier can be used as is with FM stereo tuner or high-output crystal or ceramic cartridge.



View underneath shows all components. Pads in corners protect finished surfaces.

(Fig. 2-a) feeding the inverter grid from the junction of the two resistors. The ratio of the resistors is chosen to attenuate the signal just enough to cancel the gain from the inverter stage. There lies this inverter's worst drawback: the amplitude balance of the two outputs depends on the gain of the inverter tube, which is bound to change with time, while the resistors' values stay pretty much the same.

In the ECLL800, the inverter triode has a transconductance of only 50 —count 'em—50 µmhos! Its voltage gain is nearly unity. (Note, by the way, that since the cathodes of all three sections of the tube share a common pin, the inverter grid will have to be biased the same as the output stage. Interesting.)

Now, there is something lovely about unity gain. It won't go up or down very much during the life of the tube. And it has eliminated the nuisance volttage divider.

I wasn't aware of all this until after I had breadboarded a circuit and played with it a few hours. I had (ingeniously, I thought!) made the phase inverter plate load a 150,000-ohm pot instead of a fixed resistor, so that I could compensate for what seemed to be inherent unbalance.

So convinced was I of the need to adjust that, when the experimental circuit showed there was no need for it, I attributed it to a fluke, and went ahead and built two pots into the final version. They're still in, as you can see from the

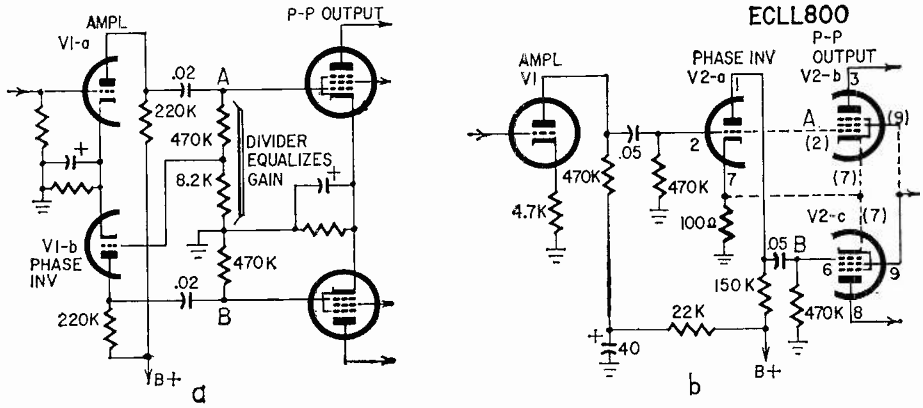


Fig. 2-a—Divider in upper output tube grid circuit, set to equalize drive voltages at A and B, does so for only one value of gain in V1-b. Fig. 2-b—Unity gain of V2-a (built into ECLL800) makes signal voltage at A and B the same, regardless of gain changes.

photos, but the center terminals are not used. They are now just expensive fixed resistors. I was too lazy to take them out.

About 24 db of negative feedback comes from the 16-ohm output taps back to the cathodes of the 12AX7 via R15 and R16. C7 and C8 counteract the transformers' tendency to make the feedback positive at superaudible frequencies.

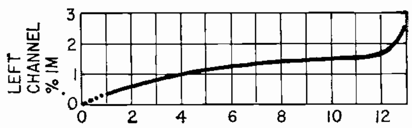
The output transformers deserve a special word. Unprepossessing as they look, they have golden hearts. Beneath all that unlovely "gunk" sleeps a very well-made transformer—especially considering the price: $5.35 from Allied Radio, Chicago. Though I made no measurements on the transformers themselves, the amplifier's performance shows them up very well. There's lots of iron, built up out of thin laminations—signs of a good transformer. They are designed for 18 watts, and are loafing here at a maximum of 10.

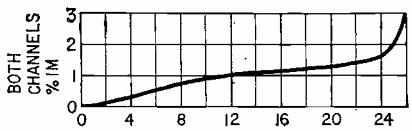
The power supply is done in modern conventional: four G-E 1N1696 silicon rectifiers connected in series pairs as a full-wave rectifier. The 220,000-ohm resistors (R22–R25) equalize backward voltage drop to prevent any one diode from carrying the full strain. R21 is a surge-limiting resistor; it protects the electrolytics and the rectifiers from the initial heavy charging current. Plenty

SPECIFICATIONS

Measurements were made with constant 117-volt ac supply and 8-ohm resistive output load.

Power output (rms, per channel, at 1,000 cycles)	10 watts
Power bandwidth (rms 3-db power points, IHF standards)	35–20,000 cycles, at 1% harmonic distortion
Frequency response (at 1-watt output level)	10–40,000 cycles, +0, −0.1 db
IM distortion (equivalent rms sine-wave power per channel, using 60 and 7,000 cycles, mixed 4:1)	Less than 1.5% at 10 watts output (see curve)
IM distortion (same conditions, both channels into common load)	Less than 1.5% at 20 watts output (see curve)
Hum and noise (referred to full output)	−77 db
Crosstalk (level of signal in "unused" channel below full output in operating channel)	−57 db
Gain (input required for 10-watt output)	1.5 volts
Damping factor at 8-ohm output terminals	9.5
Stability test (.01-µf capacitive load across 8-ohm terminal; amplifier driven to full output, 20 cycles to 20 kc)	No trace of parasitic oscillations





EQUIV SINE-WAVE POWER OUTPUT (WATTS)

of filter capacitance (160 µf total) means low hum, better low-frequency stability and better short-term supply regulation.

Biasing

In this final version, straight cathode bias is used, with a 500-µf electrolytic bypass capacitor to improve regulation. I tried two other ways: a 12-volt 3.5-watt Zener diode (1N1594) between the output tube cathodes and ground, and a simple half-wave bias supply using as a source the 6-volt heater winding (one side grounded) and the unused 5-volt winding, connected in series. According to theory, the Zener bias system should offer pretty near the ultimate in bias regulation, since between its breakdown point and the point where it just gives up and melts, the voltage across it stays constant. Its dynamic impedance is about 1 ohm, so it needs no bypassing.

As it turned out, neither the Zener nor the fixed supply provided any improvement over good old cathode bias; so cathode bias—the cheapest way—was the method I used here. Feel free to experiment, but remember that Zener diodes are destroyed utterly and almost instantly once overloaded (at $3.85 a shot, by the way—I know), while a cathode resistor can usually take it for a while.

Building it

No unusual construction techniques were used here—just the usual "good wiring practices" every construction article mentions. I recommend this layout, because it's logical, symmetrical and reasonably compact (everything fits neatly on a 9 x 7 x 2-inch chassis). If you use it, you should have no trouble with instability or hum. The only anti-hum precaution I took was to use balanced heater wiring (grounded center tap and twisted leads). The photo shows a central ground bus, but many things are grounded rather haphazardly at convenient points.

If you do have high-frequency oscillation, try first to get rid of it by moving the output transformer primary leads around, away from the grid resistors. If that doesn't help, try a low-value ceramic or mica capacitor from one of the ECLL800 output grids to cathode or ground. I had oscillation troubles in one channel only, and licked them with an 18-pf ceramic across R13. This does not affect high-frequency response but now there is no trace of oscillation or peaking in either channel.

The amount of feedback used here is about the maximum. Any more will lead to instability and raise the input voltage required for full output to such a high value that many preamps will run into distortion trying to drive the amplifier.

So, on the whole, this makes a very respectable amplifier for a modest stereo system. Total cost of the parts, new, will be something around $40. Not bad, for an honest 10 watts per channel (more on a music power rating). Happy listening! END

Tuner input impedance can cause trouble in color TV

By **BOB MIDDLETON**

MANY TROUBLES IN COLOR TV RECEPTION are caused by a mismatch between the tuner and the lead-in. The service technician will naturally look for trouble in the antenna itself, or in the lead-in, as these are the most common offenders. But it's handy to have an easy, convenient test of tuner input impedance. You can make such a test with a color bar generator.

The generator must be tunable over the channels you want to check. Feed the signal from the generator to the TV tuner first through an 8-foot delay line—just an 8-foot length of good-quality 300-ohm lead in. Now try to tune in a color-bar pattern on the set. If you can't get one, feed the bar generator directly into the set without a delay line. If you get a color pattern now, there is a serious mismatch.

If you do get a decent pattern with an 8-foot delay line, try again with a 10-foot line. There should be no change in color or brightness; if there is, you have a mismatch. If color falls out completely, the mismatch is very bad. Make a third run with a 13-foot line. The pattern should still be good.

This approach might seem a little playful, but it's based on solid theory. The idea is that a perfectly matched transmission line will transfer all its energy to the load without reflections, standing waves or consequent drop-outs.

To find the mismatch, look first for a broken lead between the set's input terminals and the tuner. Sometimes the lead is taped to a metal support. The support may have chafed through the insulation, grounding one side of the lead. Mismatch can also come from poor contacts to the tuner strip, or a defective strip.

Remember to suspend the delay line in free air during the test—don't coil it or kink it. If any two parts of the line are close to each other, a number of capacitance or inductance effects —or a queer combination of both—can take place, and tests can then easily become meaningless.

Some of you may feel that this is an unduly severe test because the generator output impedance is 75 ohms, and any reflection from the tuner is strongly re-reflected from the generator. Actually, this test closely simulates conditions with an antenna. Few antennas are really exactly 300 ohms all the way. If a color set passes the delay-line test, it will work with any impedance you are likely to come across. END

THE PATTERN DEPENDS ON THE PROBE

By ARTHUR CUNNINGHAM

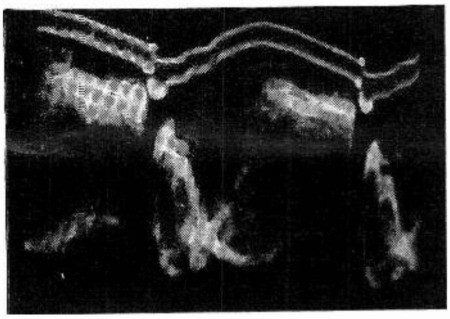
Ever complain, "My scope patterns never look like the ones in the service data?" The answer, almost always, is, "You're using the wrong probe with your scope!"

Here you'll see what happens (or doesn't happen) when you use the wrong probe, and how pretty everything looks when you use the right one. The table and diagrams will help you choose the proper probe.

These are traces of video information, made at video amplifier output. (a) What the scope shows with direct probe: a hopeless smear. (b) Through 50,000-ohm isolating probe, a little better—probe, cable, scope input capacitance have somewhat less effect. (c) Looks like what's in the book! Low-capacitance probe shunts higher frequencies very little. (d) Trace made through crystal probe.

Photos (e) through (g) waveform on last video i.f. grid as "seen" through direct, resistor and low-cap probes. Almost nothing to see! Crystal probe (h) can give you needed information; it demodulates video carrier and removes video. Notice how direct probe (e) shorts out video signal by its low impedance. Only blanking interval is discernible.

a



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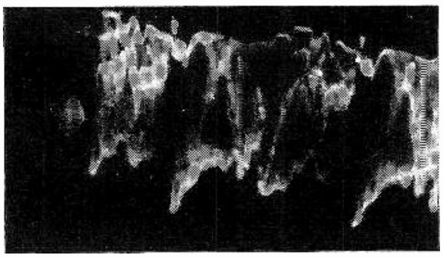

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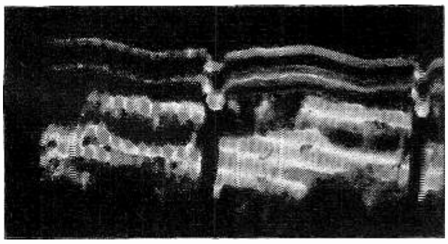

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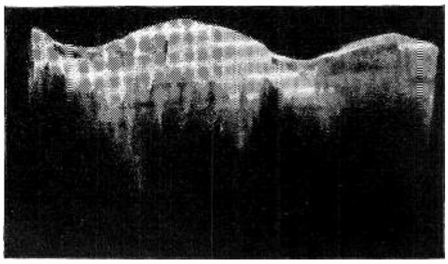

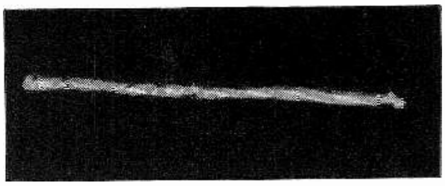

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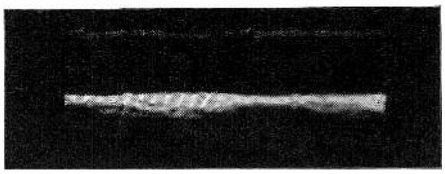

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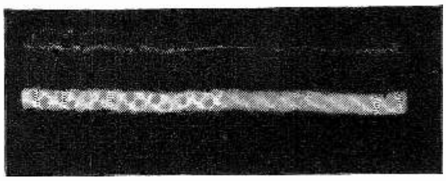

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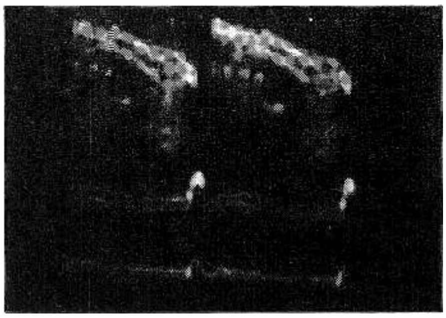
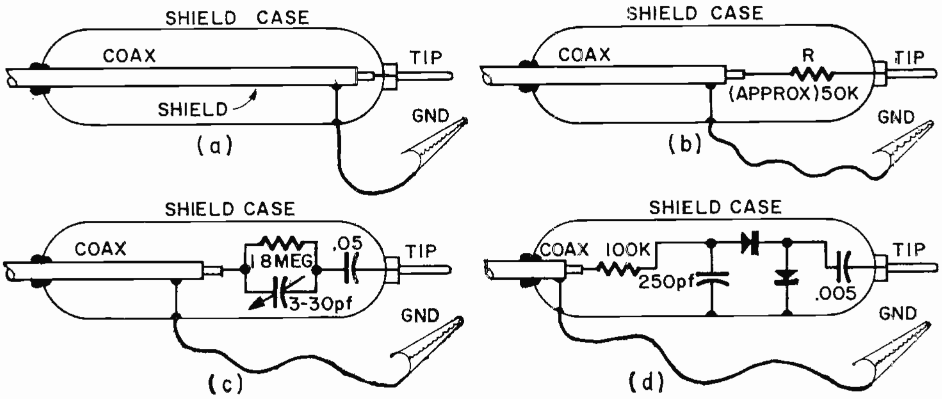


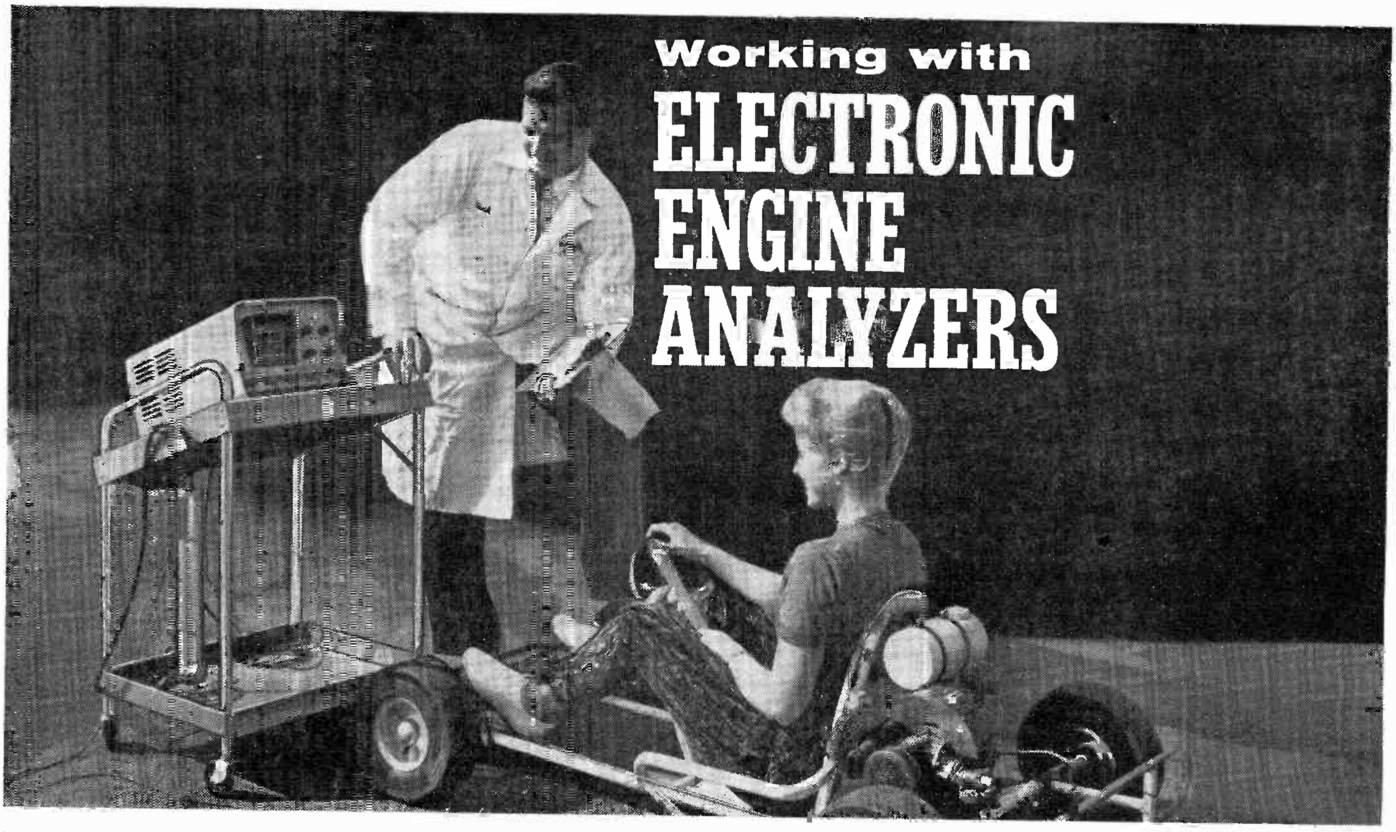
h

PROBE	USED IN
Direct	Low-impedance circuits, low-frequency signals. Response depends greatly upon input impedance and capacitance of scope's vertical amplifier.
Resistive isolating	Low-frequency circuits which have "medium-high" impedance. Resistor used mostly to isolate input impedance of scope from circuit.
10:1 low-capacitance	High-impedance circuits, medium to low frequencies and, to some extent, on higher frequencies, such as horizontal oscillator and sound testing. Useful in video circuits after video detector.
Crystal	Rf signals, before detection. Absolutely necessary for signal-tracing in video and sound i.f. stages or tuner output.

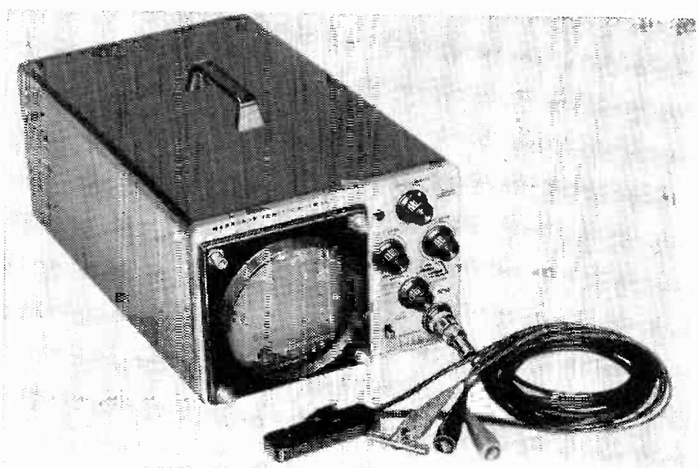
Inside four probe types: Direct probe (a) is a piece of coax, with shield running almost to probe tip, and grounded to instrument at other end. The isolating probe (b) is very similar, except for about 50,000 ohms resistance in series with hot lead. (c) 10:1 low-capacitance probe, compensated with trimmer for greater bandwidth. (d) Crystal detector probe: 2 diodes in voltage-doubler rectifier, dc blocking capacitor and filter capacitor.



Working with ELECTRONIC ENGINE ANALYZERS



By ARTHUR S. KRAMER



Heathkit's IO-20 electronic ignition analyzer.

One of the earliest electronic engine analyzers was developed approximately 10 years ago at the Socony-Vacuum Research Laboratory in Paulsboro, N. J. Several Socony engineers, seeking a better way to observe the ignition process of gasoline engines, worked out a hookup using an oscilloscope. Since that time, many improvements and additions have been made, and today the electronic analyzer is generally accepted as the way to observe engine operation. Among the automotive service problems to which it has been applied are irregular distributor cam lobes, wobbly breaker plate, incorrect breaker-spring tension, low compression, insulation leakage, coil-tower corrosion, fouled and cracked plugs, pre-ignition, and many others.

Let's review the operation of a typical automotive ignition system. Referring to Fig. 1, when the breaker points are closed, current flows through the coil, setting up a magnetic field in the iron core. This field builds up relatively slowly, so the length of time the points remain closed (dwell time) is important.

As soon as the points open, current flow stops and the magnetic field collapses practically instantaneously, generating a voltage that tries to keep the current flowing. A voltage surge is induced into the secondary (which contains many more turns of wire). The net effect steps up the primary voltage to many thousands of volts, firing the sparkplug. (The actual voltage depends on compression, air/fuel ratio and sparkplug gap.) The distributor then moves to the next position, closing the breaker points by cam action and connecting the

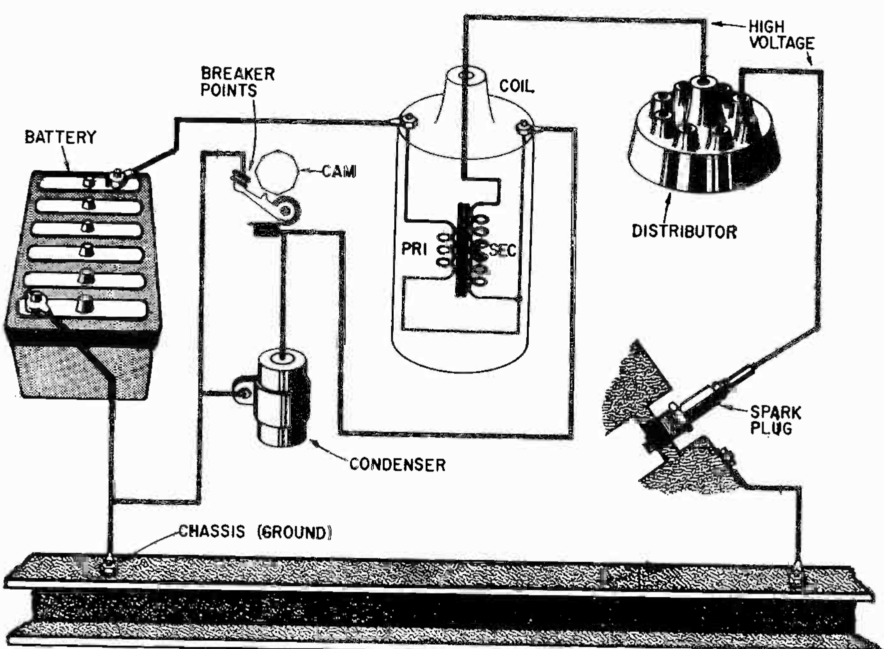


Fig. 1—Basic diagram of a typical ignition system.

next sparkplug to the secondary, and the process is repeated.

Advantages of engine analyzers

The electronic analyzer has given the mechanic a set of X-ray eyes so he can see what is occurring in the engine and thus end his blind guesswork groping.

All modern electronic engine analyzers are easy to use. About all that is necessary is to connect the power plug to an ac outlet, clip on two or three leads, make a few simple adjustments and begin observing engine performance.

The electronic analyzer saves so much time that many more jobs can be handled successfully in a work day than previously.

Airplane engines can also be checked with the Sperry analyzer.

Kit type analyzers

One way to get an electronic analyzer at moderate cost is to purchase it in kit form and build it yourself.

The Heathkit electronic ignition analyzer kit model IO-20 is an example. Only four cables need to be attached, and there are only four controls to adjust. The instrument has six basic sections: the trigger circuit, sweep generator, horizontal deflection amplifier, vertical amplifier, power supply and CRT circuit.

This DuMont ignition analyzer offers a timing light as a handy accessory.

How they work

The DuMont type 901 EnginScope is basically a cathode-ray scope with special circuitry built in to make engine tests. The instrument contains a CRT quite similar to the picture tube in a TV set, and the engine ignition voltage waveforms are displayed on its face. Special amplifiers deflect the electron beam horizontally and vertically. A "raster" presentation is featured in which each cylinder has its own ignition line, one above the other. Signals from the engine are picked up by cables running from the instrument and clamped onto various wires in the ignition system.

Battery current flows through the automobile coil while the points are closed. When the distributor cam forces the points open, the circuit is broken and the high-tension surge comes out of the coil tower and is delivered to the sparkplug where it jumps the gap.

In the oscillogram of Fig. 2, the plug firing is pictured as a straight line at the left edge of the waveform. After the plug fires, the unused energy in the coil diminishes. The scope pictures this diminishing power as a series of wiggles getting smaller and smaller.

When all the unused energy in the coil has dissipated, the wiggles stop and the ignition system is ready to start a new cycle. This is shown by a small group of wiggles which occur at the instant the points close. While the points are closed and the coil is building up the energy for the firing of the next sparkplug, the scope shows a straight line. The straight line ends when the points open. This is called the points-open signal. The period of dwell is measured by the distance between the points-close and points-open signals.

This represents a complete ignition cycle for one cylinder and is repeated

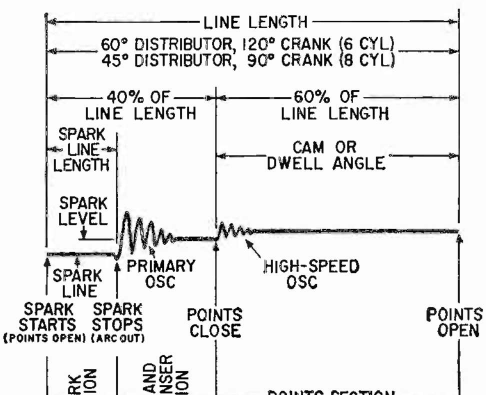


Fig. 2 — Single-cylinder display shows normal operation.

Fig. 3—Normal parade display shows all cylinders in a row.

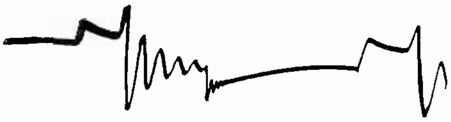


Fig. 4—The parade display can be expanded to show only one cylinder.

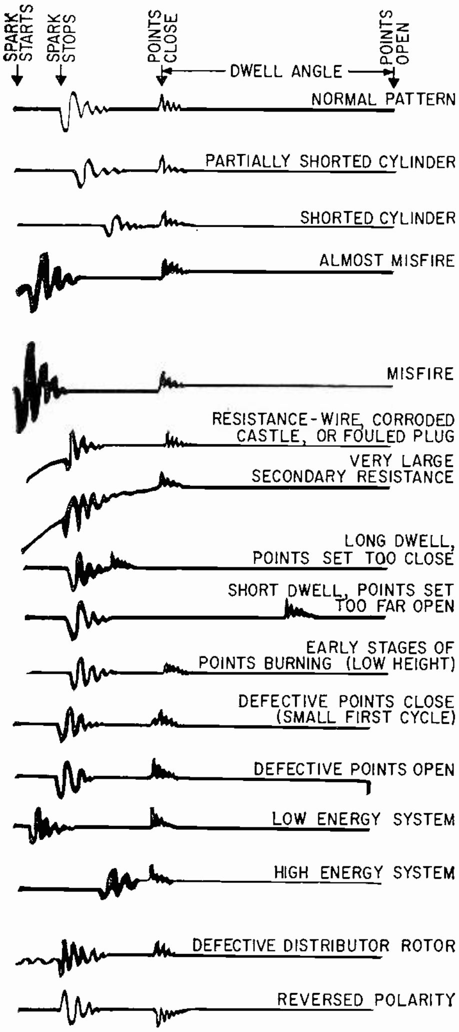


Fig. 5—Patterns seen on an engine analyzer screen. The defects shown here cover 90% of all ignition-system faults.

on the scope as a complete waveform for each cylinder as it fires. In the "raster" pattern, each cylinder is shown by its own spark line, as previously explained.

The Heyer Dyna-Vision analyzer includes a CRT, power supply and associated amplifiers. A "parade" pattern (Fig. 3) is obtained from this instrument. Here, signals from the various cylinders appear in a single line across the face of the tube. This pattern can be stretched out to permit close examination of the line from any individual cylinder.

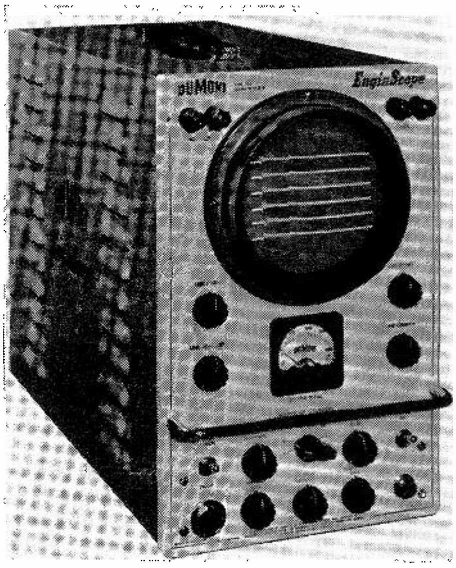
Examining a single cylinder's section of the parade pattern (Fig. 4) shows that the pattern closely resembles that of one individual line in the raster pattern, except that the high-frequency oscillations which follow "points close" appear below the line rather than above it. Other than this, the patterns are the same, and the explanation for the raster line also applies here.

The Sperry aircraft engine analyzer works in much the same way. Patterns are presented as a trace of light on the cathode-ray tube by a ray or beam of electrons that sweeps horizontally across the screen in step with engine rotation. As the beam is swept horizontally in sync with the engine, it is also deflected vertically by the changing voltage under observation, moving up and down as it crosses the screen, continuously plotting a dynamic graph of the voltage magnitude for every degree of crank angle over a selected portion of the engine cycle.

Engine analyzer applications

Fig. 5 is a rundown of common ignition problems. The normal pattern for a single cylinder appears at the top for reference and comparison. Obviously, all ailments manifest themselves as noticeable changes in the pattern. A little study of Fig. 5 will enable the user to pinpoint trouble very quickly.

Much useful information can be obtained if the actual firing voltage of the plugs while operating in the car can be measured. Plug circuits in good condition will show similar patterns at approximately the same voltage. A nor-



DuMont type 901 EnginScope.

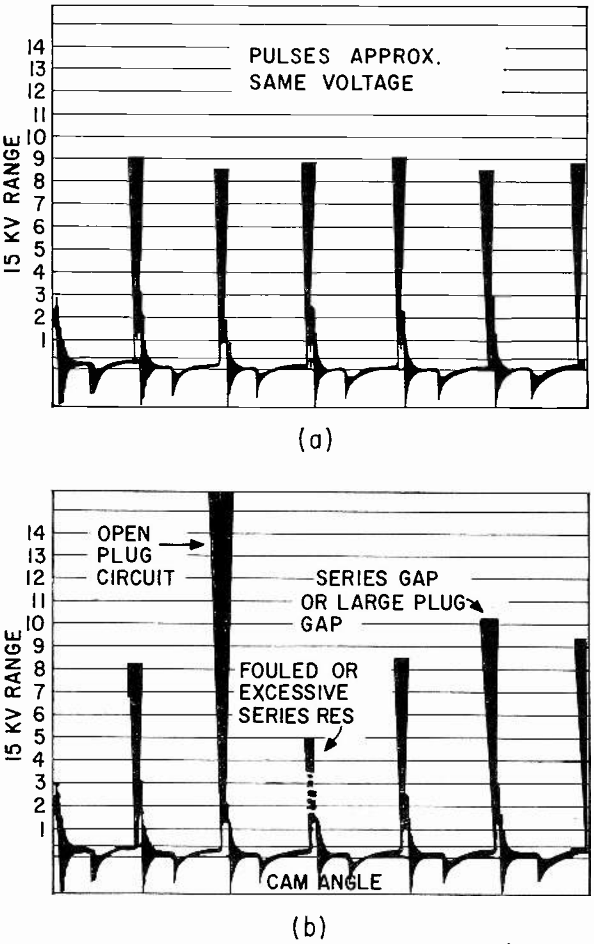


Fig. 6 — Normal (a) and defective (b) parade patterns.

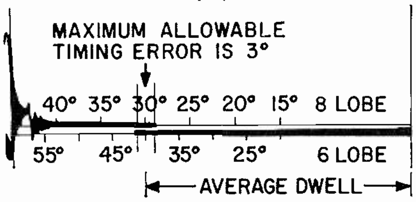
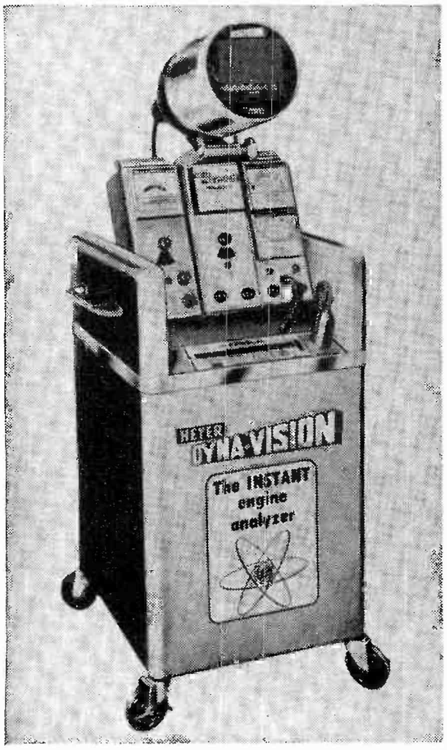


Fig. 7—Normal single-cylinder spark line.



The Heyer model 600 Dyna-Vision analyzer.

Fig. 8—This pattern reveals a bad distributor.

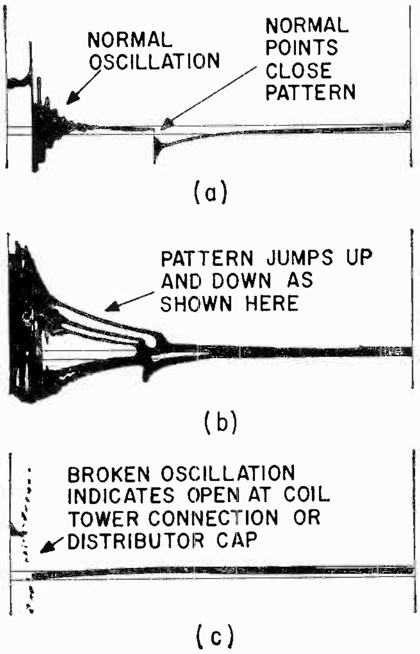


Fig. 9 — Ignition problems. a — Normal secondary pattern. b—Open inside coil. c—Open in distributor coil lead.

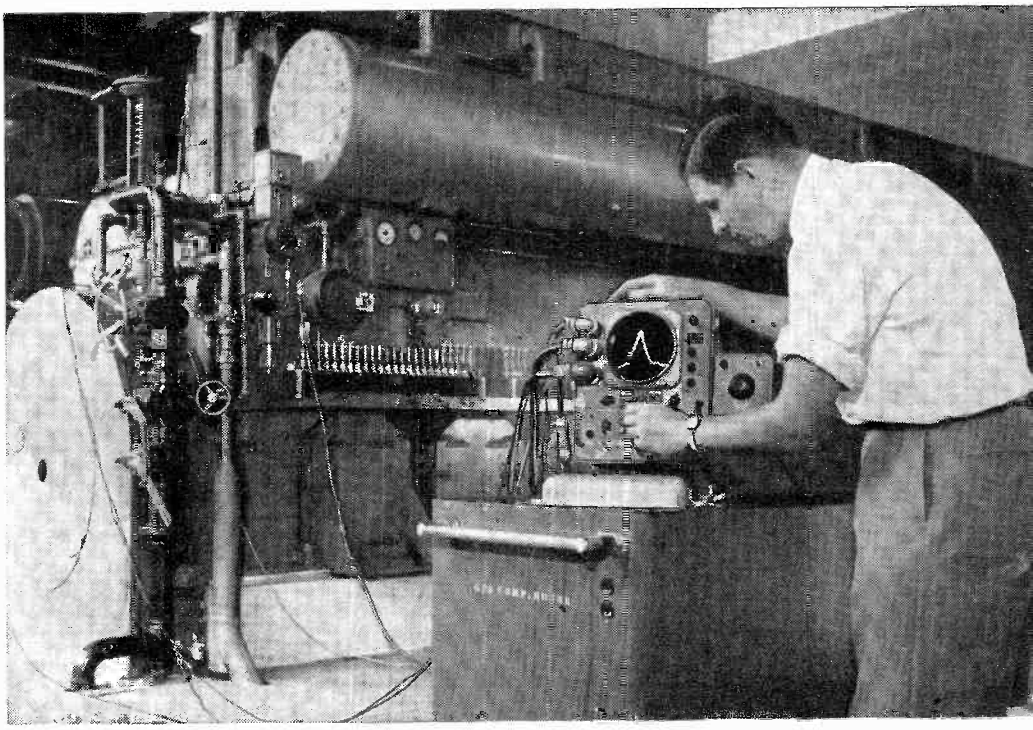
mal parade pattern is depicted in Fig. 6-a. In contrast, the patterns obtained with several ailments are shown in Fig. 6-b. The differences between them are so apparent that no great experience or skill is needed to spot them.

Distributor troubles are a common cause of irregular and erratic engine operation. A normal single-cylinder spark line is shown in Fig. 7, and the pattern of a car with a bad distributor in Fig. 8. This could be caused by worn distributor parts such as bearings or cam faces. About the only remedy is to rebuild or replace the distributor.

Coil and capacitor troubles can be easily diagnosed and pinpointed with an electronic analyzer too. In Fig. 9-a, a normal secondary pattern, note that the "oscillation" and "points close" parts of the picture are very clean and well-defined. Now examine Fig. 9-b, the pattern for an open inside the coil. Note that the pattern jumps about erratically and, in general, indicates a very bad situation in the ignition system. The pattern for an open in the distributor coil lead is shown in Fig. 9-c. Here, almost the entire secondary pattern has disappeared, indicating a serious fault in the ignition system. One pattern obtained with a faulty "condenser" in the system is depicted in Fig. 10. It is self-explanatory.

Nonelectrical troubles such as a hung-up valve, engine noise and pre-ignition can be diagnosed with the analyzer using the proper transducers to produce electrical signals to drive the scope. These patterns are shown in Fig. 11.

I wish to express my gratitude to the following companies who provided much useful information and all of the photographs used in this article: Heath Co., Div. of Daystrom; A. B. Du Mont Laboratories, Div. of Fairchild Camera and Instrument; Sperry Gyroscope Co., and Heyer Industries. END



Sperry industrial engine analyzer is checking natural gas engine.

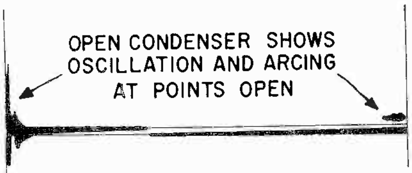


Fig. 10—Open ignition condenser causes this pattern.

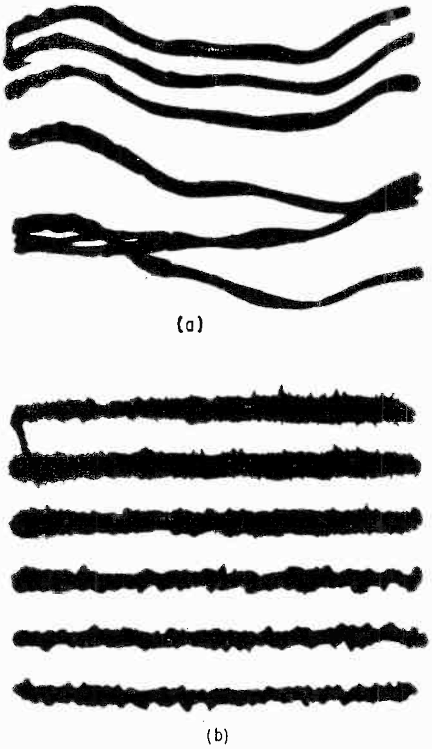
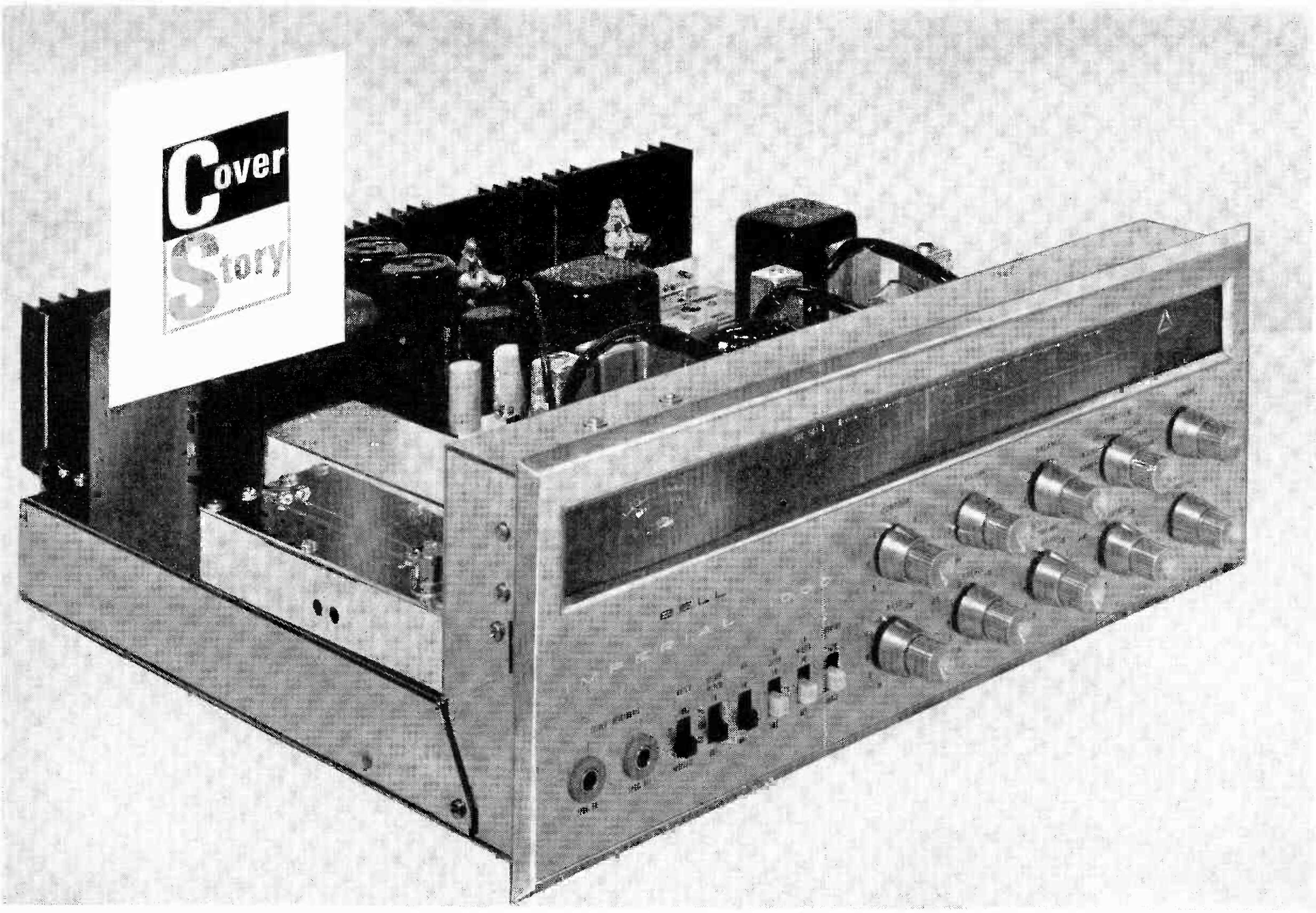


Fig. 11—Non-electrical problems. a—Exhaust manifold pressure with hung-up valve at 60 mph. b—Engine noise, normal condition.



EXPANDABILITY AND SERVICE CONVENIENCE FEATURED IN THE

BELL IMPERIAL 1000

FM STEREO RECEIVER

THE BELL IMPERIAL 1000 FM STEREO receiver is in the Cadillac class. Every detail shows thoughtful design and careful workmanship.

It is all-transistor except for the front end, which uses three nuvistors. The manufacturer claims that these provide greater freedom from cross-modulation than currently available transistor circuits, a point most engineers seem to agree on.

The receiver is designed with an "expandable hi-fi" modular concept. The amplifier–preamp can be purchased without the tuner, and the tuner added later by slipping its chassis into place, tightening four screws and making four plug-in connections (see photo).

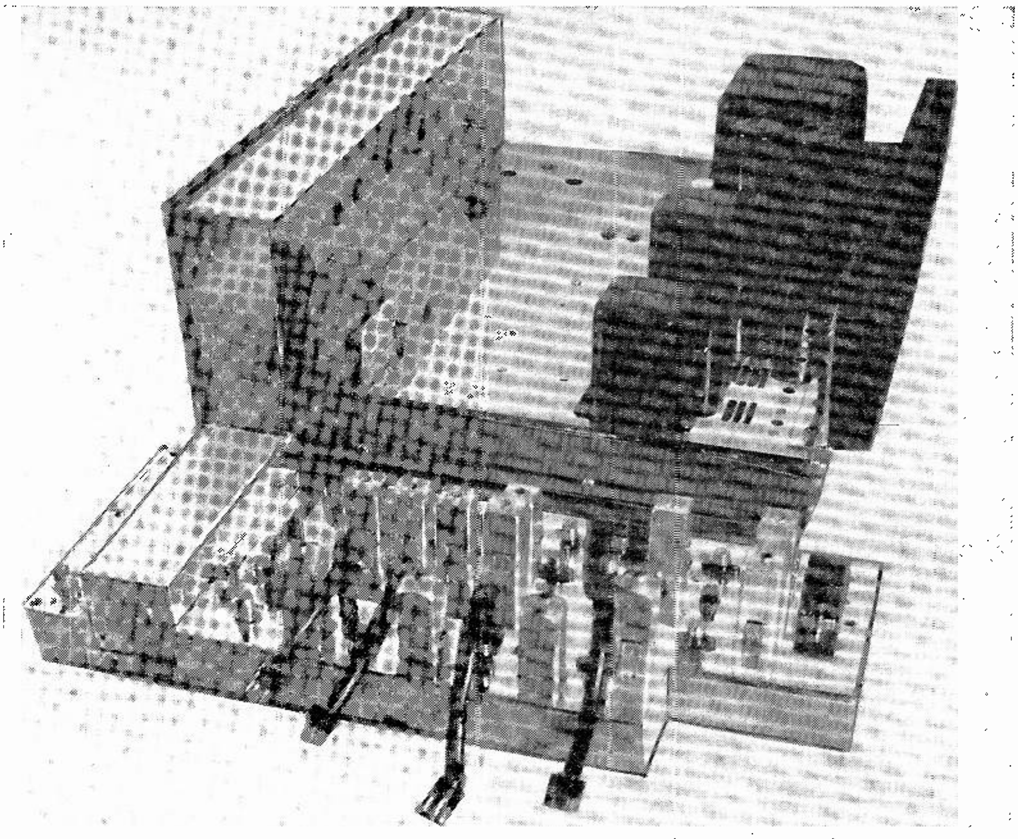
The FM dial, tuning meter and all knobs are present even without the tuner, but the dial and meter are dark and inconspicuous until the tuner is plugged in. All that shows is the manufacturer's insignia, which glows red to show that the amplifier is on.

Sound is crisp and clean throughout. Stereo separation is excellent. Sensitivity is impressive, and approximately matches, in strictly numerical terms, the best of current FM tuners. I got fine stereo reception from three stations around New York City, even though all tests were conducted on the ground floor of a steel-frame apartment building, using only a 3-foot piece of wire connected to the 75-ohm (unbalanced) antenna input.

The 1000 has afc, but hardly seems to need it. Drift without afc, even from a cold start, was so small that I probably wouldn't have heard it in the sound if I hadn't seen it on the zero-center tuning meter.

With afc, tuning is a bit tricky. A little aggressive, in fact. A station on 96.3 mc and one on 97.1 could both be made to appear at about 96.7 because of the way afc compensated for mistuning. Takes some getting used to.

The meter becomes a mono–stereo indicator when you flip a switch on the panel. (Circuit switching between mono and stereo is completely automatic.) The meter is an adequate stereo indicator, but a unit intended to sell for around $500 could well incorporate some separate device to work full-time as a stereo indicator. While flipping a slide switch is no great strain, you have to remember to do it. If you want to look for a stereo station, you must switch to INDICATE and tune until you find a station that causes the meter pointer to swing well over to the right, into the region marked STEREO. Then you must return the switch to TUNE and tune in the station precisely, watching the meter now for a center-of-channel indication. There is no way of telling



Side view of the Imperial 1000 with the tuner removed. Note bright chrome metal work and sturdy military-like construction.

from a distance whether the receiver is in mono or stereo. Even if you leave the switch in its INDICATE position, you can't see the meter pointer from very far.

The heavy damping of the movement requires that you tune very slowly, allowing time for the pointer to swing unmistakably into STEREO. With rapid tuning, the meter merely fluctuates even on stereo stations.

The 1000 has variable muting to suppress interstation hiss—a fearsome noise on a receiver as sensitive as this. Like almost all muting circuits, this one suppresses weak stations along with the noise, and obliterates more and more stations as the control is turned clockwise until finally there is no sound at all. A kind of audio squelch.

The contour control is a kind of variable loudness compensation. According to instruction, this is how it's to be used: With the contour control fully off, turn the volume up until the room volume approximates the original sound level(!). Now reduce the level by turning the contour control to the level you want. This setting of a reference level by using the volume control helps avoid the difficulty of different levels from record to record that is such a nuisance with ordinary compensated controls. (With conventional loudness-compensated volume controls, the amount of loudness compensation depends completely on the actual physical setting of the control, not on the program level. If you start with perfect compensation for one disc, then play another recorded at a higher level, you will have to turn down the volume—loudness—control to get the same volume as before, and thus get more compensation, even though you don't need it.)

But the Bell approach will help solve this problem if you go through the level-set procedure every time you or the station you're listening to changes records.

Another problem: most people grossly underestimate the actual loudness of even a solo voice or instrument —more so a large ensemble. And how many would *want* to bring the volume up to a level that approximates even for a moment the Boston Pops in a 12 x 18 living room? Still, used as designed, this system provides potentially more accurate loudness compensation than most other methods.

Tuning is deliciously smooth; there's a huge flywheel on the tuning shaft. All transformers are potted, and temperature rise is very low even after 3 hours of continuous operation. (No output transformers, by the way—just driver and power.)

The entire chassis is constructed of very heavy, mirror-finish chrome-plated steel. Dial lighting is sharp and uniform, but not so bright as to start you looking for dark glasses. All controls have that "solid feel" that betokens a well-built piece of machinery.

A feature that will appeal to both user and servicer is the hinged front panel that drops away to expose most of the front-panel wiring. There is extensive use of cabled wiring harness.

Speaker outputs are individually fused to protect the output transistors in case the speaker terminals are shorted. The fuse will also blow if a speaker of impedance lower than the rated value is connected to the terminals (for example, a 4-ohm speaker to the "8-16-ohm" terminals). This is something that might be mentioned in the operating manual, to prevent needless agony on the part of the user!

Brief mention to one useful feature: a tape-monitor input and switch for simultaneous playback of tapes being recorded on a machine with separate record and play heads. Great for checking miking and quality as you record.

The Bell Imperial 1000 is well suited to serve as the heart of a top-quality home stereo system. END

SPECIFICATIONS

(All specifications are from the manufacturer)

Amplifier

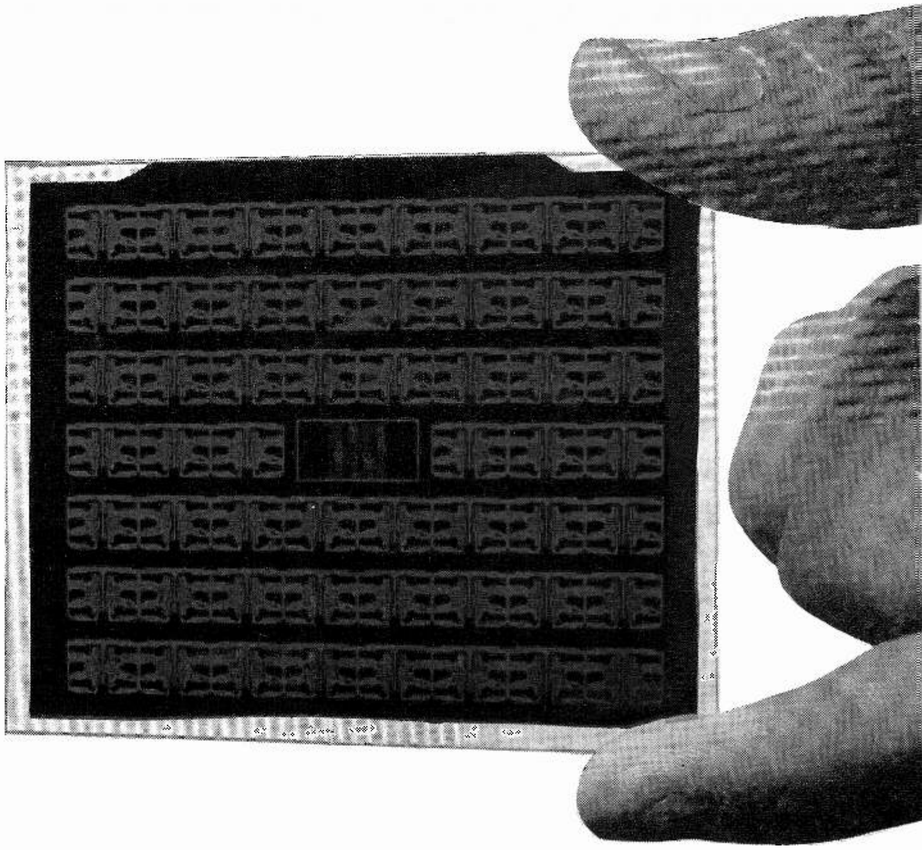
Frequency response (at full power)—9–50,000 cycles, ±1 db
Power output (both channels)
IHF music power—80 watts
Continuous rms—50 watts
IM distortion (full output, 60 & 6,000 cycles mixed 4:1) —less than 0.7%
Harmonic distortion (full output)—less than 0.7%
Noise (hi-level inputs)—80 db below full output
Sensitivity (for full output)
Ceramic input—150 mv
Magnetic input—1.5 mv
Aux input—0.5 v
Tape monitor input—0.5 v
Outputs
8–16 ohm speaker (4 ohms at reduced power)
Headphones (any impedance)
Tape recorder

FM tuner

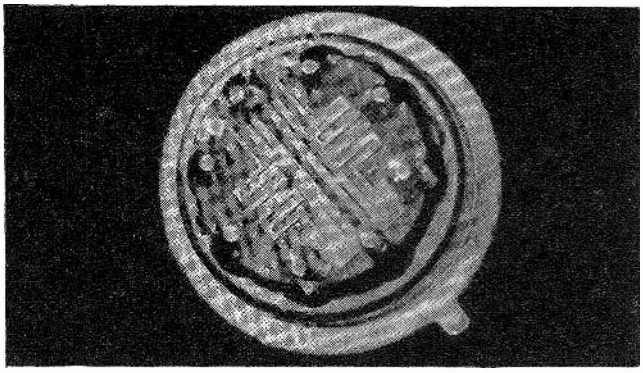
Sensitivity (IHF, 300-ohm input)—1.6 µv
Harmonic distortion (100% modulation, full limiting)—less than 0.5%
Frequency response—20–15,000 cycles, ±0.25 db
Noise—65 db below rated output
Capture ratio—2.5 db
Stereo separation—30 db from 20–15,000 cycles
Image rejection—greater than 65 db

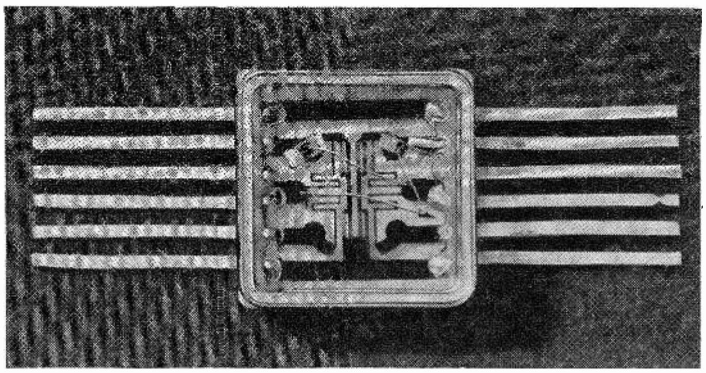
MICROELECTRONICS THE THIN FILM APPROACH

By C. D. SIMMONS*



Above, multicircuit array of thin-film circuits; below, examples of finished hybrid circuits—forms of RTL (resistor-transistor logic) flip-flops. In both cases, thin-film technique has been combined with discrete components.





Circuits are getting tinier—being made in one or two steps. . . . More information about this fascinating frontier of modern electronics

MICROELECTRONICS (OR MICROCIRCUITRY) now describes *two* basic techniques for fabricating entire circuits—transistors, resistors and capacitors—in a single package no larger than a postage stamp. How is it done?

In one technique, metallic films are deposited on glass substrates, resulting in tiny circuit patterns on wafers the size of a contact lens. This gives us *thin-film* circuits. The second method produces *solid-state* semiconductor circuits by diffusing chemicals into pinhead-size silicon wafers in the same way that transistors are made.

A third approach now being tried in the laboratories is a combination of these two basic ones. Thin-film passive components are deposited on the surface of silicon chips that contain active devices such as transistors.

The thin-film approach is closest to old-time conventional circuitry. Thin-film circuit elements—separated from the integrated microcircuit and individually packaged—readily become conventional discrete components, such as the film resistor, for example.

*Manager, Microelectronics Div., Lansdale Div., Philco Corp.

Not only are the components of thin-film circuitry like conventional ones physically; circuit design is much the same. We can translate directly from conventional circuit design to microcircuitry with thin films.

But thin films have at least three striking advantages over conventional circuitry: miniaturization, performance and reliability. An entire thin-film circuit, such as a flip-flop, can be packaged in one TO-5 transistor case. Thin-film technique produces higher quality resistors and capacitors than can be made by semiconductor methods. (Thin-film

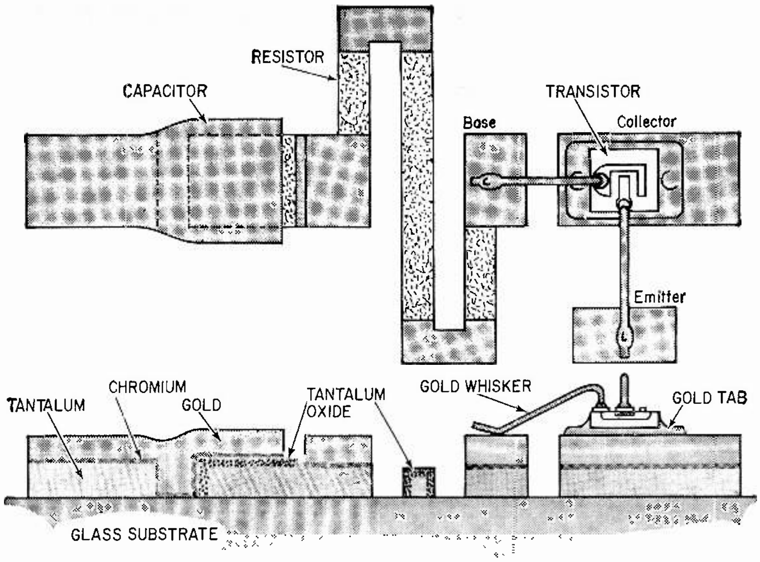


Fig. 1—Top and side views of a typical thin-film microcircuit. Tantalum pentoxide (Ta_2O_5) is a good insulator, used both as a dielectric and as a protective skin over resistor areas.

resistors have been made with tolerances as close as 0.4%.) Reliability becomes greater as deposited joints are substituted for soldered or welded connections. For example, a resistor in a thin-film circuit can be formed as an integral part of the circuit, rather than with joints between discrete components.

To introduce active elements to the thin-film circuit, semiconductors must be attached to the passive thin film. Active thin-film elements are being worked on in the laboratory, but have not yet been proved feasible.

Making thin-film microcircuits

Philco uses *sputtered* tantalum for fabricating resistors, capacitors and conductors in thin-film microcircuits.

Sputtering is a process based on an electric discharge between two plates in a gas (generally argon) at low pressure. Ionized gas atoms are accelerated to the tantalum cathode by a high-voltage field and knock off tantalum atoms. These diffuse to the glass substrate on the anode. Sputtering wastes little material, and the deposits adhere excellently. Uniform deposition is possible over large areas (3% sheet resistivity variation over a 2½ x 3-inch substrate).

Gold is afterward deposited on the tantalum to increase the conductivity of the conductors and for connections to the package and active elements. A thin layer of chromium is placed between the tantalum and the gold. This chromium layer acts as a *glue* to bond the layers together. Capacitors are formed by *anodizing* the lower tantalum layer. This produces an oxide layer (Ta_2O_5) on top of the tantalum. This becomes the dielectric. The capacitor is completed by depositing a gold layer on top of the oxide. Resistor areas (bare tantalum) are also anodized to form an oxide layer which acts as a protective skin over the resistor. The active elements—silicon transistors and diodes—are added in the form of pretested chips. Simple photographic mask changes during the photoengraving make the fabrication process more flexible. Fig. 1 shows resistor-capacitor construction and an added active element (transistor).

In the Philco process, a vacuum chamber is used only to produce the thin films. The circuitry is etched externally with high-resolution photolithographic masking. This eliminates the problems of mechanical masking. The high-resolution photoengraving, plus the high heat-handling capability of refractory tantalum, permits high density microcircuitry (more circuitry per unit area). Photoengraving also makes it possible to design and lay out more intricate patterns rapidly at lower setup cost than mechanical masking. The masking steps proceed as follows: First, the substrate with its initial tantalum layer is photoetched and the tantalum removed everywhere except where a resistor, capacitor or interconnection is to be formed. Then a second photo-mask is used to expose the remaining tantalum everywhere a resistor or capacitor is to be formed. This exposed tantalum is then chemically anodized to form an oxide layer. The chromium-gold multi-layer is placed over the entire substrate and a third set of photomasks used to remove the gold except where an interconnection, bonding point or capacitor is wanted.

Hybrid circuits

Many passive circuits may be produced in a multicircuit array, then cut apart to add the active elements and assembled into the package (either a multi-lead TO-5 transistor case or a 2-dimensional, 12-lead ceramic-to-metal package). The photos on the preceding page show a multicircuit array (RTL flip-flop) and assembled units. A seven-resistor precision ladder network is shown in Fig. 2.

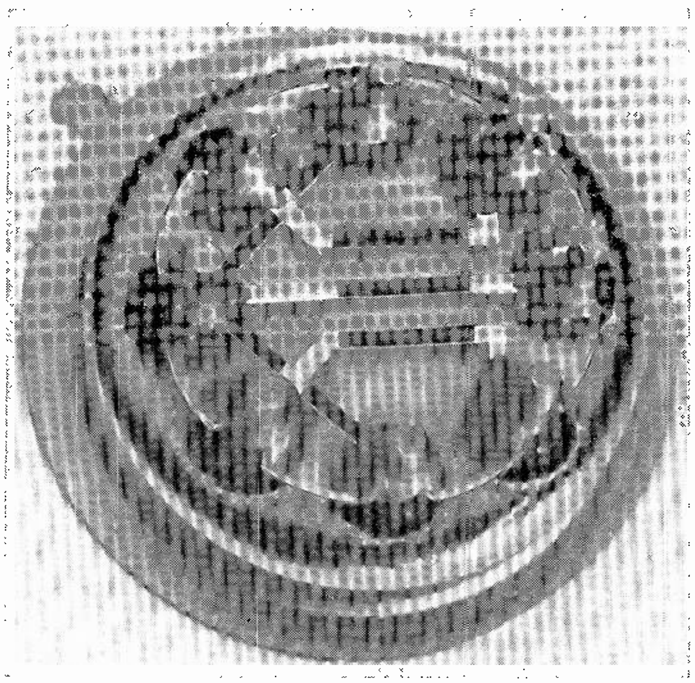


Fig. 2—A seven-resistor ladder network. Actual size of "header" is about ¼ inch. Resistors are adjusted to .04% of design value.

The thin-film diode logic commutator for an aerospace application shown in Figs. 3 and 4 is an example of thin-film circuitry. The matrix consists of 96

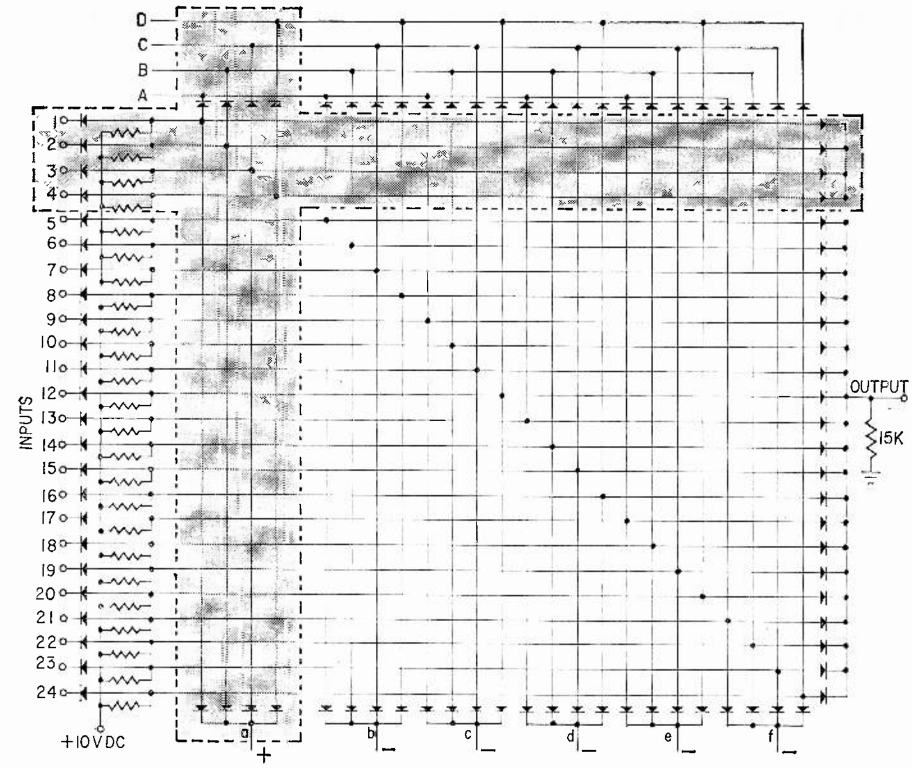


Fig. 3—Functional circuit of thin-film commutator whose operation is described in the text. A back bias of +10 volts is applied to A *and* a *and a forward bias of −10 volts to all other elements to create a path from input 1 to output.*

silicon diodes, 24 tantalum film resistors, and associated conductors and interconnections. The matrix is shown schematically in Fig. 3. The purpose of the finished commutator (Fig. 4) is to switch 24 different information points or input signals into a single output channel sequentially. The control diodes, biased by external control circuits, do the switching. (Input signal swing is limited to ±10v.) For example, if input 1 is to be monitored, the biasing arrangement would be:

1. Diode bank *a* receives a back-biasing potential (+10v), while diode banks *b* through *f* are forward biased (−10v). As a result, input signals 5 through 24 are shunted away out of system through control lines *b* through *f*.

2. Control diodes B, C and D are forward biased (−10v) while diode A is back biased (+10v). This results in input signals 2, 3 and 4 being shunted out of the system through B, C and D. Signal 1 then proceeds alone to the output monitor. END

Solid-state microcircuitry will be described in a later article.

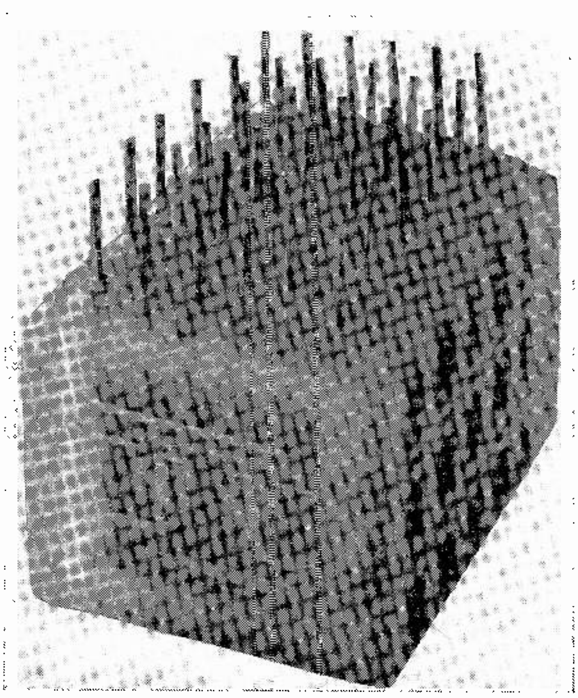


Fig. 4 — The logic commutator of Fig. 3 ready for insertion in a circuit. It is encased in a potting compound, and its volume is approximately a cubic inch.

Do You Know the Law?

By TOM JASKI

JUST about everyone who ever soldered two resistors together knows Ohm's Law. But in electronics we deal daily with many relationships expressed as laws and attributed to their discoverers, meaning they are considered to be laws of nature—incontrovertible truths about the world around us. Although some laws have been found inadequate, and some will no doubt be found to be actually wrong, the laws in this little quiz have so far stood the test of time. Here they are. Do you know the laws underlying the electronics you are using in your work?

1. Kirchhoff was a German physicist born in Königsberg in 1824. He is credited with what we call the two "Kirchhoff's laws" used in electronics. Do you know what they are?

2. When you have a current through a resistor and wish to express the losses in it, you know that this is represented by I^2R. But do you know whose law says it is?

3. Ever hear of Poynting and his law?

4. Do you know what Lenz' law is?

5. Neumann had something to say which concerns you every time you deal with an if transformer. Can you figure out what it is?

6. Again the man and the work he is most well-known for are not the law named after him. Wien, of Wien bridge fame also has a law, not dealing with bridges. Unless you know illumination, you probably don't know it. But Wien's law now also enters electronics via infrared advances.

7. Helmholz is most widely known for his research and essays on human hearing. Yet Helmholtz' law had nothing to do with hearing, but dealt with charges instead. Know it?

8. Three physicians got together and named a law after all of them, Wiedeman-Franz-Lorentz law. If you know this one, you qualify as a science professor (or you're just lucky).

9. Let's not forget the great Faraday. His law is very important in electromagnetic phenomena, and shows how this great scientist was well ahead of his time.

It is no disgrace if you do not associate these effects with their laws. Most engineers know the effects, but have all but forgotten who discovered and expressed them in the form of a law. They are useful just the same.

(Answers are on page 57)

SERVICING SOUND MOVIE PROJECTORS

Part II—Clutch mechanisms, threading, safety precautions

By JACK DARR
SERVICE EDITOR

LAST MONTH WE FOUND OUT HOW DIFferent kinds of projectors work, and some of the mechanical problems they present. This month, we'll look at two more specific mechanisms, what they do and what can go wrong with them. Also, a little lesson in threading and running a machine.

The clutch

Most better-grade projectors are provided with a clutch to disengage the motor from the gear train. This clutch can be used for still-picture projection

By JACK DARR SERVICE EDITOR

of a single frame, etc. Some units have an automatic clutch, operated by a trip lever in the film path. If the film breaks or anything jams, the clutch is automatically released, stopping the machine. The projector in Fig. 1 has this arrangement; the trip lever is hidden behind the lens barrel, but the reset lever can be seen directly below the film gate, at the bottom. It is in its tripped position; to engage the clutch, raise it until it catches.

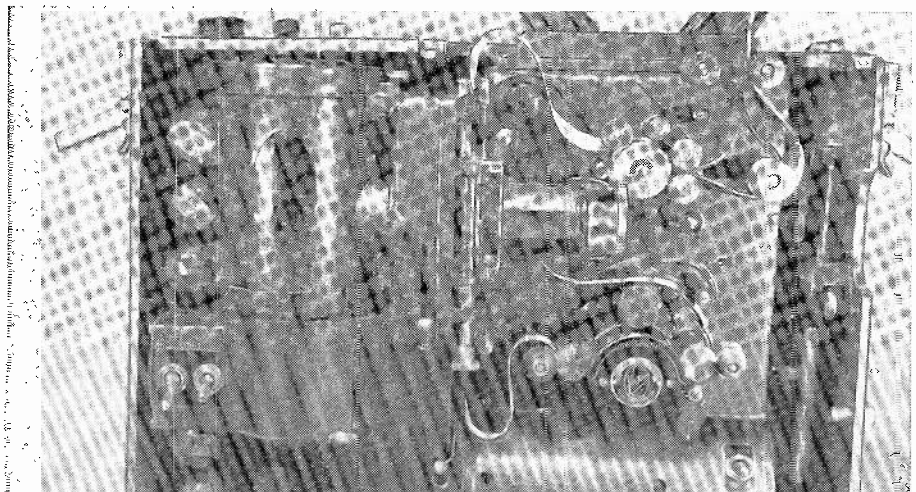


Fig. 1—Clutch on this projector is automatic. Reset lever is shown; trip is hidden behind lens barrel.

So, if you get a machine in for service with the complaint "The motor runs but nothing else will!" look at the clutch.

Safety shield

As we just said, these machines can be stopped to show only a single frame of the film, or "still." With a high-power projection lamp, stopping a frame of film in the beam of light will result in something like Fig. 2! Something must be done to reduce the intensity of the light. A perforated aluminum shield is automatically dropped in front of the lamp whenever the machine stops. This is inside the lamp housing, and fits in a slide. The top of the shield is bent, to form a "blade" in the stream of air blown through the lamp housing by the cooling fan. As long as the fan is running, the shield is blown up and out of the gate. When the air stream stops, the shield falls before the lamp. Enough light gets through the perforations to show still pictures, but the intensity is reduced to the point where it will not burn the film.

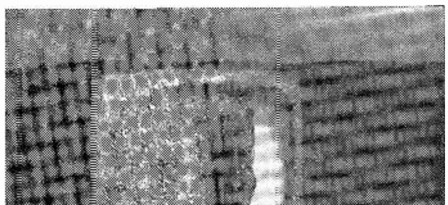


Fig. 2—This is what happens to film if it stops in the gate and the safety shield doesn't fall.

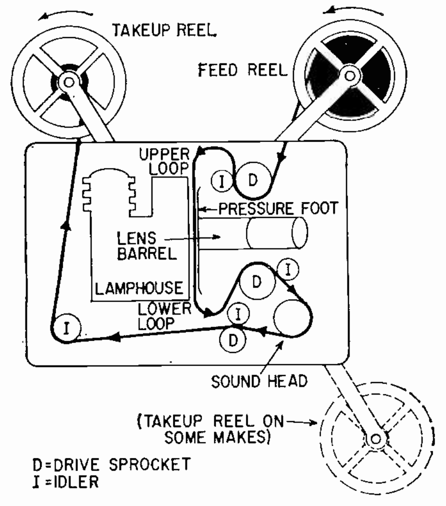


Fig. 3—This threading diagram applies to almost all machines. Some have takeup reel below feed reel, but film path is the same.

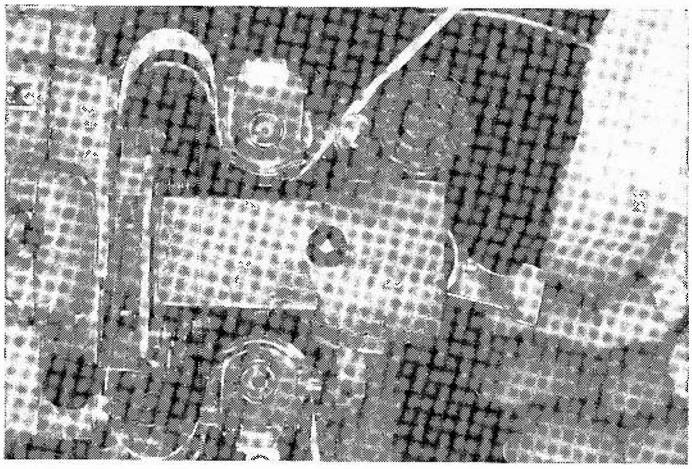


Fig. 4—Lens barrel is removed to show lever that moves it and film gate forward to allow threading film through gate. Spring - loaded pressure foot normally holds film snugly against backplate.

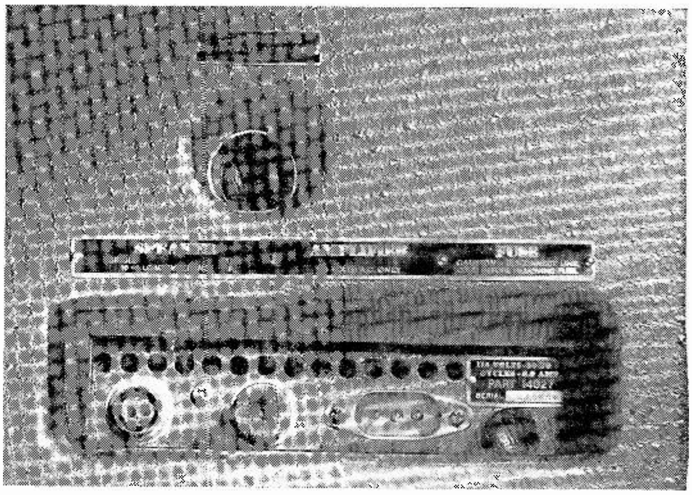


Fig. 5—Typical power and speaker connection panel. Note separate power connectors for projector motor and amplifier.

This can be checked easily by aiming the projector at the screen, without any film in it. Stop the motor and watch the screen. If you see the light dim quite noticeably, the shield is working as it should. If dust fouls the slides, sometimes the shield will not be free to "blow up", and the projected picture will be dim. You can check this by running the machine without film, and looking into the lens through dark glasses. If the shield is jammed, you'll see the perforations very plainly. Another method is to throw the machine out of focus, with the beam on the screen. At one point, you'll be able to see the image of the lamp filament, if the shield is out of the way. Usually, cleaning out the dust with a soft brush is enough to cure this trouble. Be careful, though, as the shield is made of very light aluminum, and can be damaged.

Threading up

Threading film through an unfamiliar projector can be difficult. Instructions can be found in the instruction book; if it is missing, you may have a hard time. Some machines, as noted, have guide lines, etc. to show the film path. As a general rule, though, you can thread up any "stranger" by following this sequence: Put the full reel (the feed reel) on the front of the machine. The empty takeup reel will be on the back. Start the film over the nearest idler roler, then trace out this sequence—drive sprocket, film gate, under the pressure foot—another drive sprocket — over sound head — drive sprocket – idler – then to takeup reel. There will almost always be two drive sprockets, one on either side of the sound head, plus idlers to keep the film tight, and another drive sprocket above the film gate, or pressure foot. Fig. 3 shows the basic outline of this.

You'll have to open the film gate to slip the film under it. There are two ways of doing this in commercial machines. The lens-barrel, foot, etc., swing open on hinges, as in the machine of Fig. 1, or the lens barrel and foot slide forward, operated by a lever, as shown in Fig. 4. The lens barrel has been removed here to show where the lever is located, as it is hidden when the machine is operating. The gate is open in this picture.

When you close the film gate, be sure that the film is in the groove where it must run; you'll be able to see this clearly. If the pulldown teeth are retracted, you can slide the film slightly up and down to see if it is free.

Setting the loops

The most important parts of threading up are getting the film tight over the sound head, and getting the right amount of slack in the loops above and below the film gate. The proper amount of slack is sometimes indicated by ridges on the housing. Fig. 4 shows this, and film threaded with the correct loop.

Drive sprockets always have some sort of latch to keep the film in place.

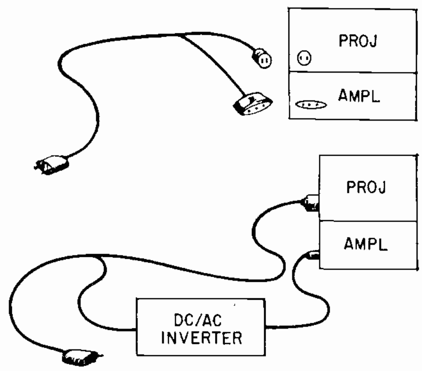


Fig. 6—Reason for separate connectors, shown in Fig. 5. On ac, both are paralleled; on dc, motor and lamp are powered directly, but amplifier power goes through dc/ac inverter.

Sometimes this is a spring-loaded tab, sometimes a spring-loaded idler roller on an arm. Both can be seen in several pictures here and in Part I.

After the machine is threaded up, turn the motor on and make a short test run. Keep your finger on the switch! If there is anything wrong, or if the film isn't threaded right, the powerful gearing can break the film instantly! The best clue here is to keep an eye on the loops: if either loop pulls down tight, something is wrong. Turn the machine off immediately and find out what! (Incidentally, damaged film can cause this trouble, so be sure to check the film. Take a close look at the section of film running between the drive sprockets. Examine the bottom edges of the sprocket holes. You may find them torn and ragged instead of nice and even. This type of damage may have been caused by incorrect threading or by worn pull-down teeth. We'll go into this in the next article.)

Motors and power supply

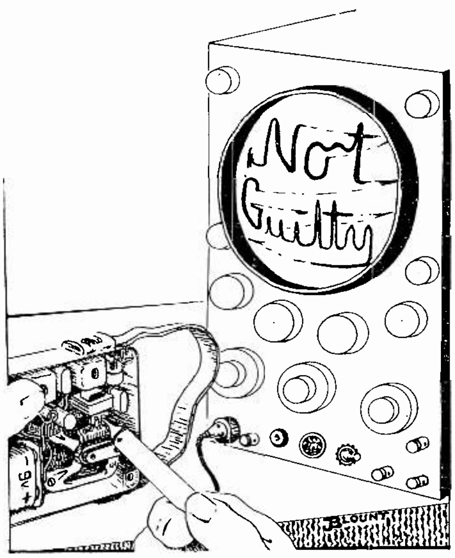
Practically all the machines I know use "universal" motors, which will operate on either ac or dc, 117 volts. The larger machines use transformer-powered amplifiers, which must have ac. Fig. 5 shows the power-supply connection panel for a well known make. The line cord for this machine is a "Y", as seen in Fig. 6.

(This feature probably originated when these machines were built for use in Army training programs. Many times, the projectors had to be used on field generators, at 110 volts dc. For this kind of service, the amplifier power plug was pulled, and a dc/ac inverter inserted between the two, as shown. Failure to use the inverter accounted for many a power transformer replacement!)

Some projectors use ac/dc amplifiers; the machine seen in Fig. 1 has this circuit. These can be used without the inverters, of course; they use such tubes as 50L6, 35Z5, and so on.

Next month, we'll examine some of the electronics of sound projectors, and offer some service tips for both mechanical and electronic troubles.

TO BE CONTINUED



Diagnosis and the Frozen Brain

By JOHN FITZGIBBON

FIXED IDEAS CAN REALLY FOUL UP THE diagnostic process while you're repairing TV circuitry. Here's a good example.

I was fixing up an old Stewart-Warner 9126 for use in some experiments. The horizontal oscillator circuit was quite conventional: 6AL5 phase detector/afc and a 6SN7 cathode-coupled multivibrator with a ringing coil for the horizontal oscillator. How simple can you get? Everything nice and normal.

Horizontal hold acted peculiarly, though. This is the slug in the ringing coil, by the way. When I turned it clockwise, from an out-of-sync state, the picture wouldn't lock in but flipped rapidly out of sync the other way! Had to back up on it counterclockwise to get it to hold. Even then, I'd get a split picture with blanking bar in the center about every third time.

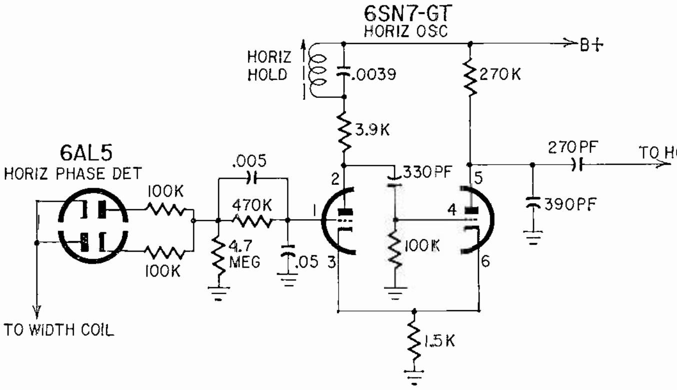
"Ah-ha!" said I. "This is afc trouble. Everyone knows that such conditions are always caused by afc. Especially since I've made the test that they tell you to: shorted the grid of the horizontal oscillator, removing the sync. Then, the oscillator made a single floating picture, pretty stable. This *proves* that the trouble is in the afc!" (Can you hear the ice beginning to form on my mental processes along about here?

So, I investigated the afc circuits. At such times "they" are usually conspicuous by their absence; they've gone out for coffee or something. So there I sat with my little soldering iron, all alone.

After a period of time which shall not be discussed, I tentatively decided that there just *might* be something else wrong, and I'd check the oscillator again. So, I unsoldered the coupling capacitors, grid resistors, grid bypass capacitors, etc., and found them all in fine shape, except for a minor leakage in the .05-μf grid bypass capacitor. After I replaced this, I happily turned the set on. Same trouble. I picked up my face from where it had fallen and resumed testing.

Eventually I came to the 3,900-ohm plate resistor. "Everyone knows" that these resistors aren't too critical; in fact, I'd replaced and changed value on any number of them in the past, without affecting the oscillator performance. Oh, well, I'd checked everything else; might as well check this one. Hmmm. About 7,500 ohms instead of 3,900. Oh, well. Replace it. Turn set on. Works perfectly. Horizontal hold falls out the same on each side; nice smooth bars instead of squegging as it has been. Hmmm. Go out for coffee.

Return. Set still perking beautifully. Check hold. Fine. Oh, me. What did I do wrong? Answer immediately apparent: I froze up on the diagnosis! At first, my tests and conclusions were OK: the symptoms *did* point to the afc, because of the way the oscillator was acting with the afc shorted out. However, after the afc checked out good, I should have realized *immediately* that this was not causing the trouble, and that the oscillator circuit was the only thing left!



I measured resistors, checked capacitors, replaced tubes and carefully measured p-p amplitudes and waveforms on the sawtooth pulses. Only one thing was amiss: *there was nothing wrong with the afc!* Everything was perfectly normal!

Despite this evidence, the brain remained frozen solid. I had made a diagnosis, and by golly I was going to stick to it! There *had* to be some trouble in that afc! So, I repeated some of the tests, then measured the sync amplitude; why, I'll never know. (It was good, too, incidentally.) So, what do "they" say at a time like this? They don't.

Moral: no matter what fixed ideas you have about a circuit, don't freeze on your first diagnosis. Always be willing to throw that away and make a new one to fit new evidence! END

GOING MULTIPLEX WITH AN ADAPTER

If your old mono tuner has what it takes, this may be the most sensible way

By HERMAN BURSTEIN

WITH MANY FM STATIONS NOW BROADcasting multiplex programs, most audiophiles who haven't yet converted from mono to stereo FM have a strong urge to do so. They can either buy new multiplex tuners or add multiplex adapters to their present mono tuners. Where the mono tuner has been a dependable servant—with high sensitivity, sharp selectivity, drift-free tuning, low distortion and low noise—the owner is rightly inclined to purchase a multiplex adapter and save money.

If maximum performance is the objective, adding an adapter may not be simply a matter of bypassing the tuner's de-emphasis circuit and making cable connections. Satisfactory multiplex reception makes greater demands on the tuner than does mono, and your tuner must be in tip-top condition. Further, the tuner and the adapter must be properly mated for good performance and convenient operation. Here the audio technician can be very useful. How useful is illustrated by this case history, which is also a checklist of things to consider in converting to FM stereo.

The customer owned a Browning RV-10A tuner (about 11 years old and one of the finest of its day) and wanted a multiplex adapter that could be tucked away in his equipment cabinet without the need for switching manually between mono and stereo. He chose the Pilot 200 adapter, which has automatic switching. The following steps were taken for maximum performance and operating convenience.

Checking tubes and other parts. A couple of tubes that failed to measure good were replaced. Electrolytics were checked, and all were good. Operating voltages shown on the schematic of the RV-10A were checked. All were correct.

Tuner alignment. The tuner was very carefully aligned. First, using a 10.7-mc signal frequency-modulated at 60 cycles, the i.f. transformers were touched up for a good "flat-top" response curve (Fig. 1), as viewed on scope. The curve should have symmetrical proportions, maximum amplitude consistent with a bandwidth of about 180 to 200 kc. Second, using the same signal, the discriminator transformer was aligned for an S-curve (Fig. 2) with excellent symmetry and linearity and maximum amplitude, as viewed on a scope. The discriminator alignment was touched up by using the test frequencies of an IM distortion analyzer to modulate the 10.7-mc signal, and adjusting the discriminator for minimum IM distortion measured at the tuner's output jack. Third, using signals of 105 and 90 mc, the rf, oscillator and mixer stages were aligned for maximum gain and for dial calibration. These alignments were then touched up by the IM distortion method.

Removing de-emphasis. FM stations are required to apply a 75-μsec boost to the audio signal, meaning that response is up 3 db at 2,122 cycles and continues to rise at a rate approaching 6 db per octave. (Thus response is up 13.7 db at 10,000 cycles and 17 db at 15,000 cycles.) For flat audio response, the FM tuner must provide 75-μsec *de*-emphasis. However, the signal fed to the multiplex adapter must be free of such de-emphasis. Therefore, the de-emphasis network of the RV-10A (Fig. 3), consisting of a 75,000-ohm resistor and a .001-μf capacitor was removed. Some mono tuners, anticipating stereo, have a multiplex jack connected before the de-emphasis network. Nevertheless, it is a good idea to remove this circuit when feeding a multiplex adapter.

Reducing shunt capacitance. To obtain as much stereo separation (distinction between left and right signals) as the multiplex adapter is capable of, the mono tuner must maintain response after the detector to 53,000 cycles. Therefore it is important to minimize shunt capacitance between the discriminator output and ground. As shown in Fig. 4, the discriminator output of the RV-10A originally ran to a selector switch (this tuner has three input jacks for high-level sources), from there to a volume control and finally via shielded cable to the output jack. This circuitous path introduced a fair amount of capacitance, which was eliminated by running an unshielded lead about 3 inches long directly from the discriminator to the output jack.

The multiplex adapter came with a short low-capacitance cable for connecting the tuner output to the adapter. A lead about half as long was substituted to reduce capacitance even more.

Remote stereo defeat. For two reasons, the customer wanted a remote control to enable him to defeat the stereo signal and hear the mono signal instead. First, he wanted a ready means of comparing mono and stereo signals. Second, sometimes the adapter is fooled by noise or strong harmonics of a mono broad-

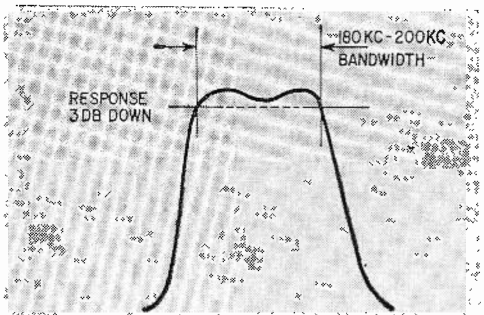


Fig. 1—Part of "what it takes" is sufficient i.f. and detector bandwidth. This curve shows how the response should look.

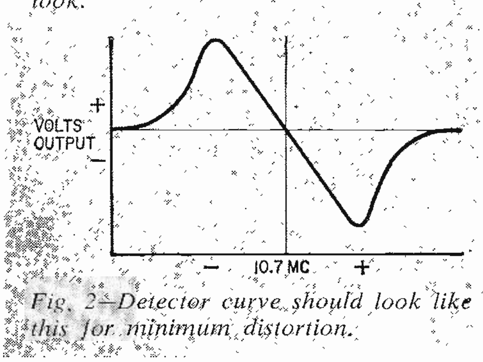


Fig. 2—Detector curve should look like this for minimum distortion.

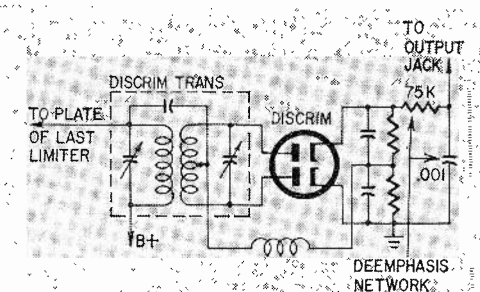


Fig. 3—Partial schematic of old Browning RV-10A's discriminator. For stereo, de-emphasis must go and so must most of stray capacitance.

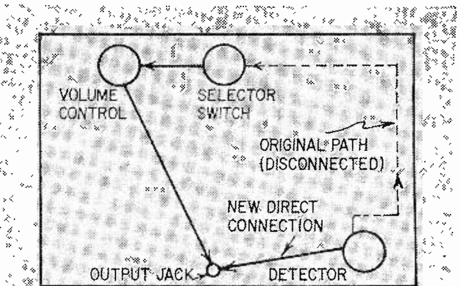


Fig. 4—Long, roundabout audio route in original layout would have meant poor stereo separation. Direct connection is always best.

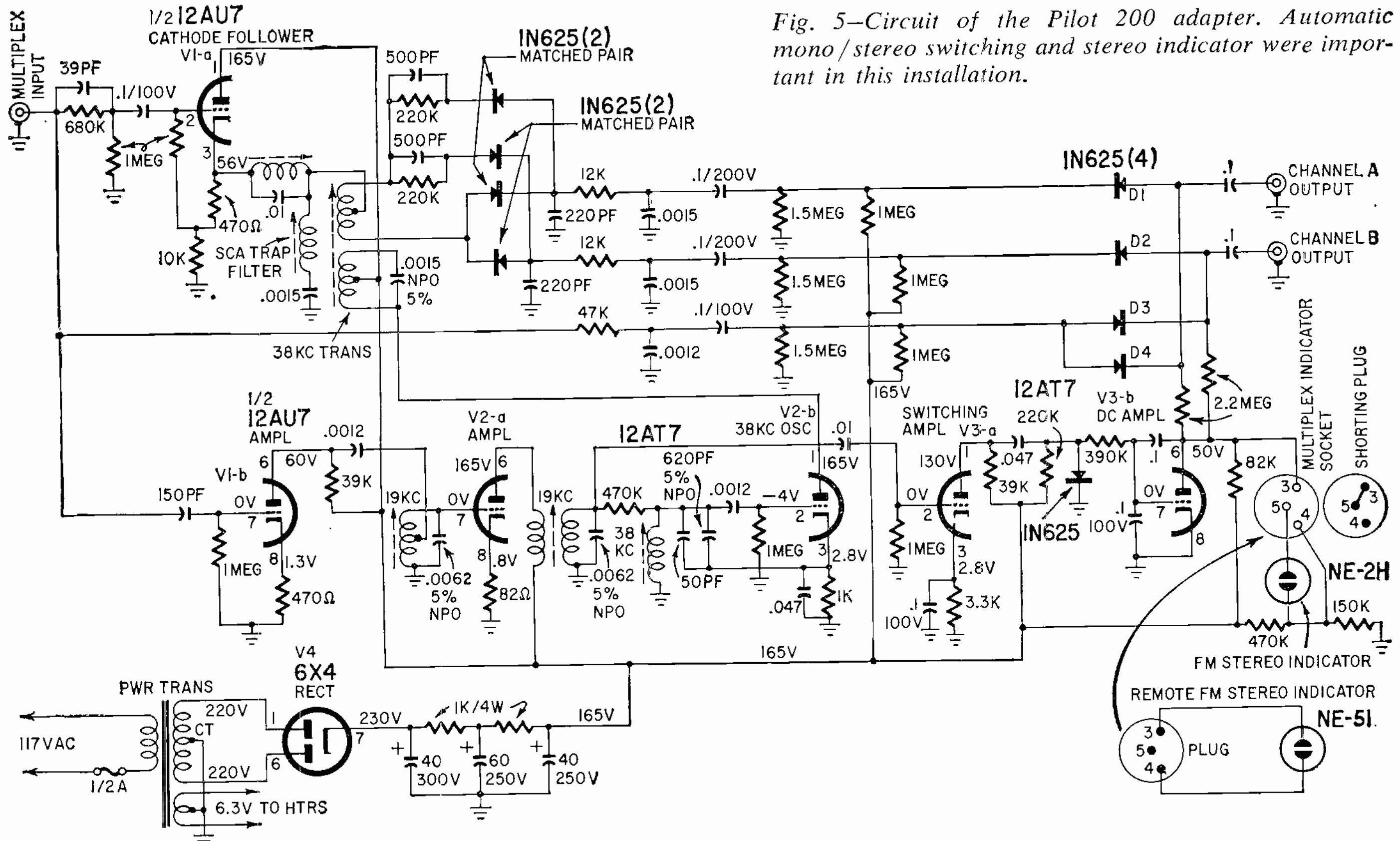


Fig. 5—Circuit of the Pilot 200 adapter. Automatic mono/stereo switching and stereo indicator were important in this installation.

cast into thinking it is receiving the 19,000-cycle pilot of a multiplex broadcast. The result is a rushing, roaring sound that closely resembles Niagara Falls. In theory, paralleling the left and right signals at the stereo preamp can reconstitute the mono signal and cancel the rushing-roaring noise. However, the customer wanted to be able to check theory against practice, and so a remote defeat switch was very easily installed as follows.

Fig. 5 shows the Pilot 200 circuit. It includes an electronic switch that, by changing the voltages across four silicon diodes (D1–D4), permits the stereo signals instead of the mono signal to reach the output jacks of the adapter. The switch is controlled by V3, which is activated by the 19,000-cycle pilot that accompanies a multiplex broadcast. To defeat a stereo signal, it was necessary only to run a lead from the grid of V3-b to the now-unused selector switch of the RV-10A and rewire the switch so that in its first position it would act as a short to ground. The lead from V3-b's grid was connected via a phone plug to one of the tuner's unused input jacks, which in turn was wired to the tuner's selector switch.

Stereo indicator. The voltage developed across V3-b's plate resistor when a stereo signal is being received also serves to light an NE-51 lamp, which is at the end of several feet of extension wire. The RV-10A is located behind a wooden panel in the customer's equipment cabinet, and the indicator lamp was mounted behind the same panel. A hole was drilled in the panel and fitted with a "jewel" to let the lamp shine through.

Ac extension socket. The mono tuner should have a switched ac socket from which the multiplex adapter can draw power. Since the Browning RV-10A had no such socket, one was installed at the end of several inches of cord (Fig. 6). The adapter could have been plugged into the switched ac outlet of the customer's preamp, but this would have meant needless operation of the adapter when, say, the phonograph was being used but not the tuner.

Antenna. The customer had been getting clean, noise-free mono reception with a simple folded dipole made of TV ribbon stapled behind his equipment cabinet. But multiplex signals are inherently much weaker than mono and there was noise on stereo programs (unless the stereo defeat was used). Also, there seemed to be increased distortion. We connected the tuner to the customer's TV antenna, and cleaned up both troubles. A dpdt switch was installed so that the owner could connect the antenna to either the tuner or the TV set. He plans soon to install a separate high-gain antenna specifically designed for FM.

The result is a satisfactory installation in performance and operating convenience. Program material sounds just as clean in stereo as in mono, noise is nearly as low, and stereo separation is excellent. The adapter is automatically turned on with the tuner, and automatically switches to stereo. The remote indicator shows when a stereo broadcast is being received. The customer can restore mono operation either through the stereo defeat switch located in the tuner or by paralleling the left and right channels in his preamplifier. END

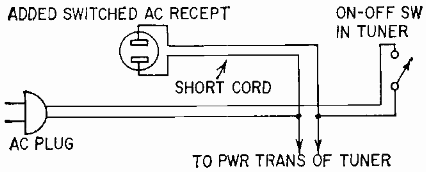
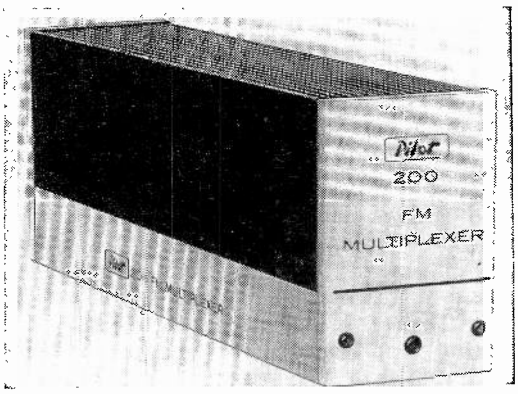


Fig. 6 — Added ac outlet turned adapter on and off right along with tuner.

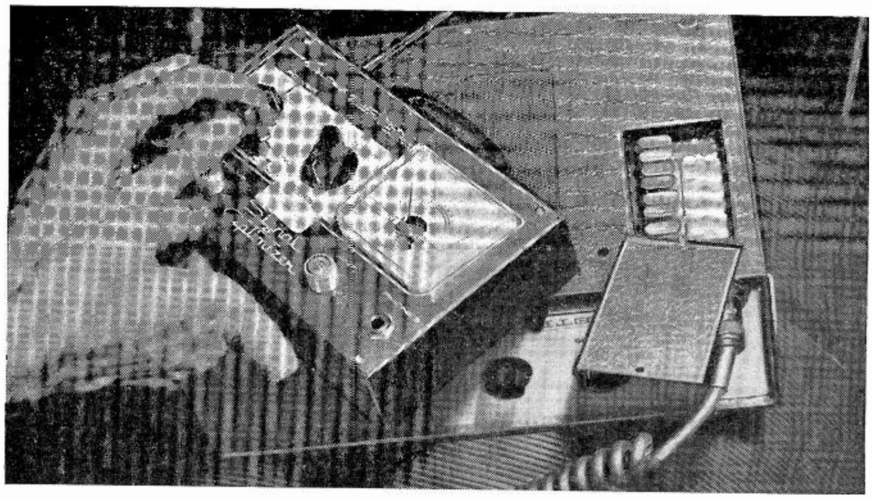


Pilot's model 200 multiplex adapter — the one used in this conversion.

You probably have most of the equipment already. What are you waiting for?

SERVICING CB TRANSCEIVERS

By JIM KYLE, KEG-3382



Most CB transceiver trouble is caused by bad tubes or bad crystals. This Globe device doubles as power output meter and crystal checker.

SOME 350,000 POTENTIAL CUSTOMERS IN this nation (more in Canada and eight South American countries) are looking for skilled radio service for both receivers and low-power transmitters.

I'm referring, of course, to the users of Class-D Citizens Radio (General Radio Service, in Canada; Comunicaciones Personales in the Latin-American regions).

You've probably run into some of these potential customers—and possibly you turned their business down either because the circuits looked too strange to you, or you felt you had to have a license to do anything.

The circuits *are* a bit unusual, yes—but certainly none of them are as tricky as a Synchroguide or a color convergence job. And, contrary to popular belief, you can do *almost* anything to a CB unit without a license! The only adjustments or repairs for which a license is necessary are these:

1. Any adjustment of the transmitter oscillator circuit which can affect the frequency of the transmitted signal.

2. Any adjustment of the transmitter audio circuits which can cause modulation greater than 100%.

3. On-the-air tune-up of the transmitter final amplifier. However, an *unlicensed* person *can* tune up the unit if it is connected to a dummy load instead of to an antenna.

You can see from this that *all* receiver adjustments, and many transmitter repairs, require no license.

If you do much of this work, sooner or later you're going to have to have that Second-Class Radiotelephone ticket. A future RADIO-ELECTRONICS article will cover the adjustments for which you need a license, and how to get one.

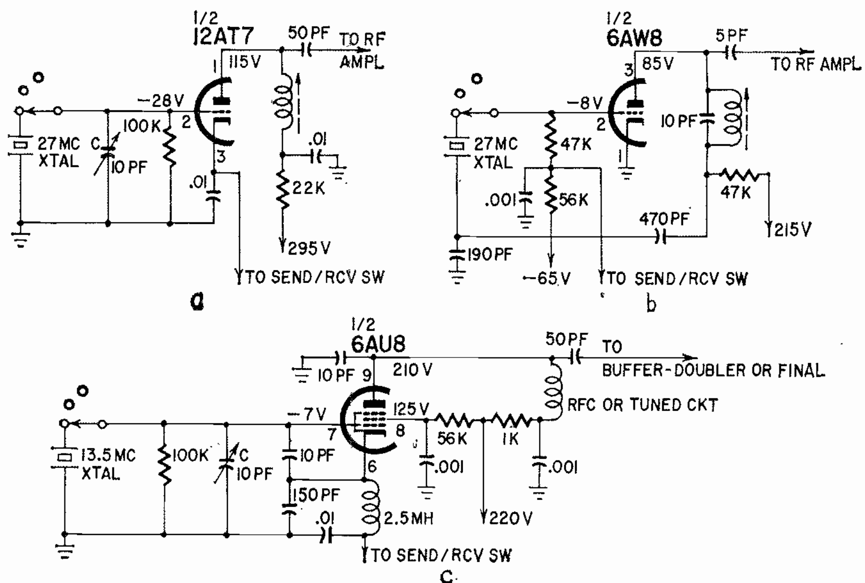


Fig. 1-a—Simplest of widely-used oscillator circuits is triode overtone oscillator. Plate voltage is much lower than supply. Uses 27-mc crystals. b—"Robert Dollar" overtone circuit also uses 27-mc crystals. This circuit is from Lafayette HE-20. c—Colpitts circuit uses 13.5-mc crystals, doubling in plate or in separate buffer-doubler stage.

What you're up against

Almost all CB units in service today are *transceivers* (combination transmitter-receivers). Transmitter and receiver share the same audio circuits and power supply.

Let's look at the transmitter first.

Most CB transmitters have either two or three stages. The first one, in all cases, is the oscillator. This is always crystal-controlled and usually uses one of the three circuits shown in Fig. 1.

The major difference between a CB rig's oscillator and any other crystal oscillator is the trimmer, C. Not all units include this trimmer, but most do. Its purpose is to adjust the crystal frequency to exact tolerance (FCC regulations allow only 1,300 *cycles* error in frequency). Unless you have a license and proper equipment to measure frequency, *don't* disturb that trimmer!

The oscillator may drive the final amplifier directly, or it may drive an intermediate *buffer* stage which in turn drives the final. The major difference between the buffer and the final is that the final is modulated. Fig. 2 shows a typical final amplifier circuit.

TV vertical output tubes, almost universally used for CB transmitters, have the dual advantages of being rugged and inexpensive. You probably already have all the popular ones in stock. (Occasionally, a set will pop up using an audio output tube instead—in the early days the 6AQ5 was popular, but the 6CX8 leads now.)

The receiver is almost identical with a standard ac-dc circuit with a few exceptions. Many CB units have crystal-controlled oscillators on the receiver as well as the transmitter. This makes tune-up easier as well as operation! Almost all have some sort of automatic noise-limiter (anl) circuit. Most also have a squelch, but this belongs in the audio circuit. Many include S-meters.

Automatic noise limiters

The anl circuits are designed to block ignition noise pulses while allowing the desired audio to pass through. All of them are based on the idea of passing the audio signal through a biased diode, then having any strong noise pulse turn the diode *off* momentarily to block the audio path. Bias from the avc line is used for the diodes; this makes it "automatic" since the bias level is proportional to the strength of the incoming signal.

A typical anl circuit is shown in Fig. 3. However, this area is one in which much variation still exists and you'll see many circuits which look nothing at all like this one!

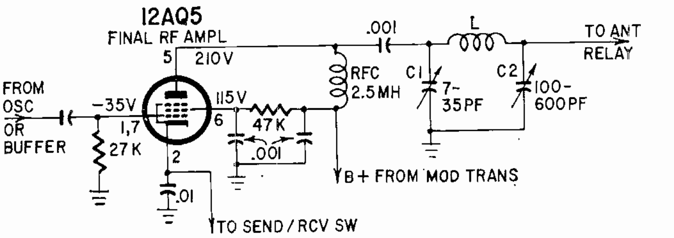


Fig. 2—Typical final amplifier (Sonar Model E). Tube could also be 6EM5 or pentode section of 6CX8.

In Fig. 3, half of the 12AL5 detects the incoming signal and develops a negative voltage across R20, R22 and R23. Avc is taken off through R21. The audio signal and a portion of the negative voltage are taken off from the junction of R22 and R23, and applied to the plate (pin 7) of the other half of the 12AL5.

The cathode of this half of the diode (the noise limiter) is connected through R24 to the avc line. With no signal applied, the plate is about half a volt more negative than the cathode. With enough signal to develop 10 volts avc, the plate will be about 5 volts more positive than the cathode and the diode will conduct. (Actually, it will conduct with any usable signal since the cathode gets full avc voltage while the plate gets only about half the avc voltage. Both are negative to ground but the cathode is more negative than the plate.)

However, the avc voltage supplied to the cathode is filtered by C25, and, if a fast noise pulse comes along, the cathode voltage will not change. The plate voltage, not being filtered, will go highly negative. This cuts off the diode, and no audio can get through. As soon as the noise pulse is past, the plate returns to normal and the audio once more passes through.

The S-meter is nothing more than a built-in vtvm measuring the voltage on the avc line. Often, to save parts, it uses an i.f. tube as its active element, comparing the screen voltage of this tube to a fixed value (frequently the cathode voltage of the audio output tube).

As the avc level rises with a stronger signal, the screen current to the i.f. tubes will be reduced and the resulting screen voltage will rise. A meter connected from the screen to a fixed positive voltage will read this rise in voltage.

S-meter circuits *can* be headaches—S-meter and hobbyist users of CB equipment love nothing better than comparing S-meter readings. Naturally, no two S-meters will read alike due to natural differences in tubes, design and circuit tolerances. About the only thing you can do for this problem is to check out the circuit, make sure it is working, and explain the facts of "tolerances" to the unhappy owner!

Getting down to business

Let's look at some concrete ways of making money out of CB — how to troubleshoot it.

These are the tools and test equipment you'll need:

1. A good signal generator, well shielded, preferably with calibrated microvolt attenuator. It must cover the range 26–28 mc, and should cover frequencies from 175 to 1,800 kc.

2. A power output meter. This may be combined with an swr bridge, as in the Cesco Transicheck, Seco Antenna Tester, and Globe Tenna-Meter.

3. 20,000-ohms-per-volt vom with standard and needle prods.

4. Vtvm of any standard type. No special probes.

Helpful but not absolutely necessary at the start is a tube tester (you probably have one anyhow). Also helpful at times but actually rarely needed is an oscilloscope.

As in all service work, the first step is to find out what symptoms the customer noticed.

If nothing at all works, the problem is probably in the power supply. Standard troubleshooting techniques apply to the ac portions of the power supplies; standard auto-radio techniques apply to the mobile-radio parts of it.

If the complaint is poor reception

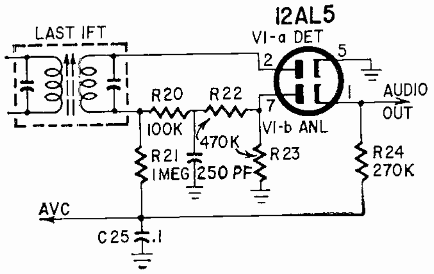


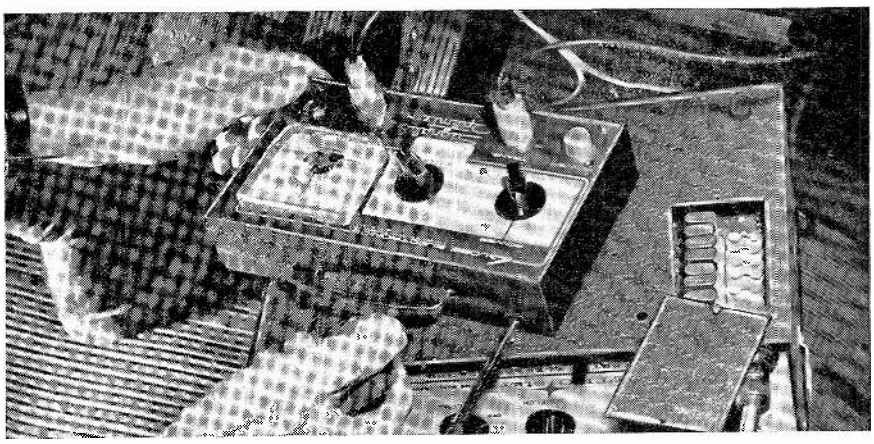
Fig. 3—Anl circuit of Globe CB-200; many others are similar series-limiters.

but transmitting performance is fine, realignment and receiver checkout are indicated. This also follows standard ac-dc practice, except that squelch controls, if present, should be turned wide open so you can hear what you are doing.

The complaint most likely to give you headaches at first is "poor transmission but the receiver works fine." This indicates troubles in the transmitter, of course. Here's how to check them out most rapidly.

Connect the dummy load and power meter to the antenna connector on the unit (Fig. 4), turn it on and let it warm up. Key the transmitter by pressing the microphone button and read output power. A reading anywhere between 2½ and 4 watts is normal for "full-power" jobs, with the average about 3 watts.

If the reading is low, connect the vtvm (set to read —dc volts) to the control grid of the final power amplifier tube and key the rig again. Normal read-



Here, power meter is inserted between transceiver and antenna, as shown in Fig. 4. If transmitter checks OK, trouble is narrowed down to receiver or audio.

ing here will vary, but should be about —20 volts.

If this reading also is low, take a reading at the control grid of the oscillator tube with the transmitter keyed on. This one should be between —5 and —10 volts with most sets.

If it's too low, substitute another transmitter crystal and see if it moves up. Frequently, a crystal will "age" and lose some of its activity. That same crystal, incidentally, may perform perfectly in another set!

If replacing the crystal does not bring output up, substitute another oscillator tube. Testing will show you nothing—substitution is the only reliable test for an rf oscillator.

If this, too, fails, measure the voltage at the plate of the oscillator in both receive and transmit. Transmit voltage should be lower than receive, and both

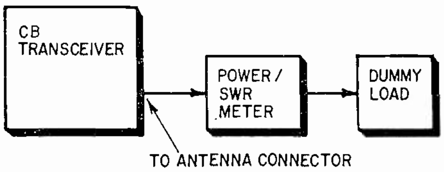


Fig. 4—Hookup for measuring CB transceiver output power. Heath "Cantenna" makes good dummy load (see June 1963 issue, p. 66), or use other non-inductive 50-ohm resistance. Avoid using light bulbs. Some power meters contain built-in dummy loads.

should be about 250 to 350 volts. (Some sets remove high voltage from transmitter tubes in "receive"; with these, proper reading in "receive" is zero volts.)

If oscillator plate voltage is less than 250, check the power supply (a few sets operate as low as 200 volts; with these, naturally, oscillator voltage will also be about 200). If there is more than about 10% difference between supply voltage and voltage at the plate, look for a defective component in the circuit.

If voltage at the final-stage grid is proper but output is still low, measure the voltage from plate to cathode of the final tube. It, too, should be around 300 (or within 10% of the supply voltage). Also measure the current by breaking the lead to the plate (Fig. 5) and inserting the vom, set to the 100-ma range. Multiply voltage and current to obtain input power in watts.

Normal input power is usually as close as possible to the legal limit of 5 watts. If your reading is less than 4 watts, retune the plate circuit to bring it up. The plate circuit usually has two variable capacitors (C1 and C2 in Fig. 2); tune C1 for minimum plate current, then C2 for maximum, alternating between them until you reach a 5-watt dc input. There is strong interaction between them, and each must usually be adjusted five or six times.

Keep the power output meter in the line when tuning the plate circuit. It's easy to load up to 5 watts input with the circuit misadjusted so that only 1 or 2 watts rf get out!

If you find it impossible to load to 5 watts, substitute another tube. If this doesn't help, trace the screen circuit for defective components.

Like everything else electronic, most CB troubles are caused by defective tubes. A close second is the aging crystal. Both, fortunately, are easy to check by substitution.

About service data: the best source of up-to-date service data on this equipment is the manufacturers themselves. The most recent count shows more than 100 manufacturers in the field, and only a few of them are represented in the data services. But you'll find almost all manufacturers eager to provide data on their equipment.

The specialized test equipment is easy to use. For example, on the Seco Antenna Tester, to measure output

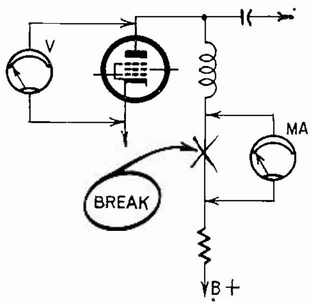


Fig. 5—Measuring dc input power. Break plate circuit and insert 0–50 milliameter or current range of vom. Measure voltage between plate and cathode, not plate and ground.

power, switch to FORWARD POWER position with the function switch, press the POWER × 1 button, and key the transmitter!

Operation of other CB test equipment has been described in recent issues of RADIO ELECTRONICS. (See "CB repairs You Can Make Without A License," February, 1963, page 34, and "CB Servicing With A CB Set," September, 1963, page 34.)

In this space, we've barely been able to skim the surface of "non-license" CB servicing; not mentioned at all are such things as antenna installations, noise elimination in mobile installations, and a number of other things that may be covered in a later article.

For more extensive data on these, recommended books are *The Radio Amateur's Handbook* published yearly by the ARRL; *The CB Radio Mobile Handbook* published by Horizons Publications, Oklahoma City, and past issues of RADIO-ELECTRONICS. Much that applies to the hams' 10-meter band applies equally well to CB installations. END

Minimizing The Vtvm Pointer Shift

The zero setting of most service vtvm's shifts as the range selector is switched. Resetting the zero is a nuisance; not resetting it gives inaccurate measurements.

The shift is caused by "contact potential" grid current flowing through the high-resistance voltage divider (Fig. 1). Since only one grid circuit

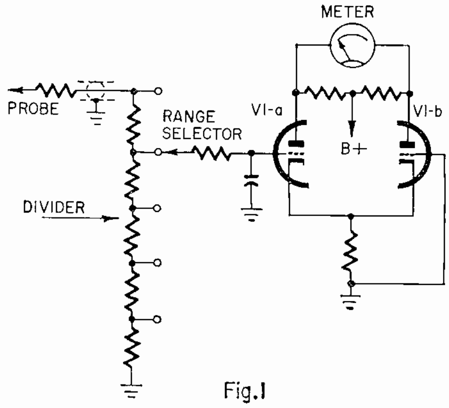


Fig.1

contains this divider, while the other is grounded, changes in voltage drop unbalance the meter circuit as different resistances are switched in. The contact grid current through V1-b remains constant—that through V1-a varies as the range selector is switched to progressively lower voltages, thus switching more resistance into the grid circuit. In some vtvm's the V1-b grid goes to ground through a high-value resistor. Grid current is still constant, of course, though it may not differ from V1-a as much as with the grid grounded direct.

To insure equal drops on both sides, use a two-pole range selector and build an exact duplicate of the divider for the other side of the vtvm bridge (Fig. 2). Now the vtvm will stay bal-

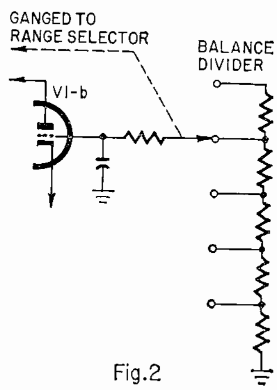
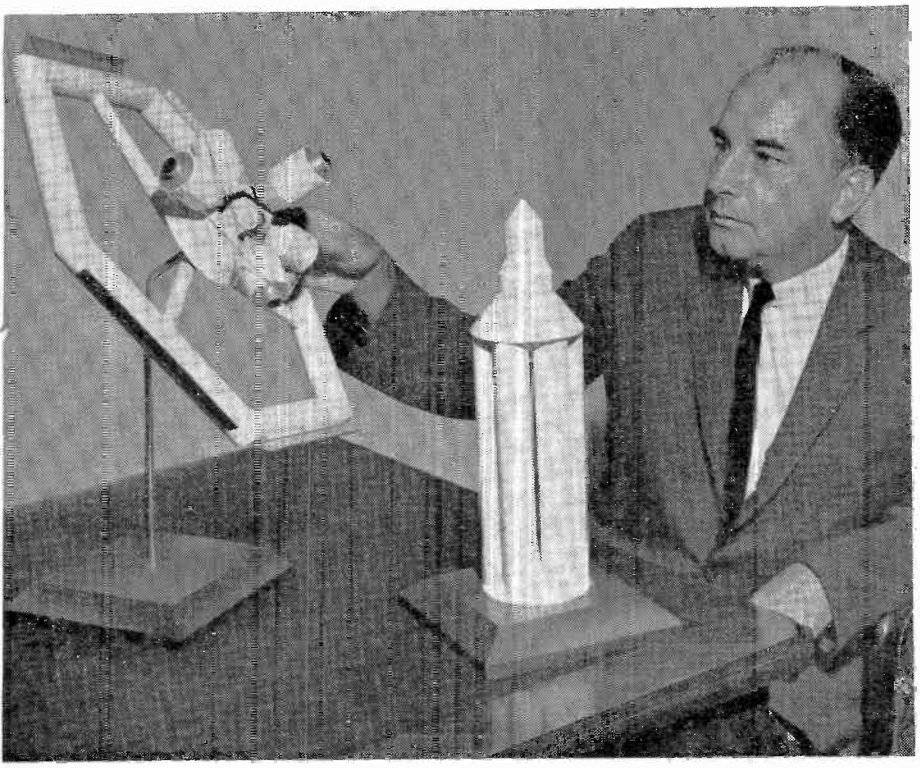


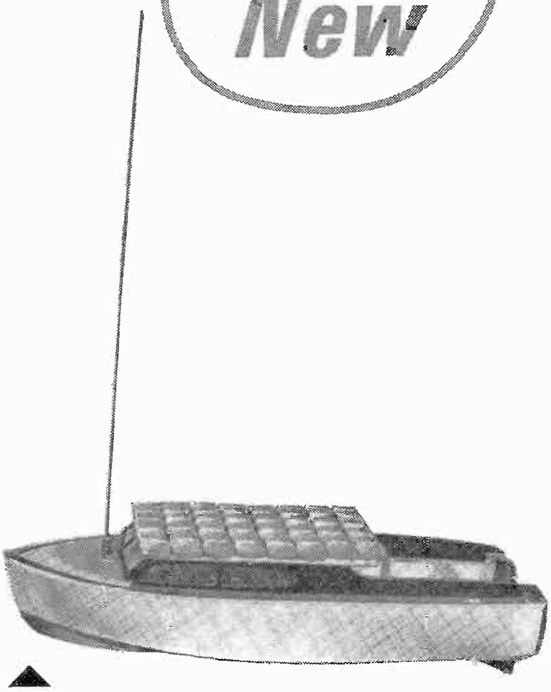
Fig.2

anced at any setting of the selector, since each grid circuit always contains the same resistance.—*R. M. Centerville*

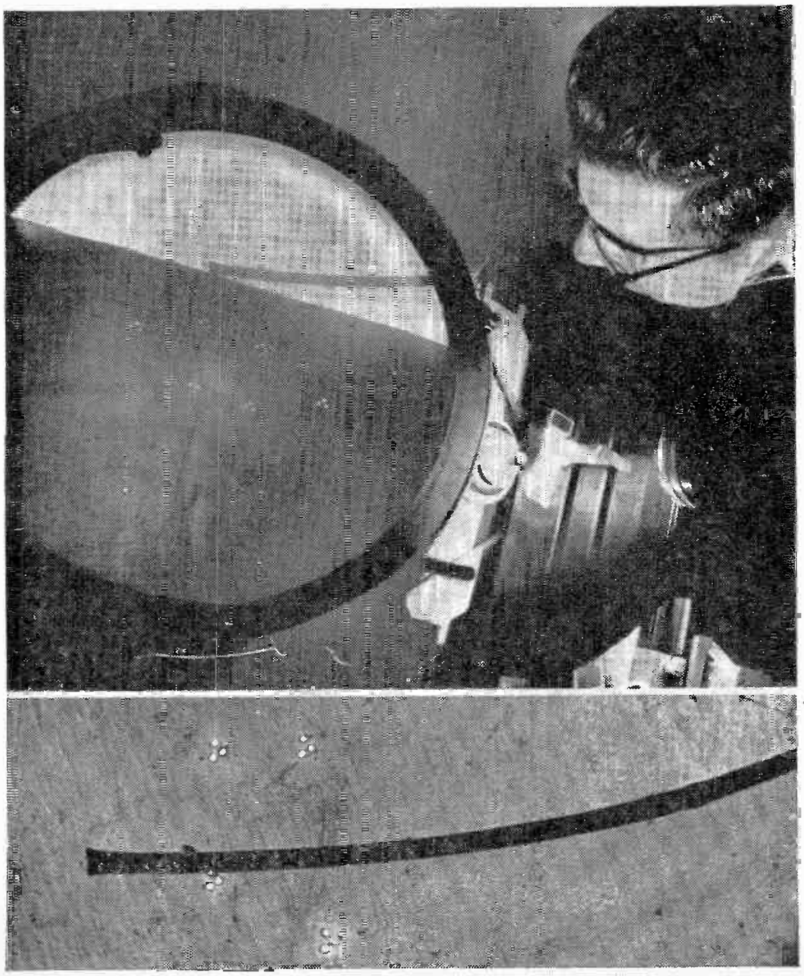
What's New

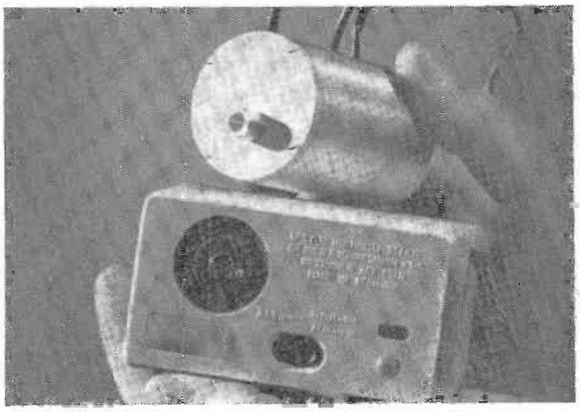


SPACE STATION DESIGN won a $400 prize from NASA Inventions and Contributions Board, and for its inventor, R. A. Berglund. The hexagonal model at left represents the station in space. The rocket-like object on the table is the same type of space station as it would appear when ready for launching.



SOLAR-POWERED BOAT uses 40 solar cells to run its small motor, moving majestically through the water under radio control on sunny days. The sun ship was built by the Rev. Robert W. L. Mark of Hawley, Pa., known to RADIO-ELECTRONICS readers as author of articles on the old one-tube Twinplex circuit.





NEW LASER is small enough to put in a coat pocket. About the size and shape of a frozen juice can, its signals can be detected 30 miles away. Raytheon developed the device and is testing it with the idea that it might be used by distressed boatmen and downed pilots to signal their position. It is shown above a small German power supply with which it was used, and which will fire it about 50 times before battery recharging is needed.

ELECTRON BEAMS DRILL HOLES in .005-inch thick tungsten sheet. Only .0008 inch in diameter, these holes are drilled by the same electron beams that occasionally burn the screen of a TV tube. In short pulses of tremendous power, the beams can vaporize the most heat-resistant materials and produce almost incredibly small holes. A human hair is shown for comparison. The experimental device was developed by Westinghouse.

Service clinic

by Jack Darr
Service Editor

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.

A LOT OF OUR MAIL ASKS, "CAN I REplace the — CRT in an old — with a (90°) (110°) — tube?" Fill in types and names yourself. Conversions such as this fall into three classes: easy, difficult and impossible. As a general recommendation, I'd say that you should never attempt a conversion job of this kind unless you're thoroughly familiar with the circuits and realize how much trouble it's going to be!

Easy conversions are those where the tubes have the same deflection angle—for instance, converting from a 17-inch 70° to a 21-inch 70° tube. Actually, we don't need much sweep to cover the added distance, for this will be surprisingly small—only about 2½ inches, horizontally.

If the set in question is one of those old "conservatively designed" jobs with ample power reserves, the job can be fairly simple. All we have to do is put the sweep circuits into first-class condition, and the extra deflection is easily obtained. However, if the set happens to be one of the "marginal" types, of the cheaper group, where every tube in the set is being driven to within an inch of its life (thus shortening said life tremendously!), you're probably going to have much trouble and woe! You know the type I mean; you've seen enough of them. The only answer to conversion questions for these sets is a firm "No!"

Conversion of these types would mean completely rebuilding the entire sweep circuit, and also the power supply! The cost of rebuilding such chassis would pay for a new color set, not only in new parts but in the time wasted. So, there's your first important factor: the size, age and type of the original chassis.

Second-stage conversions are those which have the necessary reserve power but will require part changes because of a change in the deflection angle of the new tube. For example, changing from a 70° to a 90° tube requires replacing the yoke in all cases. Also, we must watch the power supply carefully. Based on actual experiments, you'll need 50% more *power* in the vertical sweep circuit to sweep the 90° tube, compared to the 70° tube. The horizontal circuit will need 25% more power. If the low-voltage power supply will bear up under this additional drain, we're in. We *can* get more power in the sweep circuits by changing tube types. For example, 6BQ6's can be replaced by the more powerful 6DQ6's, and 6F6's in the vertical output by 6V6's, and so on.

To find out about how much power we can draw from the power transformer itself, look up the recommended replacement in a transformer catalogue and note the current rating of the high-voltage secondary. This is the limiting factor in all conversions. If the original transformer had a current-supply capability of 200 ma, and calculations show that we'd need 250 ma for the new tubes, the only answer here is replacement of the power transformer.

Yokes can usually be changed with ease. Find out the inductance of the original yoke. For example, if the yoke had a 10-mh horizontal and 45-mh vertical inductance, get a catalogue and look up a 90° yoke which has approximately the same inductances. You'll have about a 10% tolerance here, especially if the chassis has both horizontal linearity and width adjustments. Many older sets did use these handy controls, and they are always helpful in making the final adjustments after the new tube has been installed.

Converting from very old sets to very new tubes isn't recommended. For example, I doubt if it would be possible, let alone practical, to convert from a 54° tube to a 115° type! The added sweep power requirements would make this prohibitive, except in cases where the technician "just wants to see if he can do it" and has an almost unlimited supply of nonworking cash type money!

Emerson oscillator coil

The oscillator coil in an old table-model Emerson radio is open. No model number left on chassis or cabinet, of course! Tube line up: 35Z5, 50L6, 12SQ7, etc. Can you tell me where I could find a replacement coil?—J. M., Cranford, N. J.

I'm sorry to say that I can't pin this model down for you, since the number of Emerson radios with that tube lineup is almost without number! However, the chances are that it used a standard tickler-feedback oscillator circuit, since most of them did. See Fig. 1.

You can replace this coil with a

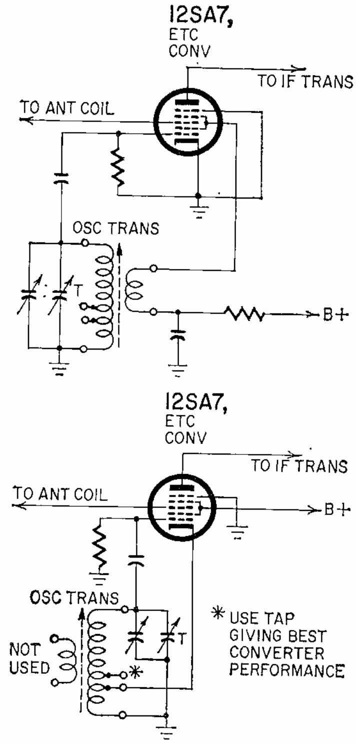


Fig. 1—Two common AM oscillator circuits. Use whichever appears in original circuit. "Universal" oscillator coils are tapped for either type.

Miller 71-OSC or any similar universal coil. This is tapped so that it can be used in almost any oscillator circuit, and has an adjustable core for tracking. (If it won't oscillate, reverse *one* of the windings—either one, but not both!)

Half inch more width

I've replaced the 12LP4 on an old Majestic TV with a 17BP4B, and it works fine. The only trouble now is I still need about ½ inch of width on each side. I've made some changes in the circuit: changed the screen resistor, and raised the B-plus voltage, etc. Any ideas?—J. G., Quincy, Mass.

You might try a few more tricks to get that last little bit of "stretch": add a small capacitor across the damper tube, about a 100–150 pf, 6 kv. Shunt the primary winding of the flyback

(6BG6 plate tap to next tap) with about a 20-pf 5-kv capacitor.

One last resort might be to replace the yoke with a 70° type. The original yoke is a 53° type, and the extra bit of deflection might do it. I believe a Stancor DY-8 should do the trick: this is exactly the same inductance as your original yoke (8.5 mh horizontal, 55 mh vertical) but is a 70° type. There are several others by other makers with the same values. Try any of these.

Streaking and horizontal bend

In a RCA KCS-136 chassis, there is an awfully short-time-constant intermittent. It shows up as a streaking in the picture, usually followed by a horizontal bend, like an "agc bend." This clears itself in a few seconds, especially if you touch a test prod or scope lead anywhere in the circuit.—R. P. M., Fayetteville, Ark.

This is probably due to an intermittent bypass capacitor. Try replacing both the .001- and 0.22-μf agc bypass capacitors on the video i.f. printed circuit board, as seen in Fig. 2. Although we haven't caught them doing it, they must be opening up to cause this kind of symptom.

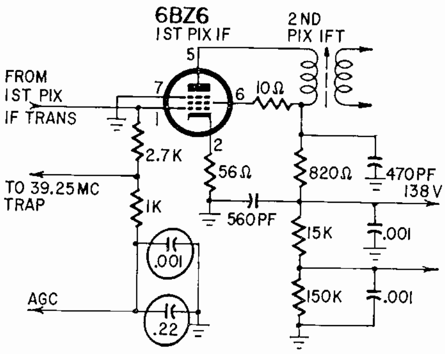


Fig. 2—Open agc bypass capacitors (circled) can cause streaking and bending of picture.

Narrowing in Zenith 24G26

The last question I asked was about a Zenith, and your answer proved very helpful. Now, how about another one? [Advertisement!—*Editor.*] *This is a 24G26 chassis. Everything has been checked, the width control is at maximum, and the horizontal drive control also at maximum. Only then can I get the screen filled. The flyback is quite noisy and seems to be running warm, the insulation is peeling. If this isn't enough, after warm-up I get white flashes and streaks in the picture, bad horizontal stability. This is intermittent, too! Shows up after the set has been on for about 10 minutes. Sometimes the thing will run for 3 or 4 hours.—N. J., Long Island City, N. Y.*

The symptoms you give are typical of those caused by one of the two 6BQ6 horizontal output tubes in this series developing a bad case of grid emission or screen emission, or possibly some gas, or all three simultaneously. The slow shrinkage, and the flashing and streaking, together with the hot flyback, all point to this cause. By the way, you said that the tubes had been checked. I ran into a bad case of this same complaint the other day, and checked the tube just out of curiosity. It tested perfect: no gas, no emission, but in an "in-the-circuit" checker, it plainly showed screen emission! So, the best and most practical test here is replacement.

The heating of the flyback also points in the same direction. If you measure the plate current, you'll probably find it running around 250 ma for the two tubes; 220 ma should be the maximum. I'd also replace the 6W4 damper with a 6AU4, because of the much higher heater–cathode breakdown rating. Also, check the p-p voltage of the drive signal which should be at least 100 volts and could be 125 volts without hurting anything.

Silvertone swap: 17HP4 to 17BP4

Can I change the 17HP4 in my Silvertone TV set to a 17BP4? I know the 17HP4 is an electrostatic-focus tube, and the 17BP4 is magnetic-focus, but I've got a spare 17BP4, and it's my set!—A. R. E., Key West, Fla.

Yes, I think you can make this change, if you don't mind a little jiggery-pokery with the focus circuit in the set. The 17BP4 specifies an EIA No. 109 focus coil with a current of 100 ma for the -BP4. If the tube you have happens to be a -BP4A or -BP4B, total current will be 115 ma, slightly higher in aluminized types.

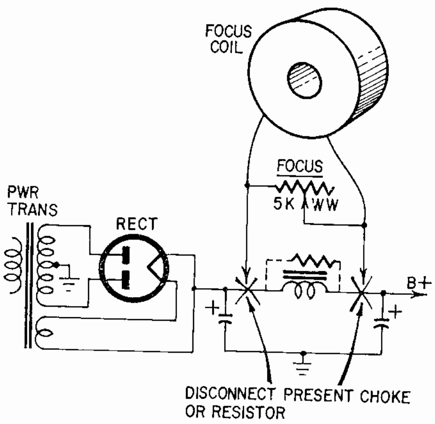


Fig. 3—To use magnetic-focus CRT instead of electrostatic tube, connect focus coil in place of filter choke or resistor. Pot across coil is focus control.

You might be able to dig up one of these focus coils from an old TV in the back room of somebody's shop. This is about the most popular focus coil, and was used on innumerable models. It might even be worth while to try one of the magnetic-focus (PM) units, such as used on several old Philco's, etc., if you can find one. This should do the work. However, if it won't, get the focus coil, and connect it into your power supply circuit in place of the filter choke or resistor (See Fig. 3). You can shunt the coil with a heavy-duty wirewound potentiometer for focus control – about 5,000 ohms.

Microphone hum

I have a good make tape recorder, which works fine as long as I use the short mike cable which came with the unit. When I connect a longer mike cable, to use it in another room, I get a terrific hum. I'm using a crystal mike on the extension. I'd like to use about 50 feet of mike cable on this. Do you think I need a preamp?—W. F., Defiance, Ohio.

No, I think you need a better ground on the *shield* of that extension cable. Since the machine works OK with the original mike, this hum must be due to stray pickup from the longer cable. Almost invariably, this is due to a poor or even an open ground connection on the shield braid.

You can use microphone cable up to 100 feet without too much trouble. If you use the small-size high-capacitance type known as lapel-mike cable, you'll get a fairly heavy signal attenuation due to the added shunt capacitance across the input. So, I'd recommend using the larger standard cable, for less signal loss.

Fusible resistors

Are fusible resistors designed to blow at a specific current rating? If so, how is this determined? Why are they made in such funny values: 4.7, 5.6 and 7.5 ohms?—J. M., Webster Groves, O.

The fusible resistor serves as a combination fuse and surge resistor in most applications. It is a special type of wirewound resistor, made of resistance wire with a definite current-carrying capacity. In normal use, it actually runs at about 90% of its rating.

The wattage at which it blows is determined by the current through the resistance and the resistance used. To increase the blowout point, we'd use a *smaller* resistor: less wattage dissipated. The "funny values" are simply preferred numbers, used for most resistors.

Converting KCS-68E to 24-inch CRT

One of our customers wants us to convert his RCA 21T159-DE, using the KCS-68E chassis, to use a 24- or 27-inch picture tube. I would prefer a short 90° or 110° tube.—J. H. G., Arlington, Va.

I'm not too optimistic about your proposed conversion to either the 24-or

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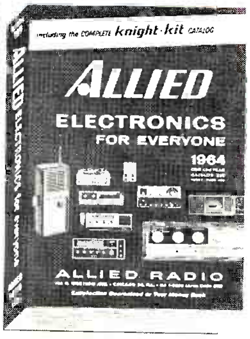

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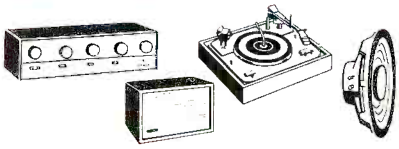

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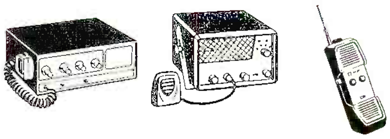

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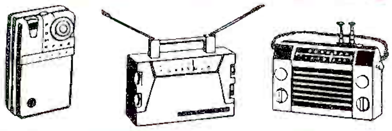

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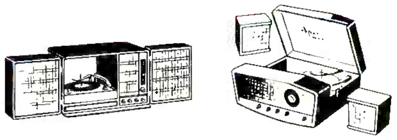

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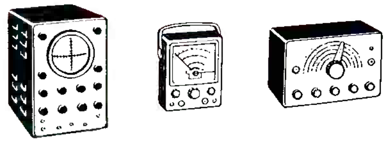

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27-inch tube, especially in the 90°–110° range. It would be entirely impossible to *convert* your present chassis to sweep a 90° or 110° tube, especially the latter. You see, when you alter the sweep angle, you must furnish additional power to drive the beam that extra distance. This requires extra *power* from the sweep systems, not only from the horizontal sweep but from the oft-neglected vertical sweep as well! Just changing the yoke from the present 70° to a 90° would not be enough. If you changed only the yoke, you'd still have a 70° picture on the 90° tube!

This conversion would require replacement of the flyback, vertical output transformer, yoke and both output tubes. It would not be practical at all for a customer, although you might try it if it was your own set, just for the experience! It will be very educational and fun, but rather expensive.

Insufficient width in Zenith

What can I do to get more width in a Zenith 16C24 TV?—L. P., Brooklyn, N. Y.

The Zenith chassis you mention has a metal-sleeve type width control. This is a brass sleeve of very thin metal slid inside the yoke. There is a small grounding clip around it, to reduce the shock hazard if the yoke should short to it. To get more width, simply slide this sleeve back out of the yoke until the picture is correctly proportioned.

If this does not give you sufficient width, check the horizontal output tube, by replacement, and also the low-voltage rectifier. Check drive voltage on the grid of the 6DQ6 horizontal output tube: this should be at least 60 volts negative. You might also check the dual .0015-μf coupling capacitor in the 6DQ6 grid circuit. It has given trouble in some sets. If it is leaky, replace it with two separate .0015-μf ceramics, of at least 600-volt rating.

PC trouble, RCA KCS-94A chassis

I have a dandy intermittent on my bench! It's an RCA KCS-94A chassis. The trouble is apparently in the horizontal oscillator circuit. Anywhere around the output half of the 6CG7 horizontal oscillator, I got a 12-cycle waveform, with the sweep set for 15,750 cycles. Then, all of a sudden, the set took off and played perfectly. I've replaced several capacitors around there without result. When I put a heat lamp on the printed-circuit board, the set started to work and played for several hours! The conductors all check out with an ohmmeter. What do you think? —J. L., Niagara Falls, N. Y.

I'm afraid that you have a thermal intermittent in that horizontal oscillator board, and that can be quite troublesome! Since you replaced most of the frequency-determining elements of the circuit, and the set refused to work until you heated the board with the heat lamp, it looks very much as if you have a thermal break in one of the conductors. A break, I might add, that is almost impossible to locate with an ohmmter, and the chassis cold.

So, set it up, get it to cut out by cooling it off, etc., and then resolder *all* the connections around the horizontal oscillator circuit, being very careful to make good, clean joints. Use just a tiny dab of soldering paste on each, if you want to. One of the small-tip medium-heat irons is very handy for this.

The basic defect is obviously one which is affecting the *frequency*, I'd say, from the waveform. This will upset the time constant of the horizontal output, damper and yoke circuit, and keep the high voltage from developing. It must be some part (probably a capacitor) opening up due to an invisible break in the pc board, because the frequency goes *up*.

Silvertone with squeal and "fuzz"

I have a Silvertone 100-210 TV which has an unusual horizontal sweep trouble. The raster is fuzzy and streaky, almost completely blacked out at the left side, and brighter at the right. The flyback squeals, and there is no boost voltage. Waveshapes around the circuit look OK, but they are a little thick and fuzzy-looking.—W.E., Toledo, Ohio

Your horizontal oscillator is off frequency: this is the customary cause of this squeal. However, since you have other symptoms (no boost voltage, etc., and most especially those "fuzzy waveforms" around the horizontal stages), I'd check some filter capacitors first.

Open or weak electrolytics will cause feedback in the wrong places, and can cause off-frequency operation of the horizontal oscillator. C1, the 40-μf input filter capacitor, has been known to cause this. Check it first. END

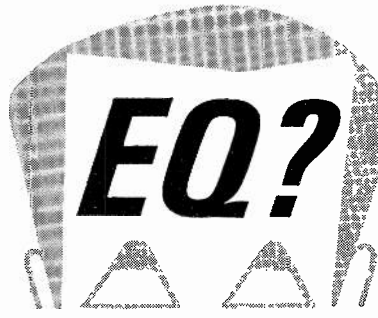
Correction

There is an error in the wiring of board 1 in Fig. 4 of the article "Build an Audio Sweep Generator" on page 28 of the September issue. R2 is incorrectly connected in the drawing.

Remove the connection between points 6 and 8 in the top row (counting from left). Connect R2 there instead. Close the gap between point 7 and the junction of C2 and R3. Pin 1 of V1 and one terminal each of C2, R3 and C3 are now common. The right-hand ends of RFC1 (left) and RFC2 (right) go to ground through R2.

We thank Frank J. Stein, of Santa Ana, Calif., for catching the wiring error.

WHAT'S YOUR EQ?



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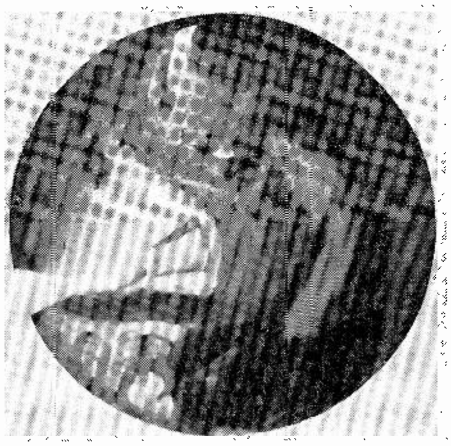
Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York 11, N. Y.—10011.

Answers to this month's puzzles are on page 68.

An Unusual Twist

A TV technician was working with an old set, when a camera-toting friend walked in. He quickly focused close up on the receiver's screen and got the picture below.

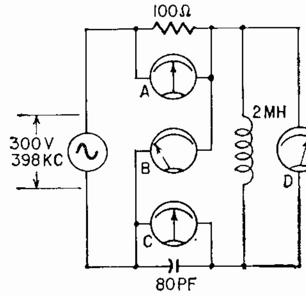
What caused this unusual twist?



What was the service technician doing to the receiver?—*Allen F. Kinckiner*

L-C-R Circuit

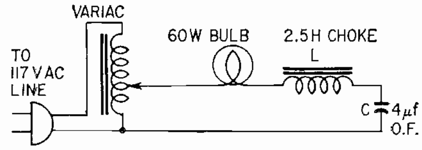
The diagram shows that the load across an ac generator is a 100-ohm



resistor, a 2-mh inductance and an 80-pf capacitor connected in series. The generator produces 300 volts at 398 kc, and the current flow through each element in the series circuit is 3 amperes. Voltmeters B, C and D are connected to measure the voltage drop across the reactive elements in the circuit. Voltmeter A measures the voltage drop across the 100-ohm resistor. Can you determine the reading on each voltmeter?—*Kendall Collins*

Bewildering Blinker

The circuit shown seems straightforward enough, but does something unusual. When the Variac is set at some critical potential around 100 volts, the 60-watt light bulb blinks at the rate of about one blink per second.



I defy you to tell me why! I had to muddle over it for quite some time to find a *possible* answer. Is something oscillating. If so, what? Try building it if you don't believe that it will work. All the parts are standard and are listed below.—*George R. Wisner*

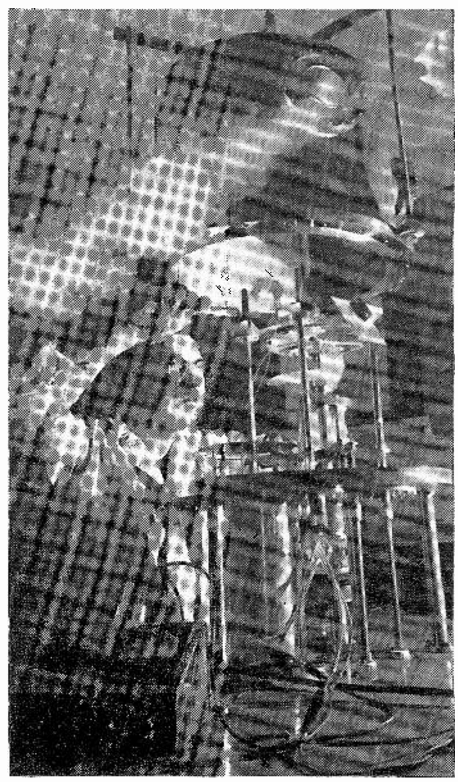
1. Variac or other source of variable ac from 90 to 125 vac.
2. 60-watt light bulb of standard home type.
3. L, 2.5-henry choke (one from an old radio will do).
4. C, 4-μf oil-filled capacitor (electrolytics won't work).

New Techniques Make Fantastic Vacuum

Thin films, only 10 atoms thick, are being grown by scientists at the Westinghouse Research Laboratories in research on the physical properties of thin films, which are becoming increasingly important in electronics.

The films are made from both metals and insulating materials, and are grown by depositing them from evaporated material inside a special ultra-high-vacuum chamber, which creates pressures less than one-thousandth of a billionth of atmospheric pressure at sea level. This corresponds to the pressure in outer space 300 miles from the earth.

To get the ultra-thin films an unusual device had to be constructed. It is a stainless steel chamber that looks something like a deep-sea diving bell. Before putting it into operation, it is baked out at a temperature of 750°F. Then the temperature is reduced by filling the space between the walls with liquid nitrogen to cool them to 320° below zero.



Senior technician Paul Raygor prepares for an experiment in the Westinghouse ultra-high vacuum chamber.

After bake-out and nitrogen cooling, extremely low pressures are obtained from only short periods of vacuum pumping. The pressure of 1-billionth of a millimeter of mercury can be obtained within an hour, and a pressure 100 times lower in two hours.

DO YOU KNOW THE LAW?

ANSWERS

(Questions are on page 40)

1. In electronics we recognize two Kirchhoff laws. The first states that "the sum of currents flowing toward any junction is equal to the sum of currents flowing away from that junction." The second law goes like this: "The algebraic sum of voltages around any closed path in a circuit is zero."

★

2. The relationship between current, resistance and dissipated energy—the familiar I^2R expression—is known as Joule's law.

★

3. Poynting's law, relatively obscure to most of us, deals with effects of transfer of energy in electromagnetic fields and is important in microwaves. It states that the transfer of energy can be expressed as the product of the values of the magnetic field and of the components of the electric field which are perpendicular to the magnetic field, and that the flow of energy at any point is perpendicular to both fields.

★

4. Lenz' law is important wherever alternating current flows, from 60 cycles to rf. So fundamental is it that it might almost be called the alternating-current counterpoise to Ohm's law. The law deals with the change in flux caused by the motion of one of two mutually coupled coils, and the direction of current in one of them, as follows: "If a constant current flows in a primary circuit (A) and if by motion of A or the secondary circuit (B), a current is induced in B, the direction of induced current will be such that, by its electromagnetic action on A, it tends to oppose the relative motion of the circuits." In other words, "Counter electromagnetic motive force." But if you don't like the way this was stated, blame J. Clerk Maxwell, the famous physicist, for that is how he expressed it. Why the ac counterpoise to Ohm's law? Simply that if a man knows Ohm's low, he knows dc; if he knows Lenz' law, he knows ac.

★

5. Neuman's law deals with mutual inductance (hence the reference to i.f. transformers) when no magnetic material is present. It states that M (mutual inductonce) is a constant for a given relative physical position of the coils, and independent of the fact that the current flows in one or the other coil, and of frequency, current and phase. It is an "appendix" of the law of conservation of energy, which will be overthrown when we move through space at greater speed than light!

★

6. Wien's law, better known as Wien's displacement law, shows that the wavelength of maximum radiation intensity is inversely proportional to the absolute temperature of a black body, and that the intensity of radiation at this maximum wavelength varies as the fifth power of the absolute temperature. Infrared detection techniques, hinging on the facts known about "black bodies," are intimately concerned with Wien's displacement law.

★

7. Helmholtz' law describes the curve of increase of a current when a circuit with R and L is suddenly closed. Thus: $I = I_0(1 - e^{-tR/l})$, which is a familiar curve to most electronics workers. (It is also related to the discharge curve of a capacitor, but this was not stated by Helmholtz.)

★

8. Wiedeman, Franz and Lorentz, all physicists, have a law which states that the ratio of electrical conductivity and thermal conductivity at a certain temperature is *independent of the conductor material!* Sounds hard to believe, but it is true.

★

9. Faraday, most famous of historical experimenters, stated in his law that if there is any closed linear path in space, and the magnetic flux in this path (surrounded by the path) varies in time, the emf induced in the path is equal to the negative *rate* of change of the flux in lines per second. This can only be expressed with calculus in formula form, so we will skip that part. But it is a fact that the importance of this discovery was not practically applied in radio for almost a century!

★

All of which just goes to show that there are many facts about nature and the world around us that we can use to good advantage in our daily work with electronics, without giving much thought to the great discoverers of science, who had powers of observation and deduction, and the ability to state them as "laws of nature."

END

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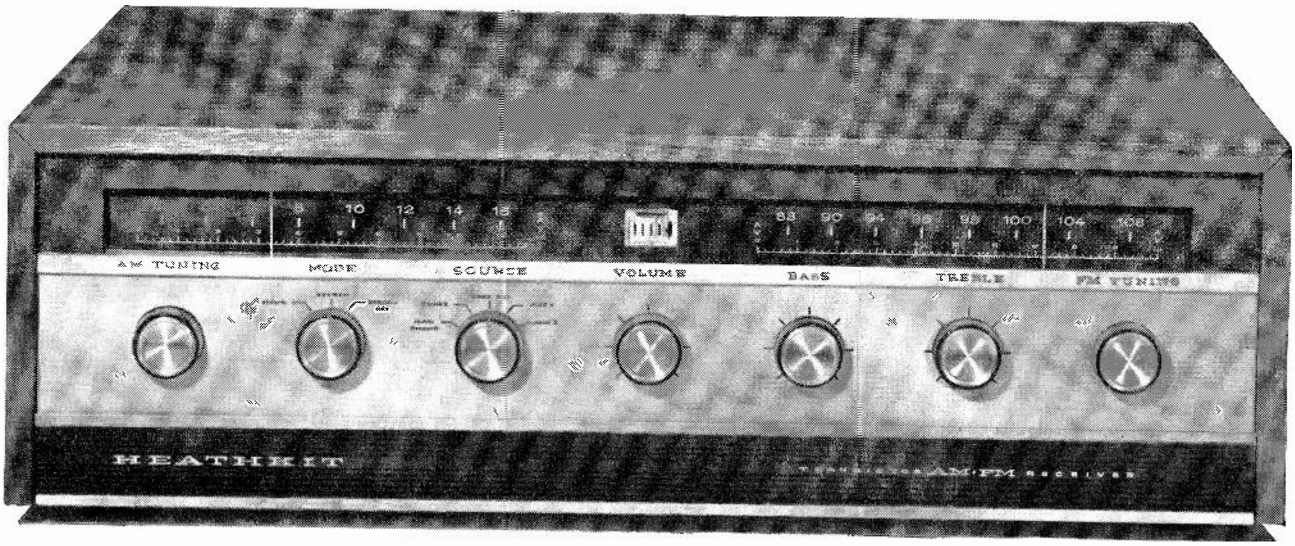

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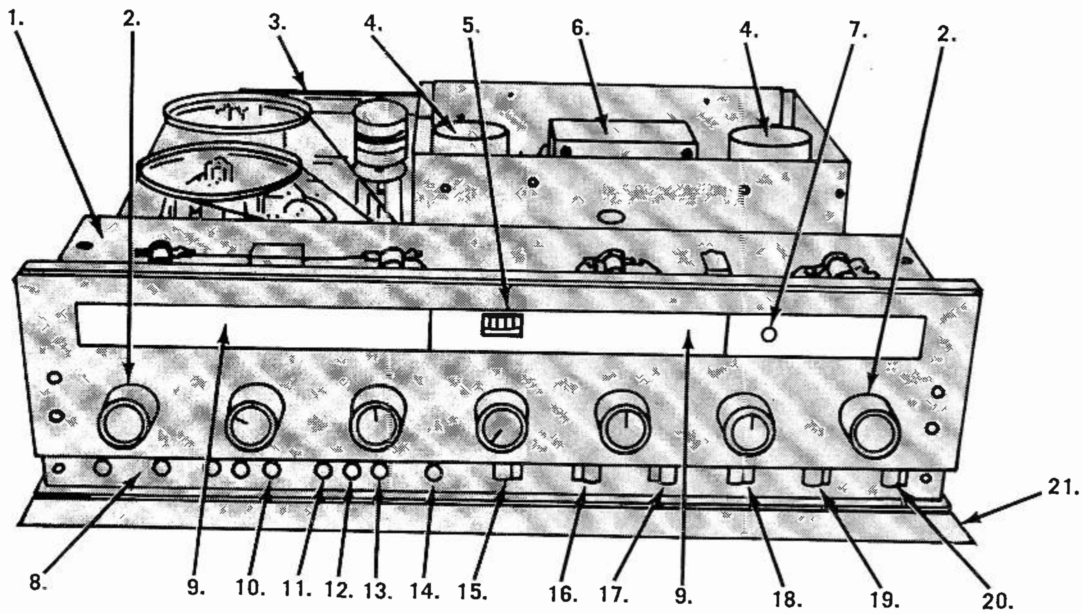

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21. Hinged Lower Front Panel (conceals secondary controls)

* 43 Transistor, 16 Diode Circuitry

LEADS IN TRANSISTOR STEREO

TUNER-AMPLIFIER

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All the electronics you need for a complete music system are "Heath-Engineered" into this handsome unit...just add two speakers and a phonograph or tape recorder! And there's plenty of advanced features to match the advanced performance of the AR-13. You'll like the way this unit *automatically* switches to stereo, thus eliminating any manual operation. In addition the automatic stereo indicator light silently signals when stereo is being received. For versatility there's three stereo inputs (mag. phono and two auxiliary) plus two filtered tape recorder outputs for direct "off-the-air" beat-free stereo recording. Dual-tandem controls provide simultaneous adjustment of volume, bass, and treble of both channels. Balancing of both channels is accomplished by a separate control. The AM tuner features a high-gain RF stage and high-Q rod antenna.

Other quality features include a local-distance switch to prevent overloading in strong signal areas; a squelch control to eliminate between-station noise; AFC for drift-free reception; heavy die-cast flywheel for accurate, effortless tuning; pin-point tuning meter; and external antenna terminals for long-distance reception. For added convenience the secondary controls are "out-of-the-way" under the hinged lower front panel to prevent accidental system changes.

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Kit AR-13, 30 lbs., no money dn., $19 mo. $195.00

SPECIFICATIONS—Amplifier: Power output per channel (Heath Rating): 20 watts/8 ohm load, 13.5 watts/16 ohm load, 9 watts/4 ohm load. (IHFM Music Power Output): 33 watts/8 ohm load, 18 watts/16 ohm load, 16 watts/4 ohm load @ 0.7% THD, 1 KC. **Power response:** ±1 db from 15 cps to 30 KC @ rated output; ±3 db from 10 cps to 60 KC @ rated output. **Harmonic distortion (at rated output):** Less than 1% @ 20 cps; less than 0.3% @ 1 KC; less than 1% @ 20 KC. **Intermodulation distortion (at rated output):** Less than 1%, 60 & 6,000 cps signal mixed 4:1. **Hum & noise:** Mag. phono, 50 db below rated output; Aux. inputs, 65 db below rated output. **Channel separation:** 40 db @ 20 KC, 60 db @ 1 KC, 40 db @ 20 cps. **Input sensitivity (for 20 watts output per channel, 8 ohm load):** Mag. phono, 6 MV; Aux. 1, .25 v; Aux. 2, .25 v. **Input impedance:** Mag phono, 35 K ohm; Aux. 1, 100 K ohm; Aux. 2, 100 K ohm. **Outputs:** 4, 8, & 16 ohm and low impedance tape recorder outputs. **Controls:** 5-position Selector; 3-position Mode: Dual Tandem Volume; Bass & Treble Controls; Balance Control; Phase Switch; Input Level Controls (all inputs except Aux. 2); Push-Pull ON/OFF Switch. **FM: Tuning range:** 88 mc to 108 mc. **IF frequency:** 10.7 mc. **Antenna:** 300 ohm balanced (internal for local reception). **Quieting sensitivity:** 2½ uv for 20 db of quieting, 3½ uv for 30 db of quieting. **Bandwidth:** 250 KC @ 6 db down (full quieting). **Image rejection:** 30 db. **IF rejection:** 70 db. **AM suppression:** 33 db. **Harmonic distortion:** Less than 1%. **Multiplex: bandpass:** ±¼ db, 50 to 53,000 cps. **Channel separation:** 30 db, 50 to 2,000 cps; 25 db @ 10 KC. **19 KC suppression:** 50 db down, from output @ 1 KC. **38 KC suppression:** 45 db down, from output @ 1 KC. **SCA rejection:** 30 db. **AM: tuning range:** 535 to 1620 KC. **IF frequency:** 455 kc. **Sensitivity:** 1400 KC, 3.5 uv; 1000 KC, 5 uv; 500 KC, 10 uv—standard IRE dummy antenna. **Bandwidth:** 8 KC @ 6 db down. **Image rejection:** 30 db @ 600 KC. **IF rejection:** 45 db @ 600 KC. **Harmonic distortion:** Less than 1%. **Overall dimensions:** 17" L x 5⅜" H x 14¾" D.

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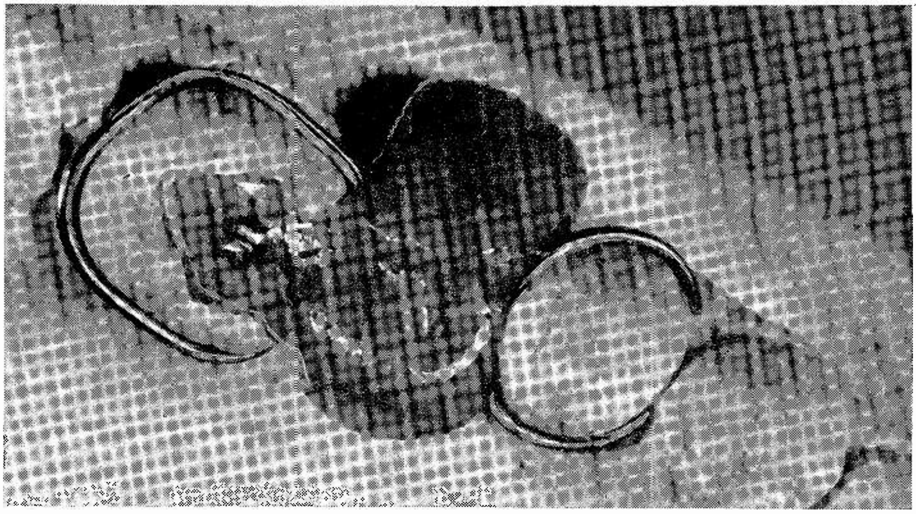

Transmitter Fits in a TOOTH!

Tiny FM transmitter uses 1 transistor

By B. R. D. GILLINGS*

WITH MINIATURE COMPONENTS PLUS A little care and patience in assembly, it is possible to make a tooth-sized radio transmitter that can broadcast signals 15 feet or more. The transmitters described here were developed for dental research, but with a little imagination similar devices could be used for a variety of routine biological applications.

Dentists have long been interested in how the teeth meet. Recent research has made it increasingly obvious that very little is known about it. When, for example, a filling or tooth is a little too high, no one can say whether the patient is likely to hit the high spot more often to wear the area away, or whether he will avoid closing his teeth on the spot because it irritates him.

One of the difficulties in investigating normal or abnormal occlusion (abnormal occlusion: irregularly arranged teeth which do not meet properly) is the upsetting effect of observation on the patient's behavior. Attaching wires or gages to various parts of his teeth or face is also likely to disturb him, consciously or unconsciously, and cause an abnormal reaction. This difficulty has, to a great extent, been solved by a tooth-sized radio transmitter.

In 1961, two scientists, Brewer and Hudson, working for the United States Air Force, got things started. They built a miniature radio transmitter (a simple 40-kc oscillator with three resistors, two capacitors, a transistor, a coil and a 1.4-volt mercury cell). (See Fig. 1). It was fitted into an upper artificial denture to determine how frequently the subject contacted his teeth while at rest and while eating. By an ingenious arrangement of triggering contacts, consisting of gold teeth, the two men were able to obtain counts for the number of tooth contacts made in different positions of the jaws. Since the radio transmitter was completely enclosed in the denture, the measuring technique did not interfere with the subject's normal behavior when wearing a full denture.

Useful though this technique is, it does not solve the problems of subjects who have all, or nearly all, their own teeth. It is highly likely that occlusal contact patterns and responses in these subjects are entirely different from those of full denture wearers.

The transmitter used in the full denture was not small enough to be used in the mouths of people who had their own teeth. We did find many suitable subjects who had one or two teeth missing, especially molars, and there was a possibility that a transmitter the size of one tooth could be fabricated to study these subjects.

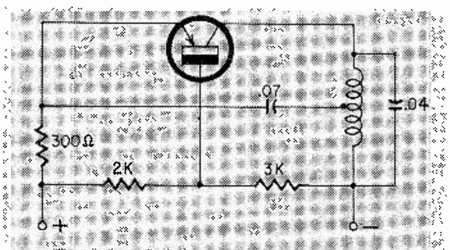

Fig. 1—Basic transmitter circuit.

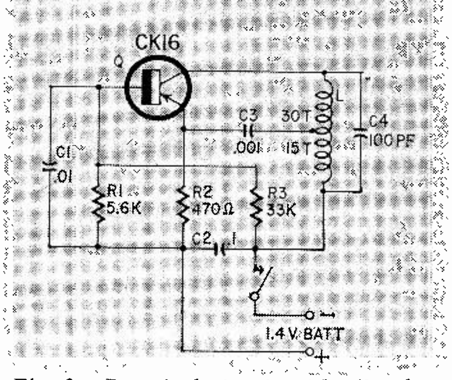

Fig. 2—Practical circuit with all values.

R. H. Dilworth, who developed the pocket personal radiation monitor now in production for the Atomic Energy Commission, and W. Greatbatch, who developed the artificial Pacemaker for the heart, were consulted regarding suitable circuitry and sources of supply of components. Following their suggestions, we were able to construct our first radio transmitter. The circuit is shown in Fig. 2. It is a keyed oscillator that broadcasts an unmodulated signal at about 3 mc.

How it is built

Before the components are hooked up, all leads should be lightly tinned, so they can be soldered with one touch of the iron. (The small components are easily damaged by excess heat.) To conserve space, trim or sand off excess insulation on the capacitors, particularly around the leads (Fig. 3-a). Before making a soldered joint, the leads must be bent together and any wire not needed for a later step cut off. This not only reduces the bulk of the joint and the amount of heat needed to solder it, but also prevents movement should another joint have to be made at the same point. A phosphoric acid flux must be used when soldering to the stainless steel battery case. If the case gets hot, the battery will be ruined. A quick touch is all that is needed.

Once a joint is made, it is almost impossible to disassemble. Because the components are so easily damaged, particularly when bending the leads, the units should be tested each time a joint is made. The rejection rate through component failure during assembly is high, and you will probably ruin your first attempt sometime near the end.

*Faculty of Dentistry, University of Sydney, Australia.

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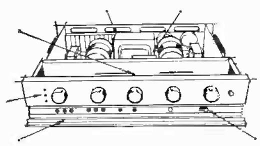

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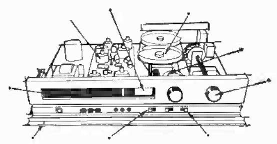

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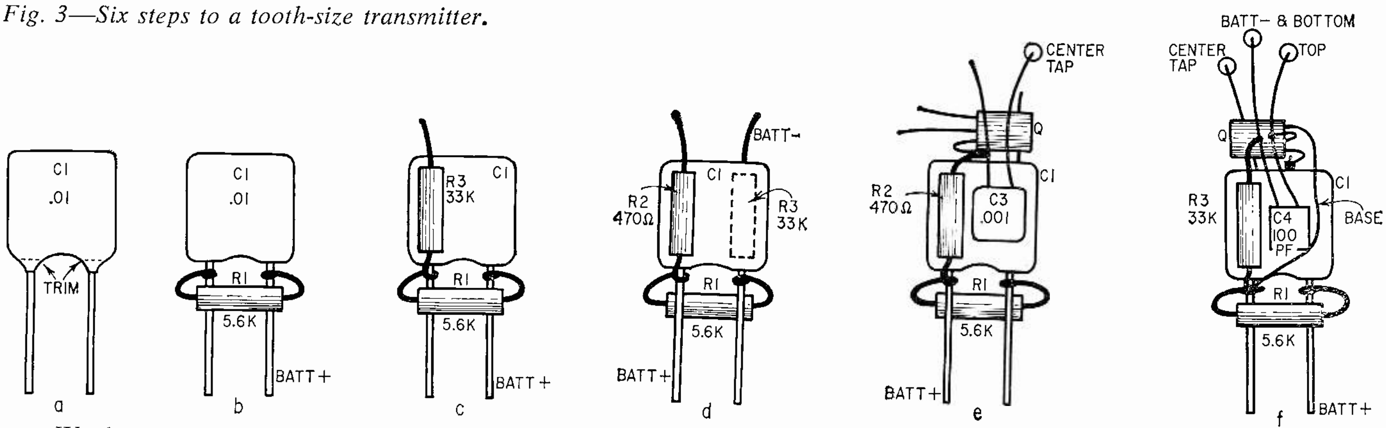
Fig. 3—Six steps to a tooth-size transmitter.



We have found that the best approach is to work from an assembly board. The components are wired together temporarily on the board, using a stock coil approximately the size of the coil, which will be wound as the last step around the finished unit. All leads are left uncut until it is decided whether they will be needed for a later step. The components are removed from the board as they are assembled, and the package is wired back on the board with the remaining components to test it after each connection is made.

We usually start with C1 and solder R1 across its two leads (Fig. 3-b). One of these leads is now the positive battery connection. The other goes to one end of R3 and the base of the transistor. R3 is now soldered in place alongside C1 (Fig. 3-c). Then R2 is soldered the same way on the other side of C1 (Fig. 3-d). Now C3 is soldered to the free end of R2 (Fig. 3-e) so it is lying flat on C1, but with the leads facing in the opposite direction. The free lead is left long, as it will connect to the center tap of coil L. The transistor (Q) is now positioned at the top end of C1 and its emitter lead soldered to the junction of R2 and C3. C4 is now positioned on the opposite side of C1, and one lead soldered to the free end of R3 (Fig. 3-f).

The lead from this joint is left long. It will be connected through the switch to the negative side of the battery and the bottom of the coil. The transistor's collector lead is now bent back and soldered to the free lead of C4. Bending the transistor wires calls for extreme care, as the unit is easily damaged, especially if the leads are rotated during bending. This lead is left long, as it will connect to the top of the coil.

The base lead of the transistor is now bent in a wide sweep across either C3 or C4, whichever is the more convenient, and soldered to the junction of C1, R1 and R3. The excess wire can now be clipped from this joint. C2, a 0.1-μf capacitor, has not been included. However, it may be essential with some batteries to prevent oscillation.

The package is now wired, except for the coil and battery connections. At the transistor end we have three leads. One goes to the bottom of the coil and the negative side of the battery and the other two to the top and center tap of the coil. The lead at the other end goes to the positive side of the battery.

RESISTORS

Three types are available, the Ohmite type being most readily available and reasonable in price.

1. Miniature metal film resistors (MMF, style b). 5,600 ohms, 33,000 ohms, (tinned copper axial leads). International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. (Very expensive, 1% tolerance.)

2. Stemag (by Arnhold Ceramics). Miniature resistors, 47 ohms, 470 ohms, 5,600 ohms, 33,000 ohms, 470,000 ohms. Laboratory Electronic Supply, 1069–1071 Massachusetts Ave., Cambridge, Mass. (Reasonable price. Imported from Europe.)

3. Allen Bradley Ohmite, type T.R. miniature resistors. 47 ohms, 470 ohms, 5,600 ohms, 33,000 ohms, 470,000 ohms. Allied Radio, 100 N. Western Ave., Chicago 80, Ill. (Used in hearing aids.)

CAPACITORS

1. Ultraminiature ceramic capacitors. 100 pf, 500 pf, .001 μf, .01 μf. Glenco Corp., 212 Durham Ave., Metuchen, N. J.

2. Sprague Tantalux Hearing Aid Capacitors. Axial Lead, 0.1 μf, Sprague Electric Co., North Adams, Mass.

TRANSISTORS

Raytheon, type CK16-A or CK17-A. Allied Radio.

BATTERY

Hearing-aid mercury cell, type RM-312. Mallory Battery Co., 13000 Athens Ave., Cleveland 7, Ohio.

COIL

Hand-wound using Formvar-coated copper wire of fine gauge, according to frequency desired.

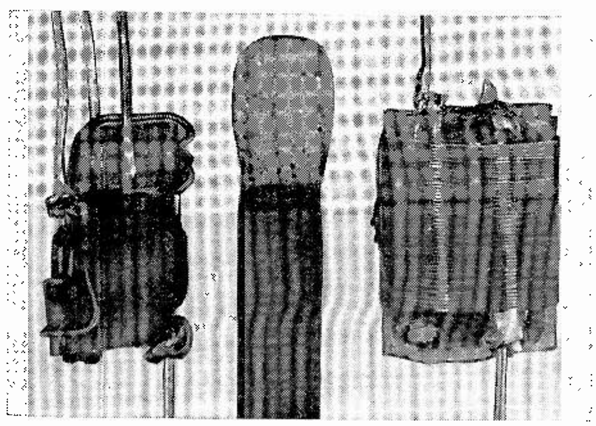
The inductor

A thin celluloid form is wrapped around the package, and the coil wound on it with Formvar-coated fine copper wire. Placing the electronic package inside the coil may affect its performance. It is helpful to have half a dozen or so coils already wound for test purposes. The coil may be layer- or scramble-wound, according to the purpose for which the unit will be used. Coil connections should be left long for testing, and be clipped short and soldered to the appropriate lead as the final step in assembly. All leads except the battery connections are next trimmed off. The coil is coated with dope and the package potted.

The battery and switch are connected last. We use a very simple switch, the poles of which consist of two gold bars insulated from each other. The switch is held in a plastic tooth filling or plastic tooth, depending on the space available, and wired into the negative lead. To operate the switch, a small gold pin is cemented in an opposing tooth, so when the jaws are in contact in the particular position we are investigating it shorts the two gold bars, completing the circuit.

Since battery life is not important in our application, we pot the battery in the package. For other purposes it might be wise to make the battery readily accessible.

The signal is received as a hissing noise. We use a marine-band portable radio 3 to 6 feet away. A more elaborate receiver could detect the signal 15 or more feet away. The signal is fairly directional and the strength of the received signal may vary as the head is turned. The packaged unit is susceptible to capacitance effects, caused by the movements of the lips and tongue. They can be minimized by placing the coil so its open ends point to cheek and tongue.



The transmitter compared to an ordinary paper match. At the right is the complete transmitter. At the left is the transmitter minus its coil.

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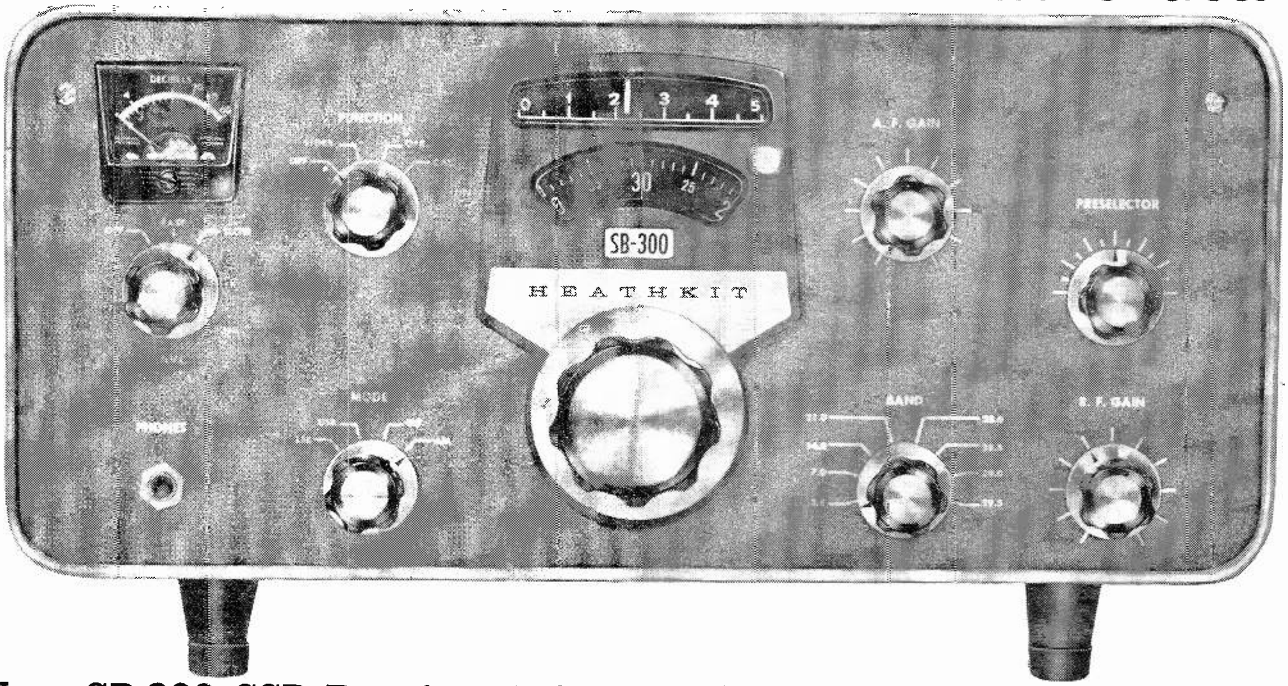

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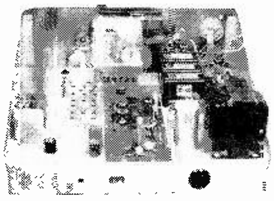

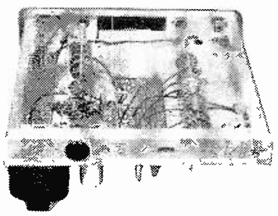

SPECIFICATIONS—Frequency range (megacycles): 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megacycles. **Frequency stability:** 100 cps after warmup. **Visual dial accuracy:** Within 200 cps on all bands. **Electrical dial accuracy:** Within 400 cps on all bands. **Backlash:** No more than 50 cps. **Sensitivity:** Less than 1 microvolt for 15 db signal plus noise-to-noise ratio for SSB operation. **Modes of operation:** Switch selected: LSB, USB, CW, AM. **Selectivity: SSB:** 2.1 kc at 6 db down, 5.0 kc at 60 db down (crystal filter supplied). **AM:** 3.75 kc at 6 db down, 10 kc at 60 db down (crystal filter available as accessory). **CW:** 400 cps at 6 db down, 2.5 kc at 60 db down (crystal filter available as accessory). **Spurious response:** Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response: SSB:** 350 to 2450 cps nominal at 6 db. **AM:** 200 to 3500 cps nominal at 6 db. **CW:** 800 to 1200 cps nominal at 6 db. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kc crystal. **Front panel controls:** Main tuning dial: function switch; mode switch; AGC switch; band switch; AF gain control; RF gain control; preselector; phone jack. **Rear apron connections:** Accessory power plug; HF antenna; VHF #1 antenna; VHF #2 antenna; mute; spare; anti-trip; 500 ohm; 8 ohm speaker; line cord socket; heterodyne oscillator output; LMO output; BFO output; VHF converter switch. **Tube complement:** (1) 6BZ6 RF amplifier; (1) 6AU6 Heterodyne mixer; (1) 6AB4 Heterodyne oscillator; (1) 6AU6 LM osc.; (1) 6AU6 LMO mixer; (2) 6BA6 IF amplifier; (1) 6AU6 Crystal calibrator; (1) 6HF8 1st audio, audio output, (1) 6AS11 Product detector. BFO, amplifier. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120 volts AC, 50/60 cps 50 watts. **Dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

• Professional styling & features at 60% savings! • Complete coverage of 80 through 10 meter amateur bands with all crystals furnished, plus provision for VHF converters • Prebuilt, calibrated linear master oscillator (LMO) • 25 KC per tuning knob revolution offers bandspread equal to 10 feet per megacycle • Built-in crystal calibrator • 2.1 KC crystal bandpass filter • Stability of 100 cps after initial warmup • Wiring harness & two heavy-duty circuit boards for easy assembly

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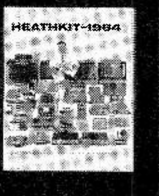

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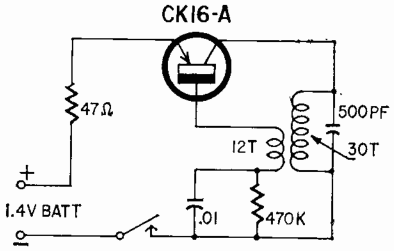


Fig. 4—Improved transmitter uses a blocking oscillator.

An improved circuit

The hiss produced when a contact is made is sometimes hard to distinguish from noise, particularly when the band is noisy, such as late at night. (On occasion we have found ourselves on the same band as WWV and the captains of Mississippi river boats.) To circumvent this problem we used the modified circuit in Fig. 4.

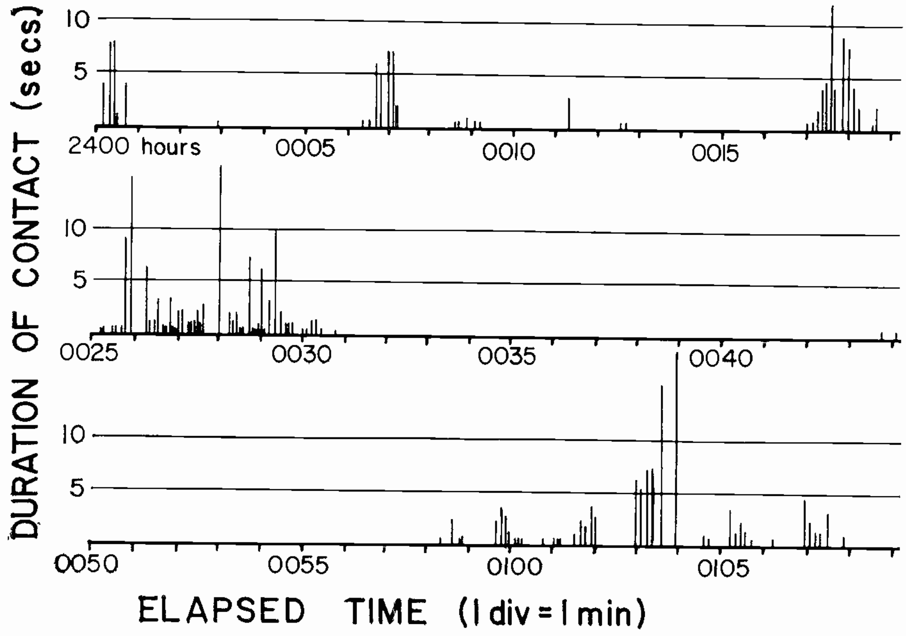
Self-blocking was introduced at an audio frequency so the signal could be more easily recognized. This approach produces a bonus in the form of a very broad band of transmission, in contrast to the narrow band of the continuous-wave oscillator circuit. Loss of reception because of signal drift is eliminated, although the audio frequency does vary a little with the temperature, the note rising when it increases. This circuit is much better for our purpose, since it not only solves the problem of drift caused by temperature variation or capacitance, but also makes the signal unmistakable. If anything, it is easier to construct and, happily, requires fewer components. The signal produced makes it simple to send Morse code by clenching the teeth—quite simple, but baffling to any unsuspecting radio receiver operator who happens to be nearby.

There are disadvantages in the design of this self-blocking oscillator too. The coil is extremely susceptible to loading—a serious problem, since the components are placed inside it. The range of transmission is also reduced considerably, sometimes to as little as 2 feet or so. If the unit will not self-block, the coil should be layer-wound and on a larger diameter (higher Q).

If range is not a consideration, the circuit should be most versatile, since the audio frequency can be altered within wide limits by varying the values of the resistors and capacitors in the circuit.

Applications

For the purpose for which it was designed, the tooth-sized radio transmitter has proved extremely useful. In one series of experiments, nightly recordings of occlusal contact patterns were recorded on tape. By playing the record back, it was possible to make a chart (at right above) showing the duration of tooth contacts at various times.



Contact patterns showing record of occlusion over period of hours.

Additional information on the subject's coughing and swallowing habits was recorded simultaneously by using a throat microphone and a 2-channel tape recorder. In this way it was possible, to find out whether the tooth contacts were associated with periods of swallowing activity, wakefulness, coughing or snoring. Units have also been used to follow the behavior of the teeth and jaws while chewing various foods.

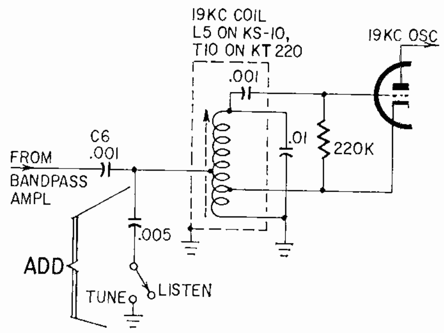
Other uses for such small units might be found. It is possible to measure large temperature variations with the units now, and they could be made even more efficient and sensitive by using thermistors. A low-impedance hearing-aid microphone inserted between the negative battery lead and the bottom of the coil turns the unit into an efficient speech transmitter. A simple copper-zinc couple immersed in a dilute acid, or even saliva, provides enough power to operate the unit, which would solve battery problems in some applications. A little inspired fiddling with the basic circuit should make possible broadcasting speech, temperature, pressure, pH and conductivity. It's simply a matter of employing suitable transducers.

Available materials

It is unlikely that any research worker or experimenter would want to make a Chinese copy of this transmitter, so no parts list in the ordinary sense is given. But the materials, though available, are sometimes hard to locate, therefore the list under Fig. 3 may be helpful. END

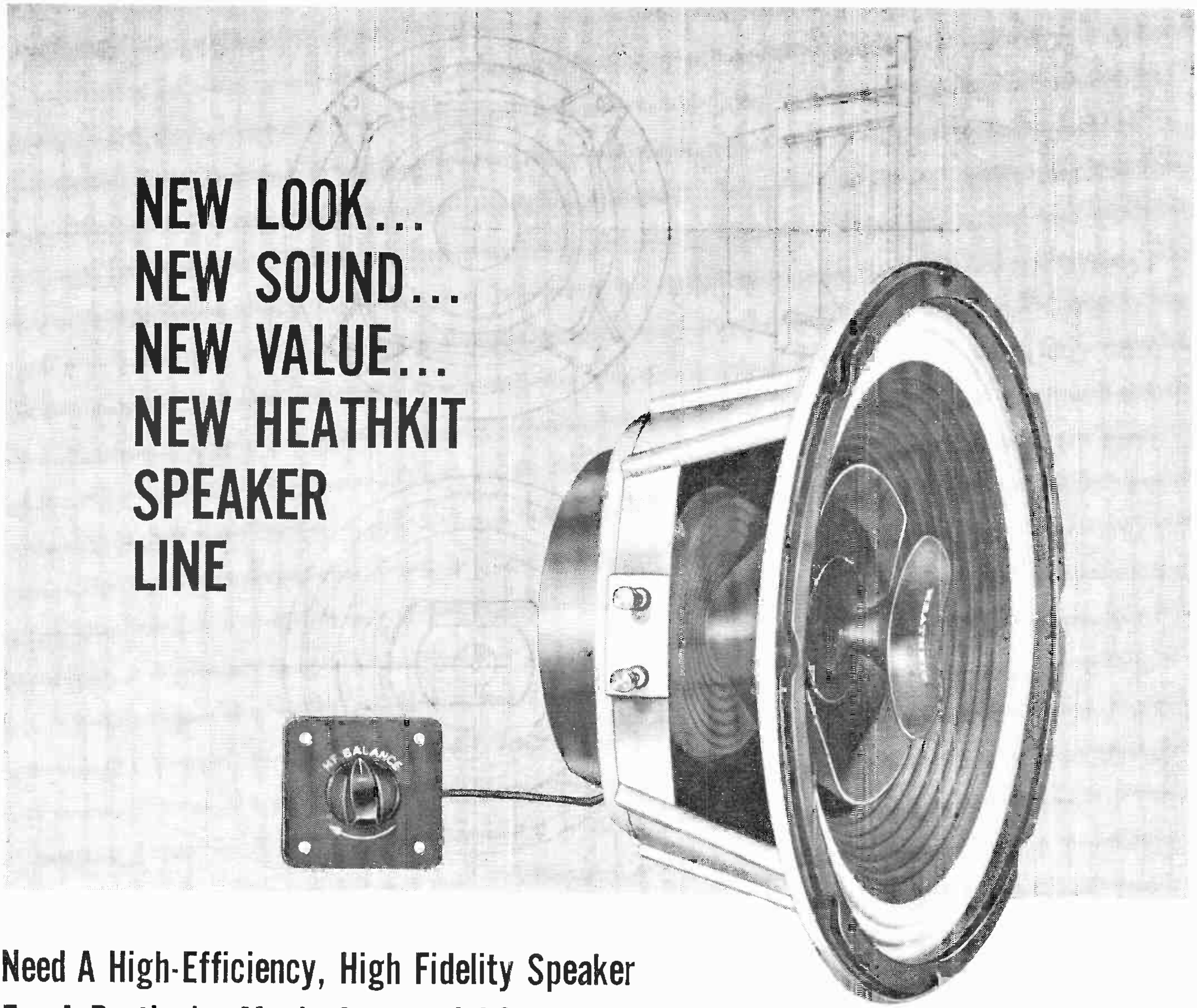
Stereo Alarm for MPX Adapters

An audible indication of stereo multiplex transmissions can be obtained by simple modifications to the Knight KS-10, Lafayette KT-220 and similar multiplex adapters. This can be done by switching a capacitor across a portion of the 19-kc oscillator coil so the oscillator loses sync by an audible frequency difference.



A .005-μf capacitor connected from ground to the junction of C6 and the tap on the coil (see diagram) will produce a distinct note of about 1,000 cycles when a stereo transmission is tuned in. You may have to readjust the tuning slug to compensate for stray capacitance when the capacitor is switched out for listening.

The gain at 50 cycles can be increased about 4 db by disconnecting the 100,000-ohm resistors between the left and right output jacks and ground when they are not needed as grid returns or input loads for the following amplifiers. These resistors are R24 and R25 in the KS-10 and R23 and R25 in the KT-220. *—Ben Johnson*



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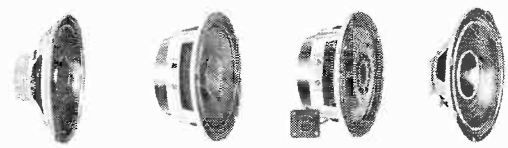

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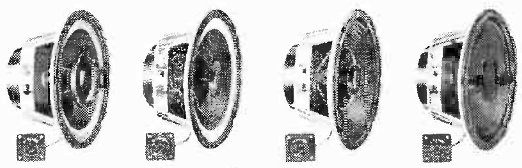

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tough fight, Ma, but I WON!

By **FRANK A. SALERNO**
(Illustrated by the author)

IT ALL STARTED A MONTH AND A HALF ago with a call on an RCA KCS-40A with no video and no sound—just a white raster. I turned the set on and saw picture and sound both come on and within seconds slowly fade away. Without turning the set off, I started changing tubes one at a time, working from the video output stage right up forward. Nothing seemed to happen until I pulled out the 6J6 oscillator and stuck in a new one. The picture and sound pushed through. Satisfied, I picked up my bag and left.

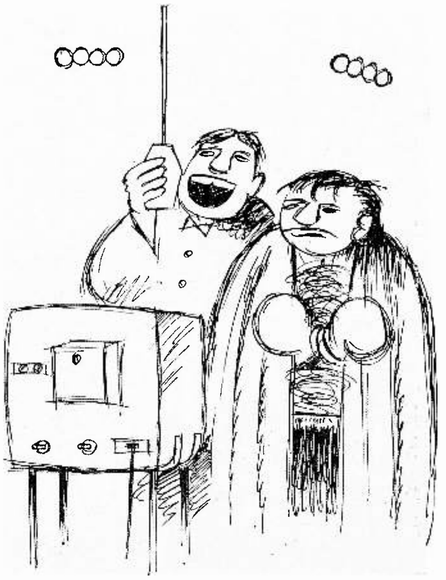
Two weeks later I was back for the same complaint. I followed the same technique—changed the 12AU7 output tube first and worked my way up front. Again, the moment I changed the 6J6, the picture and sound boomed in. When the 6J6 just removed was reinstalled, the set worked perfectly.

I was sure we had local oscillator trouble so I took the set to the shop. An off-value resistor, perhaps, in the 6J6 plate load, I thought. So the first thing I did on the bench was make resistance measurements. All OK. I set the chassis up to operate and then began my long vigil. For one whole week I waited for that set to fade. I operated it hot, I operated it cold. I raised the line voltage, I lowered it. Nothing I could do induced the receiver to act up the way it did in the customer's home. Picture and sound stayed perfect.

I delivered the set and crossed my fingers. I might have saved myself the trouble because I was back again 2 days later. Same complaint. This time I merely touched the 6J6 to make picture and sound come through.

Discouraged but not yet defeated, I took the chassis back again. This time I loaned the customer a portable set that had been sitting around the shop, unclaimed, for the past twelve months. This way I planned to allow myself more time.

Sure enough, when I set up the chassis on the bench I found myself right back where I'd started. The set



worked perfectly for days. I thought of replacing the entire tuner, but found these tuners were no longer available. So I was stuck with the repair whether I liked it or not.

Checking this receiver became my main preoccupation for the next 2 weeks. Every time I walked into the shop I'd turn the set on and wait for something to happen. But nothing ever did. I rapped it and tapped it and cooked it and covered it—everything short of kicking it—but she played on and on. I ran it horizontally, ran it vertically. No use, I was licked.

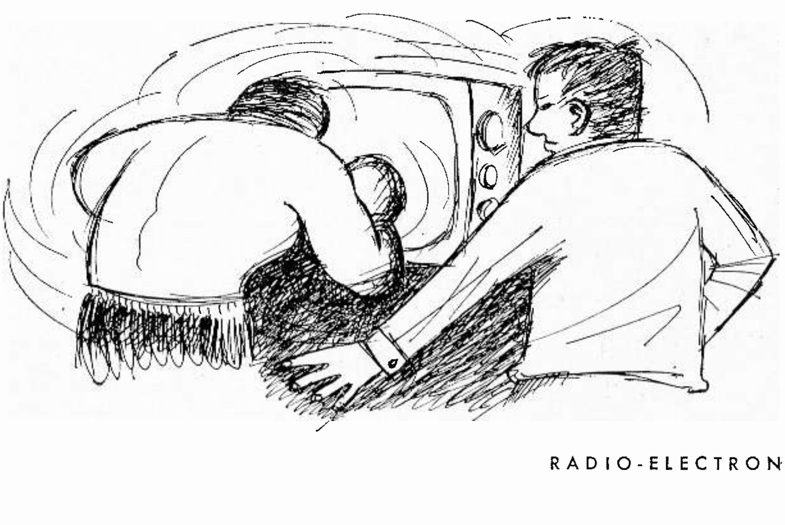
It was on a rainy Thursday morning while I was searching my memory trying to remember what incidents in my life had directed me into television servicing when fate dealt me its cruelest blow. In came the portable-set owner asking me to deliver her set on Saturday.

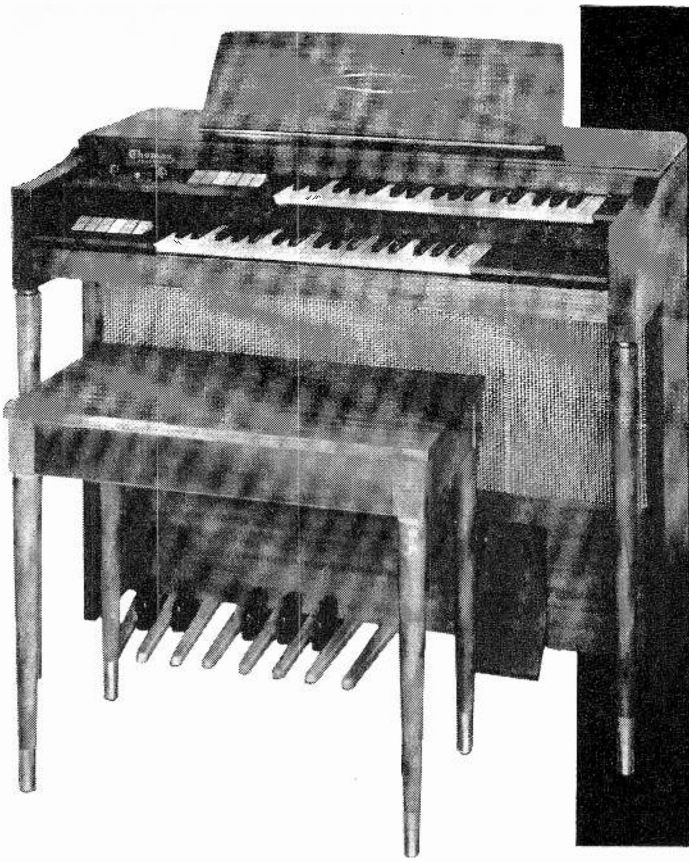
I had reached my end and on Friday morning I decided to quit. I gave the receiver a couple more tries and called the customer on the phone to make an appointment to deliver it. Just before I dismantled the bench setup, I turned the switch on for one last try and, by the beard of Allah, the picture and sound quietly faded away!

I had already had the 6J6 plugged into a test socket so I immediately took voltage measurements. Much to my surprise the grid read 6 volts negative, indicating that the tube was oscillating. For the first time I began to suspect other trouble.

As I prepared for my next tests, the thing I dreaded most happened. Into the shop walked a little old lady with a radio tucked under her arm.

"Would you kindly check this for me? I wouldn't care to leave it, it's the only one I have. In these times one gets so to depend on a radio to get the latest





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Name ____________________
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City ____________ Zone ______ State ______ news what with so much happening all over the world and so much trouble here and there and . . . My, how *fast* you work."

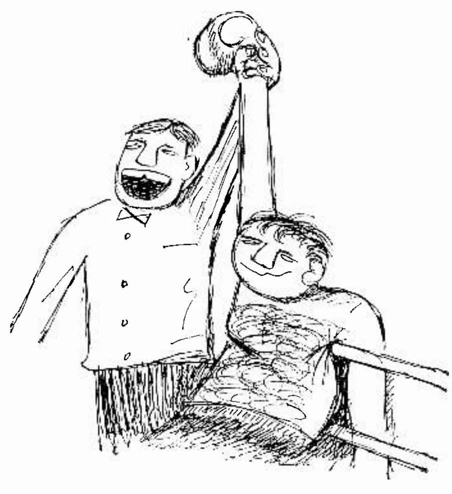
Fast, indeed, but not fast enough, for as I stood there nervously fumbling with the radio the sound on the TV receiver behind me blasted through. "Of all the luck," I mumbled.

However, there was still a spark of hope. For the first time since I got entangled with the set, it suddenly became predictable. If I allowed the set to cool off a while and then turned it on again, the picture would fade away and let me have another go at it. But I had to work fast. If I hesitated too long, everything would bounce back.

Carefully, I edged on. Plate voltages OK. Screen voltages OK. Agc voltage—aha! Too high. About 50 negative. Back to the agc amplifier. Plate voltage too high. Grid voltage too low.

Each little disturbance would snap the picture back in place and each time it did I was afraid that I'd had it. But my luck was still holding out. Every time I let the set cool off a while and then turned it on again, it gave me another chance.

Finally, after 30 minutes of touch-and-go troubleshooting I came to a conclusion. I thought I had a bad 6SN7 agc rectifier tube, but I was afraid to even go near it for fear that one reckless mistake might snap the set back to normal and leave me in doubt for the rest of my electronic life. But I had no choice. All checks assured me that this tube was the troublemaker, so I got ready for the do-or-die finale. I turned the set on, waited for it to fade, and then, like the diamond cutter who raises his cleaver after weeks of fastidious planning, I raised my screwdriver and delivered the master stroke. I hit the tube, the picture shot in, the sound blasted through and I fainted. That was it! END

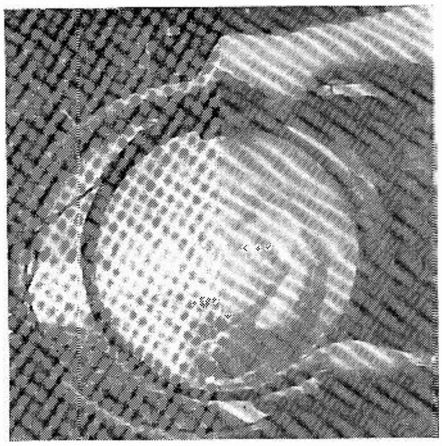


WHAT'S YOUR EQ?

These are the answers.
Puzzles are on pages 55 and 56.

An Unusual Twist

A second photo taken by the photographer answers both questions. The technician was using a degaussing coil to demagnetize the monochrome metal picture tube. The unusual twist was due

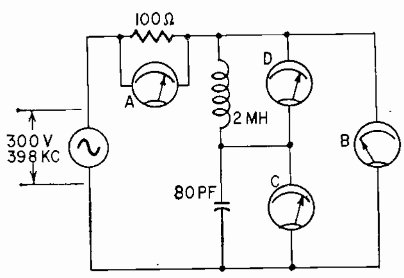


to the flux of the degaussing coil affecting the beam deflection. It might be said that the unusual twist was due to a crazy-mixed-up deflection beam.

L-C-R Circuit

The voltage across a single reactive element in a series circuit carrying ac can have a greater effective value than that of the applied voltage. Since the current in each part of the circuit is 3 amps, the voltage drop across the inductance, and hence the reading of voltmeter D, can be calculated:
$E = IX_L = 3 \times 5{,}000 = 15{,}000$ volts.

The voltage drop across the capacitance, and hence the reading of voltmeter C is:
$E = IX_C = 3 \times 5{,}000 = 15{,}000$ volts.



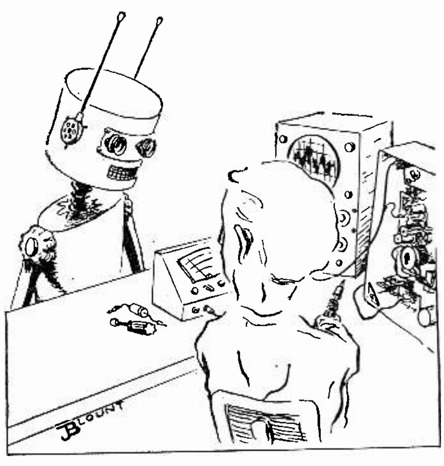
The inductive and capacitance voltage drops are equal in magnitude and 180° out of phase; so their vector sum is zero. This is shown by voltmeter B, which reads zero volts. The voltage drop across the resistor, and hence the reading of voltmeter A, is $E = IR = 3 \times 100 = 300$ volts.

Bewildering Blinker

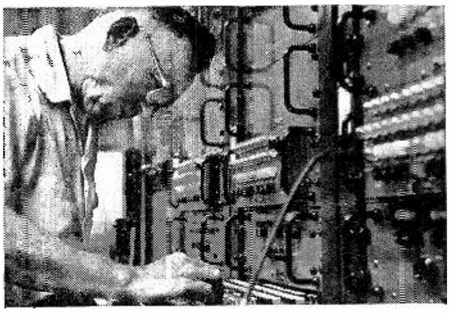
This is what I think is happening. If you have a better solution, let's hear it! This circuit is merely a simple series-resonant device with the L and C combination resonant at about 50 cycles when zero current is flowing. When current flows through the circuit, the inductor's inductance decreases with increasing current due to saturation of its iron core.

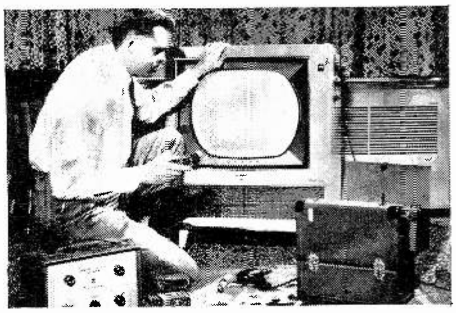
Hence, at a critical current, determined by the Variac, the circuit moves its resonant point toward 60 cycles and the lamp grows brighter. But as the lamp becomes brighter its resistance increases, the L-C series circuit goes out of resonance, and the light dims. Upon dimming, the lamp's resistance decreases and starts the cycle again.

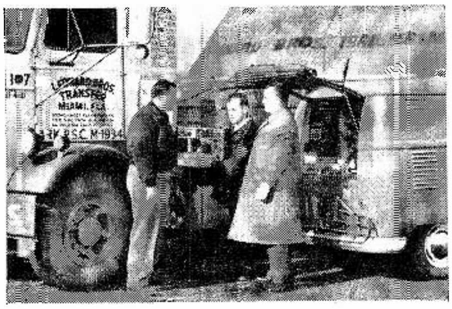
Without stretching one's imagination, it is plain to see that we have a negative-resistance oscillator constructed out of seemingly passive elements.

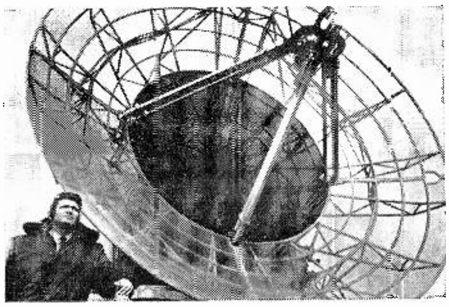


"Tom, I'm a little short. Could you loan me a fast-charge till pay day?"









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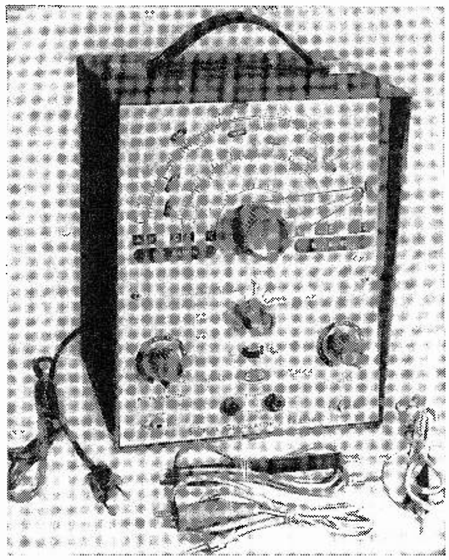

The Olson KB-141 audio and rf signal generator and signal tracer comes with probes and cables.

SMALL ENOUGH FOR THE KITCHEN-TABLE experimenter or for a service call, this combination instrument can provide frequencies between 250 kc and 120 mc (modulated or unmodulated) for alignment and signal injection. The audio modulating frequency can also be used for signal injection.

The accuracy of the Olson KB-141 depends mostly on the kit builder's ability to calibrate the instrument against a reliable signal. This is simplified for the frequencies between 250 kc and 1,600 kc. Any table radio can be used by tuning it to a station whose frequency is known. Lower frequencies can be calibrated by using their harmonics.

The zero-beat can give accuracies of better than .01% in a similar manner. The highest frequency band can be adjusted by squeezing or stretching the coil. You need calibrate only one frequency on each band. The signal tracer and audio generator need no calibration.

The audio generator is used to modulate the rf generator (see Fig. 1). There is no separate audio output jack, but the audio signal can be easily obtained. Just connect the rf/i.f. demodulator probe to the rf output jack and switch to MOD. This gives an audio signal output even though the demodulator circuit is connected backward as far as normal signal flow is concerned.

When the demodulator probe is connected to the input of the audio preamp, it can be used to trace an rf or i.f. signal provided by the generator portion of the instrument.

Switch the probes from their respective jacks and the demodulator

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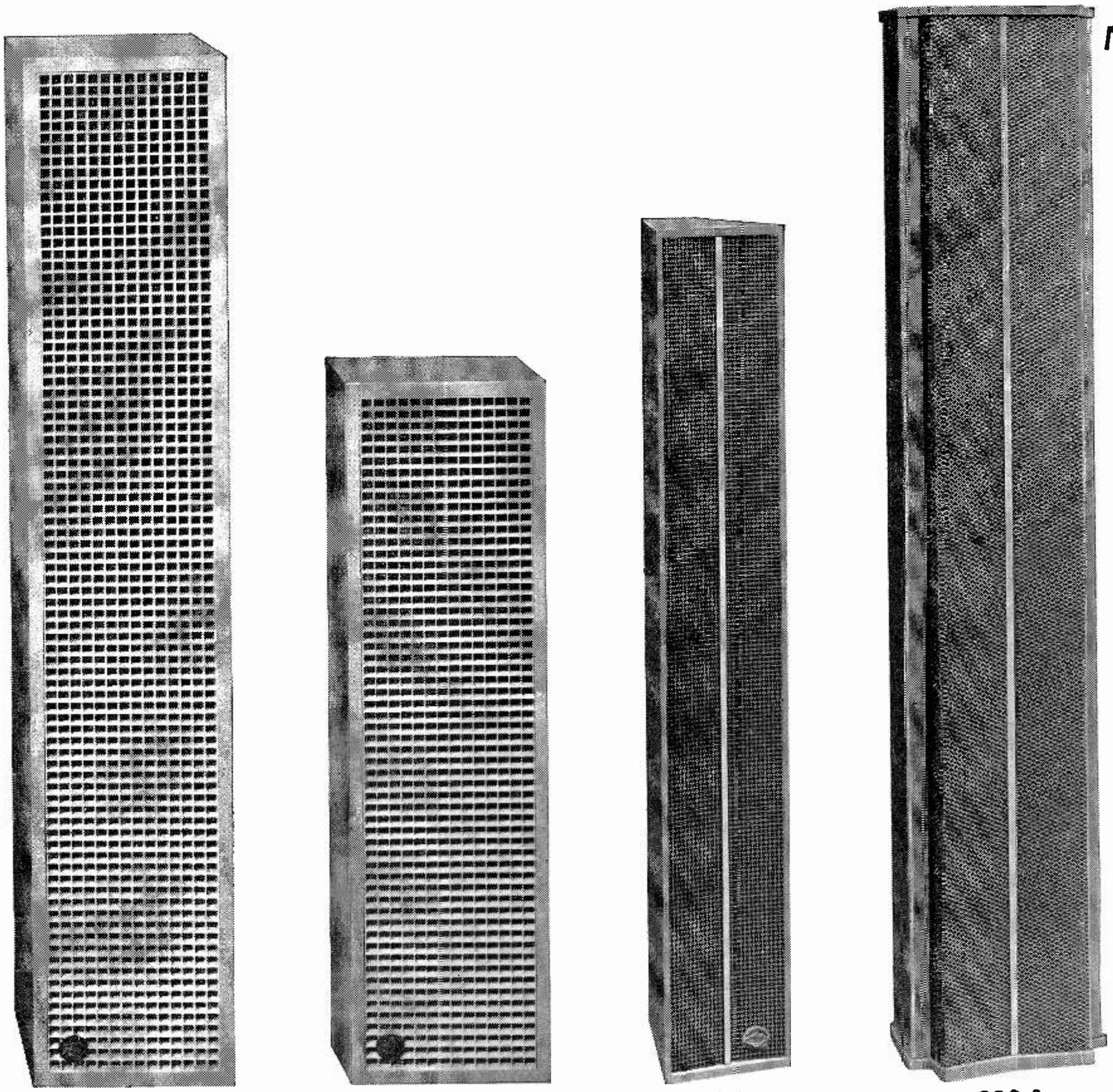

UCS-6 CS-4 CS-3 CSO-6

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	UCS-6 Full Range Music and Speech	CS-4 Full Range Music and Speech	CS-3 Music and Speech	CSO-6 Full Range Music and Speech
speakers	6 extended range 8"	4 extended range 8"	8 special multi-design	6 extended range 8"
frequency range	55—17,000 cps	70—17,000 cps	150—10,000 cps	55—17,000 cps
power capacity	150 watts IPM*	80 watts IPM*	25 watts IPM*	150 watts IPM*
impedance	16 ohms	8 ohms	16 ohms	16 ohms
vertical angle	16°	22°	22°	30°
horizontal angle	120°	120°	120°	120°
dimensions	59¼" x 10⅞" x 9 1/16"	40⅜" x 11" x 9 1/16"	48" x 7½" x 8¾"	60¼" x 11⅞" x 7¾"
shipping wt., lbs.	61	46	33	61

*Integrated program material.

UNIVERSITY LOUDSPEAKERS *Division of Ling-Temco-Vought*, Oklahoma City, Oklahoma

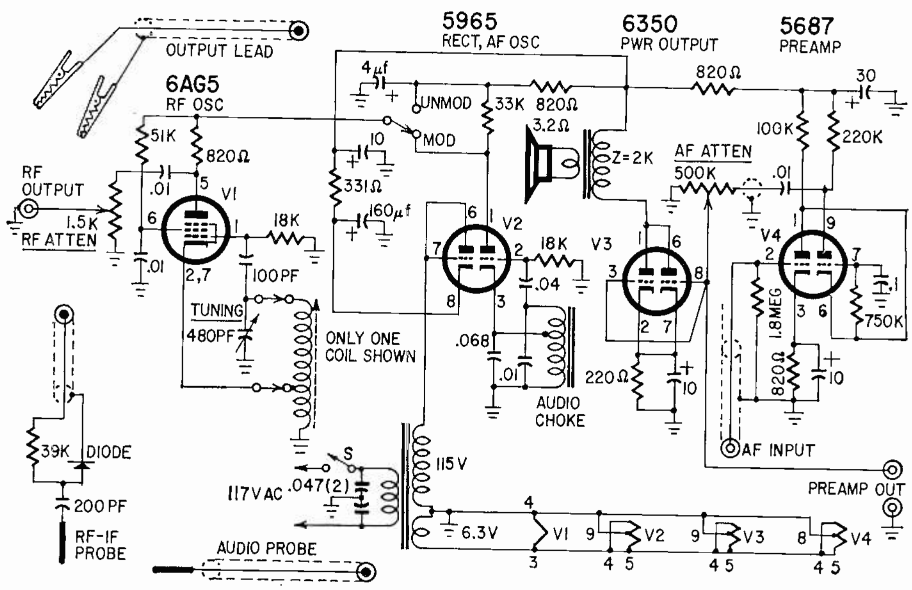


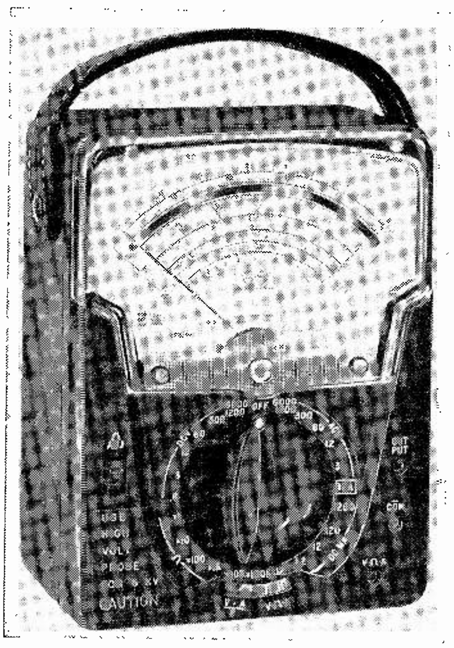
Fig. 1—Circuit of Olson's KB-141. It uses several premium tubes, one as cascode preamp.

probe will now provide an audio signal for injection into an amplifier, and the "direct" probe can be used to signal-trace. You will hear the audio signal from the speaker mounted in the top of the case.

Another jack allows the cascode preamplifier of the audio stage to be used as a separate preamplifier—to feed scopes, vtvm's or other devices that need increased signal level.—*Elmer C. Carlson*

200,000 Ohms/Volt Multitester

(Triplett 630-NS)



Triplett's 630-NS 200,000 ohms-per-volt multimeter has taut-band movement.

FOR YEARS, TOP HONORS FOR THE MOST useful radio and industrial servicing instrument have been shared by the 11-megohm vtvm and the 20,000-ohms-per-volt multimeter. Now, both are being challenged to a winner-take-all battle for superiority by the new Triplett 630-NS multimeter, one of the latest additions to the famous line of Series 630 testers.

The 630-NS is a dual-sensitivity instrument measuring up to 3,000 volts dc at 200,000 ohms per volt and up to 6,000 volts at 100,000 ohms per volt. Ac voltages in the same ranges are measured at 20,000 and 10,000 ohms per volt, respectively. The basic full-scale dc voltage ranges are 0.6, 3, 12, 60, 300 and 1,200.

The instrument operates much the same as other vom's. Besides the usual controls, there is a two-position slide switch. One position is marked V-Ω-A and the other V-A/2. In the V-Ω-A position, the full-scale voltage or current is that indicated by the range selector and voltages are measured 100,000 ohms per volt. Throwing the slide switch to V-A/2 cuts the full-scale voltage or current range in *half* and increases the voltage sensitivity to 200,000 ohms per volt.

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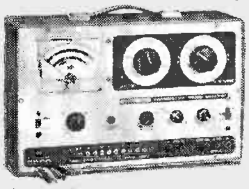
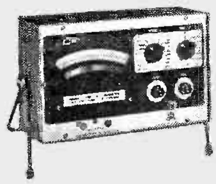
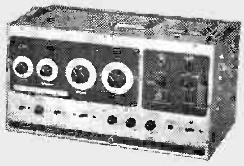


Model 960 Transistor Radio Analyst

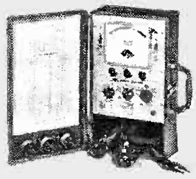
Model 360 V O Matic Automatic VOM



Model 375 Dynamatic Automatic VTVM



Model 1076 Television Analyst



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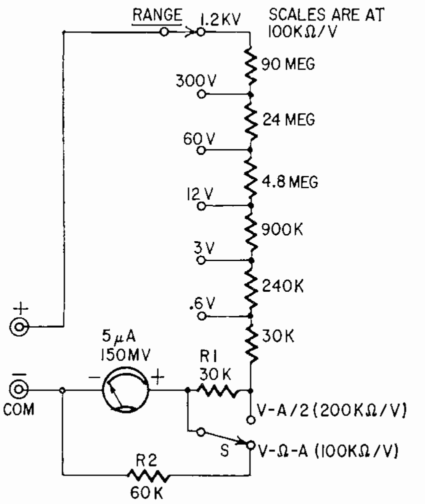


Fig. 2—Partial schematic of multiplier string in Triplett 630-NS. Switch S doubles sensitivity, halves range.

setting the slide switch, all current and voltage readings can be made on the upper half of the scale, where accuracy is greatest.

How sensitivity selector works

Let's see how the dual-sensitivity circuit works. Fig. 2 shows how the basic voltage measuring circuit works. The ranges shown on the range switch are full-scale values measured at 100,000 ohms per volt with the slide switch, S, in the V-Ω-A position. In this case, R2 shunts the meter movement to reduce the basic sensitivity to 100,000 ohms per volt and R1 is a part of the multiplier string. Sliding the switch to the V-A/2 position increases sensitivity to 200,000 ohms per volt and reduces the lowest range to 0.3 full scale and the highest to 600 volts, by removing shunt R2 and shorting out R1. The 30,000 ohms resistance of the meter replaces R1 in the multiplier string.

The principal advantage of the 630-NS is its unusually low loading on high-impedance circuits. Let's take a look at the simple 22-megohm voltage divider in Fig. 3, such as you might find in keyed-agc circuits, and see how a meter's input resistance affects accuracy as we measure the voltage across R2.

First we will use an ordinary 20,000-ohms-per-volt meter on its 250-volt range. The meter's 5-megohm input resistance shunts R2 and reduces R2's effective resistance to 3.437 megohms. Current through the string increases and the voltage across R2 and the meter drops to 35.4—less than half its actual value. With an 11-megohm vtvm, the effective value of R2 is reduced to 5.5 megohms and the voltage drops to 49.5—still a considerable error.

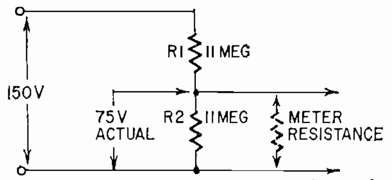


Fig. 3—High-resistance divider shows weakness of 20,000-ohm/volt meters and 11-megohm vtvms. Triplett 630-NS loads it far less, reads nearer "true" voltage.

Now, let's see what we can do with the dual-sensitivity 630-NS. Normally, we would set the range switch to 300 and the sensitivity selector to V-A/2 for 150 volts full scale at 200,000 ohms per volt. The meter's input resistance is 20 megohms, and the voltage across R2 rises to 62.4. On the 600-volt range (1,200 divided by 2) the input resistance is 120 megohms and the voltage rises to 71.5. This is laboratorylike precision, considering the accuracy of the other instruments cited in this example.

Other advantages of the 630-NS with its 5-μa, 150-mv movement can be seen by comparing its lower voltage and current ranges with the basic Triplett 630—one of the long-time standards in 20,000-ohms-per-volt instruments. For example, the first three voltage ranges on the 630 are 3, 12 and 60. On the new 630-NS, they are 0.6, 3 and 12 or 0.3, 1.5 and 6, depending on the sensitivity required or the magnitude of the voltage being measured.

Suppose that we want to measure the voltage between base and emitter in the circuit in Fig. 4. With the 630 or similar 20,000-ohms-per-volt instrument, our best bet would be to measure the voltages on the individual elements and hope that our old eyes are sharp enough to differentiate between 0.6 and 0.7 volts —two divisions well down on the scale.

With the 630-NS, we set it to 0.3 volt full scale and measure the voltage *between* base and emitter in one operation. Accuracy and readability are much greater because 0.1 volt now covers a third of the scale.

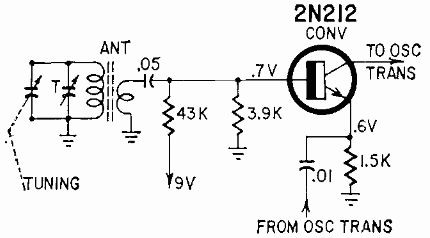


Fig. 4 — Base-emitter bias of 0.1 volt is almost unreadable on conventional bench instruments; 0.6 and 0.7 volt, indistinguishable. On 630-NS's 0.3-volt range, there's no problem.

New movement

A not-so-obvious advantage is the ruggedness of the new meter movement. The old hairsprings, pivots and jeweled bearings have been eliminated. Bearings and pivots in portable instruments take quite a beating. Friction increases with age and accuracy is impaired.

In the new "suspension-band" meter the moving coil is suspended by a pair of platinum wires finer than a human hair. They support the coil assembly, carry current to it and provide the torque to return the needle to zero. They work a bit like automobile torsion bars.

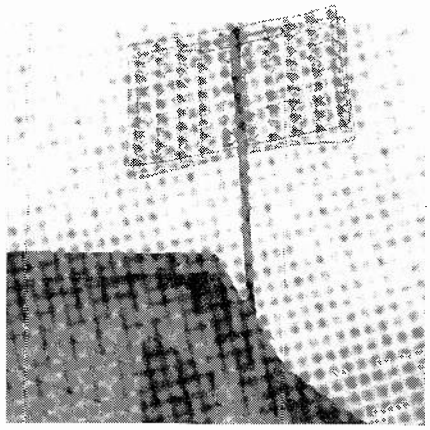
I cooked up all sorts of tests to compare the 630-NS with the vtvm and 20,000-ohms-per-volt meter so I could go on and on raving about the 630-NS and the new breed of multimeter that is sure to follow. It provides greater accuracy through lower circuit loading and a wider choice of ranges. Its mirror scale eliminates errors caused by parallax. I feel that the added versatility of the 630-NS is well worth the price differential—around $40—between it and a comparable 20,000-ohms-per-volt instrument. It won't replace the vtvm on the bench, but it comes pretty close to it. —*Robert F. Scott*

SPECIFICATIONS

Dc volts—0—0.3—0.6—3—12—60—300—1200 at 100,000 ohms/volt
0—0.15—0.3—1.5—6—30—150—600 at 200,000 ohms/volt
Ac volts—0—3—12—60—300—1200 at 10,000 ohms/volt
0—1.5—6—30—150—600 at 20,000 ohms/volt
Db— —20 to +77 in 10 ranges
Dc microamperes—0—5 at 300 mv; 0—60—600 at 150 mv; 0—120 at 300 mv.
Dc milliamperes—0—6—60—600 at 150 mv; 0—1.2—12—120—1200 at 300 mv.
Dc amperes—0—6 at 150 mv; 0—12 at 300 mv.
Ohms—0—1K—10K—100K (4.4—44—440 at center scale)
Megohms—0—1—10—100 (4400—44,000—440,000 ohms center scale)
Output—Capacitor in series with ac volt ranges

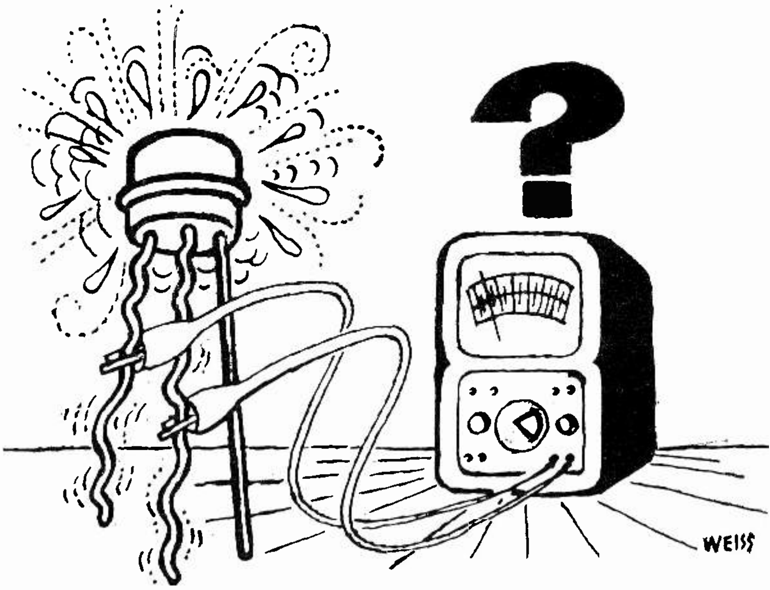
ANTENNA FOR THE LATE-LATE SHOW?

SOME RESIDENTS OF AUSTIN, TEX., SEEM to be going to desperate extremes in trying to get good TV from San Antonio, about 70 miles away. Warren Smith, a television repairman in Austin, sent us this photo of one man's approach. The antenna—possibly patterned after sleep-like-a-log-periodic principles—is exactly what it looks like: a bedspring. A local technician states that investigations indicated that reception wasn't too good. Maybe a reflecting sheet would help?



The multihelical array looks more like a search radar antenna than an ordinary gatherer of TV signals.

TRANSISTORS AND YOUR OHMMETER



A transistor can expire quietly while you're checking to see if it's good. But with a little care, you **can** use your ohmmeter.

By GENE MADISON

YOU'VE HEARD THESE VAGUE WARNINGS of dire consequences if you check transistors with an ohmmeter. Since the vom is probably the most often used test instrument, it would be nice to know if we *can* use it safely for transistor checking.

The table will show you what astonishing amounts of current flow through a resistance being measured with a conventional vom. Voltages, too, can be high. Further, the red test lead is *not* always connected to the positive side of the internal battery. The table shows only three popular meters. If you have a different one, make up a chart like this for it. You may be surprised.

Generally, an ohmmeter range that produces not more than 1.5 volts open circuit and 1 ma short circuit is safe for any transistor made, no matter how you connect it to the meter. The asterisks in the table next to certain ranges show which are safe to use under almost any circumstances.

What can you find out?

Let's see what we can learn about a transistor with an ohmmeter's "safe" range. All the following checks should be made with at least two of the three transistor leads disconnected from the circuit, and power off. Which leads you disconnect doesn't matter. The polarities are given here for p-n-p transistors; for n-p-n just reverse the test leads. (Remember to find out what the polarity of your meter is.)

Small-signal germanium: Positive lead on emitter, negative on base. About 300 to 400 ohms. Move negative lead to collector. About 10,000 to 50,000 ohms. If either reading is near zero or near infinite, transistor is bad.

Germanium power: Emitter-to-base resistance can be as low as 30 to 50 ohms; emitter-to-collector, a few hundred ohms. These types can handle ohmmeter-type currents without damage, so short momentarily between base and collector to see if that causes a sharp drop in resistance between emitter and collector. It should.

Silicon: Emitter-to-base resistance will be between 1,000 and 2,000 ohms. Emitter-to-collector resistance may be so high that it has to be measured on next higher "safe" range.

These are simple "go–no-go" checks. But an ohmmeter can also distinguish p-n-p and n-p-n transistors and identify their leads. Here's how.

Using a "safe" range, try various connections until you find a lead that measures about the same resistance to each of the other two. This is the base. If the resistance is about 400 ohms, you have a germanium transistor; if it's about 1,500, you have silicon. If you connected the positive ohmmeter lead to the base to find this information, the transistor is an n-p-n; if negative, it's a p-n-p. Now connect the ohmmeter to the remaining two leads and note the resistance. Reverse the leads and read again. Whichever connection gives you the lower reading is the one you want now.

If you found that the transistor was a p-n-p, the positive meter lead is on the emitter and the negative one on the collector. For an n-p-n, just the reverse is true.

Another test

Though an ohmmeter will not replace a good transistor tester, it can help you determine the *relative* dc beta of several transistors of the same type. For n-p-n transistors, hook the positive meter lead to the emitter, the negative to the collector, and leave the base lead completely free. The lower the resistance, the higher the dc beta. You can match transistors this way, or pick out the best from a group. It is actually an indirect measurement of I_{ceo}, or collector-to-emitter leakage END

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SIMPSON 260			
R × 1	1.5	100 ma	RED POS
*R × 100	1.5	1 ma	BLACK NEG
R × 10,000	7.5	60 μa	
TRIPLETT 630			
R × 1	1.5	320 ma	
R × 10	1.5	32 ma	RED NEG
*R × 100	1.5	3.25 ma	BLACK POS
*R × 1,000	1.5	325 μa	
R × 100,000	22.5	70 μa	
TRIPLETT 310			
R × 1	1.5	7.5 ma	
*R × 10	1.5	750 μa	RED NEG
*R × 100	1.5	75 μa	BLACK POS
R × 10,000	15.0	75 μa	

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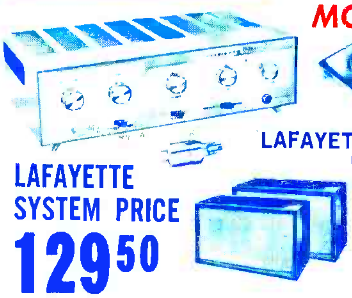

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technicians' News

Dorst Elected NATESA President

Chicago — Larry Dorst, Flint & Dorst, Inc., Milwaukee, has been elected NATESA president. He succeeds Irv Toner, Toner Radio & TV, East Aurora, N. Y.

Also elected at the NATESA annual convention was Earl Steffes of Kansas City, Mo., as secretary general, succeeding Dorst.

Harold Q. Eales, Eales Television and Radio Service, Oklahoma City, was re-elected treasurer, and Frank J. Moch was renamed executive director.

Regional officers elected are: eastern region, Richard Ambrose, Norfolk, Va., vice-president, Tom Hudson, Lynchburg, Va., secretary; east central region, Lyle Green, Oak Park, Ill., vice-president, Andy Archie, Nashville, secretary; western region, Alan B. Pickel, Las Cruces, N. M., vice-president, H. Hewson, Tigarg, Oregon, secretary; west central, Bill Childs, St. Joseph, Mo., vice-president, C. Thole, St. Paul, secretary.

Moch, Piette Speak at NATESA Annual Convention

The underpricing of TV service and the prospect of forming dealer-service co-ops were two prime topics at the annual convention of the National Alliance of Television and Electronic Service Associations in Chicago, August 22–25.

Will Piette, owner of Factory TV Service, Milwaukee, told fellow service dealers that "TV service is underpriced. "The fear of gypping the customer . . . is already a conditioned reflex," he said. This, Piette pointed out, hurts the dealer. When he feels compelled to keep service charges down, one of the first things he cuts is advertising. Because that brings in fewer customers, "we have the beginning of the end," according to Piette.

NATESA's executive director Frank J. Moch urged service dealers to enter cooperative chains, selling not only service, but home entertainment electronics products as well. He suggested that service dealers "forego the costly mania for phony independence."

"We must sublimate our now overpowering hobby attitudes, and we must accept our chosen competitors among us as worthy of our trust and respect," he said.

Moch called his plan "super service." Each man in such a co-op will do only what he is best qualified to do, and collectively the needs of the market will be satisfied. Local members of service organizations, he said, should band together for these ends. He recommended co-op advertising, buying and promotion.

With such an approach, Moch pointed out, many costs will be lower because of volume buying, reduced travel and advertising costs.

Wisconsin Service Bill Defeated

Madison, Wis.—A bill to license Wisconsin TV technicians by examination has been postponed indefinitely by a 51–37 vote in the state assembly. The measure also proposed advertising and promotion standards.

Service Dealers Briefed On California Repair Bill

Los Angeles — California officials met with TV service dealers and technicians here to explain how the new state law, aimed at preventing radio-TV repair abuses, will be administered.

The much-argued bill became law

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Try a COLORTRON. Test it against any competitive make for performance, construction, appearance. If you're not 100% convinced, we'll take it back. Your satisfaction is guaranteed.

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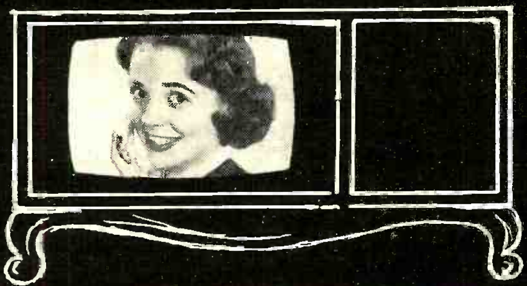

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Nothing on the amplifier is exposed to the elements—even the terminals are protected. Colortron comes complete with an all AC power supply with built-in 2 set coupler. Colortron model AP-220N 300 ohm input and output $39.95 list. Model AP-275 300 ohm input 75 ohm output $44.95 list.

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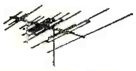

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in July. It requires all radio and TV repair firms to register with a state office, sets down certain advertising restrictions, makes a repair estimate binding on the repair firm (if one is made), and provides for itemized invoices.

Another new law, effective only in Los Angeles county, and also explained at the meeting, combats "setnapping"—holding a repaired set for "ransom" (charges in excess of an estimate), or attaching a lien to it.

Reaction to the law remains mixed and vociferous, even outside California. Howard Wolfson, Secretary of Associated Radio and TV Servicemen, Inc., Chicago, said in a letter to *Home Furnishings Daily* that the law is "another example of legislation designed to increase the burden of small service men, and pave the way for similar control in other fields."

Wolfson went on, "There isn't a repair job which can be estimated to the penny . . . service men will submit high estimates, thus losing business because of the opposition to those inflated guesses." He contended that technicians will be forced to install used parts to keep repair costs down and within the estimate.

New Virginia NATESA Chapter

Danville, Va.—A new technicians' association here known as VEA-Danville (Virginia Electronics Association) has become affiliated with NATESA. Jimmy Thomasson is president, T. R. Hughey vice-president and Lewis Adams, NATESA director.

NATESA reports that this is its eighth new affiliate in less than a year.

CSEA Elects Officers

Los Angeles—Emmett Mefford is the new president of the California State Electronics Association, a group of some 600 TV and electronic repairmen.

Mefford, formerly vice-president, fills the vacancy left by the death of Clair Lanam in July. Ralph Johonnot succeeds Mefford as vice-president. Johonnot was vice-president last year.

James Wakefield of Fresno is again CSEA executive secretary.

FTC Cites "Undisclosed" Used CRT Bulbs

The Federal Trade Commission acted recently to order tube manufacturers to stop misrepresenting CRT's using reconditioned envelopes as "new."

One company, Westinghouse Electric Corp., offered in its defense extensive, uncontradicted proof that the used envelopes were processed just as scrupulously as new ones. But, said FTC examiner Joseph W. Kaufman, even if the used bulb were just as good as a new one, a customer would be entitled to a new one if he expected it.

He noted that, when tubes are sold without any disclosure to the contrary, they are assumed by the general public to be new.

Burglarproofing Notes

From *Electrical Merchandising Week*, these anti-burgling hints:

1. If you have an alarm system, be sure it is functioning and is not easily fooled. Write to the manufacturer for information on newer systems.

2. Check with local police to see if the "scheduled check" is still used in your town. If so, try to persuade them (with the help of other businessmen in your town) of the "surprise" advantages of the unscheduled check now used in many towns.

3. Install security bars and frames *inside* the windows. Anything outside is fair game for burglars.

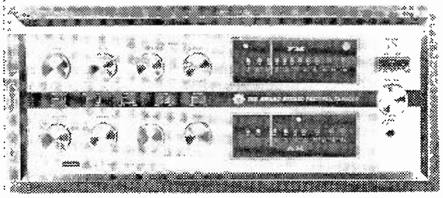
4. If your building has a skylight, cover it (from inside) with a steel security frame or heavy wire mesh.

5. Find out from a locksmith the advantages of a "deadlock" mechanism for your doors.

6. Put night lights around the building and on the roof. Lights inside, if your building has windows on the street, will make it harder for a burglar to work unnoticed. END

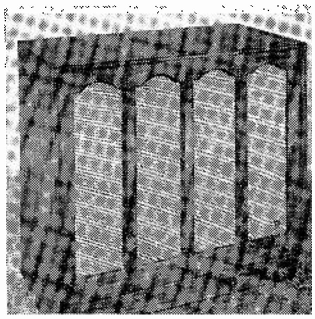
new Products

STEREO RECEIVER, Award *TA7000X.* FM stereo and AM tuners, dual preamplifiers, 70-watt stereo amplifier on single chassis. Stereo logic circuit switches FM tuner to stereo when station begins to broadcast stereo. FM tuner frequency response 10–35,000 cycles ±1 db. Tuner has stereo



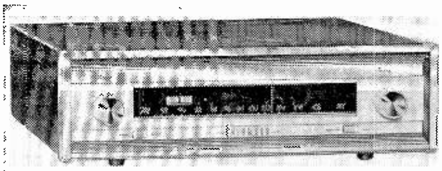
indicator light, stereo headphone reception, afc, tuning meter. FM multiplex section flat 15–15,000 cycles ±1 db, less than 1% distortion. 30 db separation across entire audio band. Power amplifier section drives any speaker system; reproduces frequencies 12–70,000 cycles ±1 db at 1 watt.—**Harman-Kardon, Inc.,** Ames Ct., Plainview, N.Y.

SPEAKER SYSTEM, *model E-V Six.* Compression vhf driver, diffraction horn. Four-way



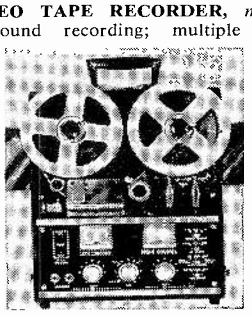
electrical crossover, crossover frequencies at 250, 800, 3,500 cycles. 18-inch low-frequency driver.—**Electro-Voice, Inc.,** Buchanan, Mich.

FM STEREO TUNER, *model S-3000 V.* D'Arsonval zero-center meter shows precise center between band limits, tunes Class-A stations without interference. Sensitivity 1.8 μv for −30 db noise



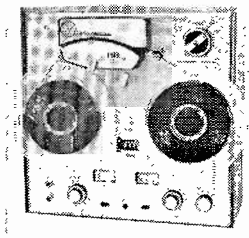
and distortion. 2.4 db capture effect. Stereo indicator light, 8-inch professionally calibrated expanded dial scale. – **Sherwood Electronic Labs, Inc.,** 4300 N. California Ave., Chicago 18, Ill.

STEREO TAPE RECORDER, *model 330.* Sound-on-sound recording; multiple sound-on-



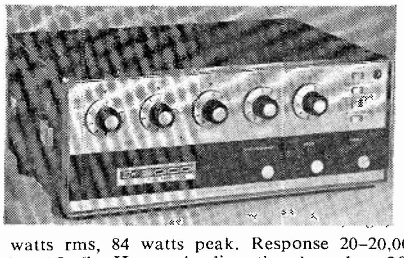
sound with channel transfer switch; multiple stereo headset outputs; input and outputs for custom installation without modification; two VU meters; internal monitoring; output for third head monitoring. Transistorized preamp booster to allow direct monitoring of recorded tape signal during recording, available as accessory. Recording speeds 7½, 3¾ ips; 15 ips accessory kit available. Four monaural tracks record 8 hours at 3¾ ips. Wow and flutter 0.20% at 7½ ips. Two stereo speakers, 2 high-impedance mike inputs, 2 high-impedance, high-level phono-radio inputs; 2 high-impedance preamp outputs, 2 external-speaker jacks.—**Roberts Electronics, Inc.,** 5978 Bowcroft St., Los Angeles 16, Calif.

STEREO COMPACT, *model 88.* Hyperbolic contour heads (erase, record, playback) of laminated, metal face construction, require no pressure pads. Silicon planar transistors in critical low-noise stages. Independent playback preamp cir-



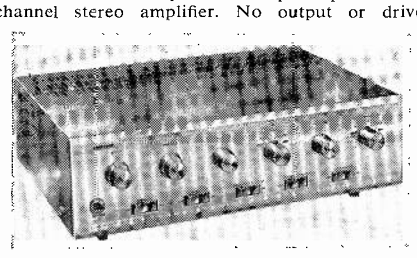
cuitry. Comparison switch for monitoring off tape or program source. Delivers 2-volt output to music system. Record–playback response 30–18,000 cycles at 7.5 ips. Sound-on-sound recording for multiple recording effects, built-in filter for FM multiplex recording. Separate record–playback volume controls, record indicator light, professional VU meters, digital counter, head shift control, 2-speed selector switch, automatic tape shutoff. Available models RMQ, quarter-track record, play; ERQ, half-track record, quarter-track play.—**Viking of Minneapolis, Inc.,** 9600 Aldrich Ave. S., Minneapolis, Minn. 55420.

TRANSISTORIZED PA AMPLIFIERS, *models 3000, 6000.* Tunable anti-feedback. Three mike channels for separate or simultaneous use, for high- and low-impedance mikes. Two inputs allow use of unit with tuner, tape recorder, auxiliary equipment. Controls for master gain, individual mike gain, auxiliary fader-type gain, tunable anti-feedback, bass and treble, rumble filter, scratch filter. Power output 30 watts rms, 42 watts peak;



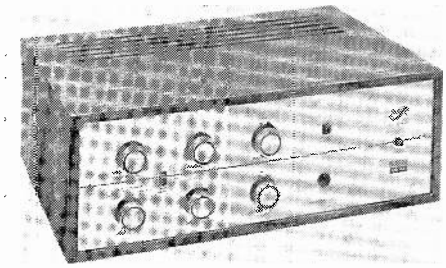
60 watts rms, 84 watts peak. Response 20–20,000 cycles ±2 db. Harmonic distortion less than 2%. Output impedances 4, 8, 16, 500 ohms; 25, 50, 70.7 volts. 117 vac, 50–60 cycles. Automatic overload protection.—**B & K Mfg. Co., Div. Dynascan Corp.,** 1801 W. Belle Plaine Ave., Chicago 13, Ill.

ALL-TRANSISTOR STEREO AMPLIFIER, *model LA-200.* Complete stereo preamp and dual-channel stereo amplifier. No output or driver



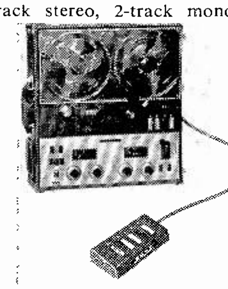
transformers. Music power 44 watts. Frequency response ±1 db, 20–20,000 cycles. Harmonic distortion 1%. Hum and noise: Tuner, −74 db; magnetic phono, −54 db. Tone controls ±10 db. Inputs: Tape head, magnetic phono, ceramic phono, tuner. Auxiliary outputs: Tape recorder, 4–16 ohms speaker impedance.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

36-WATT STEREO AMPLIFIER, *model 2036, Classic Series.* 36 watts IHF music, 28 watts continuous power, total. IM distortion (each channel) 2% at 14 watts. Harmonic distortion (each channel) 0.6% at 10 watts. IHF power bandwidth at rated continuous power, 1% harmonic distortion: 30 cycles–20 kc. Frequency response ±1 db 15 cycles–40 kc. Speaker output 8–16 ohms.



Inputs: magnetic phono, adapted ceramic phono, tuner, tape auxiliary. Sensitivity 2.3 mv phono, 250 mv others. Noise 65 db down on phono, 80 db down on others.—**EICO Electronic Instrument Co., Inc.,** 33-00 Northern Blvd., Long Island City 1, N. Y.

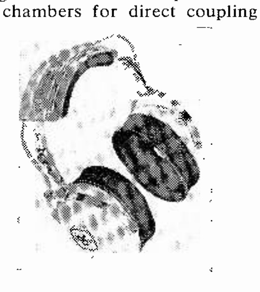
STERECORDERS. *Model 777 S-4* records 4-track stereo, 4-track monophonic, plays back 2- and 4-track stereo and mono. Model 777 S-2 records 2-track stereo, 2-track mono; plays back



2- and 4-track stereo, plus mono. Both Sony models all-transistorized, have 3 separate heads, 3 motors, all-solenoid activated mechanism, work vertically or horizontally. Speeds 7½, 3¾ ips. Stereo mixing of mike and line, sound-on-sound recording, remote control for all models, monitoring of source or tape.—**Superscope Inc.,** 8150 Vineland Ave., Sun Valley, Calif.

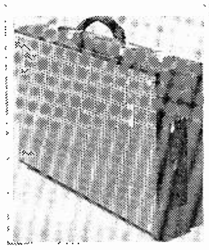
PORTABLE TAPE RECORDER, *Sony model 801-A.* Shown in September, 1963 issue, incorrectly stated as available from Sony Corp. Unit distributed solely by **Superscope Inc.,** 8150 Vineland Ave., Sun Valley, Calif.

PERSONAL HEADSET RECEIVERS, *Model 100.* Moving-coil drivers with plastic diaphragms in acoustic chambers for direct coupling between



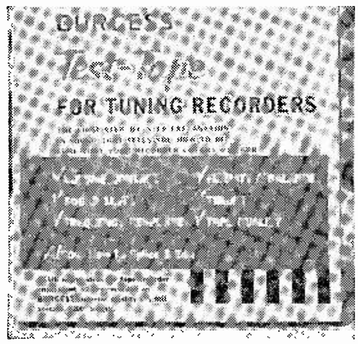
reproduced sound and ear. Polyvinyl chloride ear seals. Frequency range 10–16,000 cycles. Response ±3 db, 20–10,000 cycles. Distortion 0.2% at 100 phon level over useful range. Sensitivity (per phone) 200 µbar/volt at 1 kc. Max. power input 1 watt per phone. Nominal impedance 8 ohms.—**David Clark, Inc.,** 250 Park Ave., Worcester, Mass.

PA SYSTEM, *Diplomat*. Powered by 10 flashlight batteries. Attache case contains all-transistor 25-watt amplifier, 6 x 9 speaker, dynamic omnidirectional mike with lavalier cord and 10 feet of



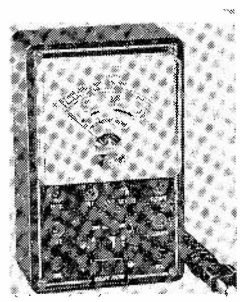
cable, 40 feet additional cable to permit separation of loudspeaker and amplifier. Two inputs, two outputs for use with additional loudspeakers.—**Ampli-Vox Div., Perma-Power Co.,** 5740 N. Tripp Ave., Chicago 46, Ill.

PRE-RECORDED TEST TAPE, *Series 111*. Cellulose-acetate base, plastic magnetic tape. Gives step-by-step instructions on checking tape recorders for volume control, sound level, frequency



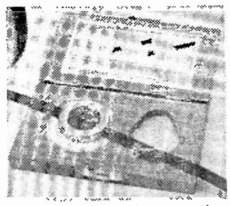
response, fidelity and balance, timing, tape quality, splicing and editing, etc. Available in reel diameters 3–14 inches.—**Burgess Battery Co.,** Magnetic Tape Div., Freeport, Ill.

HANDI-TESTER, *model 108*. D'Arsonval meter movement. Rated accuracy of 800-microamp movement 2%. Ac or dc ranges: volts 0—15—150—300.



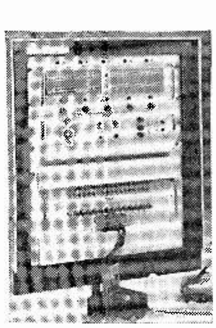
Amps 0–15. Watts 0–1,500. Resistance 0–2,000 ohms; neon leakage test 0–5 megohms. Wt. 1¼ lbs., complete with test leads, instruction manual. Available kit or wired.—**Electronic Measurements Corp.,** 625 Broadway, New York 12, N. Y.

MAGNETIC TAPE VIEWER, *No. 600*. Makes visible the data recorded on tape. May be



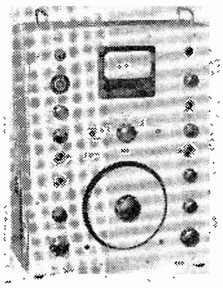
used to check recorder head alignment, track placement, pulse definition, interblock spacing, dropout areas.—**3M Co.,** 2501 Hudson Rd., St. Paul, 19, Minn.

INTEGRATED CIRCUIT TESTER, *Model 659A*. Tests all leading types semiconductor integrated circuits. Makes 36 tests on devices with up



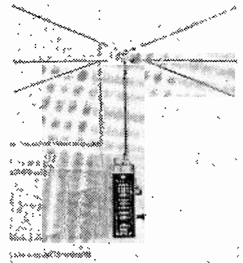
to 14 terminals. Plug-in circuit boards for bias, limits, timing and sorting. Test times vary 30 milliseconds to 5 seconds. Makes 2-point connections to each device terminal. Program boards available from manufacturer, or may be designed and constructed with instructions furnished.—**Texas Instruments, Inc.,** 3609 Buffalo Speedway, Houston, Tex.

NARROW BAND ANALYZER, *model 2107*. For analysis and linear measurements. Audio-frequency analyzer, constant percentage-bandwidth



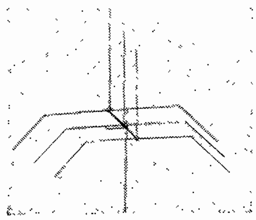
type, for analysis and linear measurements. Six selectable filter bandwidths, 6–29% of center frequency, continuously tunable 20–20,000 cycles. Measures rms, absolute average, instantaneous peak values of input signal. Rms readout gives data for all types of signals, including sinusoidal, periodic, random. Facilities for wide choice of input transducers or signals.—**B & K Instruments,** 3044 W. 106 St., Cleveland 11, Ohio.

ALL-TRANSISTOR UHF CONVERTER, *model VUC-4W*. For use with manufacturer's



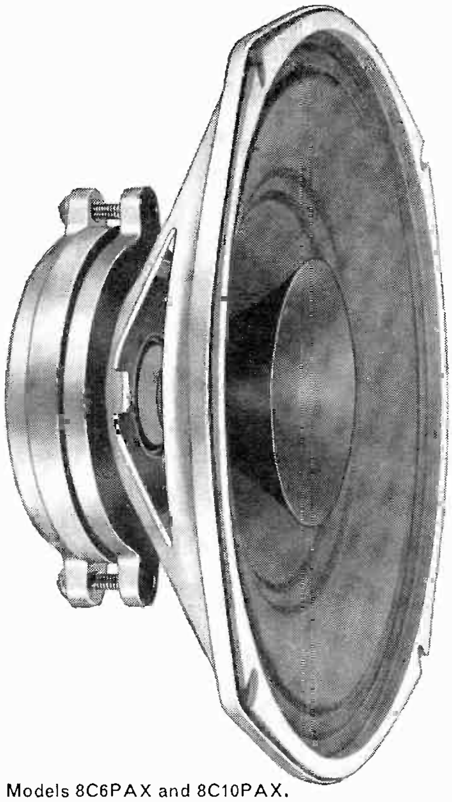
Micro-TV model 5-303W or 8-inch model 8-301W. Available with carrying case and antenna. 13 oz. Power automatically supplied from TV set.—**Sony Corp. of America,** 580 5th Ave., New York, N. Y.

TWO-IN-ONE CB BEAM ANTENNA, *model MR-77 Match-Maker*. Works vertically and horizontally. Vertical forward gain 7 db, horizontal

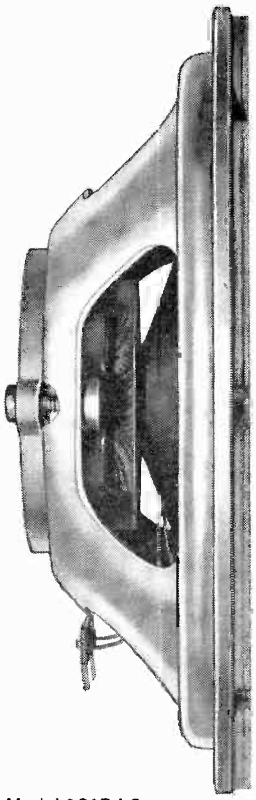


forward gain 6 db. Front-to-back ratio 15 db. Separate coaxial feeders for vertical and horizontal polarization. Boom and elements of heat-treated aluminum. Oversize clamps hold elements in place to withstand 100 mph winds. 12½ feet high, boom length 10 feet, 24 lbs. Vswr 1.5:1, 50 ohms gamma matched.—**Antenna Specialists Co.,** 12435 Euclid Ave., Cleveland, Ohio.

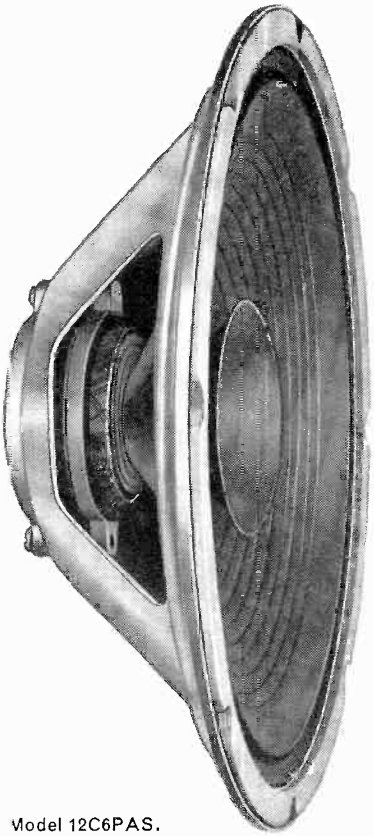
CB ANTENNAS. Ground plane *model CBGP-1* (illus) for base station installations. 360° pattern, 1-inch diameter radiating element, double U-bolt mounting device. *Model CBY3*, 3-element antenna, vertical or horizontal mounting. Up to 8 db gain. ½-inch elements, 1-inch boom; rein-



A Models 8C6PAX and 8C10PAX. Model 12C10PAX similar, but with round basket.



B Model 8C6PAS. Very shallow construction.



C Model 12C6PAS. Shallow 12″ extended range speaker with dual cone.

For your background music installations

5 new Quam speakers

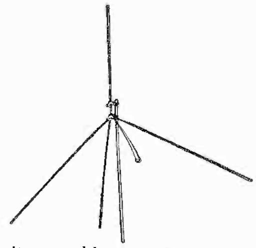
Over the hubbub of other sounds, background music has to be audible without being obtrusive. Ordinary public address speakers, designed for capturing the primary attention of the audience, are *not* the answer. These new Quam Speakers—especially designed to handle background music—*are.*

Quam offers you five background music speakers, three eight-inch models and two twelve-inch. All have ceramic magnets; four of these new units are extended range units with dual cones; two of the new speakers offer very shallow construction. (Complete specifications are given in the new Quam Catalog 63 . . . now available on request.) They meet the traditional Quam standards of utmost quality and performance satisfaction.

Remember Quam—for forty years the Quality Line for all your speaker needs.

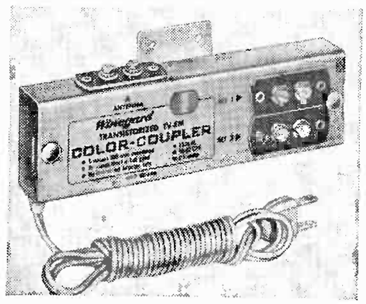
QUAM

QUAM-NICHOLS COMPANY
234 E. MARQUETTE ROAD
CHICAGO 37, ILLINOIS



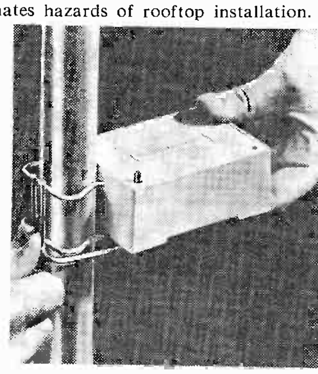
forced U-bolt assembly accepts masts to 1½ inch. —**Antennex Co., Div. Clear Beam Antenna Corp.,** PO Box 471, Canoga Park, Calif.

COLOR COUPLER, *model BC-230.* Transistorized, two-set TV coupler designed to overcome splitter loss. Permits operation of two TV sets or TV and FM set simultaneously from single an-



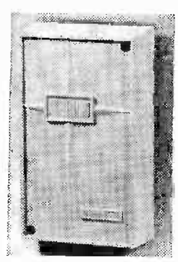
tenna and down-lead, without loss of signal. Minimum gain +7 db; isolation between coupler outputs 15 db. For both color and black-and-white.—**Winegard Co.,** Burlington, Iowa.

COUPLER ATTACHMENT, *Miracle Mount.* Mast-mounted unit for multi-set TV couplers eliminates hazards of rooftop installation. Snap-on



unit withstands strong winds.—**Blonder-Tongue Labs, Inc.,** 9 Alling St., Newark 2, N.J.

AMPLIFIED COUPLER, *model TA-66. Indoor Super-Powermate.* Two-transistor unit amplifies and feeds TV signals to up to 4 TV sets from single antenna. Gain: low band, 7.5 db, output

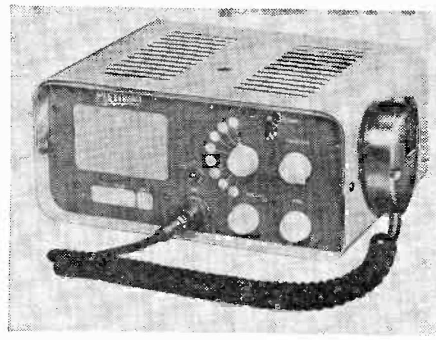


180,000 µv at each of 4 output terminals; high band, 5.6 db, output 100,000 µv at each outlet. Noise figures 4.2 db low band, 8.3 db high band. Isolated power supply.—**Distributor Sales Div., Jerrold Electronics Corp.,** 15th & Lehigh Ave., Philadelphia 32, Pa.

FM RECEIVER, *Duo-Band.* For monitoring business, police, fire, taxi and other mobile phone

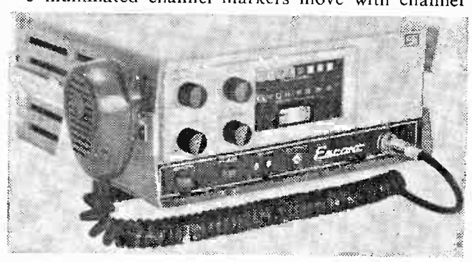
frequencies. Receives 30–50 mc and 152–174 mc bands. Dual-conversion superhet circuit, squelch, tuned rf stage, crystal-controlled second oscillator. Temperature compensated.—**Utica Communications Corp.,** 2917 W. Irving Park Rd., Chicago 25, Ill.

CB TRANSCEIVER, *Poly-Comm N.* 8 CB channels, Nuvistor front end, ultrasensitive noise limiter and squelch. Ultra high-gain rf stage dual conversion receiver. Operates to 10 miles mobile-to-mobile, to 15 miles base-to-mobile. Selectivity:



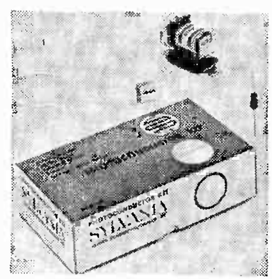
6 db bandwidth, 8 kc ±2 kc; 60 db bandwidth 20 kc ±5 kc. Audio output 4.5 watts into 4-inch PM weatherproof speaker; distortion less than 15%, 250–3,000 cycles at 1-watt output. Hum and noise 40 db down from 1 watt output. Frequency response ±6 db, 250–3,000 cycles.—**Polytronics Labs, Inc.,** 88 Clinton Rd., West Caldwell, N. J.

TWO-WAY RADIOTELEPHONE, *Escort.* Operates on CB service channels. Class D license required. Transistorized dual power supply 12 vdc, 115 vac. Heavy-duty, rust- and corrosion-proof aluminum chassis and cabinet. 8 channels plus accessory crystal socket for use on any channel. 8 illuminated channel markers move with channel



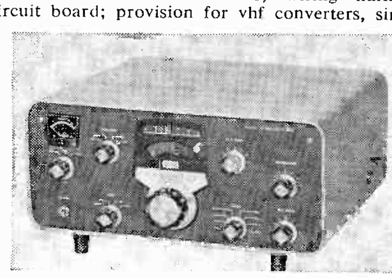
selector switch and indicate operating channel. Squelch circuit, pre-set noise limiter, universal mounting bracket. — **Pearce-Simpson, Inc.,** 2295 N.W. 14 St., Miami 35, Fla.

PHOTOCONDUCTOR KIT. Includes 3 photoconductors, ac-dc relay, resistor, mounting bracket. 52-page circuits booklet explains in detail



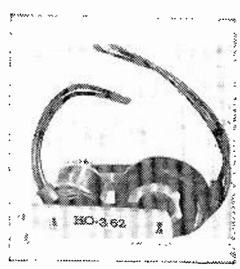
how to assemble counting devices, photoflash slaves, model railroad crossing guards, game room target shoots, many other devices.—**Sylvania Electric Products, Inc.,** 730 3rd Ave., New York 17.

SSB RECEIVER KIT, *model SB-300.* Complete coverage of 80–10 meter bands. Linear tuning with 1-kc dial calibrations. 2.1-kc crystal lattice filter; stability 100 cycles after warm-up; prebuilt linear master oscillator, wiring harness, circuit board; provision for vhf converters, single



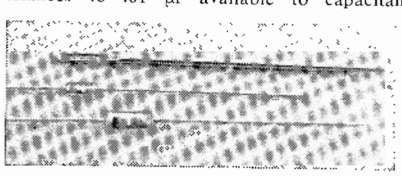
switch control of power and antenna leads; accessory crystal filters for CW and AM operation; audio feedback.—**Heath Co.,** Benton Harbor, Mich.

REPLACEMENT FLYBACKS for use with Zenith TV sets. No's HO-362-367 (6 units) replace 20 part numbers for applications in 77 chassis and



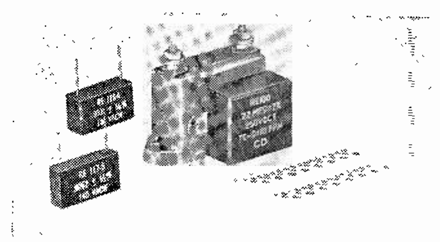
624 models.—**Stancor Electronics, Inc.,** 3501 W. Addison St., Chicago, Ill. 60618.

MONOLYTHIC CEROD CAPACITORS. Cylindrical ceramics with layer-built capacitor elements, fully molded in thermosetting resin. *Types 262C and 263C* comparable to ¼- and ½-watt composition resistors, respectively. *Type 262C*, capacitances to .01 μf available to capacitance



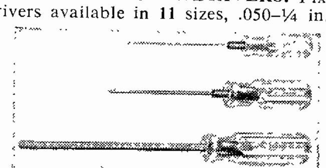
tolerances ±10%; *type 263C*, upper capacitance range to .033 μf, capacitance tolerance ±10%. Capacitors rated to 100 vdc, temperatures to 85°C, may be operated to 125°C at 50 volts.—**Sprague Electric Co.,** Marshall St., North Adams, Mass.

MICA CAPACITOR PACKAGES, *Type RE.* Resin-encapsulated custom single- or multiple-silvered mica capacitors, interconnected in series, parallel or series-parallel. Designed in many combinations of ratings, operating characteristics, sizes, form factors, terminals, mountings. Operating tem-



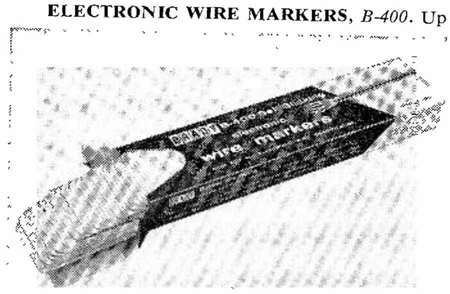
perature range −55°C–+150°C.—**Cornell-Dubilier Electronics Div., Federal Pacific Electric Co.,** 50 Paris St., Newark 1, N. J.

ALLEN HEX SCREWDRIVERS. Fixed-handle drivers available in 11 sizes, .050–¼ in. 4-inch



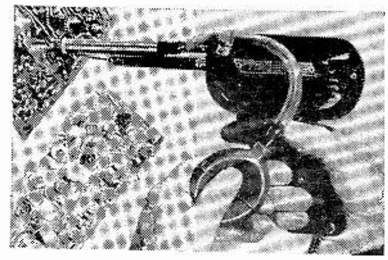
blades on smaller sizes, 6-inch blades on larger. Detachable Allen hex blades in 8 sizes, 1/16–3/16 inch. Singly or in plastic pouch.—**Xcelite Inc.,** Orchard Park, N. Y.

ELECTRONIC WIRE MARKERS, *B-400.* Up



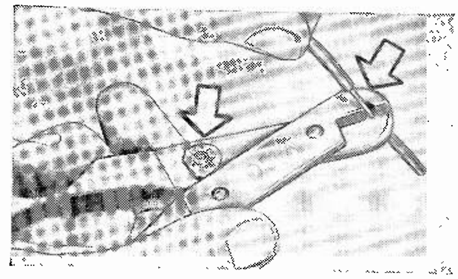
to 3,750 individual markers in ¾ x 2 x 9-inch Combination Pacs. Adhere to any wire or insulation including nylon, plastic, silicone, rubber, glass or nylon braid, Teflon. Withstand 30 days immersion in No. 10 oil at 65°C, resist temperature to 150°C indefinitely, to 200°C with slight change in background color. 3.5 mils thick.—**W. H. Brady Co.,** Dept. 403, 726 W. Glendale Ave., Milwaukee 9, Wis.

SOLDERING GUN ATTACHMENT. Cleans printed circuit terminals. Attaches to soldering gun in less than 5 minutes. Hollow, tubular tip of



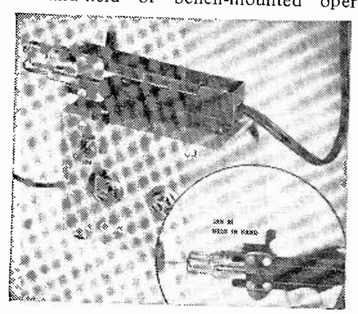
gun heats terminal, suction bulb sucks solder into stainless steel tube.—**Oneida Electronic Mfg. Co.,** Meadville, Pa.

WIRE STRIPPER with assortment of solder-



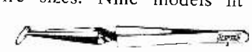
less terminals. Calibrated dial allows instant adjustment of blades to 8 different settings for cutting and stripping 24- to 12-gauge wire. Plastic-covered handles spring-loaded to stay open when not in use.—**Vaco Products Co.,** 317 E. Ontario St., Chicago 11, Ill.

THERMAL WIRE STRIPPER, *No. 80P.* Tips mounted on small tweezer-type handle. Attachment allows hand-held or bench-mounted operation.



Three-position heat switch on control box provides heat for high or low-temperature insulations.—**Hunter Tools,** 9851 Alburtis Ave., Santa Fe Springs, Calif.

ANTI-WICKING TWEEZERS, *N type.* Prevent solder on stranded cable from creeping up under insulation. Made of beryllium copper to precise wire sizes. Nine models fit wire gages



16–32. Short tip hole.—**Hexacon Electric Co.,** 186 W. Clay Ave., Roselle Park, N. J.

SILICONIZED SPRAY PAINTS. Resistant to heat, weathering, corrosive atmospheres. In 15-oz. spray cans; black, white, aluminum, grey, gold. —**Injectoral Co.,** 6 Bay 50th St., Brooklyn 14, N.Y.

END

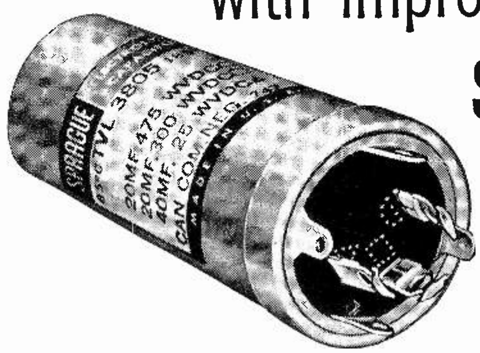
All specifications from manufacturers' data

See the new
RADIO-ELECTRONICS MARKET CENTER
on Page 113

WHY bother with makeshift twist-prong capacitor replacements?

When you substitute capacitor sizes and ratings, you leave yourself wide open for criticism of your work . . . you risk your reputation . . . you stand to lose customers. It just doesn't pay to use makeshifts when it's so easy to get the *exact* replacement from your Sprague distributor!

Get the right SIZE, right RATING every time with improved



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booklets New Literature charts catalogs

CB RADIOS shown in 4-page leaflet. Photos and specs on Commaire models ED-276 and PT-27 (CB radio with AM receiver).—**Vocaline Co. of America, Inc.,** 100 Coulter St., Old Saybrook, Conn.

SHORT GLOSSARY OF EMI TERMS, 12-page booklet, lists common EMI (Electro-Magnetic Interference) terms.—**Ace Engineering & Machine Co., Inc.,** 60 Tomlinson Rd., Huntingdon Valley, Pa.

MICROLIMIT OPTICAL DIAMETER GAGE described in 4-page Bulletin No. 14-203-B. Photos, operation data, full specs.—**Weston Instruments & Electronics Div., Daystrom, Inc.,** 614 Frelinghuysen Ave., Newark 14, N. J.

PAPER-OIL CAPACITORS described in 24-page Bulletin 2423. Includes manufacturer's types 40-71 and MIL-C-62 equivalents. Engineering data shown in graphs and charts.—**Sangamo Electric Co.,** Springfield, Ill.

HI-FI CATALOG. 16-page booklet describes Thorens and Ortofon turntables, tone arms and cartridges, plus Cecil E. Watts cleaning accessories. Photos, full specs.—**Elpa Marketing Industries, Inc.,** New Hyde Park, N. Y.

CIRCUIT RESISTOR ELEMENTS, shown in Barretter Product Bulletin. 2-page sheet gives description, application data, filament resistance/current chart. Line drawings show configurations. —**Tung-Sol Electric Inc.,** 1 Summer Ave., Newark 4, N. J.

TAPE TIMING CHART. Gives playing time of tapes, footages for reels 2¼ to 14 inches, speeds 1⅞ to 15 ips for full, dual and quarter-track recorders. Includes odd lengths, European-type reel lengths.—**Saxitone Tape Sales,** 1776 Columbia Rd., N.W., Washington, D.C.

RELAY LISTINGS in 12-page revised Catalog 100. Data on 50 standard relays in 550 contact arrangements and coil voltages. Four-page insert describes mercury-wetted contact relays.—**Potter & Brumfield,** Div. AMF, Princeton, Ind.

CONVERSION FACTORS. 8½ x 11-inch reference table lists conversions for a large number of quantities, ranging from atmospheres to watt-hours, printed on light card, suitable for wall hanging.—**Precision Equipment Co.,** 4409G Ravenswood Ave., Chicago 40, Ill.

REPLACEMENT TRANSFORMERS listed in 22-page Catalog TV-63/64. Prices, application data, specs and dimensions for 735 transformers, yokes, flybacks, filter chokes. 18 new listings.—**Triad Distributor Div.,** 305 N. Briant St., Huntington, Ind.

ZENER DIODES listed in 4-page technical bulletin, outlining JEDEC types. List of part numbers, Zener voltages, Zener test currents, impedances, maximum temperature coefficients and case types. Graphs on temperature derating and Zener impedance, schematics on available case types.—**Solitron Devices, Inc.,** 500 Livingston St., Norwood, N. J.

SCREEN ROOM FILTERS detailed in 2-page Data Sheet NPJ-127. Specification chart, installation notes, line drawings, photo. Aluminum-cased electrolytics described in Data Sheet NPJ-124.—**Aerovox Corp.,** Distributor Div., New Bedford, Mass.

FERRITE DEVICES. 28-page booklet discusses magnetism, ferrites, isolator theory, design and application, rotators, circulators and other microwave ferrite devices.—**Sylvania Electric Products, Inc.,** 1100 Main St., Buffalo 9, N.Y.

SOLDERLESS TERMINALS, connectors, hardware, tube sockets, terminal strips offered in illustrated, 12-page Catalog No. PMR-3. Full specs, many line drawings and photos.—**Waldom Electronics, Inc.,** 4625 W. 53 St., Chicago 32, Ill.

INDICATOR LIGHTS, LAMPHOLDERS, LENSES shown in 16-page Catalog 6302. Illustrations, tabulated technical data, diagrams.—**Drake Mfg. Co.,** 4626 N. Olcott Ave., Chicago 31, Ill.

DC GROWTH IN INDUSTRY, 16-page information bulletin explains in simple language the advantages of dc, describes manufacturer's dc recorders. Liberally illustrated.—**Amprobe Instrument Corp.,** Dept. REG-8, 630 Merrick Rd., Lynbrook, N.Y.

LC TUNERS, INDUCTORS shown in Catalog TI-73. Technical, electrical, physical data on 142 standard models LC tuners, fixed and variable inductors, tank circuits. Many photos, charts, graphs.—**JFD Electronics Corp.,** 15th Ave. at 62 St., Brooklyn 19, N. Y.

1964 PARTS CATALOG, No. 640. 422 pages show stereo and hi-fi components, CB and ham gear, test instruments, PA equipment, radio and TV parts. Many items in kit form. Fully illustrated.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

ELECTRONIC PRODUCTS offered in 445-page, illustrated Catalog 230. Items include amateur gear, electronic components, audio equipment, shortwave sets, test instruments, many others. Photos, full specs.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

MINIATURIZED MICA CAPACITORS detailed in 2-page Bulletin 528; ceramic trimmers in Bulletin 527.—**Erie Resistor Corp.,** 644 W. 12 St., Erie, Pa.

COAXIAL CABLE, 160 types, listed in 8-page catalog. Data on Mil-Spec cables, community antenna TV cable, twinline and other special-purpose cables.—**ITT Distributor Products Div.,** PO Box 99, Lodi, N.J.

SPEAKER SYSTEMS described in illustrated foldup leaflets. Brochure MT shows bookshelf size, 5-speaker Model TF-4. Brochure MX shows miniature Model X-11.—**Jensen Mfg. Co.,** 6601 S. Laramie Ave., Chicago 38, Ill.

ELECTRONIC COMPONENTS. 16-page Catalog No. 63 lists jacks, plugs, switches, audio connectors, mike connectors, audio accessories, molded cable assemblies. Descriptions, line drawings.—**Switchcraft, Inc.,** 5555 N. Elston Ave., Chicago 30, Ill.

LET'S TAKE THE GUESSWORK OUT OF ALTERNATORS. 8-page report gives functional comparison of alternator system vs. ordinary dc generator. Tells how to choose alternator system for any vehicle, discusses charging-system symptoms.—**The Leece-Neville Co.,** 1374 E. 51 St., Cleveland 3, Ohio.

UNIDIRECTIONAL DYNAMIC MIKE, dual impedance model 545S Unidyne III, described in 3-page technical bulletin. Complete data on applications, installation, connections, operation, acoustic considerations, full specs. Schematic diagrams, graphs show response and directional patterns.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

MAGNETIC LATCHING MICROMINIATURE RELAYS, Bulletin GEA-7241A. Describes all-welded relays magnetically latched for short power pulse operation. Electrical and mechanical characteristics. Diagrams show dimensions and mounting.—**General Electric Co.,** Schenectady 5, N. Y.

END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufactures, whose addresses are listed at the end of each item. Use your letterhead - do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears.

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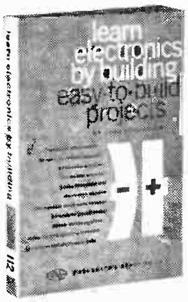

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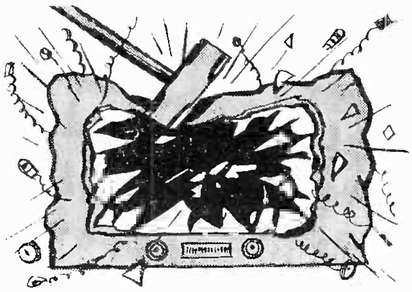

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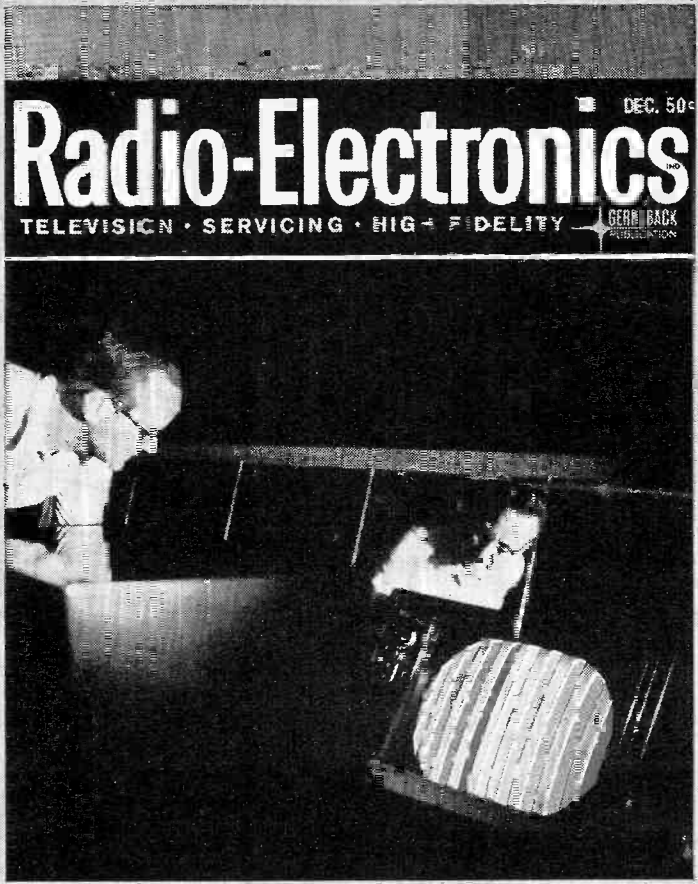

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COLOR TV ISSUE

Radio-Electronics Color TV Issue will be the definitive study on the subject. It will provide the most complete coverage of color television ever assembled in one magazine—written by an outstanding array of technical writers and contributors.

Here are just some of the features which will be in the issue:

- **Installing the Color Picture Tube**
  A profusely illustrated, step-by-step article for the technician.
- **Color TV Roundup, 1964**
  All about the new color TV receivers, complete with features on their circuitry.
- **Newest Color TV Set — the RCA CTC-15**
  A behind-the-scenes look at the latest color chassis.
- **The Color Television Era**
  Analysis of past and present trends in color TV, with some shrewd guesses as to the future. For the dealer, service technician and set owner.
- In addition — pages on color test equipment, new tubes for color, antennas and boosters, and color TV servicing.

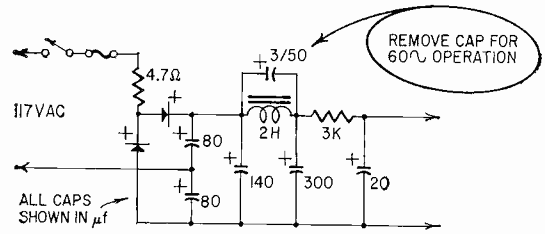
DECEMBER ISSUE (on sale November 19)

TECHNOTES

60-cycle Trouble in 25-cycle Sets (Sylvania 533003S)

In Canada many 25-cycle TV sets operate on 60-cycle lines, usually with few filtering problems. Filters designed to remove 25- and 50-cycle ripple do even better on 60 and 120.

But on this one chassis, failure of a particular part can produce some peculiar sights. A fixed double bend shows up in the picture on transmissions locked to the local power



frequency, and a moving weave on telecasts not tied down to the power frequency. On weak signals, the picture jitters and rolls, and a vertical bar hangs in the middle of the screen.

This is caused by a partial short in the 3-µf 50-volt electrolytic across the filter choke. At 25 cycles, this resonates with the choke, presenting a high impedance to ripple. At 60 cycles, it can be more of a nuisance than a help if it fails. Removing it cures the complaint.—*D. K. Vanderwater*

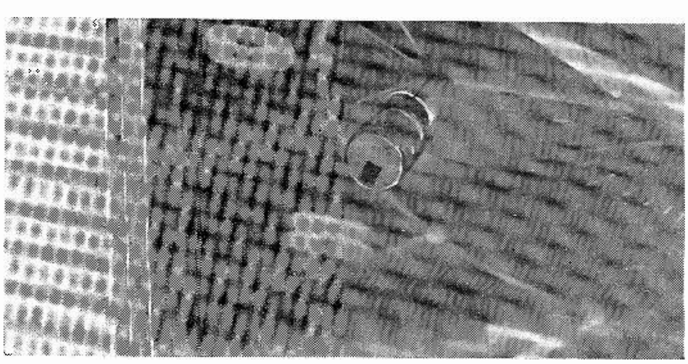
RCA Color: 800, 900 Series

Frequent failure of the 6DQ5 horizontal output tube in these sets can be caused by an intermittent where the 6CG7 horizontal oscillator PC board connects to chassis ground. Oscillator heater failure removes drive to the 6DQ5, causing excessive dissipation.

If the 6CG7 heater is lit, try wiggling the tube to find the intermittent. The best cure is to resolder all four ground lugs on the horizontal oscillator board.—*Arthur R. Richman*

Clock Radio Knobs

If you own a clock radio or are often called upon to repair them, you know how easily the clock control knobs can get lost. A quick professional-looking replacement can be made by cutting a ¾-inch length of ¼- to ⅜-inch diameter plastic rod and drilling a hole the same diameter as the



control shaft to a depth of ½ inch down the center of the new knob. For slotted shafts, cut a small rectangle from a tin can. It should be ¼ inch long and slightly wider than the diameter of the hole. Heat it with your soldering gun and, using needle-nose pliers, force it into the hole of the new knob. Finally, no matter what type of shaft, fill the hole with cement and press the knob onto the shaft. A dot of red fingernail polish serves as a pointer.—*Ronald S. Newbower*

Squirrel Behind the Bars

The customer telephoned, reporting two black lines on his television screen. He also declared that the sound was mixed with a frying noise which drowned out the announcer's voice.

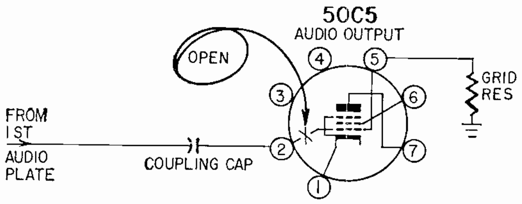
The technician put in several unrewarding minutes checking the set without locating an offending component. Not to be discouraged, he fired up the portable TV set reserved for such baffling occasions. The lead-in was secured and *lo*— the same black lines appeared on the portable screen. A check on some neighbors' sets firmly established the existence of a strong 120-cycle radiation along the street.

The technician mounted his truck and turned on the car radio. The noise drowned out all but the local broadcast station. After a false start in the wrong direction the point of highest noise intensity was located at a hydroelectric distribution pole a half block from the customer's home.

Inspection revealed that a squirrel had climbed across an insulator bearing a primary line. The squirrel's tail was lying on the cross arm of the pole which was freshly watersoaked by overnight rains. The final repair of the neighborhood problem was in sight. The power company was called and the squirrel borne to his last resting place. TV reception returned to normal.—*D. K. Vanderwater*

No Sound in Ac-Dc Five-Tuber

The trouble was no output on a five-tube ac-dc radio. A slight hum at the speaker was detectable. Tubes were OK. Signal substitution at the grid (pin 5) of the 50C5 output tube revealed normal output. After investigation, I noticed the coupling capacitor from the first audio was connected to pin 2 of the 50C5, and the 50C5 grid resistor was connected



to pin 5. Playing a hunch, I removed the tube and found no continuity between pins 2 and 5. The cause of the trouble was obvious. The connection in the tube itself was open. A piece of wire from 2 to 5 on the socket cured the trouble for all time.—*Sidney Claire*

Snow on the Beach

A set in the lobby of a Miami beachfront hotel showed a lot of snow, A new 6BZ7 rf amplifier didn't help. I decided to inspect the antenna.

It was a V (conical), well installed. Connections and lead-in were good. No sign of trouble.

Returned to the lobby, checked tubes and connections again. All OK. Tried an indoor antenna—no better.

On a moment's inspiration I put the ohmmeter leads across the lead-in: only about 100,000 ohms, where it should have been infinity!

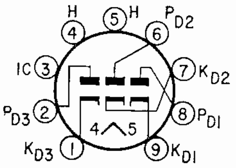
Back up the ladder to the antenna. The wooden cross-braces on the antenna V's were damp with salt spray—shorting out most of the signal.

A new and different antenna corrected the trouble. And I made a mental note not to use that kind near the ocean again.—*H. R. Holtz*

New Semiconductors and Tubes

6GQ7, 19GQ7

Hum control and high perveance are the primary features of these two new 9-pin miniature triple diodes. They were designed for AM-FM receivers, where triple diodes are used to simplify



6GQ7, 19GQ7

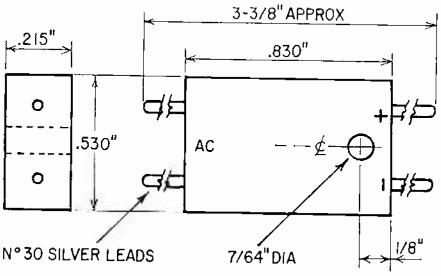
switching designs and reduce manufacturing costs.

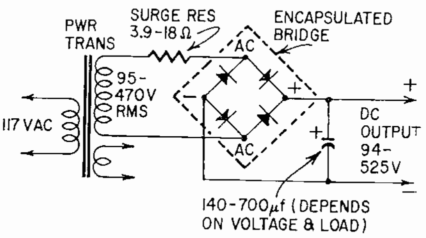
The diode sections are similar electrically to those of the 6AL5. Each section is completely independent, except for the heater.

The 19GQ7 is the 150-ma series-string version of the 6GQ7. Both tubes are made by Raytheon.

Silicon bridge rectifiers

The drawing shows the physical and electrical configuration of a new series of miniature encapsulated silicon full-wave bridge rectifiers, designed to replace the four separate diodes usually





used. A number of high-fidelity amplifiers are now using bridge rectifiers, and should one or more of the diodes fail, it may be more economical to replace the entire bridge with one of these.

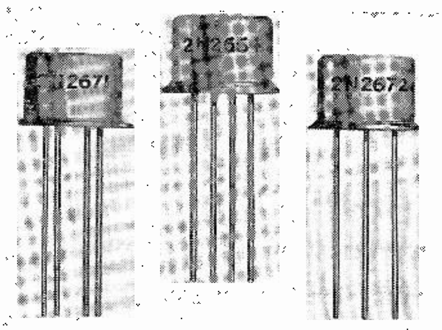
There are eight versions, for rms ac input voltages from 95 to 470 volts, and corresponding dc outputs (into capacitive filters) of 94 to 525 volts. Maximum capacitive-load output current is 1.3 amps, or 1.8 into a resistive load. The bridges will operate up to 140°C.

Maximum forward voltage drop at 25°C and peak current is only 1.2 volts per rectifying element—or 2.4 volts total. The devices are made by International Rectifier Corporation.

2N2654, 2N2671, 2N2672

The appearance on the market of these three transistors demonstrates just how routine the use of transistors for higher-frequency amplification has become. The 2N2654 is a germanium PADT high-gain vhf transistor designed especially for "mass-produced, high performance FM radios" (quoted from the manufacturer's release).

Cutoff frequency is 250 mc, and power gain at 100 mc is 18.8 db. Best



of all is the price: $0.85 in 1000-up quantities, and about $1.30 singly.

Another recent device is the 2N2671 (from Amperex, as are the other two in this item), which is "an economy, low-noise FM transistor" with a 14-db power gain at 100 mc and an 8-db noise figure. Amperex claims that it will work at as low as 3 volts. *It* goes for only $0.50 in quantities of 1,000 or more.

Less spectacular (and cheaper, too) is the 2N2672, a "universal AM-short wave transistor", for rf and i.f. stages in receivers for standard AM broadcast and short waves to 6 mc. Like the others, one of its most attractive features is its low feedback capacitance: 1.5 pf for this one. High current gain, too—about 150. It is priced at $0.40 in 1,000-up quantities.

Tiny light sensor

This is a very-miniature photoresistive (or photoconductive, if you like) light sensing device, 1/16 inch in diameter and less than 1/10 inch high. Texas Instruments, manufacturer of the device, claims it to be the smallest of its kind commercially available.

The sensor, called the LSX 600, is designed to be fitted directly into a 1/16-inch hole in a printed circuit board. Two simple soldering operations connect it.

Suggested applications include character recognition, tape and card reading

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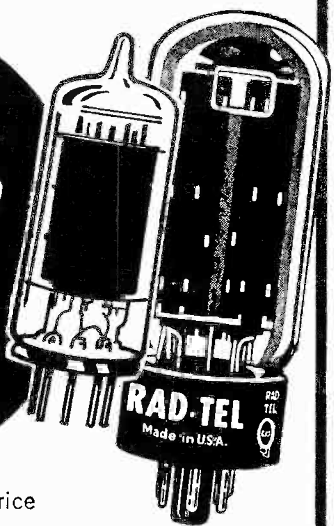

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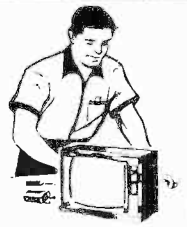

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	1J3	.79		6BA6	.50		6SK7GT	.95		12DL8	.88
	1K3	.79		6BC5	.61		6SL7GT	.84		12DQ6	1.04
	1R5	.77		6BC8	1.04		6SN7	.65		12DS7	.84
	1S5	.75		6BE6	.55		6SQ7GT	.94		12DT5	.76
	1T4	.72		6BF5	.90		6T4	.99		12DT7	.79
	1U5	.65		6BF6	.44		6T8	.85		12DT8	.78
	1X2B	.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
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	4CS6	.61		6CN7	.70		11CY7	.75		12SQ7GT	.91
	4DT6	.55		6CQ8	.92		12A4	.60		12U7	.62
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	5BK7	.86		6CY5	.70		12AF3	.73		18FW6	.49
	5BQ7	1.01		6CY7	.71		12AF6	.67		18FX6	.53
	5BR8	.83		6DA4	.68		12AJ6	.62		18FY6	.50
	5CG8	.81		6DE6	.61		12AL5	.47		19AU4	.87
	5CL8	.76		6DG6	.62		12AL8	.95		19BG6	1.39
	5CQ8	.84		6DJ8	1.21		12AQ5	.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	.59
	5U8	.84		6DT8	.94		12AV7	.82		25CD6	1.52
	5V6	.56		6EA8	.79		12AX4	.67		25CU6	1.11
	5X8	.82		6EB5	.73		12AX7	.63		25DN6	1.42
	5Y3	.46		6EB8	.94		12AY7	1.44		25EH5	.55
	6AB4	.46		6EM5	.77		12AZ7	.86		25L6	.57
	6AC7	.96		6EM7	.82		12B4	.68		25W4	.68
	6AF4	1.01		6EU8	.79		12BD6	.50		32ET5	.55
	6AG5	.70		6EV5	.75		12BE6	.53		35C5	.51
	6AH4	.81		6EW6	.57		12BF6	.60		35L6	.60
	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
	6AU4	.85		6J5GT	.51		12CN5	.56		117Z3	.85
	6AU6	.52		6J6	.71		12CR6	.67		807	.75

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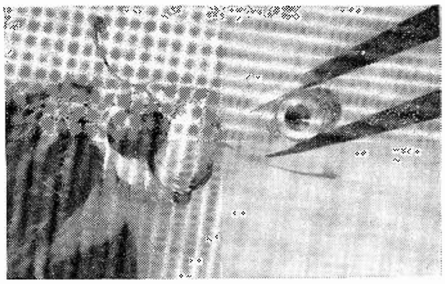
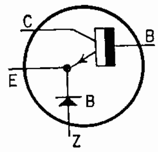


and velocity indicators. Dark current is typically 10 μa at 100°C, light current about 1 ma. Power dissipation is 50 mw.

The photo shows a fascinated moth inspecting the sensor. TI wants you to notice the size of the sensor compared to the size of the moth's eye. Perhaps he is considering a replacement?

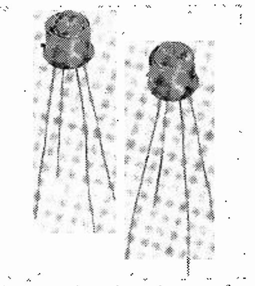
Integrated reference amplifiers

Some gentlemen at General Electric have come up with what seems like a fine idea: they have combined a voltage reference device with a dc amplifier.



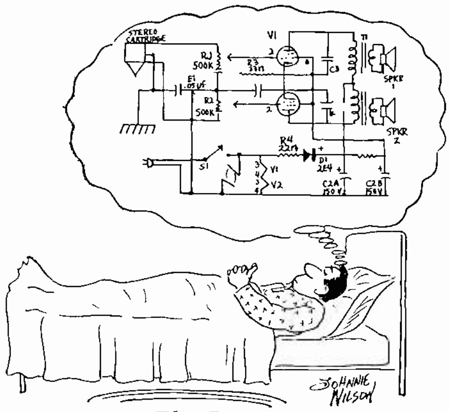
Specifically, they have put in one TO-5 package a Zener diode junction and a transistor—semiconductor analogues of the gaseous voltage-reference tube and (usually pentode) amplifier in so many tube regulated power supplies.

Some of the advantages of the marriage are lower cost than the two separate units, both in initial manufac-



ture and in production later, fewer connections, better temperature match, less space.

The device is used to control a series or shunt regulating element in regulated current or voltage supplies. END

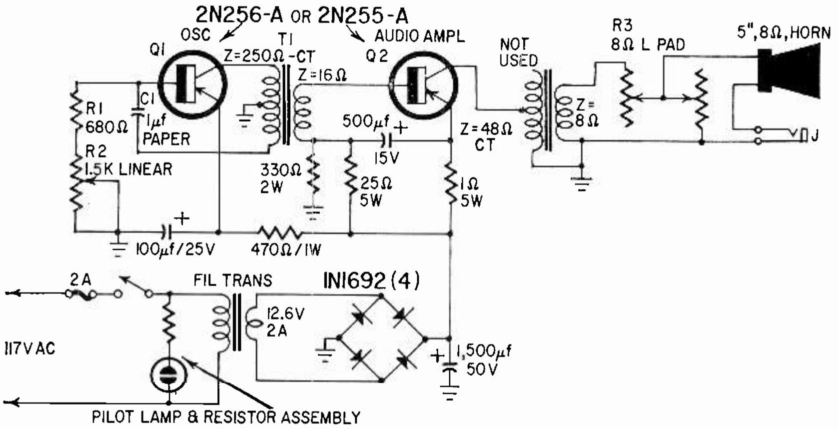


The Dreamer

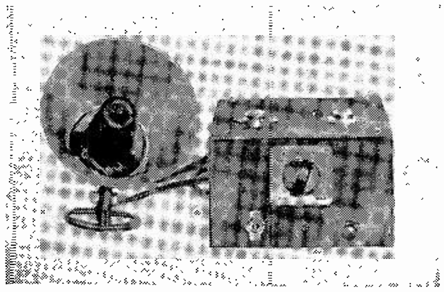
noteworthy Circuits

Industrial Tone Alarm

Here is an inexpensive, easily built, oscillator–audio amplifier that packs a hefty wallop and is rugged enough for industrial use. It lends itself well to a host of applications where a triggered tone alarm is required to attract attention. For example, in areas such as go–no-go gaging or nondestructive testing, a pair of contacts on the actuated relay, connected across jack J, will complete the speaker circuit, producing a loud tone.



The unit is straightforward in most respects with a base-driven 2N256 oscillator driving a 2N256 audio amplifier. Feedback from transformer T1 is fed to the base of transistor Q1 through C1. The oscillator tone is controlled by the values of C1, R1 and R2, with R2 providing a small adjustable tone range. The component values produce a tone range between 700–1100 cycles, which seems effective for most applications.



R3 is an L-pad speaker volume control and also provides a load across T2's secondary when the speaker is disconnected. The unit runs continuously but sounds an alarm only when a pair of external contacts connects in the speaker. An alternative to speaker switching would be switching transistor Q2 in and out. Keying the oscillator produces a slight chirp. Other methods of switching will occur to you.

The alarm is constructed on a 5 x 6 x 1-inch utility box with chassis.

The cabinet top is a satisfactory heat sink. The transistors are mounted with a Cinch-Jones Type 2W-1 or equivalent Workman or Motorola anodized wafer. Coat the wafer on both sides with silicone grease for improved heat transfer from the transistors to the chassis.

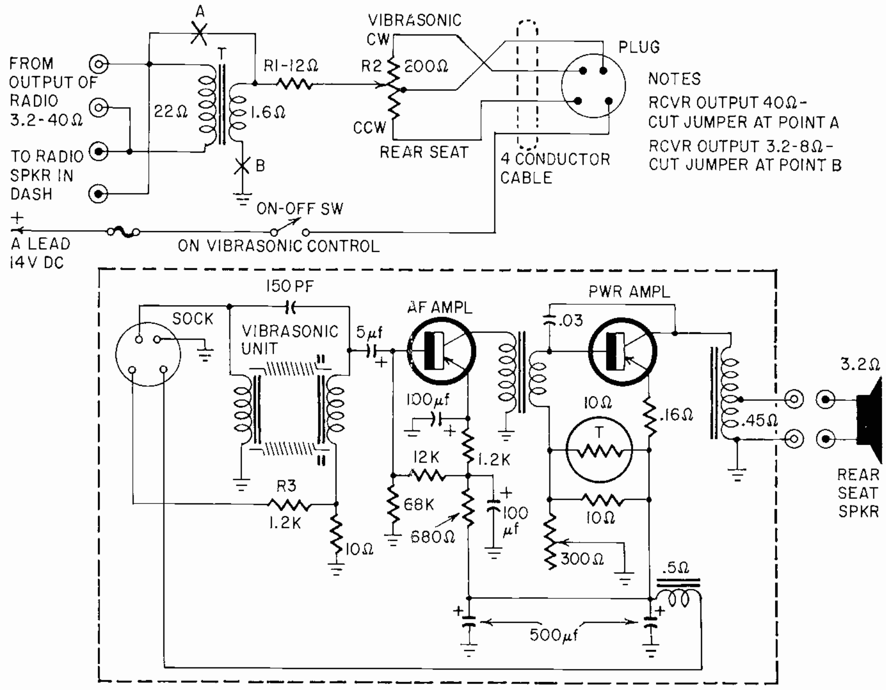
The power supply is a full-wave bridge giving 12 volts dc.—*D. R. Ripani*

Reverberation in a Car Radio

Add the Motorola Vibrasonic unit to a car radio and you have reverberation. At the heart of the two-transistor reverberation system is an input and an output transducer separated by a delay line made of two precision-wound springs. The input transducer receives the audio signal from the radio output and converts it into a mechanical rotary motion. This motion is transmitted via the springs, which introduce a specific delay, to the output transducer that converts the rotary motion back into an electronic signal. This delayed signal is then amplified and fed to the car's rear-seat speaker.

The diagram (right) shows the circuit. Audio from the auto radio is fed the Vibrasonic input through coupling transformer T. R1 protects the input transducer against overloads at high signal levels. R2 is the Vibrasonic level and rear seat speaker fader, controlling the input to the system.

When R2 is at the center of its rotation, the audio signal is grounded. If the control is turned clockwise from this center position, the audio signal is fed to the delay line. Counterclockwise rotation feeds the audio through R3 and the output transducer to the amplifier, bypassing the delay circuit.—*Warren Roy*



Heathkit Multiplex Adapter

Would you like to modify your Heathkit AC-11 FM multiplex adapter so the pilot carrier does not beat with the tape recorder's bias oscillator when recording a stereo broadcast? It's easy. You simply install a 19-kc filter in the adapter's output circuits.

Fig. 1 shows the cathode-follower

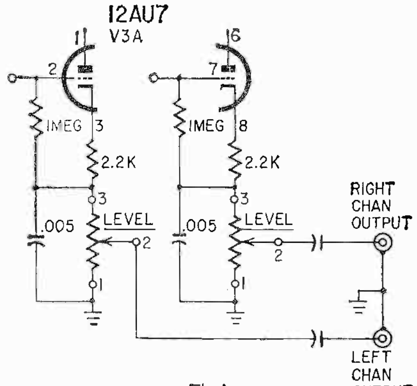


Fig.1

output stages in the AC-11. Fig. 2 shows one of the output stages with the 19-kc filter added.

Order two Heathkit No. 45-48 19-kc coils. Connect a coil and 200-pf

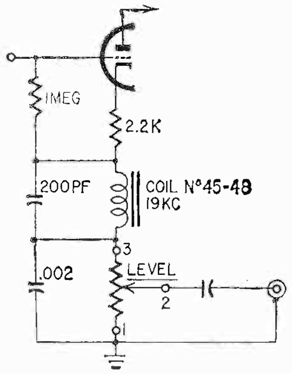


Fig.2

capacitor in parallel between the bottom end of each 2,200-ohm cathode bias resistor and lug 3 on the output level control as in Fig. 2. Replace the .005-μf capacitors across the level controls with .002-μf ceramics.

Caution: Mount the coils horizontally so they won't pick up hum from the power transformer. Insulate all leads and keep them as short as possible.—*P. D. Ross* END

50 Years Ago

In Gernsback Publications

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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 November, 1913, Electrical Experimenter

Experimental Radiophone Arc Set, by H. Winfield Secor.

Coherer Receiving Sets, by Henry Scott.

New French Wireless Apparatus, by H. Gernsback.

Great Lakes Wireless.

How to Make an Interference Preventer, by Eugene Dynner.

Coherer Receiving Set.

try This one

Coupler for Phono Pin Plugs

Two cords with phono pin plugs can be quickly and easily joined together with this shielded adapter.

You will need a 1-inch length of brass, copper or iron pipe (inside diameter at least ¼-inch), and an outside diameter of about ⅜-inch. (I used a 1-inch length of threaded brass nipple, known to electricians as "⅛ pipe nipple" and sold at most electrical supply counters.) You will also need two single-hole-mounting phono pin jacks (imported units sell for as little as 8¢ each).

Assemble the coupler as shown in the photo.

Top: Cut a 1⅛-inch length of flexible insulated wire and solder one end to the center lug of the left-hand jack. Then solder the jack securely into the end of the brass tube. Solder the other end of the wire to the center lug of the right-hand jack and solder the jack into the remaining end of the tube. The soldering is not difficult—simply run a little solder all around the ends of the tube where the jacks join the tube.

Center: The coupler ready for use.

Bottom: The coupler barrel is wrapped with tape to improve its appearance. Two cords with phono plugs are shown plugged into the coupler.—*Art Trauffer*

Jumper for Series-String Sets

When you troubleshoot, say, a video i.f. in a series-heater set by bypassing the stage with a capacitor, you have to remove the tube. This of course kills the heaters.

To get around this dilemma, find a defective 7-pin miniature tube with a good heater, and cut off all but the heater pins (3 and 4). Replace the pulled tube with this dummy to complete the heater circuit.

Be sure that the heater rating of the dummy is the same as that of the tube you're replacing. In fact, why not accumulate a set of dummies for this kind of troubleshooting?—*E. L. Deschambault*

Inexpensive Photocell Housing

The transparent plastic bubble in which experimenter type International Rectifier Corp. photocells are sold makes an excellent dome enclosure for uncased cells such as the B2M selenium unit and thin-wafer silicon cells. This bubble is almost hemispherical, 2 inches in diameter and ½ inch high. It has a flat ⅛-inch lip around its base.

Using a razor blade, carefully remove the bubble from the card to which it is glued. Then mount your cell on a 2-inch diameter disc of thin plastic. (Wafer cells may be cemented to the disc; the B2M requires a short 6-32

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Pay-TV Accepted in Hartford

Hartford, Conn.—Local residents have apparently accepted subscription TV as another entertainment medium, according to *Home Furnishings Daily.*

For more than 2,000 homes in the Greater Hartford area such programs are regular fare, and they pay about $6 a month to watch them.

Hartford launched pay-TV over uhf channel 18 late last year after FCC authorization to conduct a 3-year experiment to test pay-TV's feasibility.

New installations of the Zenith decoders are being made at the rate of about 75 per week, and station operators are reported as "very pleased." Installation costs $10, and after the first 3 months (which are rent-free) a weekly rental of 75¢ goes into effect.

Beyond that, clients pay only for what they watch. Rates vary from 25¢ to $3 per program, with the average about $1 to $1.50. The station offers 30 hours free and 30 hours pay TV a week. Credit is given toward rental charges, based on the number of pay programs watched. Programs now consist chiefly of new movies and live sports events.

Service technicians and TV dealers in Hartford appear to be reacting favorably to the new service, HFD reported.

screw passed through its bracket hole and a hole drilled in the disc.) Two ¾-inch 6-32 screws passed through the disc serve as terminals, to which the cell pigtails are connected internally, and also as mounting screws. Fiber washers will insulate them if the assembled unit is mounted on a metal panel. Finally, fasten the bubble to the disc with a thin layer of cement or glue applied to the lip of the bubble. This construction is shown in the photograph.

Several small cells may be enclosed in one dome and wired together to form a solar battery.—*Rufus P. Turner*

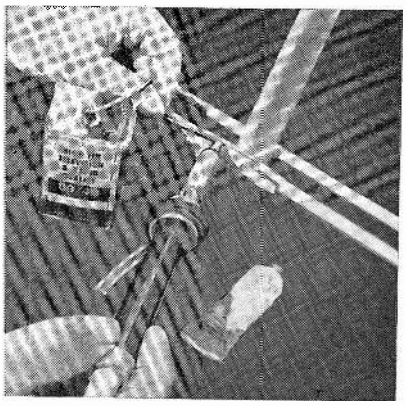
Rotating Rat-tail Is Reamer

For reaming out small holes in chassis and more particularly for speedily shaping an odd-sized or irregular hole in metal components, few tools will work as fast or as well as a 2-inch piece broken off a fine-toothed rat-tail file chucked in an electric drill.—*Henry Josephs, Sr.*

Solder Antenna Hardware

Many antenna components are held together with aluminum studs riveted in and threaded on the ends to hold the terminal nuts and washers for the lead-in.

After such antennas have been in service for a while, exposure to the weather causes the studs or nuts to



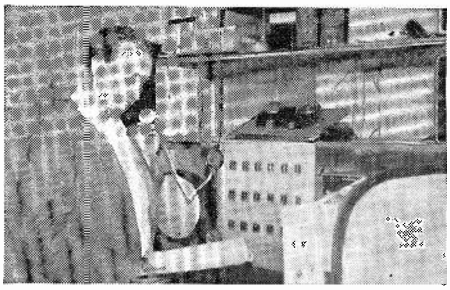
loosen. Then, when you try to get the terminal nuts off, or tighten them, the entire stud turns and makes the job hard.

To prevent this, before we ever use the antenna component, we tin the aluminum of the stud and the adjacent areas, and solder it fast. (Using Al-Met flux and multicore solder, a soldering iron puts solder on aluminum just as easily as if it were copper.)

That way the stud stays fixed throughout the life of the antenna.—*Harry J. Miller.*

Bench Tape Recorder for Case Histories

A small tape recorder kept within easy reach on the service bench is great for making "mental notes" while serv-



icing, preserving case-history information, recording symptomatic noises for later comparison, and such uses. Better than notes: tape won't blow away or get coffee spilled on it!—*Harold Davis*

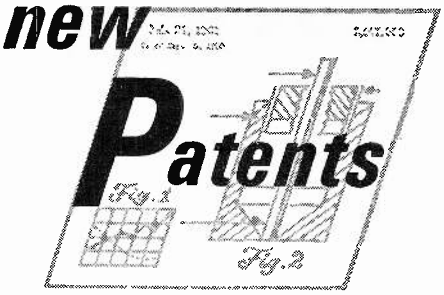
Rod Cleans Solder Holes

You can make a printed circuit service aid by taking a small aluminum rod and grinding down one end to a fine point. Use it to clean holes of solder after removing a defective part and before the new part is replaced. Insert the tapered end into the circuit as soon as the solder is liquefied and hold it there until the solder cools. Since the solder will not stick to the aluminum, this leaves a clean opening.—*L. S. Kroll*

Cure for Cord Tangles

The radio–TV and electronic hobbyist and service technician has always been plagued by tangles in power cords. If microphones and telephones can have coil cords, why not other types of electronic equipment? There's no sense wasting hours untangling cords when a few minutes and dollars spent on coil cords bought from your electronic parts catalog will rid you of the trouble forever. (Allied catalog No. 50N938, price 83¢–6 feet long, 10 amperes capacity.)—*John A. Comstock*

END



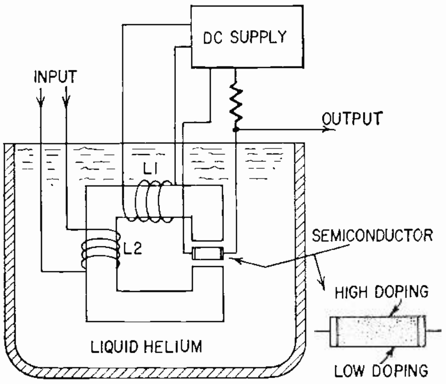
Low-Noise Amplifier

PATENT No. 2,979,668

William Crawford Dunlap, Jr., Birmingham, Mich.
(Assigned to Bendix Corp.)

At extremely low temperatures, germanium is an insulator. Placed in a magnetic field and biased by dc, the semiconductor begins to pass current. Doping the semiconductor unevenly makes some parts begin to conduct before others, and the transition from insulator to conductor occurs gradually.

The 200-volt dc power supply biases the semi-



conductor and also passes current through L1 to create a magnetic field. This field is modulated by signal flow through L2. Magnetic core and semiconductor are immersed in liquid helium (4° K).

Varying the effective field at the semiconductor changes its resistance, producing corresponding changes in the output voltage.

Signal Identification

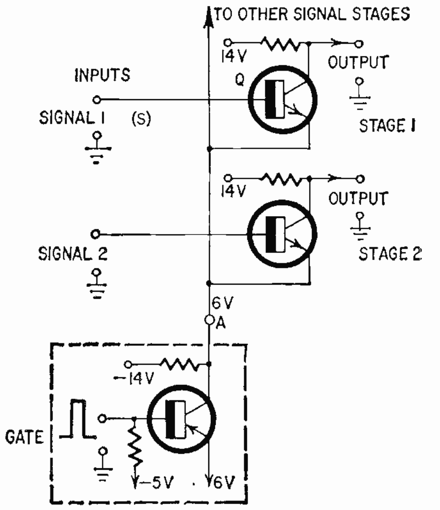
PATENT No. 3,092,732

Richard E. Milford, Glendale, Ariz.
(Assigned to General Electric Co.)

This circuit determines which of several signals is the most positive. Only two signals are shown here, but as many as 14 or more may be applied, each to its own stage. Signals may vary between −5 and 6 volts, for example. Normally the gate conducts, so 6 volts appears at lead A to block each signal stage.

To identify the desired signal, a positive pulse is impressed to block the gate. Then −14 volts appears at A.

Now consider a most-positive signal, S, ap-



plied to a transistor, Q. Base-emitter voltage is nearly zero, so S appears at all emitters. Since S is more positive than any other signal, it blocks every transistor but Q. Only Q generates a negative output pulse to identify itself.

Instant Monitoring

PATENT No. 2,969,529

Paul R. Gilson, West Covina, Calif. (Assigned to Burroughs Corp., Detroit)

In magnetic data processing, it is desirable to be able to check a recording immediately. This can be done if the read (playback) and write

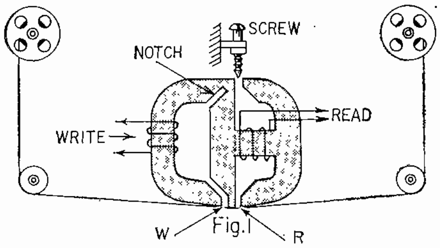


Fig.1

(recording) heads are near each other, so that the output may be compared with the input. However, when the heads are too close, undesirable magnetic coupling may result.

Fig. 1 shows a special core design that permits the heads to be within .05 inch of each other without coupling. W and R are the fixed gaps of the write and read heads, respectively. The notch is also a fixed magnetic gap. The upper-right gap is adjustable with a screw.

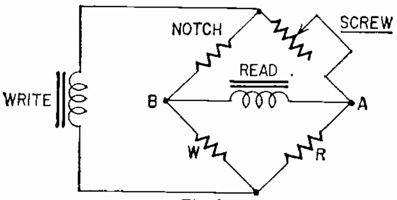


Fig.2

The core is actually a magnetic bridge that may be redrawn (Fig. 2) in the form of the more familiar electrical bridge. Reluctance is drawn as resistance, magnetomotive force as voltage. When the variable arm is adjusted for balance (the gap screw), the flux (current) through the bridge paths are such that no mmf (magnetomotive force — voltage, in this analogy) can appear across the read coil.

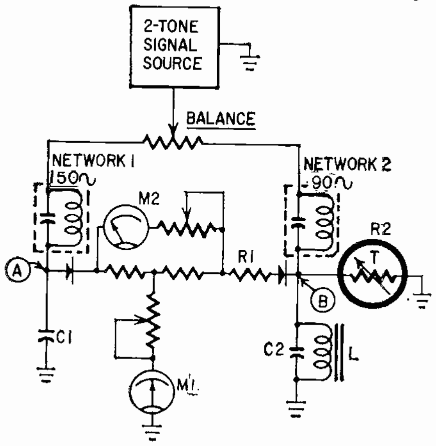
Since the write coil cannot affect the read coil, the only output from the latter will be from the tape.

Glide-Path Indicator

PATENT No. 3,049,667

Samuel L. Broadhead, Jr., Cedar Rapids, Iowa, and Arthur L. Kemper, Marion, Iowa. (Assigned to Collins Radio Co., Cedar Rapids)

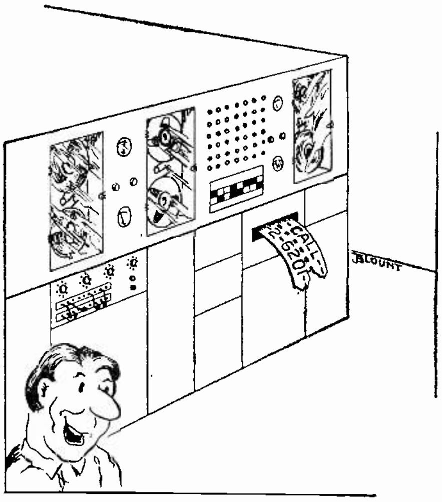
This guidance system depends upon two tones: 90 and 150 cycles. An airplane pilot knows his exact position in flight from the relative strength



of these frequencies. Network 1 is inductive below 150 cycles, and C1 is added to resonate it to 90 cycles. Network 2 is capacitive above 90 cycles, and L is added to resonate it to 150 cycles. The signal is essentially 90 cycles at A, and 150 cycles at B.

The rectified signals flow through M1 in opposite directions. This meter has a zero center, so its deflection shows which tone predominates and by how much. M2 is a voltmeter with a colored flag which shows only if the signal strength is high enough for reliable operation.

Thermistor R2 stabilizes the circuit. C2 is an rf bypass. R1 compensates for the nonlinearity of iron-core conductor L. END



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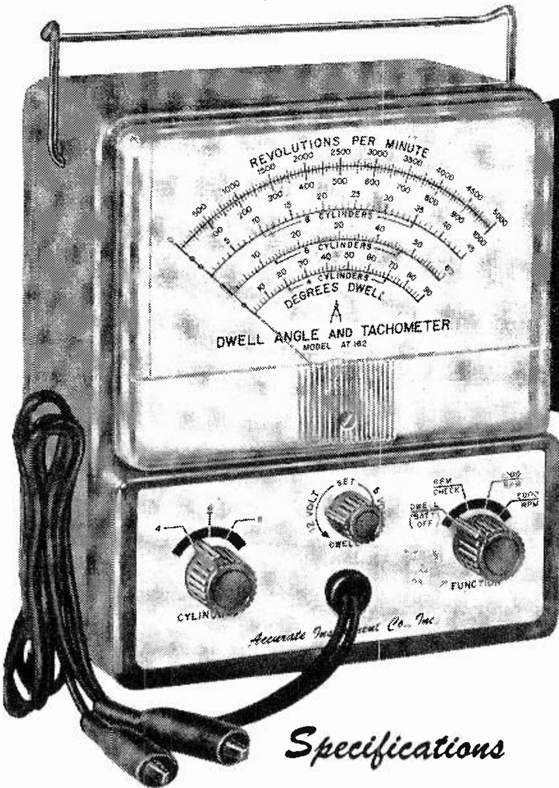

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RADIO ASTRONOMY, by Jean Louis Steinberg and James Lequeux. *McGraw Hill Book Co., Inc., 330 W. 42 St., New York 36, N.Y. 6 x 9 in. 260 pp. Cloth, $9.95.*

Written by two European experts in the field. About one third of the book is devoted to electronic equipment for radio astronomy. Radio telescopes and interferometers each get a long chapter.

VECTOR AND PHASE ANALYSIS, by Alan Andrews. *Howard W. Sams & Co., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in, 128 pp. Paper, $2.95.*

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ELECTRONICS CIRCUITS HANDBOOK, by Tom Kneitel, WB2AAI. *Cowan Publishing Co., 300 W. 43 St., New York 36, N.Y. 6 x 9 in., 126 pp. Paper, $3.00.*

A compilation of useful schematics, construction hints and operating data on ham and CB equipment. Many items are unusual and hard to find elsewhere. Transmitters, receivers, test devices, noise limiters and frequency standards are included.

MODERN PHYSICS (2nd Edition), by Robert L. Sproull. *John Wiley & Sons, Inc., 605 3rd Ave., New York 16, N.Y. 6 x 9 in., 630 pp. Cloth, $9.75.*

An advanced physics text, starting with fundamental particles, going through nuclei and atoms and wave-particle experiments to introductory quantum mechanics. A good deal of attention is given to electrical, thermal and magnetic properties of solids from the viewpoint of electronics.

TV SERVICING MADE EASY, by Wayne Lemons. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 160 pp. Paper, $2.95.*

Fast troubleshooting, service hints and test gadgets are described in practical language. Shows how to cut servicing time, particularly in the more complicated TV stages: horizontal sweep, high voltage, agc.

ESSENTIAL CHARACTERISTICS. *Receiving Tube Dept., General Electric Co., Owensboro, Ky. 5½ x 8½ in., 302 pp. Paper, $1.50*

This spiral-bound manual has separate "strip" pages below the main pages, so that a tube's characteristics (main pages) may be consulted while viewing its basing diagram (in numerical order on "strip" pages). Pix tube and special tube listings, plate characteristics, useful schematics are included. END

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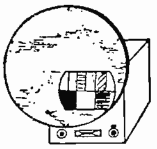

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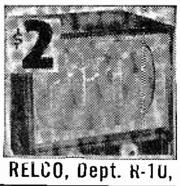

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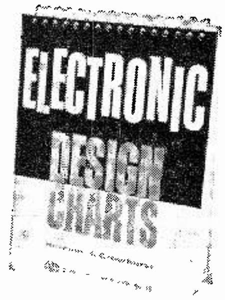

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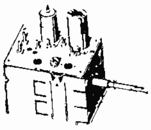

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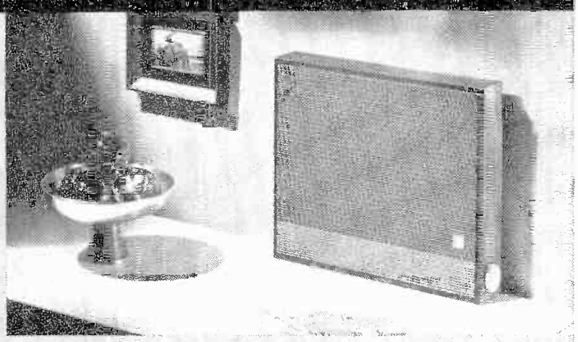
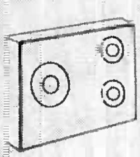




X-20 3-speaker 2-way system. May be used with amplifiers having 4, 8, or 16 ohm output. Power rating 6 watts. Adequate room sound with 1 watt to speaker. In oiled walnut $39.95

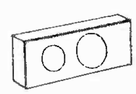
SLIM COMPACT X-20 3-speaker 2-way system

Unbelievably excellent sound quality is yours from Jensen's famous X-20 speaker system. A specially designed woofer with powerful SYNTOX-6® magnet, plus *two* tweeters provide smooth, wide-range sound for your listening pleasure. Extra slim . . . perfect for wall mounting. Convenient side control allows volume adjustment. Dimensions: 12⅞" H, 15⅜" W, 2⅝" D.

NEW ULTRA-COMPACT X-11

2-speaker 2-way system

A special woofer with a new moving system precisely matched to its diminutive enclosure is largely responsible for the truly remarkable performance of the X-11. A 3" tweeter extends high frequency response to 14,000 cycles. Improved efficiency gives full room volume with amplifiers of low power rating. Volume is adjustable by a control on the side of the cabinet for convenience in extension speaker applications. Dimensions: 6⅝" H, 13$^{11}/_{16}$" W, 4" D.



X-11 2-speaker 2-way system. May be used with amplifiers having 4, 8, or 16 ohm output. Power rating 6 watts. Adequate room sound with 1 watt to speaker. In oiled walnut $29.75

JENSEN LOUDSPEAKERS

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