
13 SEP.61

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Contents

Staff:

editor-publisher .... Wayne Green W2NSD
publications manager .... David Fish
associate editor .... Don Smith W3UZN
associate editor .... Jim Kyle K5JKX/6
associate editor .... Marvin Lipton VE3DQX
associate editor .... Charles Spitz W4API
subscriptions .... Mrs. Green
transportation .... needs paint
printing .... O'Brien Superban Pressers

Western Representative: Jim Morrissett WA6EXU
Box 847, Reseda, California. Ph: DI 5-2077

COVER: Mosaic.

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. . . de W2NSD

(never say die)

Reciprocation

Senator Barry Goldwater has just introduced a bill into Congress to permit reciprocal licensing of amateurs. It was referred to the Committee on Commerce. Please write immediately to your representative in Congress asking for support of Senate Bill S.2361. Here is your chance to be a hero, don't muff it through laziness or disinterest. Sit down and write. This could have far reaching results toward preserving our frequencies in the long run.

Get Rich Quick

Nonsense, of course. Well, as mentioned an issue or so back, I'm anxious to make some information available at low cost that might not otherwise see print. We're getting set up to publish small booklets, between ten and twenty pages long, right at our 73 office. This will keep costs down, keep me out of trouble running the offset press and Varityper, and make it possible to make these available at a low price.

This will also make it possible for us to pass along a good piece of the income from such a venture to the author of the booklet. I figure we can put out the booklets for 50¢ to 75¢ each and return 20% of this to the author. This means up to $200 for every thousand booklets we sell. OK, stop fidgeting. I'm open for suggestions as to the subjects. One benefit of publishing small booklets is that they can cover one particular subject quite thoroughly and don't take the year or so of work that a regular book does.

Suggested subjects: Nuvistor circuits compendium and discussion; De-noising cars; Mobile antennas; Conversion of Motorola FM gear for ham use; Complete receiver construction articles; Antennas for 1296 mc; How RTTY Works; RTTY Converters; What TT printers to get and where to get 'em; How to keep a ham club alive and kicking; Roster of 432 mc stations; Who's Who on 1296; etc. If you can think of a subject that you think 1000 people will pay 50¢ to read about then check in to make sure that you arent' racing someone else on the same subject.

Once published, we'll keep the booklet in print as long as it continues to sell. We'll push it in 73, you may be sure, and we'll not only sell it directy but have it on sale in as many radio parts distributors as possible. Most booklets should sell well over 10,000 copies . . . none of the seven books I've produced in the field have sold less!

Bulletins

It is probably bad policy to tell everyone what we're planning for the future, but I'd like to see the reaction and a little discussion of it might just get someone thinking.

Our policy, right from the start, has been not to have any monthly activity columns in 73. There is no notion of changing that. We've proven rather conclusively that there is no need for more columns. But there is a need for communications between fellows with similar interests. RTTY never got off the ground until there was a bulletin keeping everyone in touch with the happenings in the field and serving as a clearing house for operating news and technical discussions.

At present 73 is subsidizing the "73 News," put out by Marvin Lipton VE3DQX. This is a monthly paper which is sent out to all of the editors of ham club bulletins around the country (and the world) to give them news flashes of interest to help them with their bulletins. If the number of club bulletins coming in here with notes of credit to "73 News" is any indication, Marvin is doing a splendid job.

Undoubtedly there is a need in many other ham fields for a bulletin to exchange information. It is a lot of work to put out something like this. I've been through it myself, so I really know what it is all about. I started mine with a circulation of 50 on a hand mimeo and wound up with over 2500 three years later using offset printing. This was what got me into the publishing field originally and look what happened! With that warning I suppose I have discouraged you.

Though we have over two hundred thousand hams in the country, there are only a few who have the drive to take things into their own hands and do something about problems. We have a need for communications in many fields and a lot of good would be done if people were to suddenly decide to start a bulletin in that field. Note: most everyone will cooperate with you and send in information, but there will be a few who will fight you tooth and nail just on general principles. They want to know who the hell you are to set yourself up as the big cheese, etc.

Ditto and mimeo machines are quite inexpensive in used shape and are invaluable to the bulletin producer. It is amazing how these things grow. I now have a small mimeo, a large mimeo, a Ditto, five different types of typewriters and a Varityper. Next comes an offset press, a stapler, and a large paper cut-

"Terrific!...Unbelievable... Best rig – ever"!

Here are a few unsolicited comments from owners of Clegg VHF equipment

Clegg Zeus VHF Transmitter FOR 6 AND 2 METERS

A highly efficient, 185 watt AM, high power VHF transmitter for full coverage of the amateur 6 and 2 meter bands and associated Mars frequencies.

Automatic modulation control with up to 18 db of speech clipping provides magnificent audio with "talk power" greater than many kilowatt rigs.

This beautiful unit with its ultra-stable VFO is the ultimate in VHF equipment for amateur and Mars operation.

99'er Transceiver FOR 6 METERS

This completely new transmitter-receiver is ideal for both fixed station and mobile operation. Small in size, low in cost, and tops in performance, the 99'er offers operating features unequalled in far more costly equipments. The double conversion superhet receiver provides extreme selectivity, sensitivity and freedom from images and cross modulation. The transmitter section employs an ultra-stable crystal oscillator which may also be controlled by external VFO. An efficient, fully modulated 8 watt final works into a flexible Pi network tank circuit. A large S meter also serves for transmitter tune-up procedure.

From Ohio:

". . . I am a quality control supervisor with a leading electrical manufacturer and this Zeus transmitter is to me the finest piece of workmanship that I have ever purchased or inspected . . ."

Richard E. Hayes, K8UXU

From New Hampshire:

". . . We feel that our new Zeus is the best thing that ever happened to us since we have been in ham radio (5 years) . . ."

Hazen & Beatrice Bean, K1JFQ

From Florida:

". . . We are well satisfied with the results of this unit as we have worked forty DX contacts in little more than three hours on May 23, 1961, including six new states which we were unable to work in the past two years with a 120 watt, 6 & 2 transmitter of a different mfg. . . ."

Jack Edlow, K4YIW

From California:

". . . Never before have I been more pleased with a piece of gear than I am with my Zeus. In two days I have worked 24 states with several contacts in each, (phone) on six meters. And the signal reports — yow! For the most part unbelievable . . ."

Jeanne & John Walker, WA6GEE

From Pennsylvania:

"Words cannot express the pleasure and performance of ZEUS. I have worked 5 states 5-9, plus I have given you $1,000,000 advertisement . . ."

Dr. A. Schlecter, K3OEC

From Puerto Rico:

". . . I want to inform you of the excellent results obtained with the Zeus Transmitter I bought one month ago. Taking advantage of the band opening, I have been able to work up to the present thirty-eight states, including California . . ."

Pedro Fullana, KP4AAN

From New Jersey:

". . . I would like to tell you I am more than delighted with the operation of the Zeus. Have had nothing but good reports from other Ham's . . ."

Donald E. Gillmore, WA2QCQ

From Georgia:

". . . This set is terrific. I've had terrific results with it. It's the best rig — ever."

George E. Missback, K4QOE

K8CHE in Ohio tells about 99'er

". . . with the 99'er haywired in from a four element beam, through 100 feet of coax, through a matching network, through a length of 72 ohm twinlead, and then through a length of 300 ohm twinlead to reach the 99'er, we could read the Michigan stations Q5! and back through the above haywire we were able to put 4.4 watts into the antenna as measured by a RF ammeter! . . ."

Ken Phillips, K8CHE

Clegg LABORATORIES

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ter (I have a small one).

Once you have the machinery you can start by mailing your first thin bulletin to those few chaps you know who are interested in the field. Ask them all to recommend more readers. By the time you are putting out the third or fourth issue you will have most everyone on the list.

What fields are there? Lots come to mind right way. Ham TV, FAX, 220 mc, 432 mc, 1296 mc, contests, 2M SSB, 6M SSB, 75M DX, 160M DX, plus bulletins on VHF, SSB, awards, DX, etc., which would stress different aspects than are being covered by presently published bulletins. You can probably think of some that I have missed.

You'll never get rich putting out a bulletin, but you will have more fun than you've ever thought possible. I'll help anyone that wants to get started in any way I can (I'm short of money right now, but maybe by next year, if a few more advertisers will start using 73, we'll be in shape to even help that way). We'll give you every hand we can through the pages of 73 also as long as you don't tie up too firmly with other publications.

Changes

The result of the poll on our diagrams was in favor of the gray background. We'll try to get the engravers to make the gray lighter and the diagrams larger. I get just as distressed as as anyone when I see how small some of them come out. Absurd. We topped ourselves last month with the construction details on the Impedance Bridge. I'm having larger copies made of them for anyone interested in building the instrument. These should be available any day now for $1. I'd like to send 'em out free, but we're constantly shying away from bankruptcy and I don't want to topple us. By next year we should be able to do things like that for the fun of it. We will if you'll keep needling those non-advertisers.

(Turn to page 69)

Club Subscriptions

As announced a few months ago, clubs may send in group subscriptions at the rate of $2.50 per one year subscription in groups of five or more subscriptions. These subs must start with the next published issue and be for just one year. Orders for back issues should be sent in separately. By simplifying the procedure we can offer this reduced rate.

The regular subscription rate is $3 per year; $5 for two years; $4 per year for DX operators outside North America. All back issues are 50¢ each. Send your name, call and address to 73 magazine, 1379 E. 15th St., Brooklyn 30, New York. Include money.

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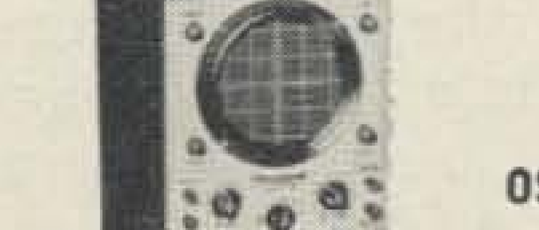

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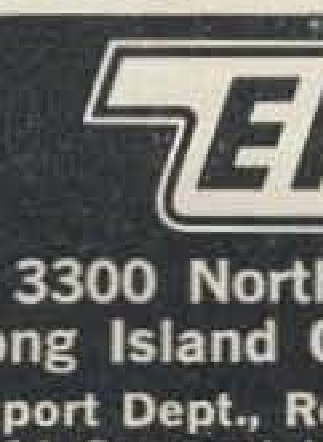

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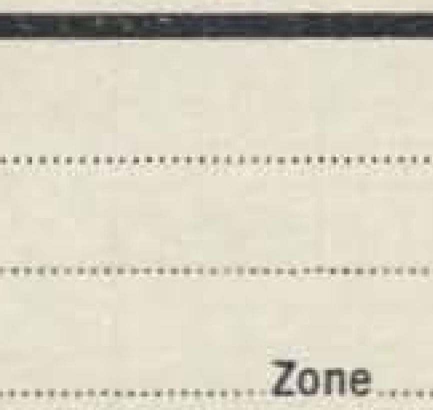

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Silicon Rectifiers

and how not to blow them up

Hank Cross W1OOP
111 Birds Hill Avenue
Needham 92, Massachusetts

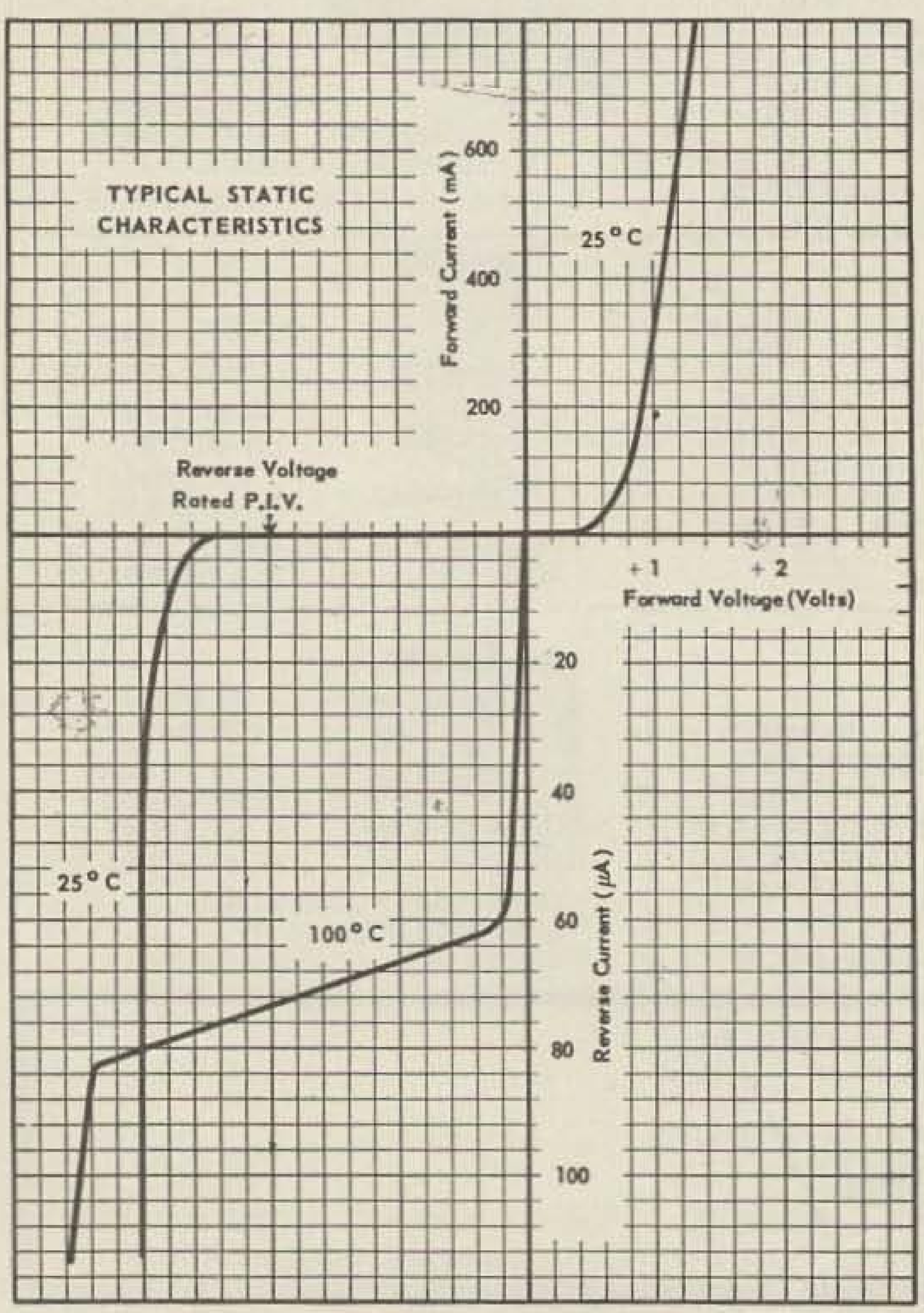
MANY hams and engineers that I know are mad at silicon power rectifier diodes. They tried them once and the results were disastrous. (The engineers are madder, because they thought they knew what they were doing). Nowadays the diodes are better and cheaper, and people are still popping them.

What Not to Do

If you own a slide-rule and a scope, plus lots of diodes, you can work out how to get away with almost anything in the way of a circuit. For the simple way out, avoid:

Choke Input Filters. When you open transformer primary, diodes get voltage surge, blow up.

Half Wave rectifiers, except direct off the line. That unloaded transformer is murder on the backswing.



What to Be Sure to Include

A Series Resistor. For 115 volt rectifiers, ten ohms seems adequate for all commercial diodes. Transformer secondary dc resistance should be at least six ohms per hundred volts, add some if there isn't enough.

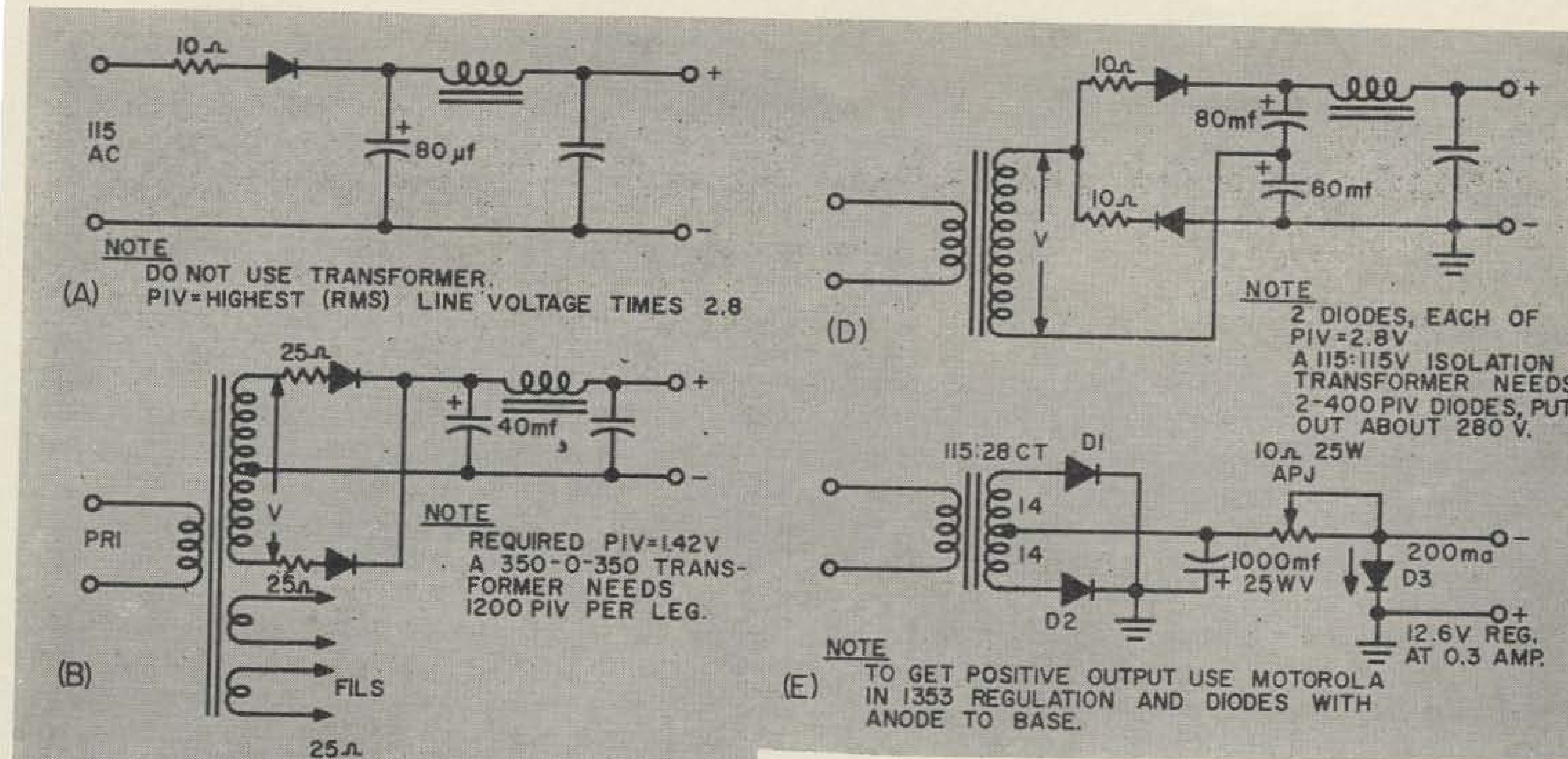
A Fuse. Secondary fusing (NOT a slo-blo) is smartest. Even 83's put out less into a short. And transformers cost money.

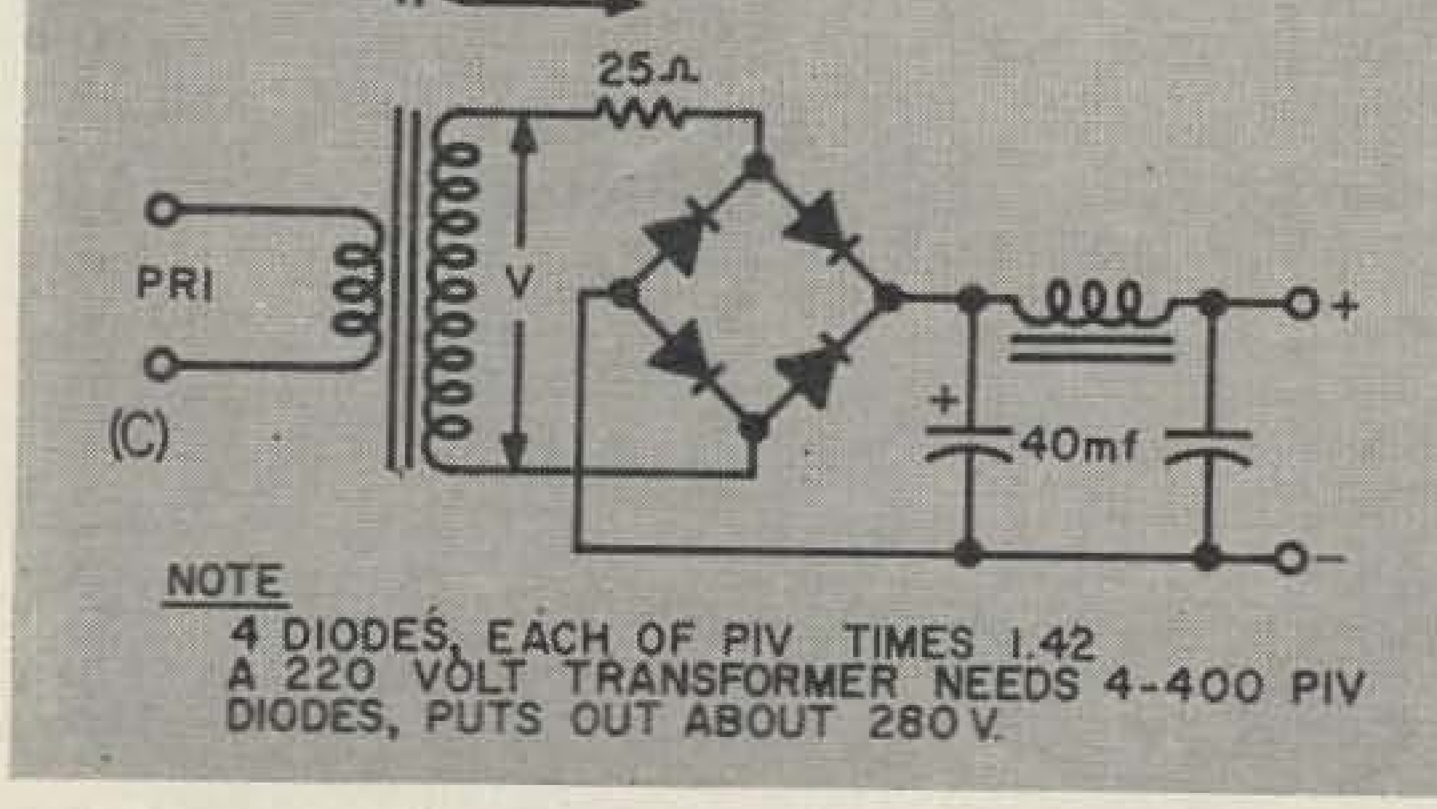
Enough peak inverse rating to do the job. Most small silicon diodes die of back voltage. My "115 volt" line went up to 138 without help from a variac one night: that's 200 peak or 400PIV for an ac-dc rectifier. My silicons didn't go, but a 500 volt electrolytic spread Reynolds Wrap all over the shack! (The power co. said it was a defective regulator). If you replace a 5Y3, 5U4 or 6X5 with silicon diodes, do not be surprised if the transformer runs hotter. Adding series resistance to replace the "plate resistance" (about 200 ohms in the case of a 5U4) will cool things down, if you want.

Ratings

Figure 1 shows the "plate characteristic" of a silicon diode—almost any diode. A volt in the right direction makes amperes flow; a good diode has a fraction of a microampere of leakage at room temperature in the reverse direction, up to the "avalanche" voltage, which depends on the diode and the temperature. Lower temperature gives less leakage and LOWER breakdown voltage; higher temperatures (up to that of melting solder at or near the junction) give greatly increased leakage, higher avalanche voltage, and slightly less forward drop (at least for low forward currents).

The surge and forward current ratings are set so as not to melt the working parts; the rated PIV (peak inverse voltage) is picked so that it's below the avalanche voltage at minus 65C, even (a comforting thought). For some reason (such as fairly fancy testers) diode manufacturers don't put in a factor of





safety—you have to do that. A term, "maximum allowable RMS voltage" shows up on some rating sheets: it usually means that you could test the diode into a resistor at that voltage, but in any real circuit half as much voltage would be excessive, so forget it.

For a GE 1N1490 (to pick a type that I have used a lot of) the ratings read:

Maximum allowable PIV	400 volts
Maximum allowable RMS voltage 280 (see remarks above!)	
Maximum allowable continuous reverse dc voltage	400
Maximum allowable dc output at 125C ambient	250 ma
Maximum allowable dc output at 25C ambient	750 ma
Maximum allowable one-cycle surge current	15 amps
Max. full-load forward drop	0.55 volts
Max. leakage current, full-cycle av at 125C	0.3 ma

The power lost in leakage and in forward drop are about the same at 125C, which is hotter than I would run *any* silicon diode for any length of time beyond a few seconds.

What this means can be shown by some circuits. Figure 2 A using a 1N1490 will take 117 ac and give about 150 dc at up to 500 ma.

In circuit 2-B you'd need three of these diodes in series for each side of a 350-0-350 volt transformer, and get about 400 out under the transformer's rated load . . . six in all for 300 mils out of an old TV transformer.

The bridge rectifier in 2-C could use a 110 to 220 volt isolation transformer (sold as a 220 to 110, most likely) to give 280 volts at 300 ma continuously with a 100 watt transformer, such as Stancor P-6383, and a 125 mfd input capacitor.

Figure 2-D shows how to get 280 volts dc from only two diodes and a 115 to 115 isolation transformer. A 50-watt unit is good for about 125 ma. Popular in modern TV sets.

In any of the above circuits, more output voltage than the example requires either higher PIV diodes or more in series. The price of diodes above 600v is quite high; at present it is cheapest to buy 400 or 500v units and put them in series.

Replacing Seleniums

The rules are simple: a six-plate selenium stack equals a 400 PIV silicon diode. An eight-plate stack should be replaced by a 500 or 600 PIV silicon. In choke-input circuits using seleniums, where the selenium rectifiers have "aged" but are not burnt, put the silicon diodes *across* the seleniums, and let the seleniums soak up voltage surges to protect the silicon junctions.

Heat Sinks

The bolt-on silicon diodes are used for higher average currents, but in many cases there is no need to bolt them to anything better than a solder lug. Rather than use mica washers and risk shorts, I prefer to bolt the diodes to individual plates of 1-16 in. aluminum and insulate these plates, such as with threaded ceramic standoffs. These cooling fins should usually be vertical. By picking circuits, it is often possible to run the diode cases at ground potential and avoid insulating, as in Fig. 2-E. The voltage regulator or "Zener" diode is what gets hot, so pick the polarity to go with your diode. . . . W1OOP

Tuning Bypass Capacitors

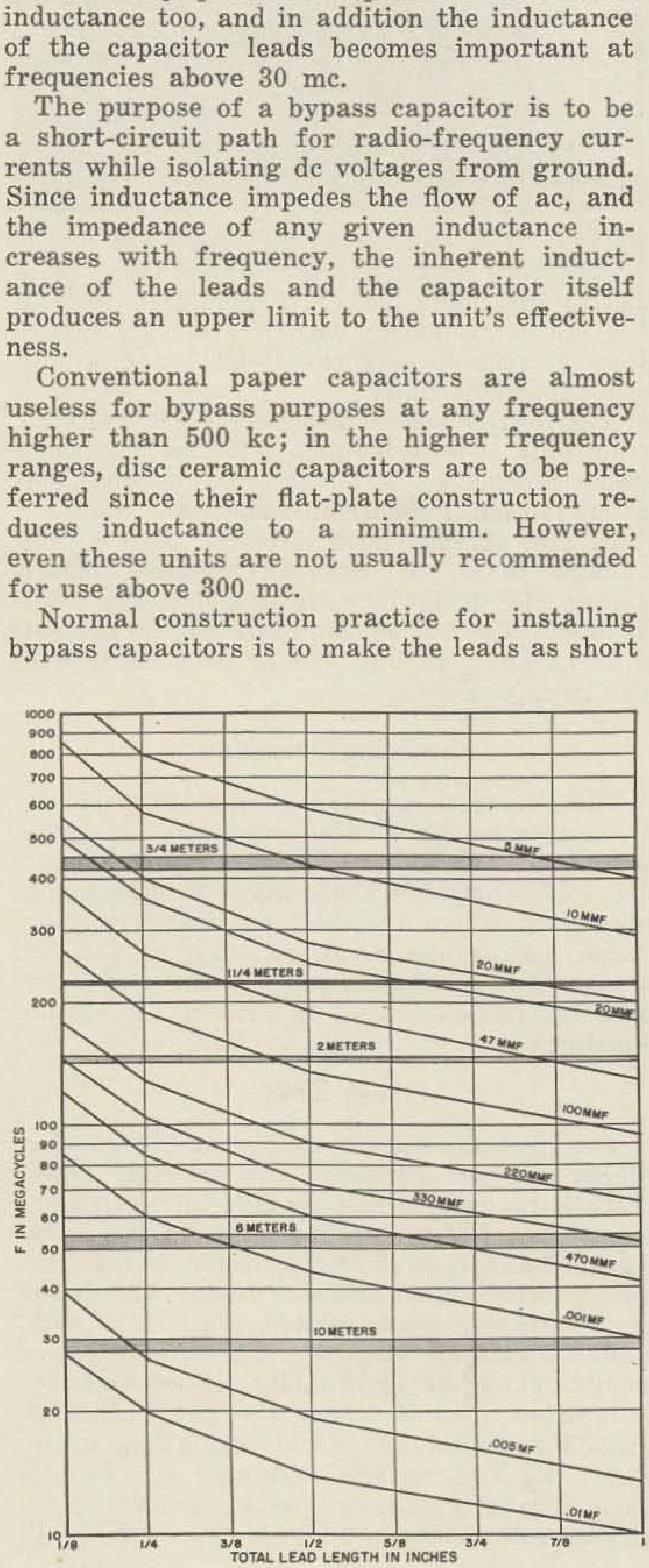
Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

ESPECIALLY in the VHF regions and above, bypass capacitors can prove troublesome in both receivers and transmitters. Almost all commercially produced capacitors have some inductance too, and in addition the inductance of the capacitor leads becomes important at frequencies above 30 mc.

The purpose of a bypass capacitor is to be a short-circuit path for radio-frequency currents while isolating dc voltages from ground. Since inductance impedes the flow of ac, and the impedance of any given inductance increases with frequency, the inherent inductance of the leads and the capacitor itself produces an upper limit to the unit's effectiveness.

Conventional paper capacitors are almost useless for bypass purposes at any frequency higher than 500 kc; in the higher frequency ranges, disc ceramic capacitors are to be preferred since their flat-plate construction reduces inductance to a minimum. However, even these units are not usually recommended for use above 300 mc.

Normal construction practice for installing bypass capacitors is to make the leads as short as possible to reduce any inductance contributed by them to an absolute minimum. As an example, a one-inch length of No. 20 wire has an impedance of 8 ohms at a frequency of 60 mc, and this 8-ohm impedance is enough to seriously upset the action of an otherwise-normal amplifier circuit.



Not so well known—although it was first described in 1948—is the fact that this lead inductance can be used to tune the capacitor to frequency, thus extending its use to frequencies higher than the normal limit and at the same time making its action more efficient than is otherwise possible.

For instance, a 470 mmfd capacitor with no inductance at all would have an impedance of approximately 6 ohms at a frequency of 50 mc. The same capacitor, if installed in a circuit with a total lead length of ¾ inch (say ⅜ inch for each lead), would exhibit approximately 0.25 ohm impedance at the same frequency—a 25-fold reduction in impedance.

We said earlier that the upper limit for normal disc ceramic capacitors is in the neighborhood of 300 mc. By using the leads to tune the capacitor to series resonance, this limit can be extended upwards to more than 800 mc—enough to allow operation on another band.

Here's what happens: The inductance of the leads, and of the capacitor itself, is used to tune the capacitance to series resonance at the operating frequency. If circuit Q were infinite, the impedance at resonance would be zero; however, with circuit Q as low as 5 (and it's usually higher than this) the resonant impedance is still less than 0.25 ohm.

Inductance of the wire normally used for leads on disc ceramic capacitors is approximately 25 millimicrohenries per inch. If you like, you can plug this into the resonance formula and calculate length for yourself.

However, to save you the trouble, we've calculated the values for the range from 10 mc to 1000 mc, lead length from ⅛ inch (the shortest usually found in practice) to 1 inch, and selected capacitor values from 5 mmfd to 0.01 mfd. The result is the graph shown in Fig. 1.

To use the graph, first find your frequency on the left-hand scale. Reading across, you'll find several diagonal lines which intersect the frequency line. Each of these represents a usable value of capacitance. Read downward from the intersections to the lower scale to determine total lead length necessary for series resonance.

A couple of words of caution are indicated at this point. First, total lead length means the length of one lead added to the length of the other. If the graph says ⅝ inch, one lead can be just 1/16 inch long and the other 9/16, or they can each be 5/16 inch, or any other combination which totals ⅝ inch. Secondly, since capacitance values are rarely more accurate than 20 percent, the best bet is to cut the leads a trifle longer than indicated and then to dip the unit to frequency with a GDO.

When possible, it's best to use the highest-value capacitor that can be resonated. The reason for this is that the effective bandwidth will be greater and the circuit will be more tolerant of errors.

For example, to quote directly from Volume 18 of the M.I.T. Radiation Laboratory Series, on page 326, if a 500-mmfd capacitor is resonated at 60 mc, the range over which its impedance is less than half an ohm extends from 57 to 63 mc. For a series-resonant 0.002 mfd capacitor, the corresponding range is from 50 to 72 mc.

This trick may also be used to help suppress harmonics and subharmonic feedthrough in transmitters, by deliberately using the smallest possible capacitor and resonating it very carefully to frequency. Because of the low capacitance and narrow series-resonant bandwidth, the capacitor will be effective only at operating frequency. At lower frequencies it will be a large capacitive impedance, and to harmonics it will look like an rf choke since a resonant circuit appears inductive at frequencies higher than resonance. In both cases, the result will be negative feedback to all signals except those at the chosen frequency, which will go through unhindered. This is especially applicable to screen bypasses, and can also be used for capacitance-coupling to pi-network output circuits. . . . K5JKX/6

RK34's

An excellent bargain in transmitting tubes is the RK34. These are low power dual triodes that make excellent exciters, drivers, multipliers, and finals. The plate dissipation is 10 watts, the maximum plate voltage is in the vicinity of 300 with a maximum plate current of about 80 ma. The full input power can be used up to 250 mc and it doesn't require too much drive. It is the ideal choice for a low power 6 or 2 meter final. The RK34 sometimes known as the VT-224 or 2C34 is available surplus for a few pennies. The probable reason for this is that it is an older type tube. I don't know the exact price that they sell for but I have seen them as low as 25¢ and once I have seen a few of them selling for 10¢. It would be hard to find a better bargain in transmitting tubes than this. . . .WA2INM

Harvey R. Pierce WØOPA
5372 E. Bald Eagle Blvd.
White Bear Lake 10, Minnesota

The Simplescope

Do you have to ask others "How's my modulation?" Do you have to wonder if you are modulating 100%? Do you know how much hum you have? If your speech clipper is clipping? If you have enough drive? If you aren't sure of your phone signals, AM or SSB, build the "Simplescope" and find out!

The name "Simplescope" comes because this is as simple as an oscilloscope circuit can get and still monitor AM, DSB, and SSB signals. I do not claim that this 'scope does a perfect job, or that it cannot be improved. My purpose is to present to you a proven, useable, simple, low-cost oscilloscope monitor. It works as well as many more expensive and more complicated instruments in telling you what your modulation is like, with a minimum of parts and expense.

The total cost shouldn't run over $15.00, but I can't be very definite here, because prices vary so widely from catalogue to catalogue. And what do you have in your junk box? Many of the parts values are not critical, and substitutions can be made if you happen to have a substitute part hanging around. The most important item, perhaps, is the 'scope tube. The model illustrated used a 2AP1A. Latest prices I have for the 2AP1A is $6.99. The 2AP1 will do equally well, and costs only $3.50 from Barry Electronics. The rest of the parts show wide variations in price, too.

The simplification of this oscilloscope monitor lies in the elimination of all non-essential controls and features. This leaves four controls, two passive and two active. The two passive controls are the "Brilliance" and "Focus" controls that can be set once and then rarely touched. The two active controls are the "Function" switch and the "Width" control, that are changed occasionally. There are no vertical or horizontal centering controls because in my experience the undeflected spot of the average 2AP1 or 2AP1A is close enough to the center for average use. Vertical "Height" controls were left out because the ones that worked well were quite complicated. Amplifiers were left out because the sensitivity was more than adequate for the average ham transmitter of 60 watts or more. In fact, the model illustrated was used with great success on a 7½ watt AM transmitter on 10 meters.

This Simplescope is built in a standard 5 x 9½ x 3 chassis with an aluminum plate (not shown) to cover the "bottom" (now the side) of the cabinet. The power transformer is mounted outside at the rear to prevent its magnetic field from deflecting the spot. Don't try to mount it inside. The front end of the 2AP1 is held and framed by an old 2" meter case. Below it on the front panel are the "Function" switch and the "Width" potentiometer. The two knobs on the top rear are the "Brilliance" and "Focus" potentiometers. On the rear, above the power transformer is a terminal board for the audio input and the control circuit, protected by a perforated aluminum cage to prevent careless fingers from touching high-voltage circuits. Above this "cage" is the phono-type jack for the rf input.

Inside, the power supply components are on the bottom and most of the 'scope parts are at the top rear. The pictures do not give any detail here, as the details are obscured by the ten wires from the CRT base. The silicon diodes are mounted on a tie-point strip on the bottom rear. The two 8-mfd, 150-volt electrolytics are between two tie-point strips on the side, and two 1 mfd, 600 volt condensers on the bottom below them. The four bleeder resistors are mounted between them and a tie-point strip on the bottom, center, which also furnishes tie-points for the 117-volt leads for line cord, transformer, and switch. On top, under the handle, the hand-carved U-shaped saddle and aluminum strap that holds the rear of the 2AP1 can be seen. The CRT is wrapped with a strip of felt to protect it.

To save space and cost, no socket was used for the 2AP1. Instead, I used pin clips from two dismantled wafer sockets. Ten are needed. I soldered different colored wires to the lug part of each contact, slipping insulation tubing down over the wire, joint, and lug. These contacts were then pushed onto 2AP1 tube pins, with the lugs inward. Two wraps of ½" wide electrical tape keeps the wires in place and prevents twisting and shorting. Some octal sockets of the molded variety will give pin contacts that can be used with the lug in line with the contact part. Then the insulated sleeve can be pushed down over the tube pin too. While useable, these lugs take up a bit more room. In either case, the contacts and wires are put on CRT before it is installed. After the CRT is put in place, *with*

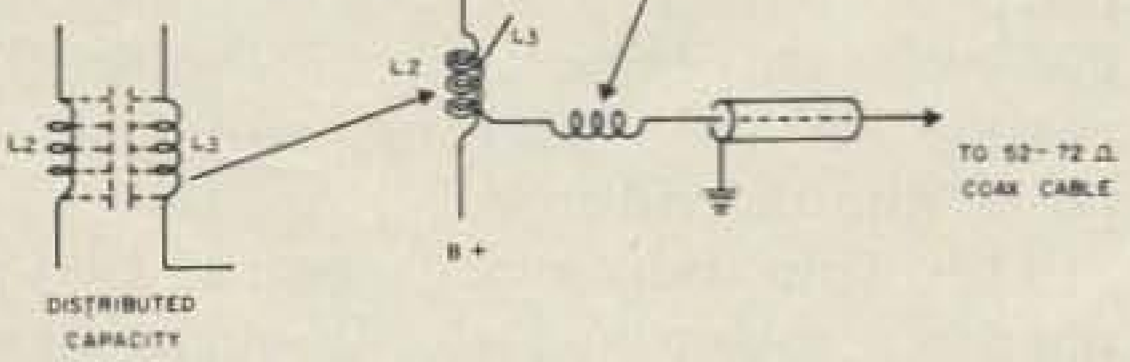
ONLY ONE KNOB TO TUNE THE 200V!

What's behind this knob? The Broadband Principle.

What is meant by a broadband transmitter? It is a transmitter with all stages designed to eliminate the need for manual tuning. Each stage has tuned circuits that are broadly resonant over a predetermined portion of the radio spectrum; for instance, 3.5 MC to 4.5 MC, 13.5 MC to 14.5 MC, etc. The signal is amplified in each broadband stage and is ultimately coupled from the plate of the final RF Amplifier to the antenna feed line through a broadband coupler.

WHAT'S IN A BROADBAND COUPLER? No copper sleeves, ferrites or any other "lossy" elements . . . just wire!

There are no motors, servos or sensing circuits required to keep the 200V tuned up! The design of the broadband coupler does the job for you. It works like a transformer with a primary and secondary.



The primary L_1 L_2 is resonant at the high frequency end of the desired passband. Part of the secondary L_3 L_4 is wound bifilar with part of the primary. The bifilar winding has a distributed capacity between the wires. This capacity appears as a series resonant circuit with L_4 at the low frequency end of the desired passband. By controlling the size of the bifilar winding and the mutual coupling between L_1 and L_4, it is possible to show the amplifier plate an essentially constant load impedance across the desired passband.

EFFICIENCY? As long as the tube sees the proper plate load impedance, it will deliver power to that circuit. If this impedance is equal to that produced by a normally tuned and loaded circuit and the broadband coupler is not constructed with "lossy" elements, it follows that the RF power will be transferred to the load at essentially equal efficiency.

LOADING? Why do you normally tune and load an RF Amplifier? To make the tuned circuit show the proper load impedance to the plate of the tube at the desired frequency.

The output circuit of the 200V is designed to match 52 to 72 ohm coaxial transmission lines without dipping, loading, or tuning of any kind!

SWR? If the SWR is 2:1 or less, the reflected change in plate load impedance through the broadband coupler will be negligible.

HARMONICS? The broadband coupler could be designed wide enough to pass the 2nd Harmonic generated by the output tubes; however, since this is undesirable, the passband is restricted to one megacycle and a series trap circuit built-in to reduce 2nd and higher order Harmonics better than −50 db. The Harmonic rejection of the broadband coupler is equal to or better than a properly tuned Pi network.

The overall broadband circuit design makes possible a true single knob controlled transmitter. The *ONLY* tuning control is the VFO. In fact, the bands are so arranged that if you have the VFO set to 7280 KC and band switch to 20 meters, the transmitter is instantly ready to operate on 14280 KC; or switch it to 15 meters, and you are instantly on 21280 KC. The 200V is a Band Hopper's dream transmitter. It is the only transmitter that tunes like a receiver and yet provides the best sounding signal on the amateur bands!

73 Wes

Wes Schum, W9DYV

Write for 200V brochure for more detailed specifications.

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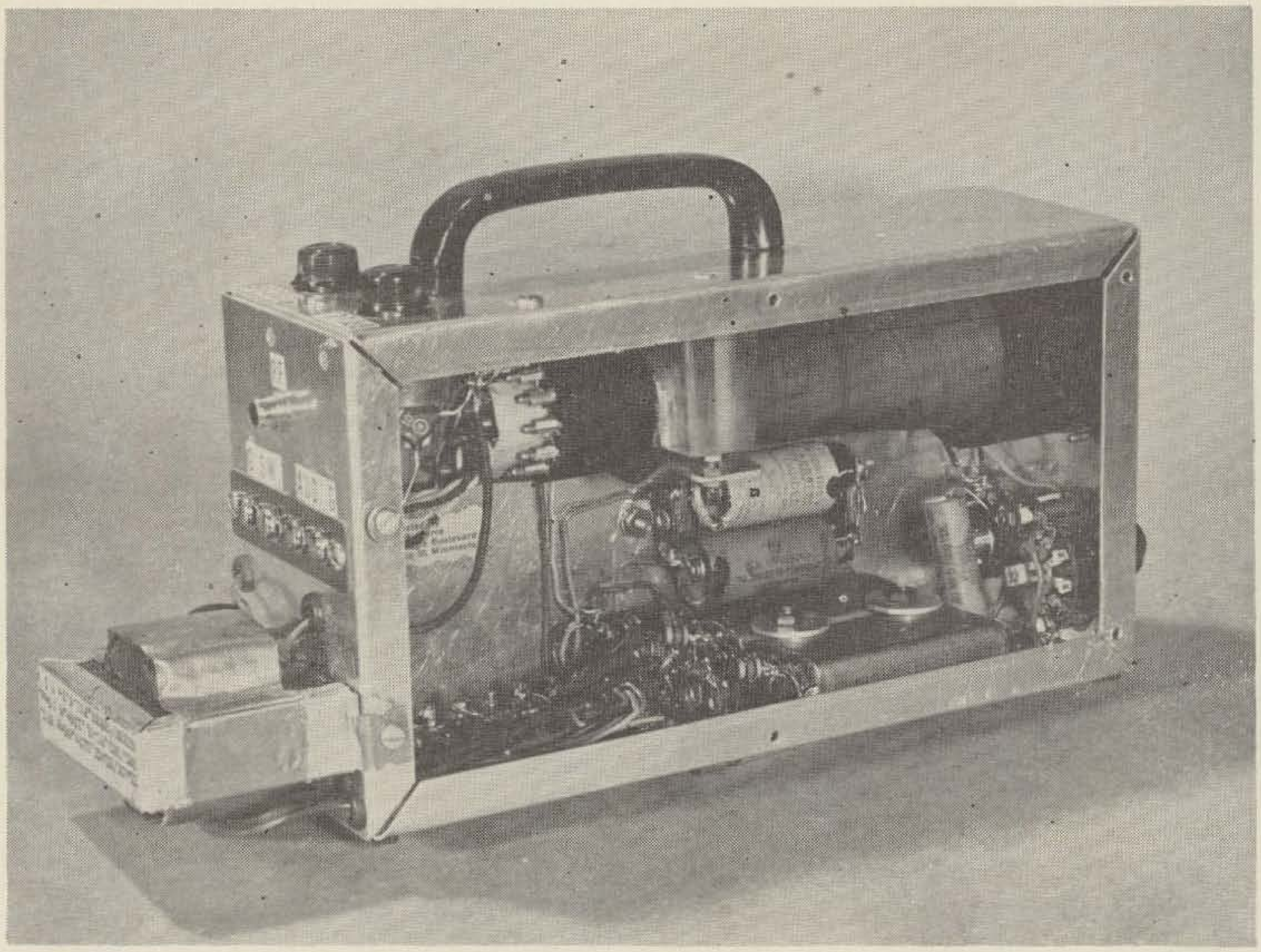

the key of the locating pin on the bottom, the wires are cut to the proper lengths and soldered. Encugh slack should be left in these wires to allow the 2AP1 CRT to be rotated 15 degrees either way to "level" the pattern later. While there are 10 wires coming from the CRT, cnly 7 colors are needed because pins 3, 7, and 9 are all ground and can be the same color, and pins 1 and 2 are connected together and can be the same color. Incidentally a likely source of both pin contacts and colored leads, already soldered, is a used TV picture-tube socket. Get a couple from your TV serviceman. Be sure to keep a record of the CRT pin numbers and colors, just in case. Write them on the inside of the side cover, where they won't get lost. This is also a good place to paste a schematic of the Simplescope, too.

Looking at the schematic diagram, Fig. 1, shows the rf input going direct to pin 6 of the 2AP1, with a 2½ mh rf choke furnishing a dc and low-frequency ground. Vertical height is determined by the coupling to the transmitter. Various methods of coupling will be discussed under installation.

The horizontal circuit consists of a .01 mfd blocking capacitor and the 1 megohm "Width" control. The "Function" switch connects this to the "AUD" terminal for a trapezoid type pattern or to one side of the 117-volt line for the "envelope" type. More resistance must be added between the "AUD" terminal and the modulated voltage in the transmitter in a ratio of one megohm, 1 w., added for every 200 volts in excess of 250 volts. The voltage rating of the blocking capacitor should be twice the dc voltage.

The function switch is a two-pole three-position wafer switch. It turns the power on to the Simplescope, and changes the pattern from the "Envelope" type with 60 cycle sweep to the "Trapezoid" type of display. This switch must be of the smaller size wafer to fit in the space allotted, but otherwise it is not particularly critical as to make or rating.

All three potentiometers shown should best be of the medium size, and have a linear taper, but here again there can be variations. If you have a pot of the right size, use it regardless of taper. And it won't make much difference if the value is up to 25% off. As to size, use them if they fit the space available. Because the "Brilliance" and the "Focus" pots operate at fairly high voltages above ground, they should preferably be mounted on an insulating board, and not the chassis, and their knobs should have recessed set screws.

All fixed resistors are one watt carbon. The .01 capacitor from pin #10 of the scope to ground is part of the power supply filter, in effect, and keeps stray voltages from intensity modulating the trace. It could be made a larger value, if you happen to have one, but for convenience in size a .01 mfd 1 k volt disc ceramic

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is best.

The power supply is a full wave voltage quadrupler and uses a small and inexpensive transformer ($1.35 from Olson) and silicon diodes rated at 150 v RMS. These diodes range in price from 49¢ to $3.75 each. Current ratings are not very important here as the current drain is low, only a few mils. The voltage ratings should be *at least* 150 volts RMS for the 130 volt transformer, higher voltage ratings are OK if you want. Selenium rectifiers can also be used, but they take up a lot more space, are harder to mount and give less output voltage. The capacitor values given are a compromise between various factors of size, cost, and availability. The builder can use higher values of both capacity and voltage here if he wants, if the capacitors will fit the space. The 47 ohm resistor in one lead of the transformer is the usual surge-limiting resistor to prevent damage to the diodes from the charging current into the capacitors. It can be increased in value to 100 or 150 ohms without harm. The four 470 K ohm resistors form the bleeder, and here, too, some variation can be allowed, but lower values reduce the output voltage, and higher values slow down the discharge rate.

With the values given for this quadrupler supply, the output voltage is 600 volts, plenty for the 2AP1 CRT tube which will work on as little as 300 volts. Lower voltages give greater deflection sensitivity but less margin in brilliance. With lower voltages the scope is much more susceptible to stray magnetic fields from adjacent power transformers and chokes, audio output transformers, etc.

The high voltage to the scope is turned on and off by a switch or relay contacts connected to "SW" and "G." This system was chosen over the "Blanking voltage" system because one of the leads is ground and as a result any accidental short circuit of these leads to each other or to ground, can do nothing more than turn on the scope spot or trace. The Simplescope should be turned on and off with the transmitter, otherwise the undeflected spot will soon burn a dark spot in the screen, or a dark line if the 60-cycle sweep is used. For temporary testing purposes the two terminals may be connected together without harm, of course. If a relay, either ac or dc is used to turn the high voltage on and off simultaneously with the transmitter, it should *never, never* be mounted in, on, or near the scope since the magnetic field of its coil will distort the pattern on the Simplescope.

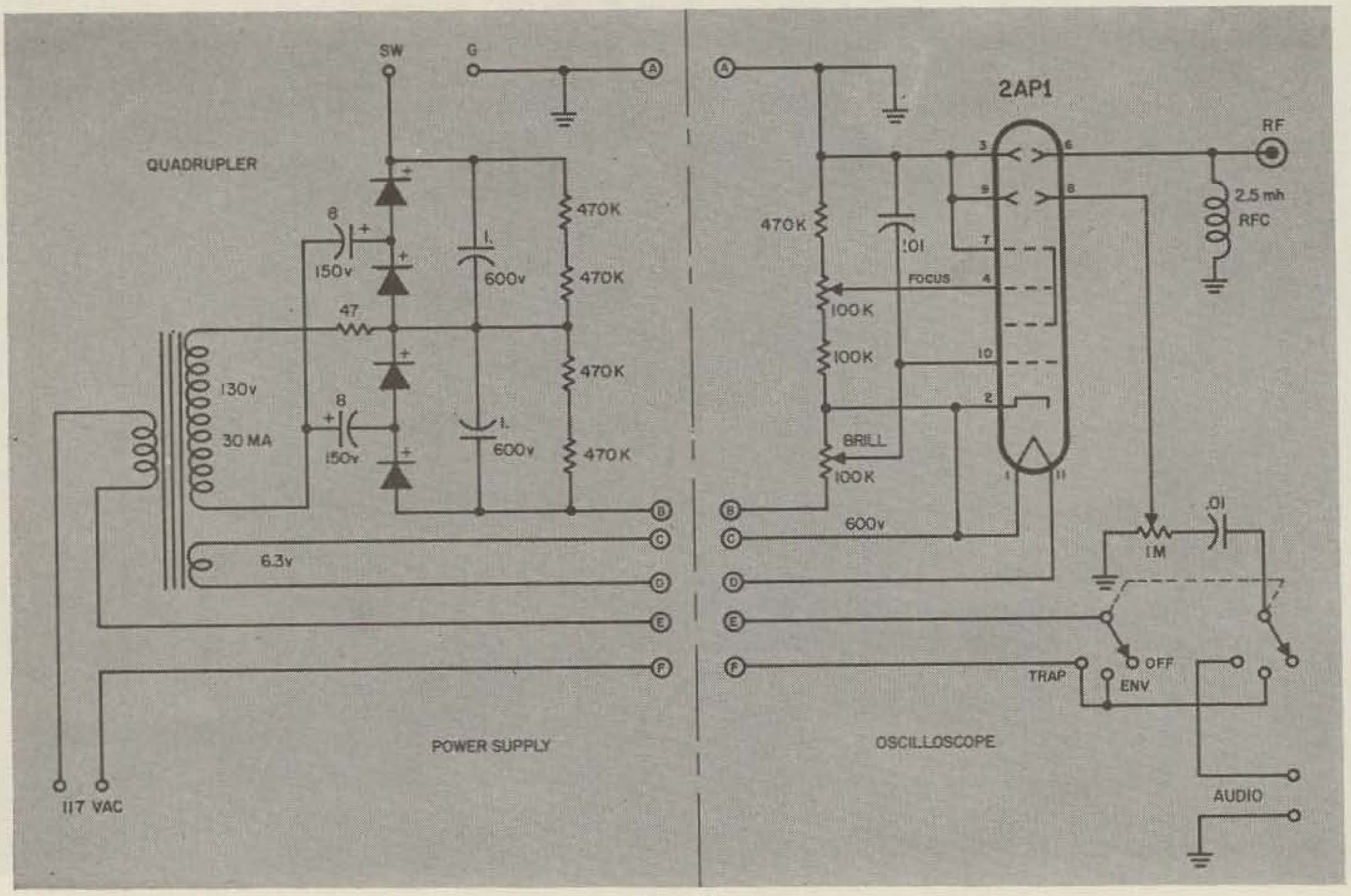


Fig. 1

Fig. 2 shows two alternative power supply circuits that can be used to fit different power transformers that the builder may have in his junk box. Fig. 2A is a doubler circuit, suitable for transformers with a high voltage secondary of 225 to 300 volts. Be sure the rectifiers used will stand the transformer voltage. Fig. 2B is a half-wave circuit for transformers with a high voltage secondary giving from 500 to 750 volts. While the 5Y3 voltages ratings are exceeded, the current is very low, and the tube gives no trouble. There is plenty of room to mount it horizontally inside the chassis. Transformers less than three inches wide for mounting on the rear of the chassis can be had for both the above circuits, but if yours is too big, it could be mounted separately, at the cost of reduced mobility, compactness, and utility of the scope.

In using junk box transformers be sure that the high voltage centertap is *not* internally grounded. (It is in a few types I have run across.) *Please note that in none of these power supplies is the negative grounded.* This is *one* case in which neither the negative high voltage, the cathode nor the heater circuit is connected to a ground. For simplicity and safety in the input and deflection circuits the *positive* end of the high voltage is the ground.

The same circuit and parts values shown in Fig. 1 may be used with the 3AP1 or 3BP1 scope tubes provided higher voltage power supplies are used. About 900 to 1000 volts are needed with these tubes. Of course a larger cabinet is needed, and the pin numbers will be different.

In figuring dc voltages from your power supply add 20% to the RMS ac rating of the high voltage winding and multiply by 4 for the quadrupler circuit or 2 for the doubler circuit. The half-wave circuit will give more than a 20% increase.

If you don't have an old 2-inch meter case to hold and frame the face of your CRT tube, there are other methods that can be used.

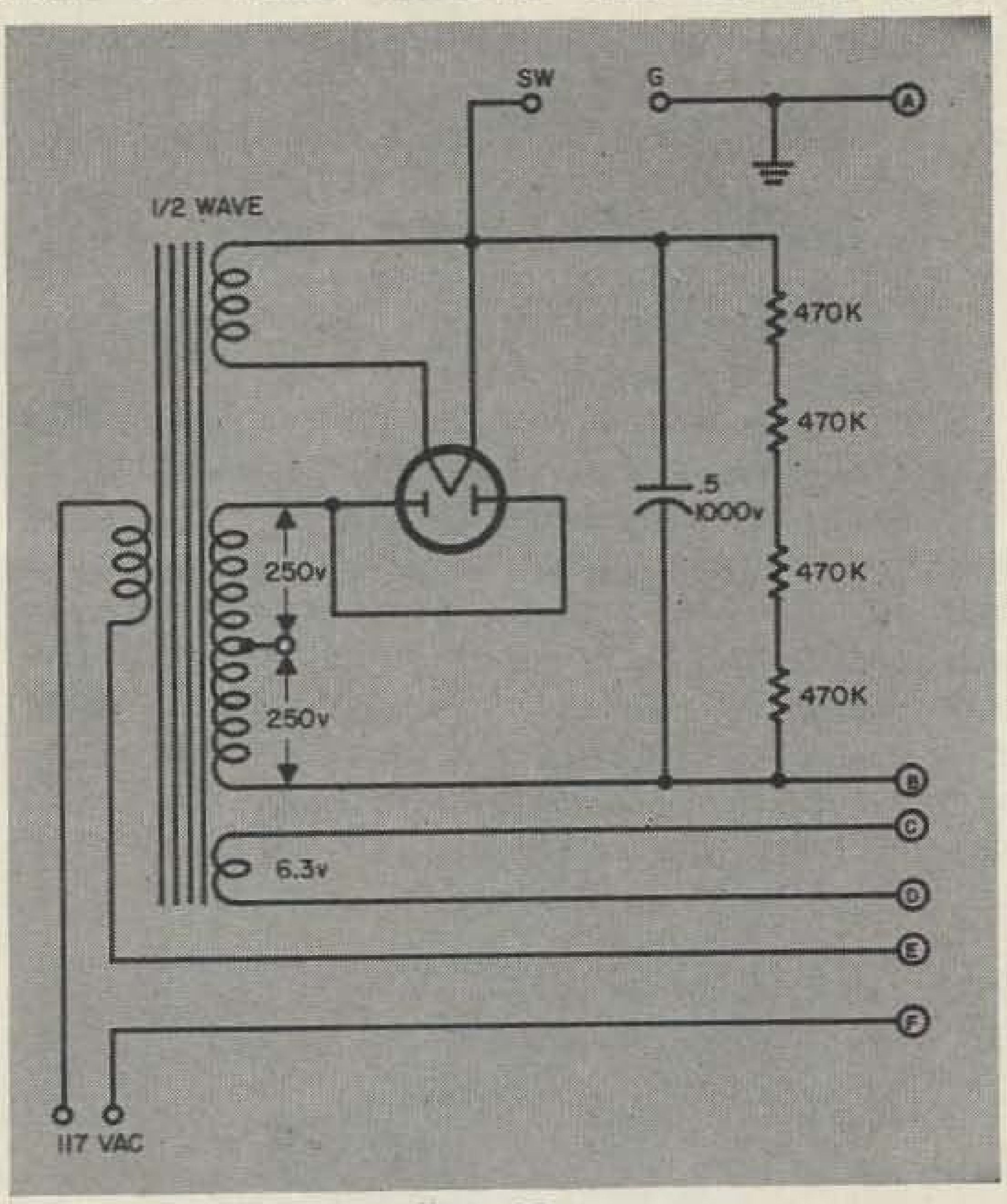


Fig. 2B

Probably the simplest is to make a grommet by slitting a length of rubber or plastic tubing of about ¼" diameter and putting it around the opening. Or leaving the edge of the hole bare and supporting the end of the tube by three or four small rubber grommets bolted to the panel around the hole on the inside. A frozen orange juice can is a loose fit for the end of the CRT. With both ends cut out, and

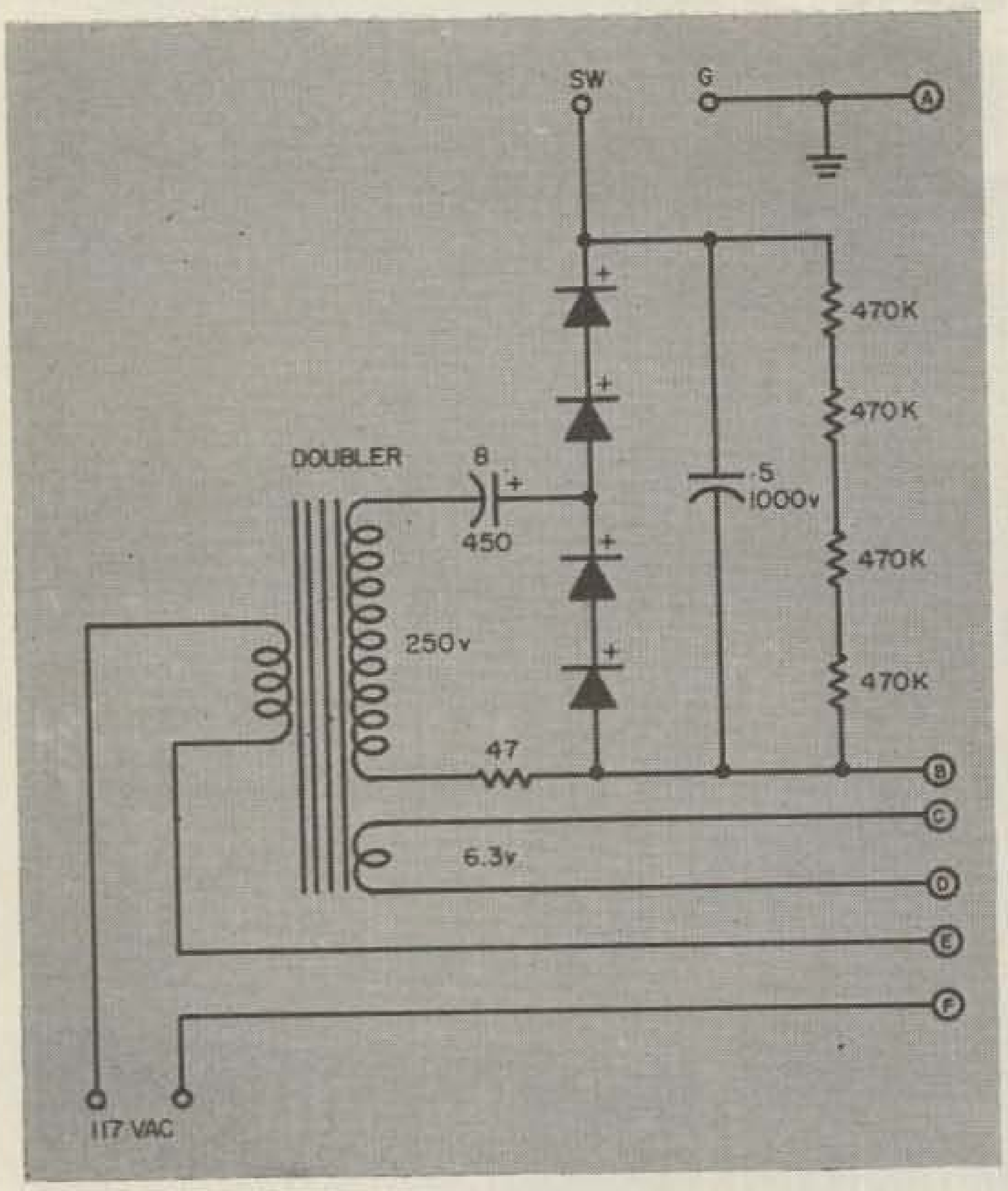


Fig. 2A

painted black, this makes an excellent light shield when slipped over the tube.

If an old 2-inch meter case is used, the glass is discarded and in most cases the support for the zero adjusting screw must be cut out to make the face opening round. Cutting this out is best accomplished with a coping saw using a metal-cutting or jewelers blade, and rounding the edges with medium or fine emery cloth. Clear nailpolish will shine the sanded surface beautifully.

In building and wiring the Simplescope there are few critical points. In the power supply polarity of the diodes and the capacitors must be carefully checked. Because no grounds are used in the rectifier-filter-bleeder circuit, be careful all parts are well insulated from ground. In the scope circuit, outside of the same insulation precautions, the only important thing is to keep the rf lead to pin #6 short and as far away as possible from everything else. All the other wires can run as convenient. And I might repeat again here that the builder should color-code the leads from the CRT tube and keep a record of them for future reference.

Testing is simple. With "SW" to "G" connections open, plug it in and turn it on. See if the CRT tube lights by looking for a glow in the base. OK? Now turn it off and hook a voltmeter from positive to negative. Any voltmeter that reads 1000 volts at more than 1000 ohms per volt will do. Turn on the power. Voltage OK? Turn off the power and connect "SW" to "G" temporarily, set the "Focus" control half on, and turn the power on and the function switch to the "Trapezoid" position. Adjust the "Brilliance" pot until a spot appears, then adjust the "Focus" control for the finest spot. Readjust the brilliance if the spot is surrounded by a halo. Turn the function switch to the "Envelope" position and advance the width control. The spot should turn into a horizontal line. If the line can't be made long enough to go beyond the edges of the tube face, try reversing the ac plug in the socket, or ground the scope case, or both. If the line isn't exactly horizontal, loosen the CRT clamp and rotate the tube until it is. The brilliance and focus controls can now be touched up to get the best results. Failure to get proper results at any point of the above test should pin-point the trouble for you. If you have to check for voltages at any time, don't forget that the case is *positive*.

The undeflected spot should be fine and round. If it is a line, or "S" or "O" shaped there is some stray ac field that is affecting it. Pull the ac plug while observing the spot, and if it changes shape at the instant the plug is pulled, it is the scope transformer's field causing the trouble. The cure is to position the transformer differently. Sometimes a copper shorting band as shown in the picture will help. I put this band around this transformer while working on the problem of putting the transformer inside the case. It did help, but not enough. In the position shown for this type of transformer, the band was not needed, but was left on to protect the windings.

If the spot is not close enough to the center of the CRT tube face to suit you, and you are of an experimental nature, try putting a small (1" x ¼" x ¼") magnet different places around the cabinet. You'll probably find a place where the spot will center and the pattern won't distort.

Now that you have the scope built and tested, the next step is to install and use it. There are four different connections to be made for proper operation, but first you must find a place to put it. The Simplescope is small, requires little desk room, and all the wires come out the back, but you must bear in mind that the electron beam of the tube is very susceptible to magnetic fields, so it shouldn't be put anywhere in the field of a transformer, even an output or modulation

transformer. In general, this means six inches distance. Don't depend on a cabinet to "shield" the transformer, either. You may have to experiment a bit to see where it will work best. Turn the Simplescope on, get a fine spot on the face of the tube, and move the scope around, seeing where you can put it where, (A) you can see the tube face clearly without glare, and (B) where the spot is not moved by either 60 cycle or audio fields from transmitter or receiver.

The first connection to be considered is the power line. This 117 v. 60 cycle power should preferably come from the primary of the filament transformer of your transmitter. This connection assures you that the Simplescope will only be "on" when the transmitter is on. Other sources can be used, but at the risk of having the Simplescope left on accidently, because it gives no light or sound to indicate the switch is on and the high voltage and heater active. Of course, if you habitually use a "Main Switch" that turns off everything in the station, it is OK to use such a controlled 117 v. outlet.

The second most important connection is the rf pickup. The simplest method is to connect an antenna to the rf jack thru a variable capacity of some sort. The antenna length and position and the amount of series capacity will control the vertical height, which should be about one inch. The best method is to run a short piece of RG58 or 59/U from the rf jack into the transmitter and couple it through a small capacitor to the antenna coax. The value of the coupling capacitor will depend on several factors, but in general the higher the transmitter power and the shorter the coax from the scope, the smaller the capacity that will be needed to produce a satisfactory pattern on the CRT face. With very low powers, a direct connection can be made. An advantage of this method is that if the transmitter output is into a very low SWR line on all bands, the scope pattern will be the same on all bands. Various other pickup methods for getting rf may also be used, such as from antenna tuners, etc. The point is to feed enough rf in to get a readable pattern.

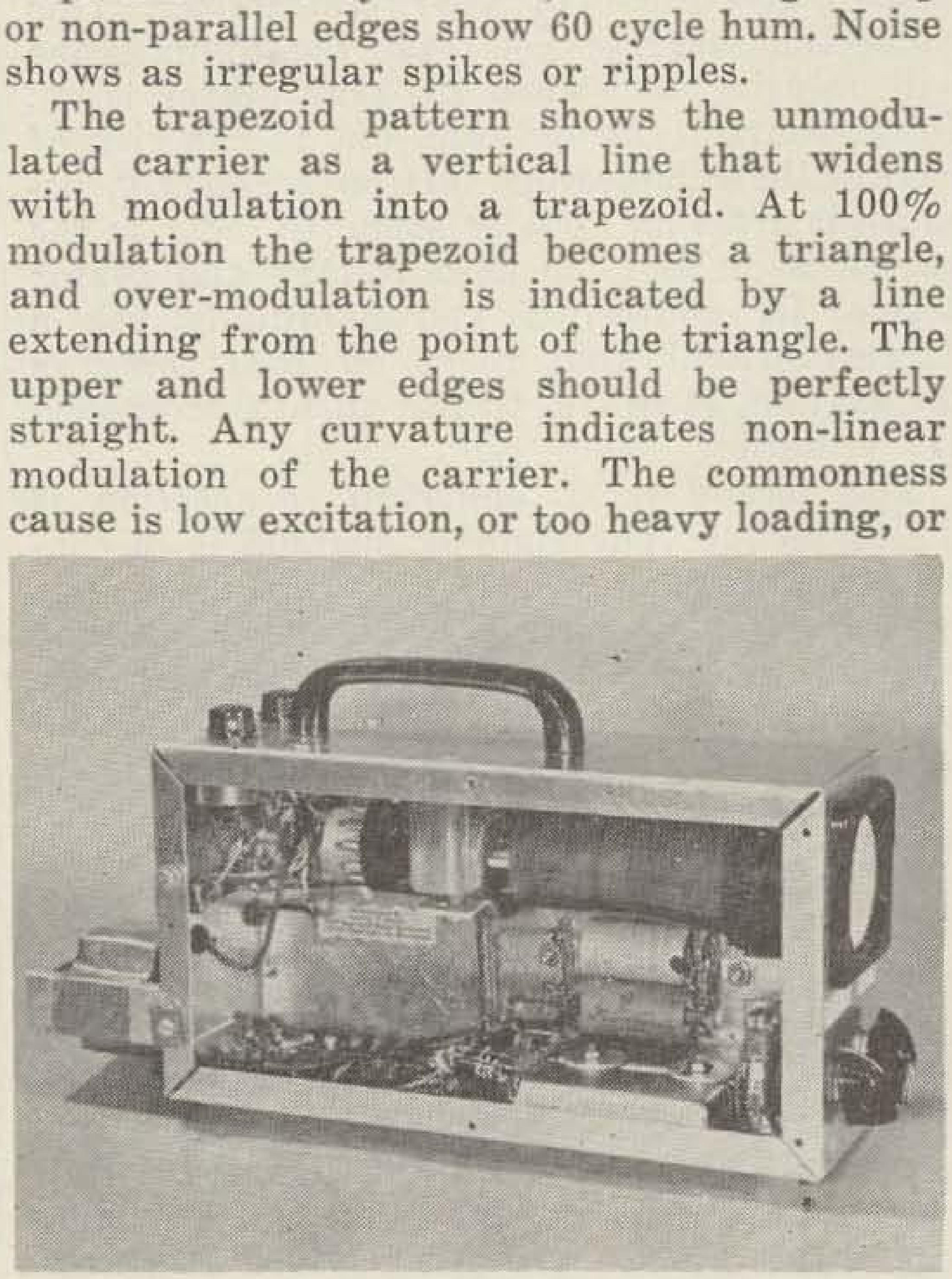
The third connection is the control line "SW" and "G," the terminals that must be connected together at the same time that plate voltage is applied to the transmitter. They may be connected together by extra contacts on the send/receive switch, antenna relay or plate relay, or as mentioned previously by a separate relay activated by the send/receive switch.

The last connection to be made is for the audio. The "AUD" terminal is connected to the actual modulation voltage in the transmitter. It must NOT be connected to the speech amplifier, driver, modulator plates or primary of a modulation transformer. Any connections but to the actual modulated voltage will give a false picture because it will not contain all the phase shifts and distortions that may occur in the modulator. Thus the proper connection to a plate-modulator transmitter is to the terminal of the modulation transformer that connects to the rf plate circuit. For clamp- or screen-modulated transmitters (such as the DX40) the connection is to the screen terminal of the modulated tube. For DSB and SSB transmitters. The connection is to one terminal of the modulating voltage system. In this case the Simplescope may not be satisfactory because some DSB and SSB modulating systems operate at such a low level that there isn't enough audio voltage to give a satisfactory deflection horizontally. For the Simplescope illustrated it takes about 25 volts RMS or 70 volts peak-to-ptak to produce a usable horizontal sweep (about ½ inch). Where the dc voltage being modulated is over 250 volts, additional resistance should be added in series with the "AUD" lead as previously mentioned, and this resistance is preferably installed in the transmitter to reduce the hazards of bringing the full voltage out of the transmitter. If more than one megohm is needed, use a series of 1 meg. one watt carbon resistors instead of a single larger value, to prevent possible arcing troubles. In cases where the modulation transformer terminals are available without digging inside the transmitter (the B&W 5100B, for one) these added resistors can be enclosed in a length of insulating tubing, or very thoroughly taped with a *good* electric tape for protection, and placed outside the transmitter. The "AUD" connection on the Simplescope can be made a high-voltage terminal and the resistors placed inside the case. Don't forget to ground the scope to the transmitter.

Of course the Simplescope can be used "as is" for temporary modulation checks with *no* connections to the transmitter, just using the "envelope" type of pattern to check modulation percentage, but this type of check doesn't tell all the story. For a temporary check it is only necessary to connect the "SW" terminal to "G" as when the Simplescope was tested, put the "Function" switch in the "Envelope" position and feed enough rf into the rf jack (from an antenna or pickup wire) to make the vertical height about ¾ inch, and advance the width control until the envelope is the full width of the CRT face.

The unmodulated envelope pattern is a green ribbon, with top and bottom edges straight and parallel. When the carrier is modulated, ripples occur on these edges, the size of the ripples and waves depending on the modulation percentage. A wave on the top edge will be a mirror image of the wave on the bottom edge. "Perfect" 100% modulation occurs when the outer extremities of these waves double the width of the unmodulated ribbon or envelope, while the inner extremities just meet in the middle, making a bright dot. Over modulation is easily detected as the dots turn into dashes. Clipping and limiting can be detected as a flattening of the peaks of these waves at a certain width of the pattern. Frequency response can be roughly judged by the proportion of high and low frequency waves under average modulation. Close observation is necessary for any wave-form distortion with the Simplescope because of the 60-cycle sine-wave sweep, but major troubles can usually be detected. Hum and noise show up well in the envelope pattern. Hum is seen as humps, dips, or loops in the top and bottom edges of the pattern. Two humps and two dips or two loops show 120 cycle hum, and a single loop or non-parallel edges show 60 cycle hum. Noise shows as irregular spikes or ripples.

The trapezoid pattern shows the unmodulated carrier as a vertical line that widens with modulation into a trapezoid. At 100% modulation the trapezoid becomes a triangle, and over-modulation is indicated by a line extending from the point of the triangle. The upper and lower edges should be perfectly straight. Any curvature indicates non-linear modulation of the carrier. The commonness cause is low excitation, or too heavy loading, or



both. Poor design of the final is also a possibility. In efficiency-modulated finals (Grid, screen, cathode, or suppressor modulated) the correct adjustment shows up as the best-looking trapezoid.

In the trapezoid position SSB signals show as the "Bow-Tie" pattern. See the side-band handbooks and articles for interpretation. It is beyond the scope of this article to give instructions for interpreting scope patterns beyond the most common and simple effects. The Simplescope will monitor your modulation, hum, and excitation constantly and accurately. When you use it you'll never have to ask anybody, "How's my modulation?" Or, "Have I got any hum?" You'll know!

In conclusion I want to thank Bob Rode, WøBRE, for taking the excellent photographs as well as many useful suggestions for the design, and to Jim Borders, KøKMD, for building the preliminary model. Jim's worked the first time he plugged it in, and I hope yours does, too! Have Fun! . . . WøOPA

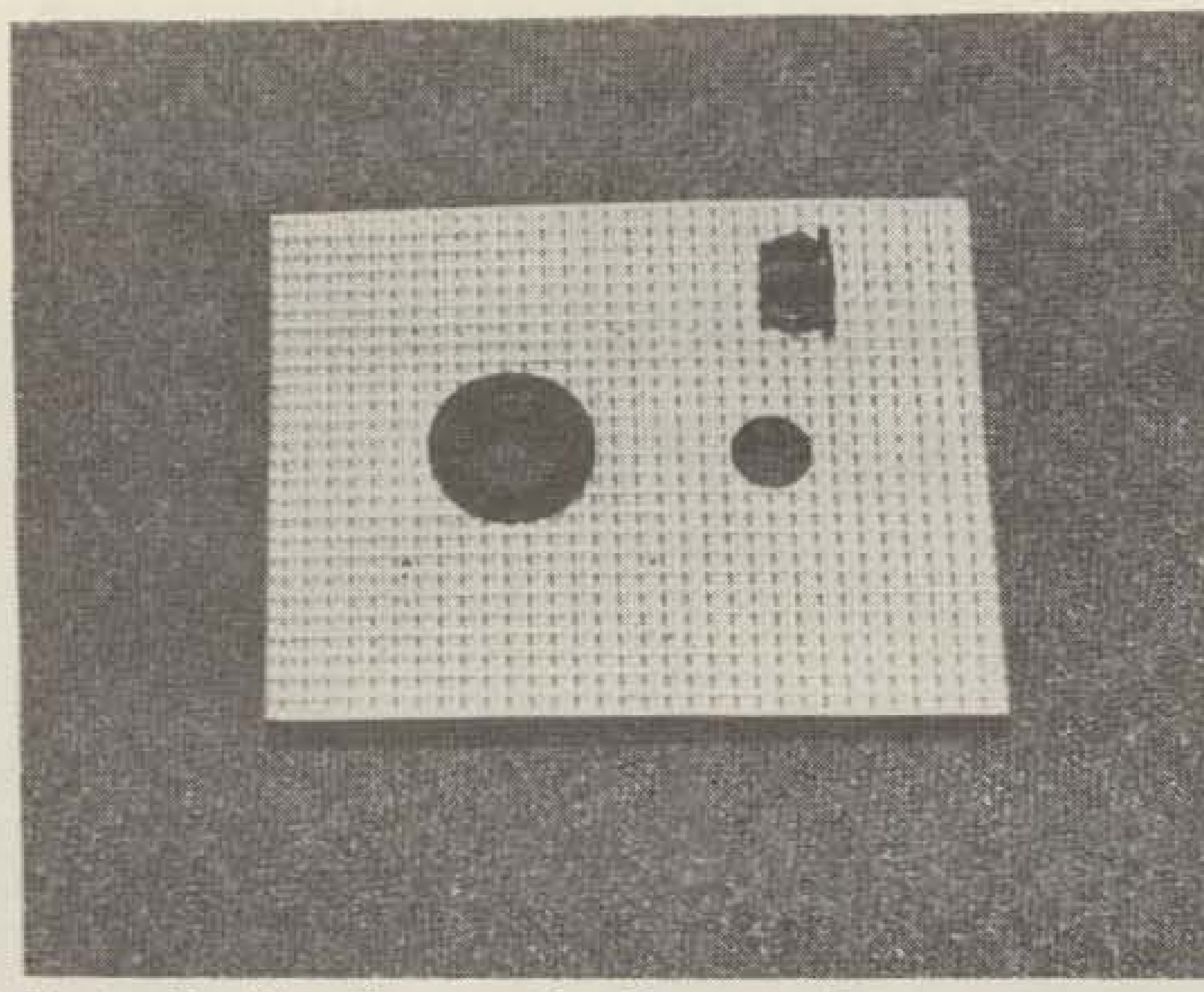


Photo Credit: Morgan S. Gassman Jr.

Snap Bushings Customize Equipment

Roy E. Pafenberg

THE appearance deficiencies of ventilation and clearance holes drilled in thin sheet aluminum are recognized and compounded if pre-finished enclosures are used. John Howard, K8MME, in a September, 1960 QST article, "Aluminum Eyelets Make Good Fever Medicine," proposes an answer to the problem. The solution is very effective, however there is work involved and the eyelets must be backed up for peening.

The use of plastic snap-in bushings came to mind and information was requested from the Heyman Manufacturing Company of Kenilworth, New Jersey on their line of HEYCO nylon bushings. The literature received by return mail provided the answer to this and other perplexities that plague the amateur constructor who attempts to achieve commercial appearance with hand tools.

As shown in the photograph, these HEYCO bushings are made of black nylon and will firmly lock into any chassis or panel up to ⅛" thick. They are available to fit clearance holes from ⅜" to 2", with inside diameters ranging from 3/16" to 1⅝". These bushings are ideal replacements for the conventional rubber grommet and the smaller sizes will provide painless eyewash for cabinet ventilation holes.

Advantage may be taken of the excellent bearing surface characteristics of nylon by using these bushings to ease the friction in the mechanical assemblies necessary in high power transmitter construction. For example, the SB-375-4 bushing snaps into a ⅜" clearance hole and provides a ¼" bearing surface. These dimensions make them ideal for use as component control shaft feed-thru bushings. Being somewhat flexible, they are less critical of alignment than are the conventional metal panel bushings and friction is reduced.

For filling unusued panel holes, the same style bushing is made with a smooth finished, closed top and sold as a hole plug. Aside from affording a welcome change from the usual chrome plated version, these provide an excellent means for the insulated mounting of a variety of components. The thin but strong nylon top is readily drilled to accommodate a jack or other part. Don't be concerned about the plugs pulling out. Though they are installed with finger pressure and are just as easily removable, the manufacturer claims they will withstand a 35 pound pull.

With all the advantages cited, there must be one fly in the ointment. These bushings and plugs are apparently available only through the manufacturer in minimum quantities of 100 each. Aside from the inconvenience of mail order buying, this is no real problem since the prices are low enough to make purchase in 100 lots attractive. For example, the smaller size bushing shown in the photograph sells at $1.90 a hundred, less 1% on cash transactions. A letter to the company will bring catalog sheets and from that point you are on your own.

VFO Chirp vs. 6AU6

Al Brogdon, W4UWA/K3KMO
316 West Fairmount Ave.
State College, Penna.

FOR some odd reason which has never been satisfactorily explained to me, several commercial equipment manufacturers have chosen the 6AU6 as a VFO tube. From my own experiences, and those of quite a few other hams, the 6AU6 is a mighty poor choice for this service. The case histories of two popular pieces of ham gear I have owned tell the story:

A number of years ago I bought a Heathkit VF-1 VFO. After building the thing with extreme care in order to produce a stable unit, I was disappointed to learn it chirped like mad when I keyed it for break-in CW. The 6AU6 tested OK, and all other parts of the VFO seemed fine. On a hunch, I tried plugging in another 6AU6. All of a sudden—the chirp was gone! And still a third 6AU6 produced the chirp again. Obviously there is some feature of the 6AU6 such that, although it may test red hot on a tube checker, it may still chirp. And as long as I owned that VFO, the thing would key beautifully for break-in CW —the *only* way to work CW.

Recently, I bought and assembled a Viking Navigator. As most of you know, this transmitter and others in the Viking line feature grid-block time-sequence keying. The operation is simply this: When the key is closed, the keyer tube allows the VFO to start and go through any chirp inherent in the VFO circuit, then after the frequency is stabilized (a matter of a few milliseconds), the keyer tube turns on the buffer. Thus, the VFO may chirp, but it will do so at a time when the signal is not on the air. Well, when I started keying my Navigator, a V sounded like "yoop yoop yoooooooop." Oh Lord here we go again. What was happening was that the 6AU6 was chirping over such a long time period that it was *still* settling down when the buffer came on.

Sure enough, it turned out to be the 6AU6. Another brand new tube that tested "jes fine" on a tube tester, but chirped away. So instead of plugging in another 6AU6 and taking the chance on it going soft and having to soon be replaced, I decided this is the time to try a more permanent cure. Besides, I was losing patience with those 6AU6's.

To state it simply, I checked the tube manuals and found that I could interchange a 6AH6 with the 6AU6, and plug it right into the VFO tube socket without making any wiring changes. Since I have been using the 6AH6, the Navigator has functioned perfectly with no chirp.

In the course of many CW contacts, I have run into several other fellows that have had the same chirp trouble with their VFO's, especially when cathode keying the Heath VF-1, with no time-sequence keying to take up the slop. A couple of these fellows have tried switching tubes and using 6AH6's with the same results I did. Now don't get the idea that switching to a 6AH6 will cure all your VFO chirp—please understand that this only applies to cases where the 6AU6 itself is the cause of the chirp. You may have chirp originating in any of a number of other sources in the VFO. Simply changing tubes won't cure all these sources.

But if you have a Clapp VFO circuit, such as the VF-1, the DX-100 VFO, Viking (Ranger, Navigator, etc.) VFO, or a homespun job, using a 6AU6—it's worth the try to get rid of an annoying chirp by plugging in a 6AH6 to see what happens.

As a closing note, calibration should be checked after switching tubes. The calibration will usually shift just a little bit due to the change from the 6AU6 to a 6AH6, and if you chase DX near the band edges, always play safe. W4UWA/K3KMO

Beryl Dassow W9HKA
Clifton, Illinois

Console

DURING some period of a radio amateur's life there comes a time when he becomes conscious of the fact that the operating position leaves quite a bit to be desired. That is from the standpoint of orderliness, ease of operation and flexibility. Therefore, as can be seen in the photographs, an operating console was constructed.

The use of the standard relay rack panel spacing of 19 inches was used to provide the required orderliness. The grouping of the various pieces of gear as to the most active area on the console, gives us the ease of operation. The use of tempered hardboard cut to rack and panel size (or larger as in the case of the second photo), gives us the needed flexibility. Flexibility in that it makes it much easier to use either regular relay rack panel mounted equipment or the cabinet type as shown in both photos.

The unit as shown in the present dimensions may be a trifle large for the average amateur's allotted space. However it can be readily pared down to a three-panel width without adverse effects as to the overall usefulness.

This type of relay rack panel mounting was chosen over that of the semi-circular console design because of the simpler method of construction.

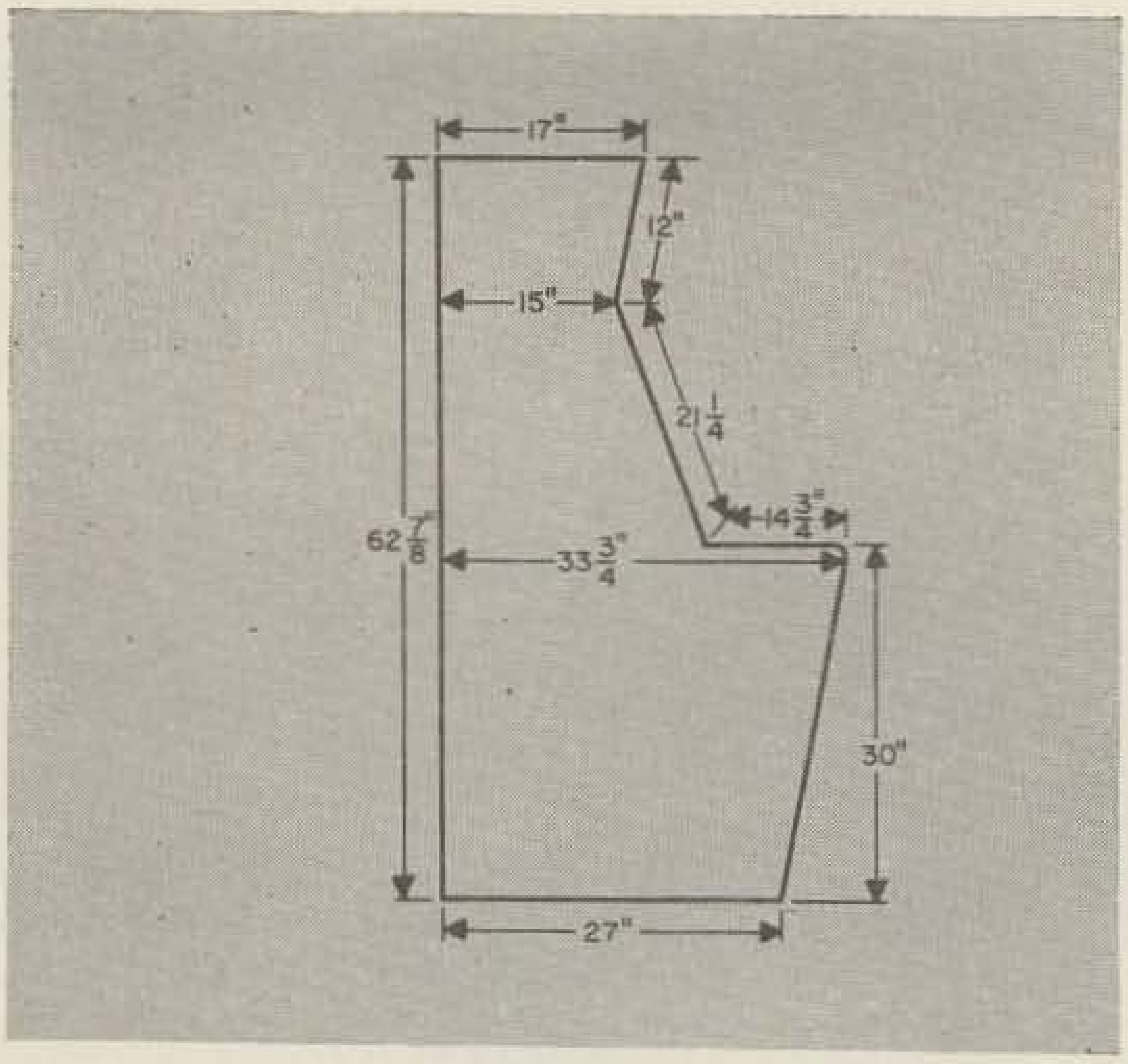
The entire rack may be constructed with hand tools with the exception of the vertical dividing and mounting pieces. For a four-panel width as shown, a total of five pieces, each about 5½ feet in length is necessary. These can be usually cut at the lumber yard from a 2 by 3 or 2 by 6 fir stock at the time of purchase. See Photo 5 and Figures 3A and 3B.

Note also there are no special joints required. Since butt joints are used in most cases the unsightly joints are quite noticeable. To overcome this problem quite effectively, flexible wood trim tape is used. The type used is made by Weldwood in 8 foot lengths and the width varies from one inch to 1½ inches across the desk top front.

The desk top is covered with a piece of vinyl material. The material as shown was fastened with a pressure-sensitive adhesive and a great deal of care must be exercised when cementing the vinyl to the plywood desk top. The usual procedure is to place a newspaper between the two cemented pieces and gradually remove same as the vinyl is carefully rolled into position. To trim the vinyl edges, a beading strip is tacked into place. The wood tape as mentioned earlier will cover the front edge of the vinyl.

You will notice upon adding the various widths of wood strips and panel areas, an allowance of an extra half inch. This is to give a final $\frac{1}{16}$ of inch spacing on either side of each panel when mounted. The vertical spacing is sufficiently oversize as well.

Photograph number one shows the original console construction. However after the author traded equipment it was then necessary to make additional room for the newly acquired Valiant which is "over-size." This is easily ac-



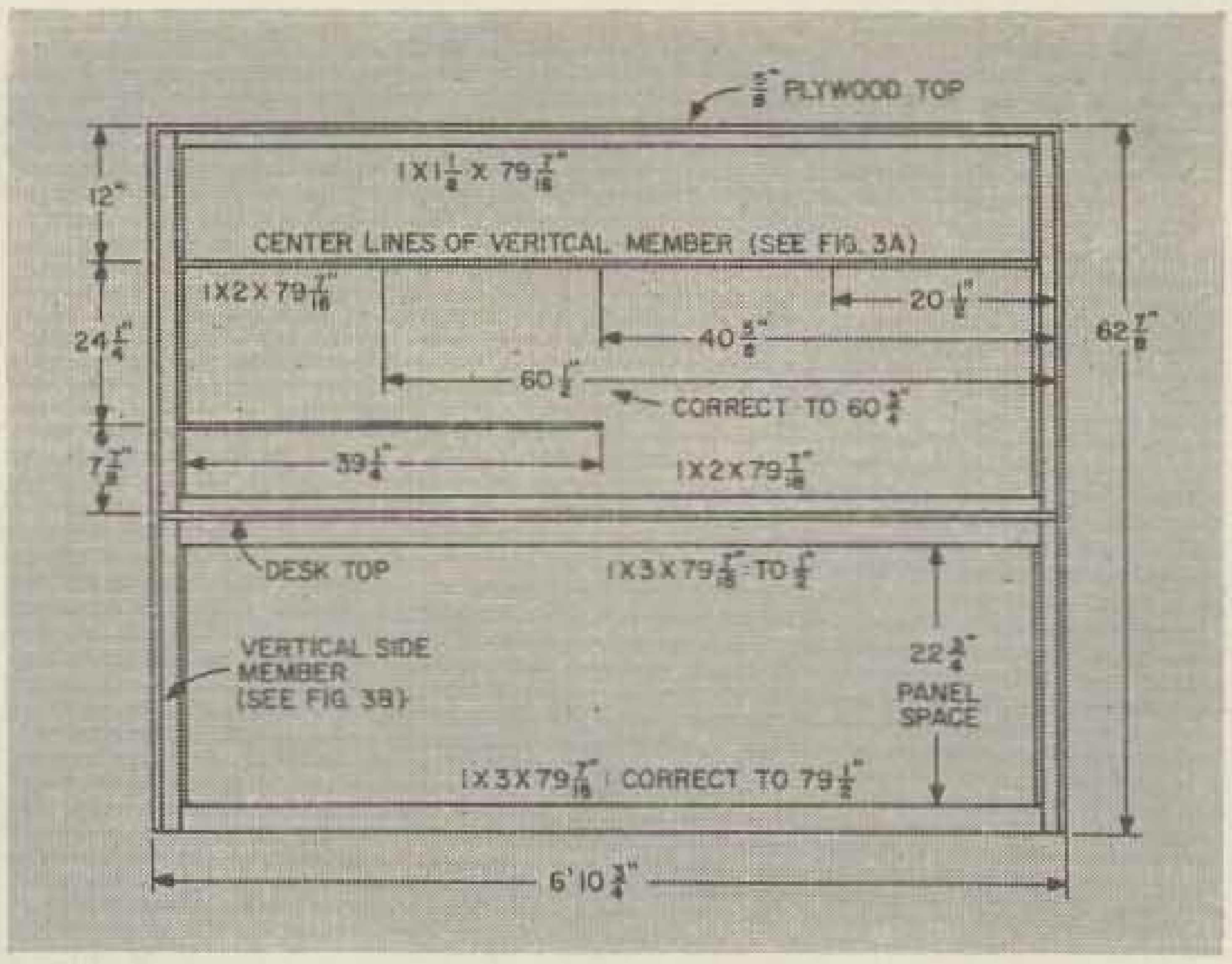


Fig. 2

← Fig. 1

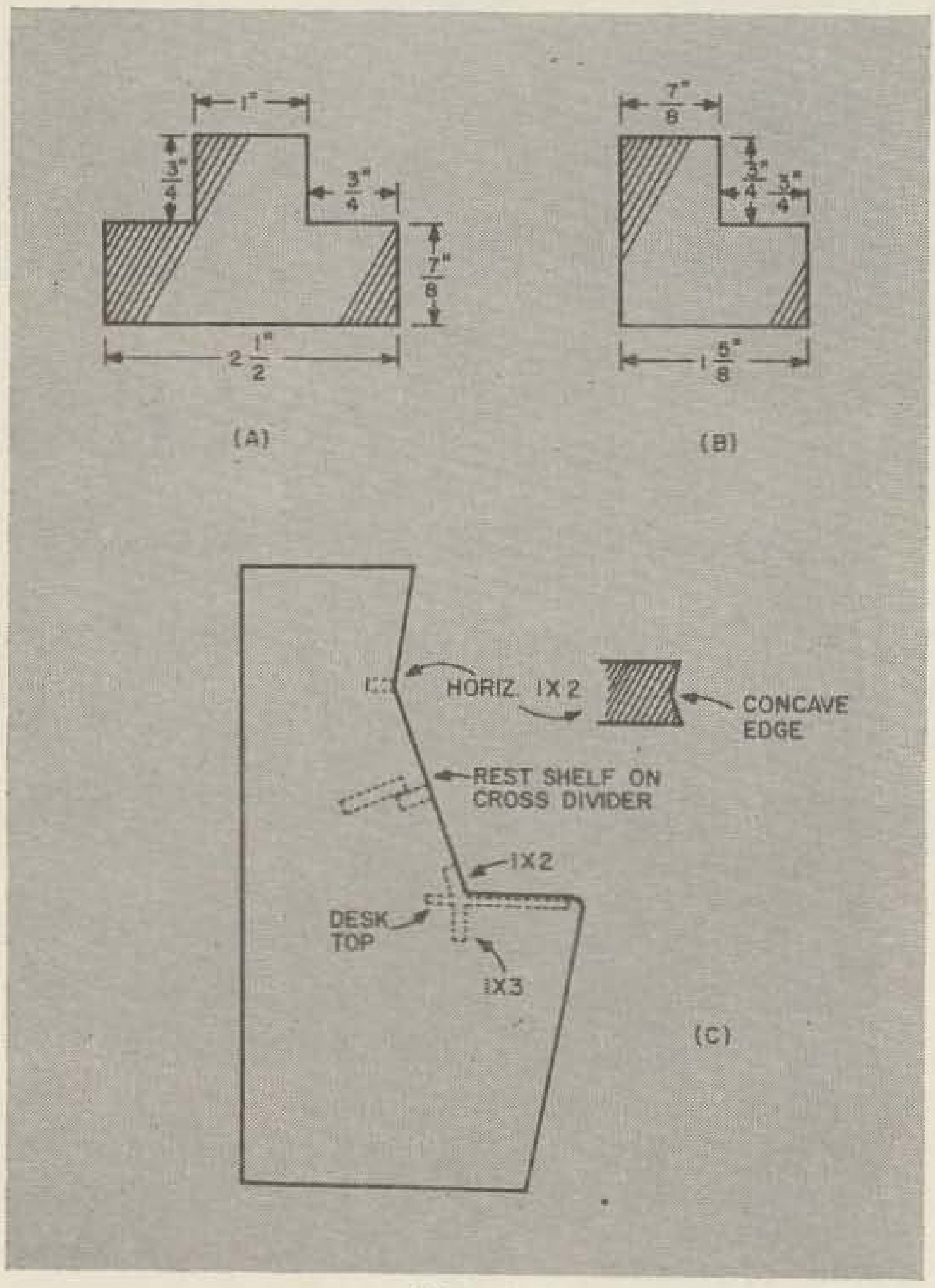


Fig. 3

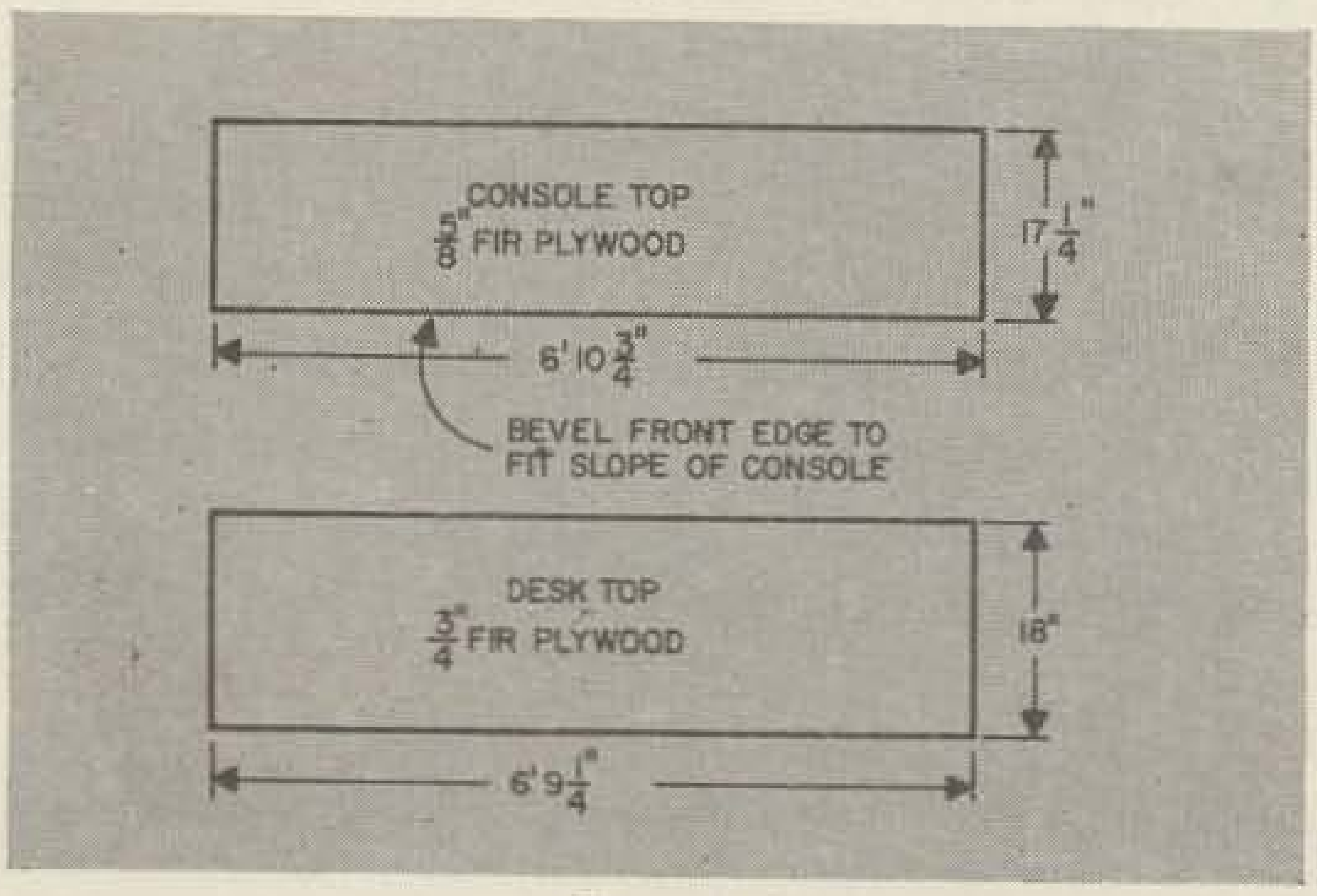


Fig. 5

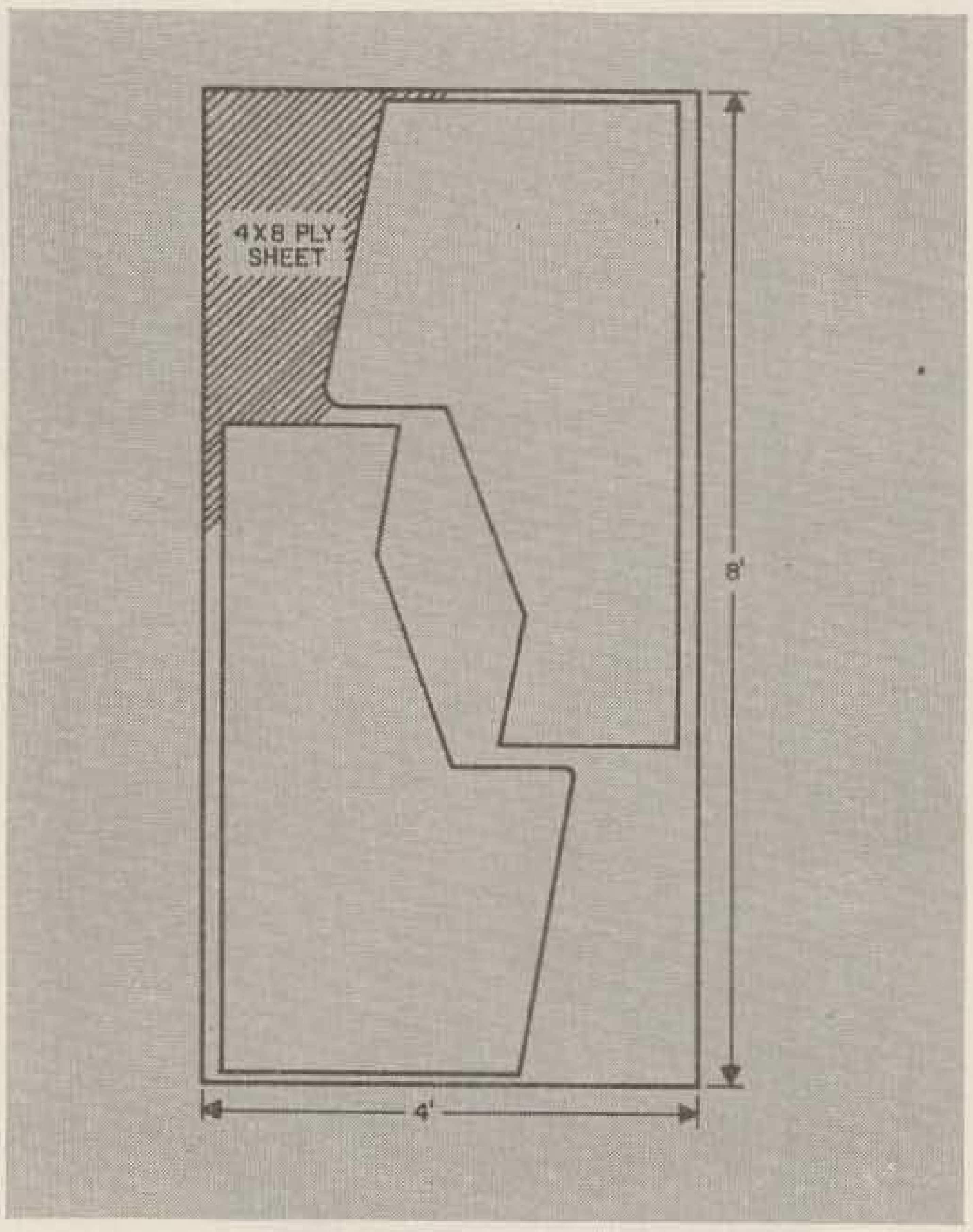


Fig 4

complished by the removal of a vertical member. Note in Photo 4 the addition of a brace for added strenthening when this vertical piece is removed. Also added as per Photo 2, is a horizontal 1 by 2 for dividing the new panel across the bottom. This then leaves a space of 13¼ by 39¼ inches for use by the 6N2 and the Valiant. Other arrangements can be made to suit each individual station depending on the gear to be mounted.

As far as the mounting of the cabinet-type equipment, it is necessary to construct a simple shelf from the plywood left in the cutting of the sides or ends. It is best to run a vertical brace from the rear of this shelf down to the 2 by 4 tie at the bottom of the console. Note this 2 by 4 in Photo 3 across the bottom back

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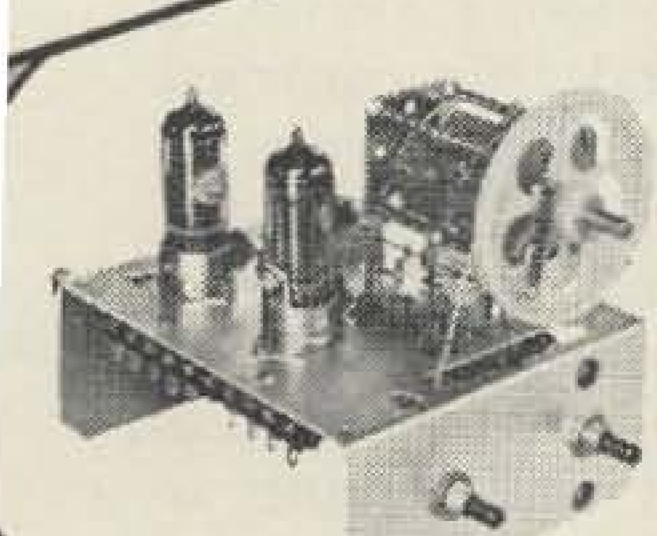

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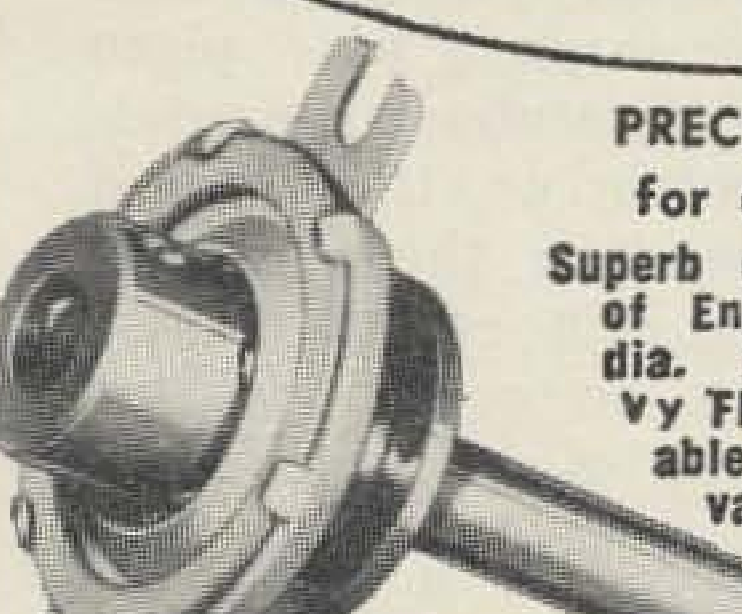

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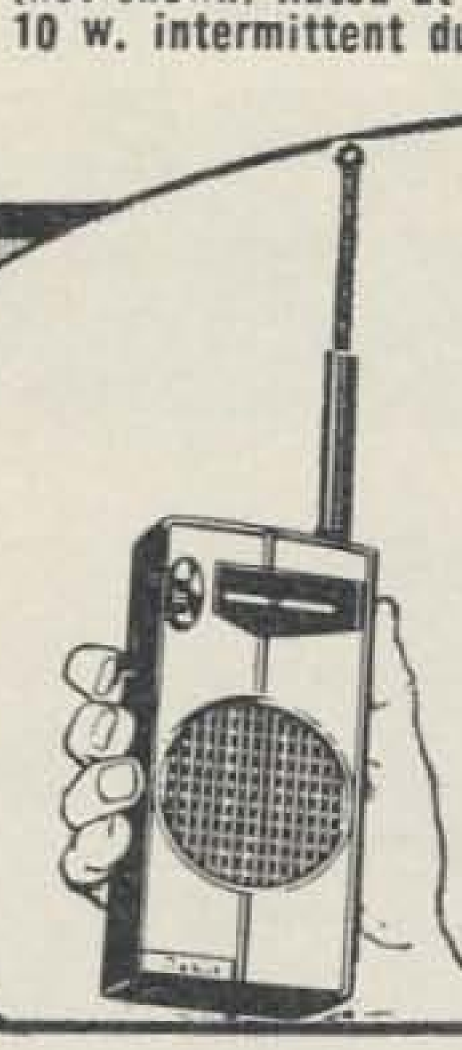

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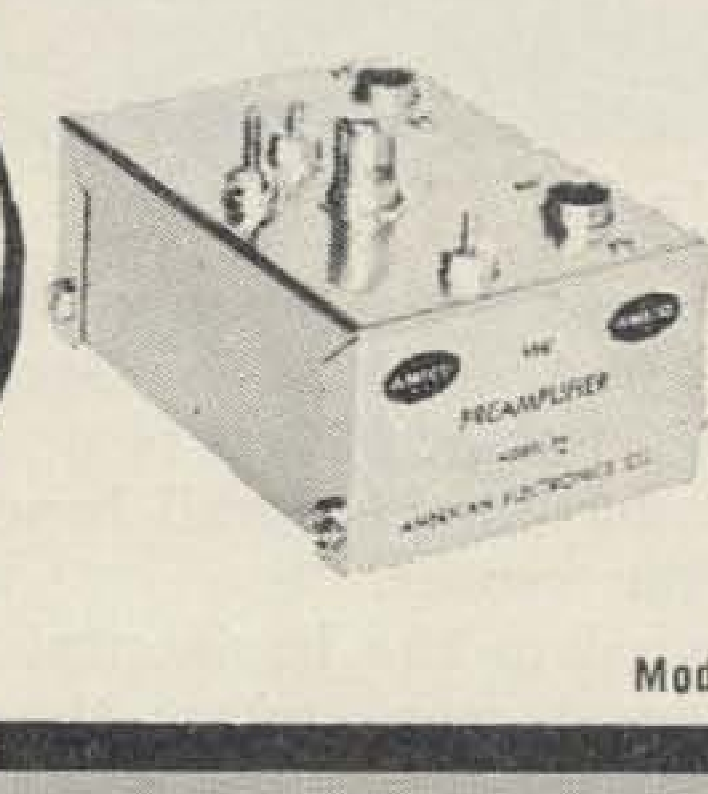

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of the console. When cutting the hardboard to fit the cabinets, cut the round portions (corners) somewhat undersize and then file with a half-round file to fit. The straight edges can be cut with a coping saw as one will be working near enough to all four of the edges. The above may sound tedious but the hardboard saws and files very easily and the result gives a fair fit.

If one is careful in laying out the sides, one sheet of ¾ inch thick fir plywood in the 4 by 8 foot size will suffice. The plywood should have both sides good. See Figure 4. The few remaining pieces are then saved and used as angle braces, shelves etc. Perhaps it should be pointed out that the width of the console is such that it will clear a regular three foot door. If you have anything less it will be necessary of course to cut this dimension down to clear your opening.

While not discernible in Photo 4, two screen door turn-buckle type braces (connected in "series" for the required length) are used across the console directly in back of the upper horizontal ¾ by 2 inch strip. With reference to Photo 3 again, the 1 by 1½ inch strip that is fastened to the bottom of the sides and to the bottom front of the unit can be seen. This is merely a trim, however it does eliminate

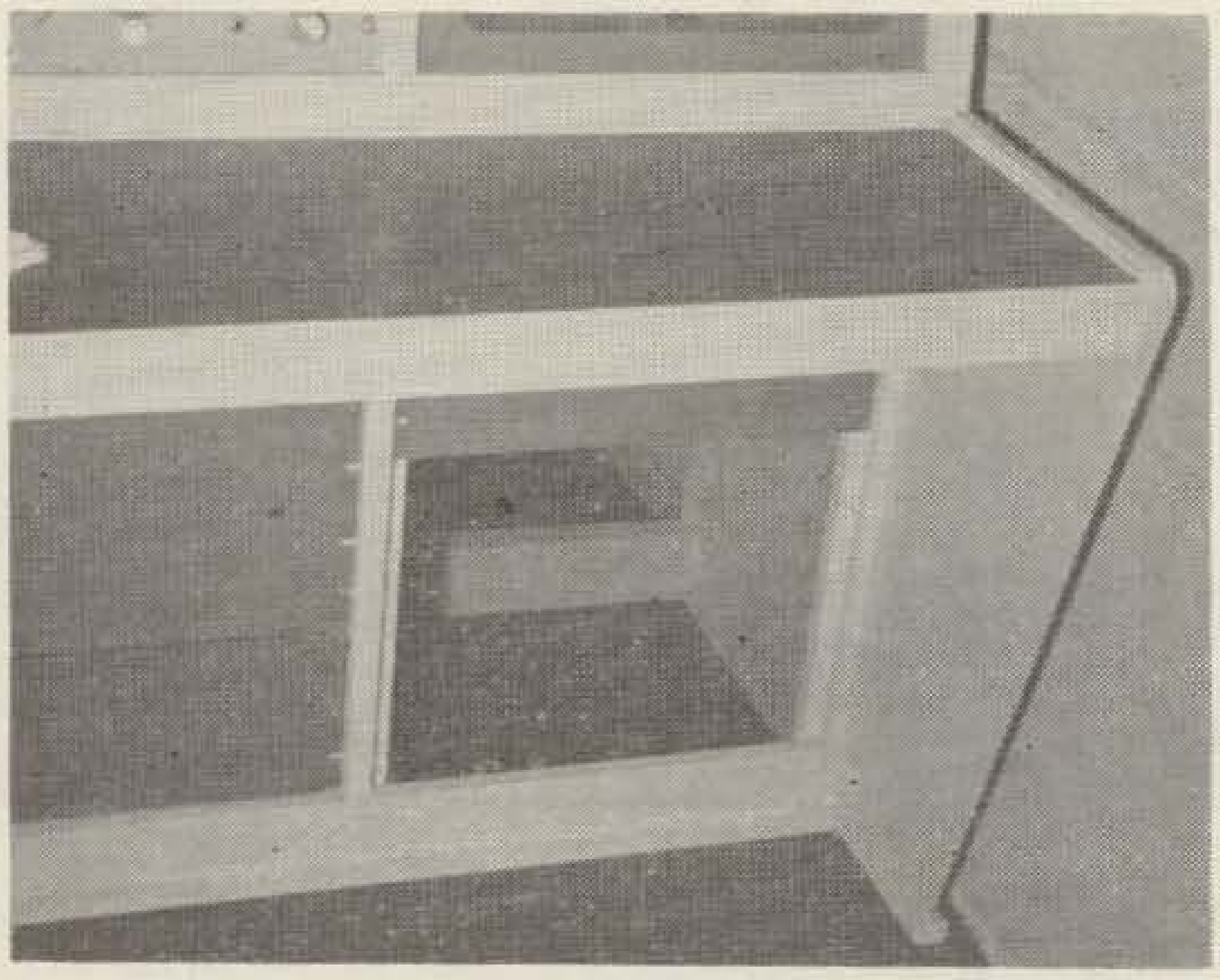


Photo 3

splitting the plywood edges when moving the console about during construction. The strip across the front edge of the desk top is used for rigidity and also conceals the small brace needed underneath in the center.

A reminder with regard to the horizontal 1 by 1½, 1 by 2 and 1 by 3 inch strips; these should be as straight and free of knots as possible. The given dimension for the *width* is the exact size used. These pieces are cut from a board a size larger to secure the final widths and are not necessarily stock 1 by 2's, 1 by 3's etc.

The finished color of the unit itself is a light gray. Our supplier referred to it as French gray. This is a rather light color and is more contrasting to the darker blue gray panels. It

Photo 2

seems impossible to secure the same shade of gray when ordering panels, and this contrast has a tendency to make the various shades of rack panel gray less noticeable. If most of your panel gear will be home made, each panel may be given a light coat of paint from a pressurized paint can. Just a sufficient amount to change the shade of gray but not enough to eliminate the wrinkle finish.

As to the final cost of the described console; a figure of twenty-five dollars should cover practically everything that is required. The main item of course is the large 4 by 8 piece of plywood which in itself costs about nine dollars. If one desires to cover up the unused portions of the console pending the purchase of more equipment, it is less costly to use masonite board. This can be easily painted gray with a pressurized can of paint as mentioned before. Usually two coats are necessary.

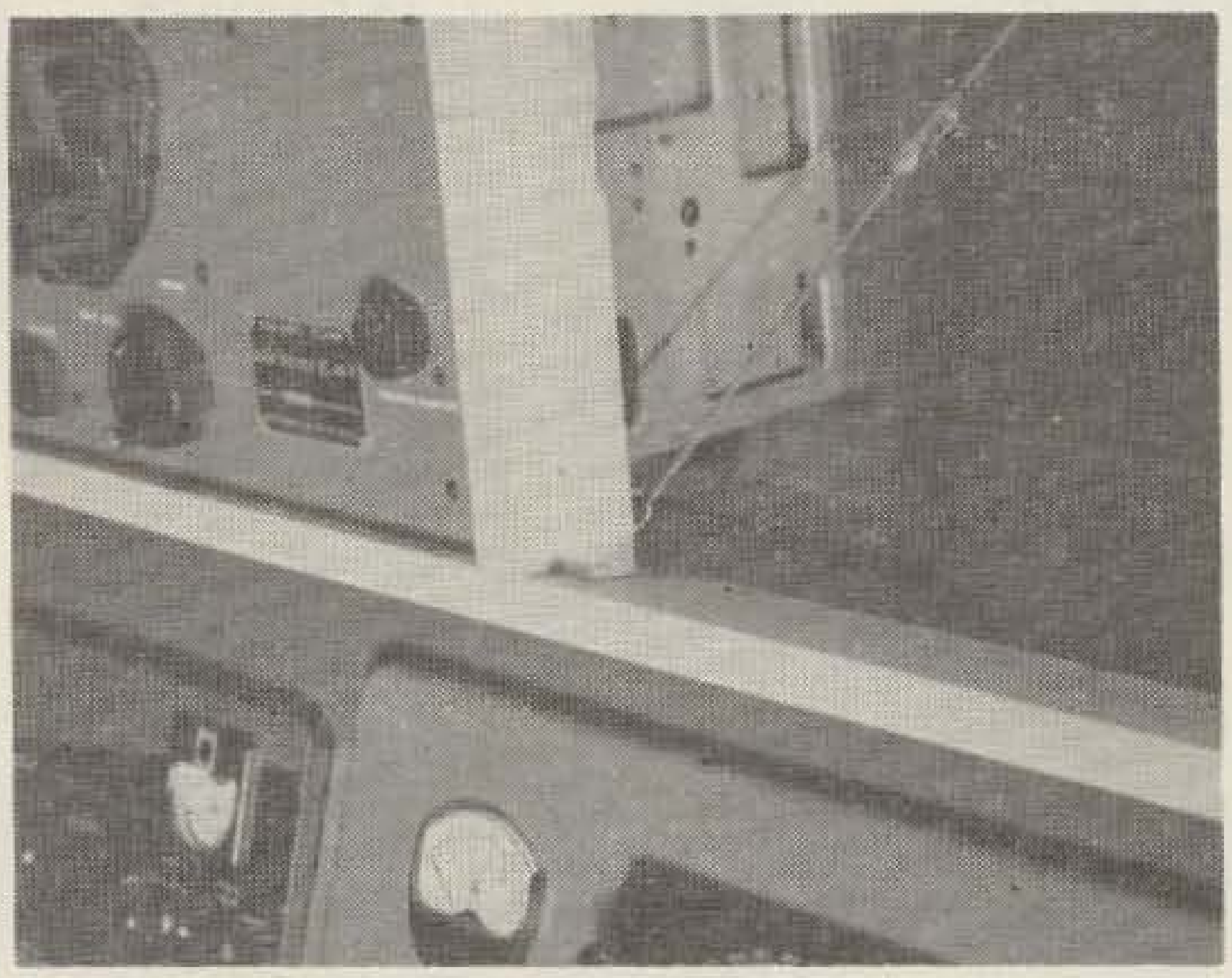


Photo 4

A brief description of the various pieces of gear as mounted by the author may be helpful. Besides the familiar BC-348, Valiant, 6N2, NC-300 etc. we have added at the lower left a 5¼ inch panel with several sockets mounted at the left. A cable with a matching plug then can be switched around to use either the Valiant alone, or the Valiant as an audio driver,

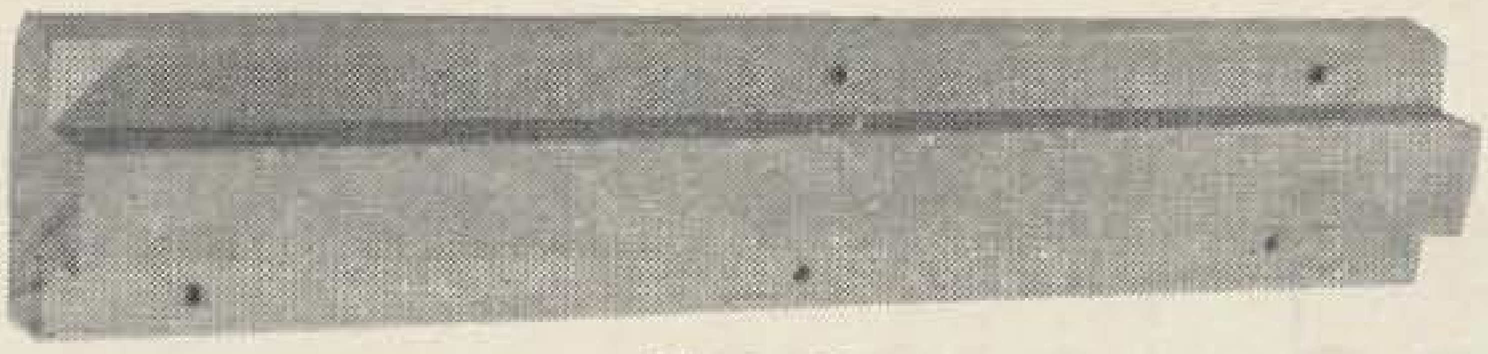


Photo 5

or to the 6N2.

To the right of this panel is the inter-com speaker so the operator will not fail to hear the dinner call. Underneath the National speaker is a 1¾ inch patch-panel strip for various audio inputs and outputs. The "eye" at the left is for monitoring RTTY signals. The 10½ inch panel to the right of the speaker contains the National VHF converter units. Directly below this is an audio termination board similar to the one below the speaker. The push-buttons above the NC-300 are used for Conelrad monitoring and WWV and CHU time signals. Underneath the desk are two power supplies and an RTTY terminal unit.

After you have completed your console you are sure to enjoy many happy hours of operating pleasure with everything in order, at arms reach and you still may alter the unit at will. *However*, don't let your visitors go behind the scenes—its one big messy mass of wires and cables.

To ascertain quickly the main items required the following list can be used as a guide.

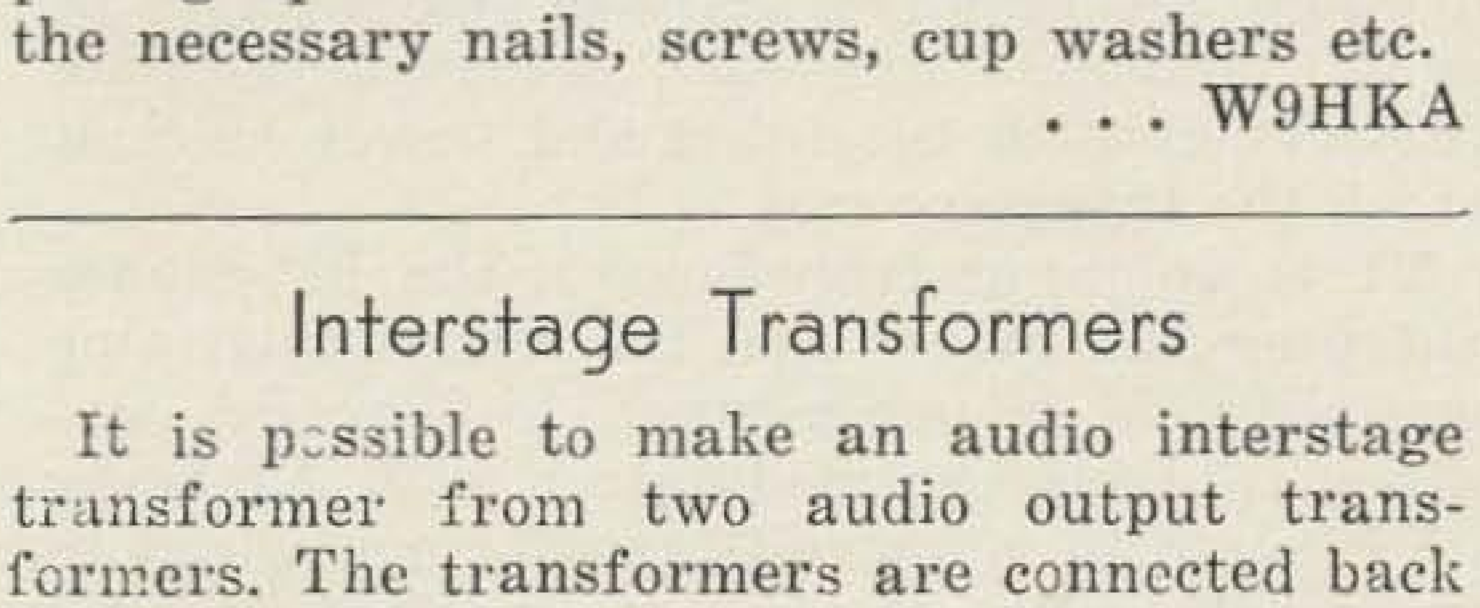
- 1—¾" x 4' x 8' fir plywood (sides)
- 1—⅝" x 17¼" x 70¾" fir ply (top)
- 1—¾" x 18 x 69¼" fir ply (desk top)
- 1—1 x 1⅛" x 79 8/16" strip
- 2—1 x 2 x 79 8/16" strip
- 2—1 x 3 x 79 8/16" strip
- 1—1 x 2 x 39¼" strip
- 1—2 x 4 x 81¼"
- 18'—2 x 3 fir stock (for inside vert. members)
- 11'—2 x 2 fir stock (for outside vert. members)

The above is for the console as shown in photograph number 2. Add to the above list the necessary nails, screws, cup washers etc.

. . . W9HKA

Interstage Transformers

It is possible to make an audio interstage transformer from two audio output transformers. The transformers are connected back to back with the voice coil windings together. While this doesn't always provide a theoretically perfect match, it will work perfectly most of the time. For details see diagram.



Class B Modulators

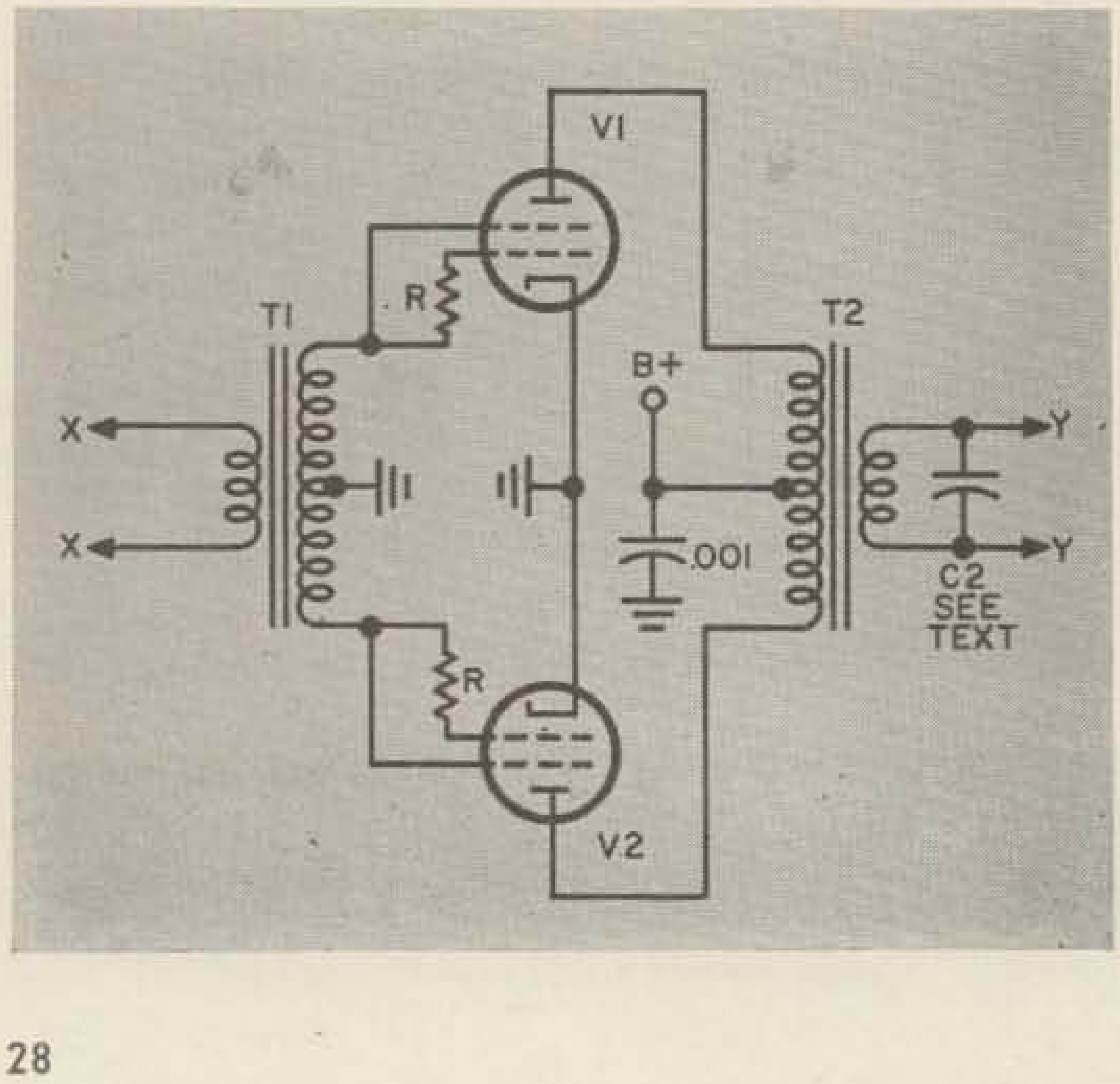
Larry Levy WA2INM

NOT many hams realize that the power supply for a plate modulator on an AM rig usually has to be larger, or as big as, the power supply powering the final.

In Class A applications, the power supply has to be able to deliver twice as much power as the final input. A Class A modulator has the maximum theoritical efficiency of approximately 30%. Practical efficiencies average about 20-25%. In an application where a transmitter of 100 watts input is being modulated by a Class A modulator, the modulator input will be between 200 and 250 watts. It could be more, as these figures are not counting transformer losses or mismatch.

Class AB modulators draw lower standby currents and therefore require a smaller power supply than Class A. The size usually is about equal to the one used to power the final. The efficiency runs about 40-50%.

The most efficient form of modulator is Class B. Class B differs from Class A and AB in that driving power is required, whereas in Classes A and AB no driving power is required, only voltage. Considering the cost per watt, it cost far less to get an additional 5-10 watts of drive than to build the additional capacity in the power supply. Most Class B circuits require a fairly stiff bias supply capable of giving a few mils of current. Several other circuits use triodes and require a large amount of drive. The most practical (and the simplest, therefore the cheapest) circuit is one using zero bias and tetrodes. The efficiency runs between 70 and 75% and the power supply can be about ½ (or even less) the size of the power supply used to power the final. It must be capable of large current peaks and well-regulated.



In a tetrode, the screen voltage as well as the grid voltage, has a lot to do with the plate current. In a case where the screen as well as the control grid are at ground potential, the plate current is extremely low, usually in the order of a few mils. When the screen starts to become positive, the plate current starts to increase greatly, as long as the grid is not negative. In the circuit shown, a very high audio voltage is applied between the screens. Resistor "R" lowers the voltage on the grid in the proper ratio. Otherwise, the grid dissipation of the control grid would probably be exceeded, as well as the fact that so much positive voltage would drive the tube into saturation and cause severe distortion.

In a typical cycle, with no signal, the screens and control grids of both tubes are at ground potential and the plate current is extremely low (5 mils per tube with 807's). When an audio signal is applied, on the first half of the cycle, one of the tubes (call it V1 for convenience) starts to conduct because of a positive voltage on the screen and control grids. At the same time, Va is driven beyond cutoff by the negative voltage on both grids. At the end of the first half of the cycle, both grids are at ground potential, and on the second half of the cycle the same thing happens with V2 conducting and V1 cut off. About 100 to 400 volts of audio are required between the screens, or 50 to 200 volts from each screen to ground. This varies with the tubes and power level at which the tubes are run.

T1 is an input transformer, the impedance matching the driver and the modulators. One possibility is to use a small hi-fi or PA amplifier to drive the modulators with T1 being a PP plate to voice coil transformer wired in reverse. Usually one delivering about 5 watts will do fine. T2 should match the modulator plates to the final. Sometimes connecting a small capacitor across the secondary of the modulation transformer will improve the quality of the modulation. If you desire to experiment, C2, which is optional, can be between 500 mmfd and .01. Usually one about .005 works well. The voltage rating should be at least two or three times the plate voltage on the final. The purpose of this condenser is to reduce some of the higher order harmonics of the audio signal. This will help reduce the bandwidth of the signal. These harmonics, as well as higher frequency fundamental signals, may be present at the input of the modulator. There is also a possibility of the modulator itself generating some harmonics.

Using this basic circuit, modulators in almost any power class can be built. The one I am using uses 807's to modulate a 100 watt transmitter. The plate voltage is about 350 volts. The value of R is 27K. Approximately 3½ watts of drive are required. The standby current for two tubes is 8 ma. On modulation peaks this increases to about 220 mils. Using 750 volts and a little more drive, this same modulator can fully modulate a transmitter in the 200-250 watt power class. At 750 volts on the plate, the standby current is only about 15 or 20 mils. For lower power rigs, 6V6's will give about 18 or 20 watts output and will nicely modulate a 40 or 50 watt transmitter. 6L6's have more than enough modulation for a 6146, 807 or any transmitter up to about 80 or 90 watts.

The power transformer used in these modulators can be one taken from an old TV or radio. There is not mucn load on the power transformer as the peak currents are drawn for relatively short periods of time. Most of the time the standby current is only a few mils and this gives the transformer a chance to recover.

One possibility for a modulator tube is the 1625. The characteristics are identical to an 807 except that it has a 12 volt heater and a different socket. They are available for about 25¢ surplus and a pair of them are capable of modulating a 200 to 250 watt transmitter. They can be run at lower power levels, run quite cool, and are efficient. For lower power levels it is more practical to use lower plate voltages, as the efficiency (practical) increases when the tube draws lower standby current.

This modulator has been in use for over a year without any failures in tubes or components. The reason I mention this is that most of the parts come from the junkbox and some of them (especially in the power supply) are being subjected to overloads of 300-500 percent (on peaks). The results have been excellent and this modulator combined with speech-clipping in the driver completely modulates the transmiter at a cost lost lower than the power supply alone of a Class A modulator.

. . . WA2INM

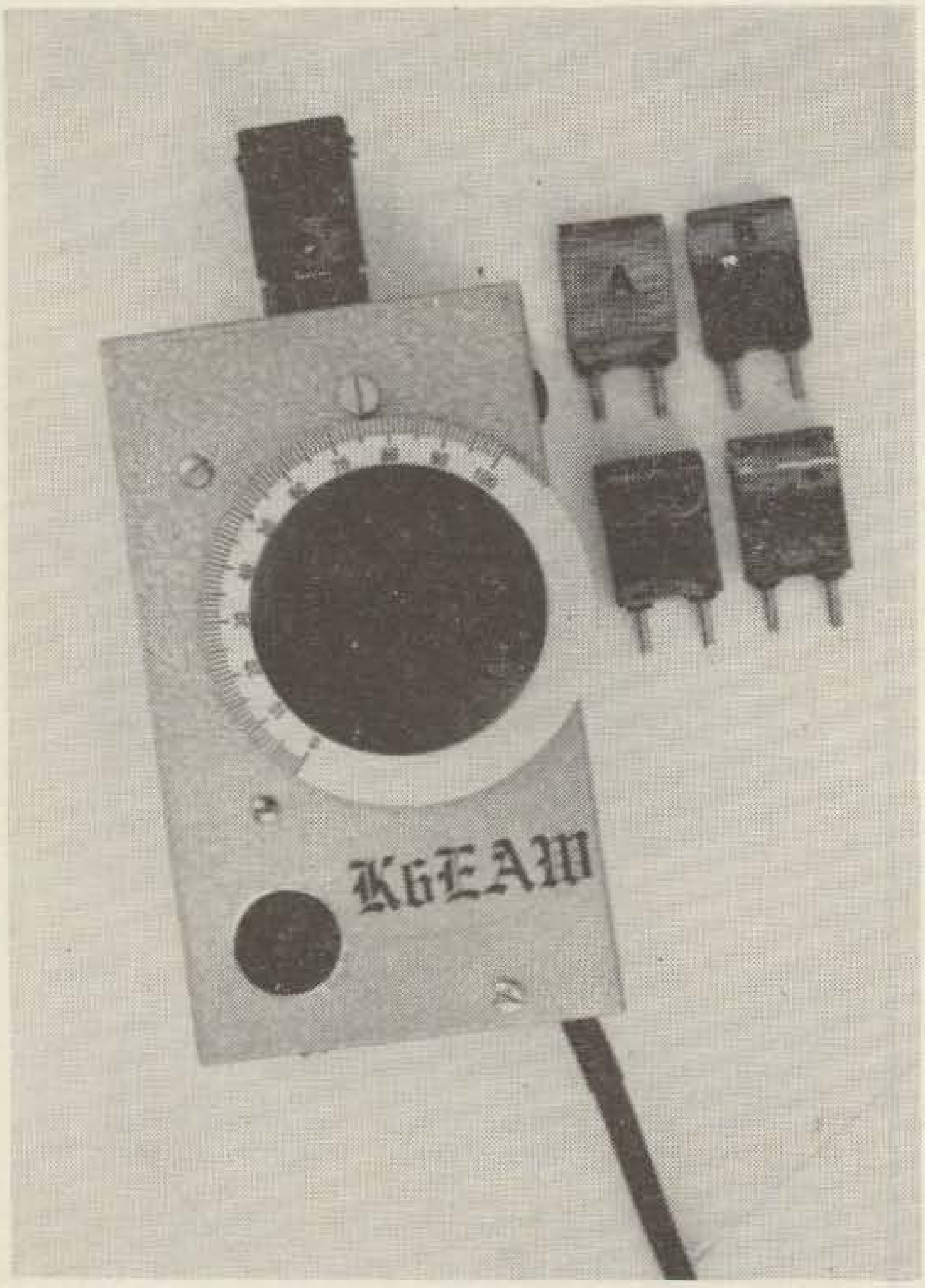
Letter

Dear Sir:

This will acknowledge your letter of recent date regarding amateur radio call letters on registration plates. You are advised that no call letter plates are to be issued under the present plans for 1962.

William S. Hults
Commissioner of Motor Vehicles
State of New York

New York is a rotten state.



An "Eye" For Resonance

Roy A. McCarthy K6EAW
737 W. Maxzim Ave.
Fullerton, California

If you don't have a grid dip oscillator you are probably missing out on a lot of the fun of ham radio. Simply knowing a new circuit is in tune before applying the power to it can change frustrating initial tune up procedures into pleasurable operating. Of course the GDO is far from being new, but the added expense is sometimes a bit too rough for hams on a limited budget. This one cuts the cost practically to the bone, especially if liberal use is made of junk-box parts rather than insisting on exact duplication. None of the components are critical in value.

Use of a tuning eye instead of a meter not only cuts down on the expense, but has a further advantage in that sharp dips can be detected which might be passed over with a meter. This is due to the instantaneous response of the eye. The major disadvantage of a tuning eye, namely the limited life of its brightness, was overcome by mounting it inside the case and using a simple optical system for viewing.

The instrument was intended mainly for use on the 6 to 80 meter bands. These are covered by four coils, each of which covers at least two ham bands. The inductance was adjusted so that a single calibration chart could be used for these ranges. A fifth range, covering approximately 50 to 100 mc was added, but no attempt was made to adjust it to the chart for the other ranges. This range acted a bit peculiar, since it was approaching the upper frequency limit of the circuit.

The circuit uses the familiar Colpitts oscillator tuned by a two gang midget superhet type capacitor. The oscillator grid voltage is monitored by the miniature tuning eye. To allow for variations in the grid voltage developed in the oscillator a sensitivity control, R4, in conjunction with R2 acts as a voltage divider to set the eye's grid bias until the eye is nearly closed. A tuned circuit coupled to L1 absorbs power from the oscillator, reducing the grid bias, and causes the eye to open slightly, indicating the resonance frequency of the tuned circuit.

A filament transformer was used to furnish heater power for the two tubes, and a simple half wave rectifier and capacitor filter supply about 150 volts of B+. The only connections to the case are through the tuning capacitor frame and the rf bypass, C4. This prevents any possibility of getting a shock from the power line. The coil is isolated from any dc voltages present by C2 and C3. Use of overrated capacitors will provide just about as much protection as the oil impregnated paper in most low cost transformers; however, for peace of mind a transformer using a 115 or 130 volt winding could be used to isolate the few milliamps used in the B+ supply.

The GDO was constructed in an LMB Tite-Fit Chassis Box #780, which is 5¼ x 3 x 2⅛

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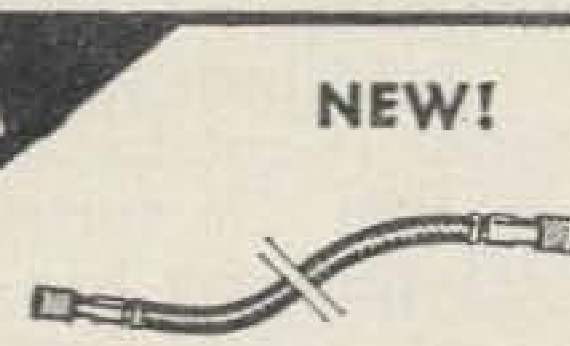

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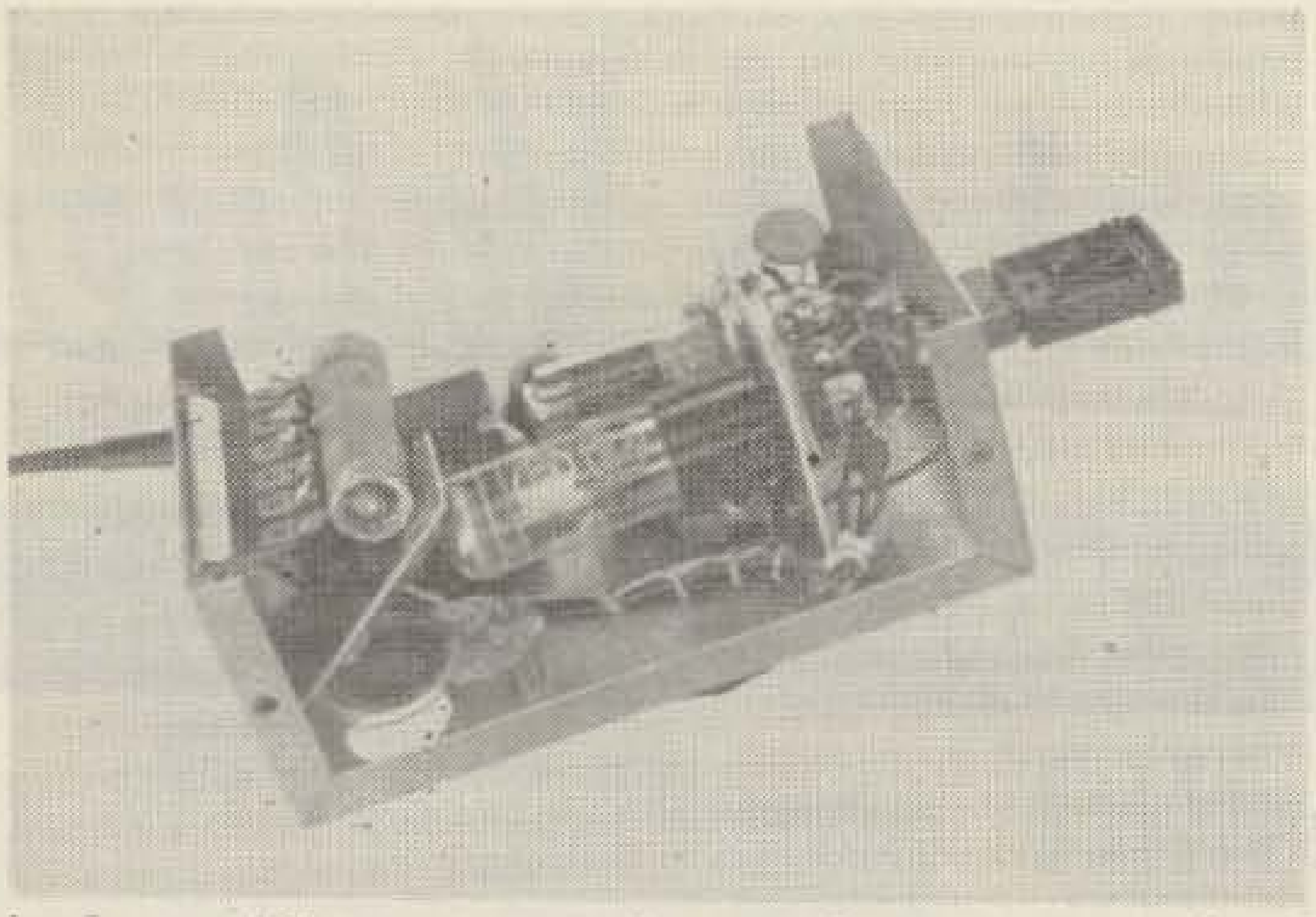


inches. All components used were standard radio parts except the tuning eye. The one used is a 7 pin miniature version made in Japan. These are made there by several manufacturers and are known interchangeably as the 6E5M and 6ME5. A regular 6E5/6U5 could be substituted if enough space is allowed for it in the layout. The tuning eye was mounted inside the case alongside the 6C4. A plain mirror is used to project the image through the hole in the top of the case. A small plastic lens is mounted just below the hole to provide magnification of the image. This provides easy viewing even in brilliant daylight. The mirror can generally be found in the xyl's discarded purse and cut down to size with a dime store cutter. The lens used was found in a box of Cracker-Jacks but similar ones are available in the Five & Tens.

Use of a crystal socket for the coil socket permits testing surplus crystals to check their activity and approximate frequency. The crystals which are defective can be dismantled and used for the coil forms. The cover is removed and discarded as are the various pieces of hardware inside. A piece of 1/16 inch plastic or similar insulating material is cut to fill in the space under the coil so that the turns wound on there will not be deformed by handling. The plastic should be cut a bit short so that the wires can be inserted into the cleaned out pins. Incidentally, cleaning out the pins (of the old solder) is simple if you merely heat them with the iron then give a mighty whoof of air into the xtal holder.

Wind the lowest frequency coil first and after checking its performance coat it with Q coil dope quite liberally. Each higher frequency coil is then wound in turn, checking its tuning and adjusting the inductance as required by removing extra turns or folding back part of a turn. Adding the polystyrene Q dope has a negligible effect on the tuning. The higher frequency coils can also be adjusted slightly by spreading a turn or two away from the main winding.

A simple commercial dial calibrated from 0 to 100 was used in place of the usual hand calibrated dial. A graph was plotted showing frequency vs. dial reading and cemeted to the bottom of the dipper, with a protective coating of plastic. The extra care used in trimming the coils paid off in an easy to read calibration chart, and 3.5, 7.0, 14.0 and 28.0 are at exactly the same spot on the dial.

Since the receiver in the shack only covers the ham bands it was used only for accurate spot checking of the frequency coverage. The remainder of the calibration was accomplished with the aid of an all band signal generator. Removing the cover of the signal generator exposed the coils & allowed using it as an accurate absorbtion wavemeter. The extra high band coil was calibrated by QRMing the TV set.

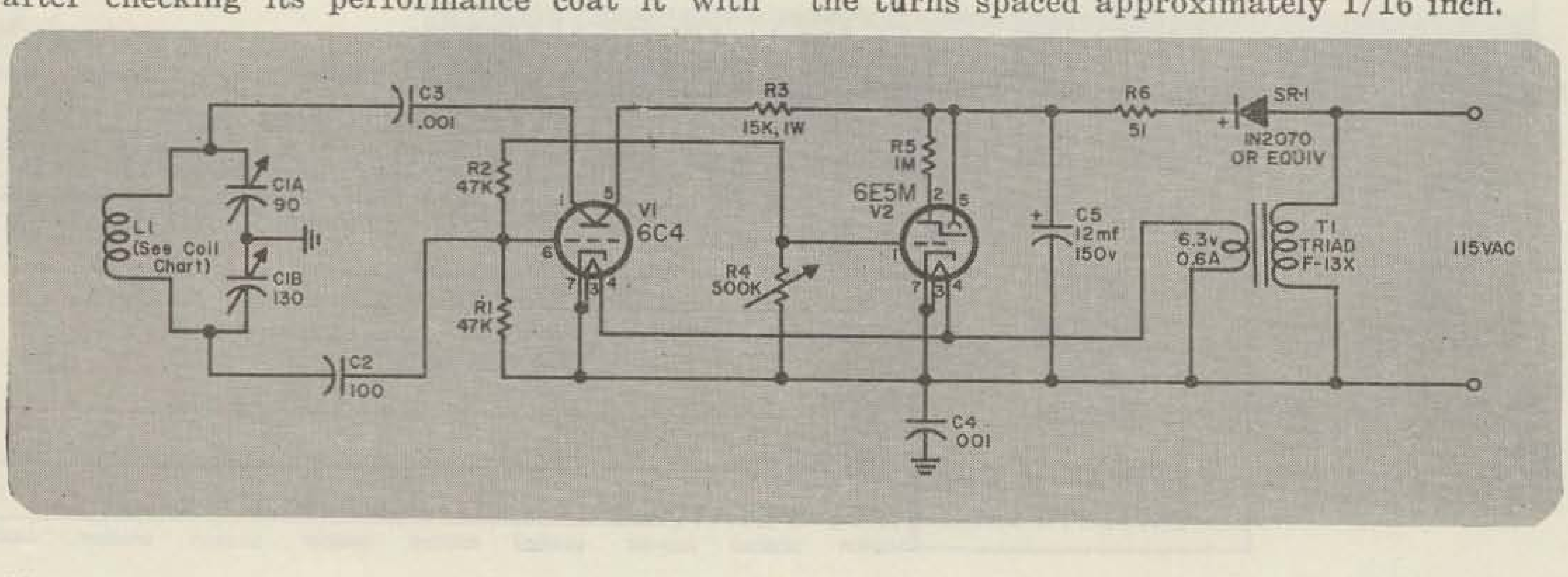
The construction and wiring are not particularly critical in view of the low frequency coverage intended. The best procedure is to get together the major component parts, then determine the layout and size of case needed. Individual calibration of the oscillator can be made a game rather than a chore by first winding a test coil to see what the circuit will do, then trying to wind the coils as close to the calculated numbers as possible.

. . . K6EAW

Coil Table

	Range	# turns	Wire size
A	3.2 to 7.4 mc......	70	28
B	6.4 to 14.8 mc......	24	28
C	12.8 to 29.6 mc......	9¾	28
D	25.6 to 59.2 mc......	3¾	28
E	50 to 100 (approx) mc.	1¾	18

All coils were close wound (except E) at the top of FT-243 crystal holders. Coil E had the turns spaced approximately 1/16 inch.



Break-In a la Transwitch

Ernie Austin W7AXJ
Bob Austin K7DVB
3211 S.E. Franklin St.,
Portland 2, Oregon

4 transistors	22½ positive volts
5 resistors	110 negative volts
3 potentiometers	Dash of capacitance

Mix judiciously. Connect to transmitter, receiver and TR switch. Adjust potentiometers for optimum operation. Place rig on air carefully. Relax and enjoy the finest and fastest CW break-in operation ever heard.

A transistor can readily be used to take the place of a relay in low current switching circuits such as grid-block transmitter keying arrangements. A typical circuit is shown in Fig. 1. The voltage applied to the emitter of the transistor can be as shown or may be obtained from sources such as the collector of the output transistor in the W5LAN version of the popular "TO" keyer. (Marland M. Old, W5LAN, "Transistorized Electronic Key and Monitor," QST, May, 1959.)

Break-in operation requires some form of control of the receiver gain. This, too, can be accomplished with a transistor. There are so many different circuits in use for receiver muting, however, that it would be impractical to attempt to describe how transistors could be applied to all of them. Therefore, this article will be confined to one arrangement which has been used successfully with the hope that it will inspire other circuit designers to develop units with broader application for presentation to the communications fraternity.

A particularly effective form of receiver muting is shown in Fig. 2. It will be recognized as the circuit used in some of the Hallicrafters receivers in which the sensitivity is controlled by varying the cathode resistance of several tubes. The "Monitor" potentiometer controls the receiver gain on "Standby" so that the receiver can be used to monitor the transmitted signal.

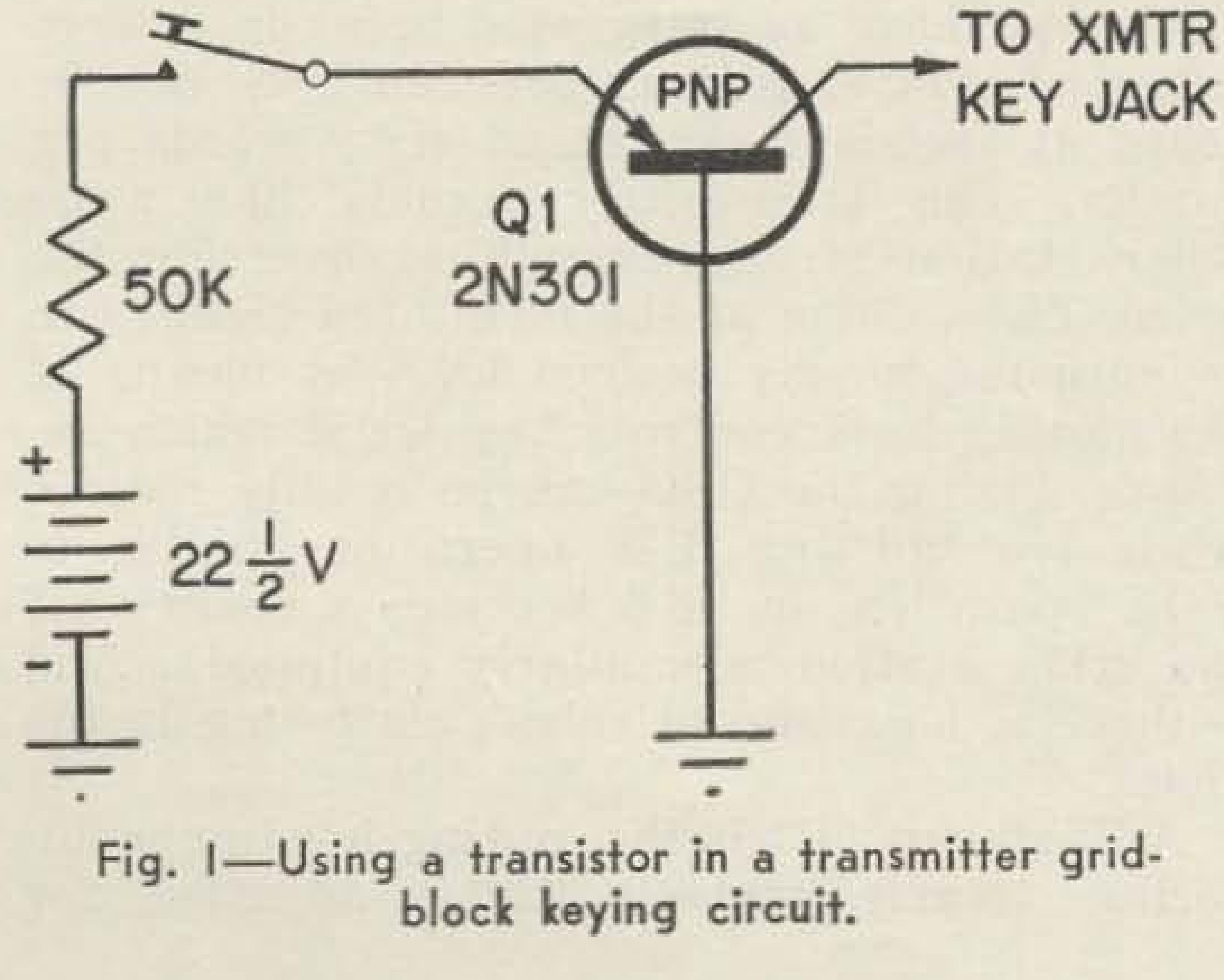


Fig. 1—Using a transistor in a transmitter grid-block keying circuit.

The transistor in the upper half of Fig. 2 has been added to the original circuit to reduce the sensitivity of the receiver when the key is closed and restore the receiver to normal sensitivity when the key is opened. The "Rec-Stby" switch is left in the "Stby" position when the transistor is used. Also the condenser which shunts the sensitivity control in the original circuit has been rewired so that it, too, is lifted from ground when the receiver is muted. This makes the receiver recover its sensitivity more rapidly so that breaks between dots can be heard at high keying speeds.

A "Muting Level Control" may be connected as shown in Fig. 2 and extended to some convenient location on the operating desk. This makes it possible to adjust the monitoring volume level while transmitting. This control is labelled R1 on the diagram. When it is used the "Monitor" control is set at minimum gain.

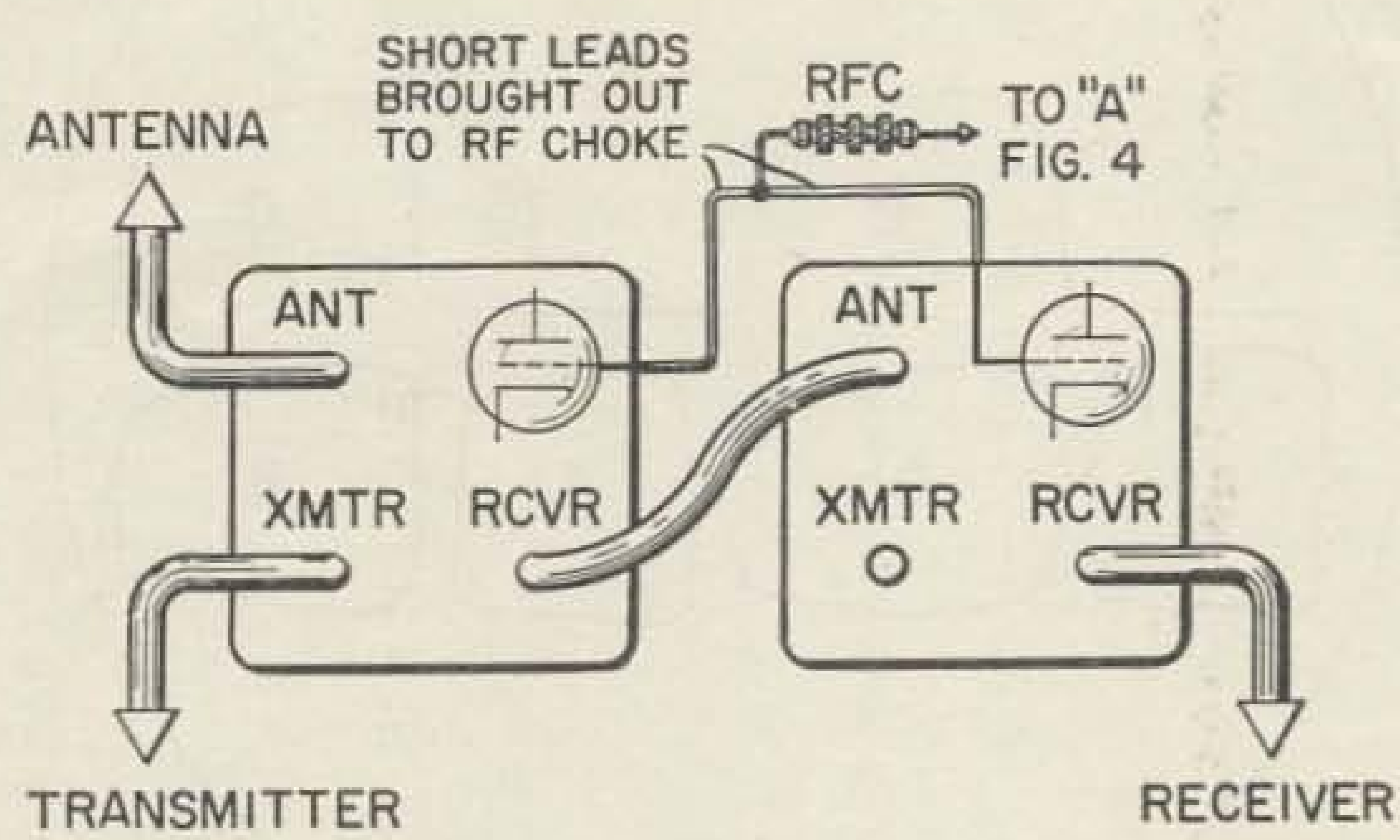


Fig. 5—Using two TR switches to increase isolation between transmitter and receiver.

It will be seen that two of the basic requirements of break-in operation have been met. However, these two circuits cannot readily be operated from the same keying source without too much interaction. It is advisable to introduce a third transistor.

Fig. 3 combines the circuits of Fig. 1 and 2 and adds the third transistor. Note that the first two transistors were PNP types while the third one is an NPN type. The base of Q2 is now keyed by Q3 which, with its associated resistors and the negative potential source, take the place of the 15 volt battery and 15K resistor used in Fig. 2. The voltage divider potentiometer R3 determines the operating point of Q2 through Q3. It is adjusted for maximum receiver gain with the key open. The 0.5 mfd capacitor from the base of Q2 to ground and the 150K resistor, R4, from the collector of Q1 to ground, improve the timing characteristic of the circuit which is controlled by the 100K resistor R2.

The timing action of the circuit is shown in Fig. 6. The receiver gain is reduced to a very low level before the transmitter is turned on and the transmitter is turned off before the receiver gain is restored to normal. The amount of time between "receiver off" and "transmitter on" is the timing characteristic which is controlled by R2. R2 also affects the leading edge of the transmitted signal at some settings.

If the transmitter comes on before the receiver gain is reduced keying thumps will be heard in the monitored signal. These thumps will be generated in the receiver, giving a false indication of the signal transmitted on the air.

With some transmitter-receiver combinations using a TR switch this combined circuit may be adequate. However, if it is necessary

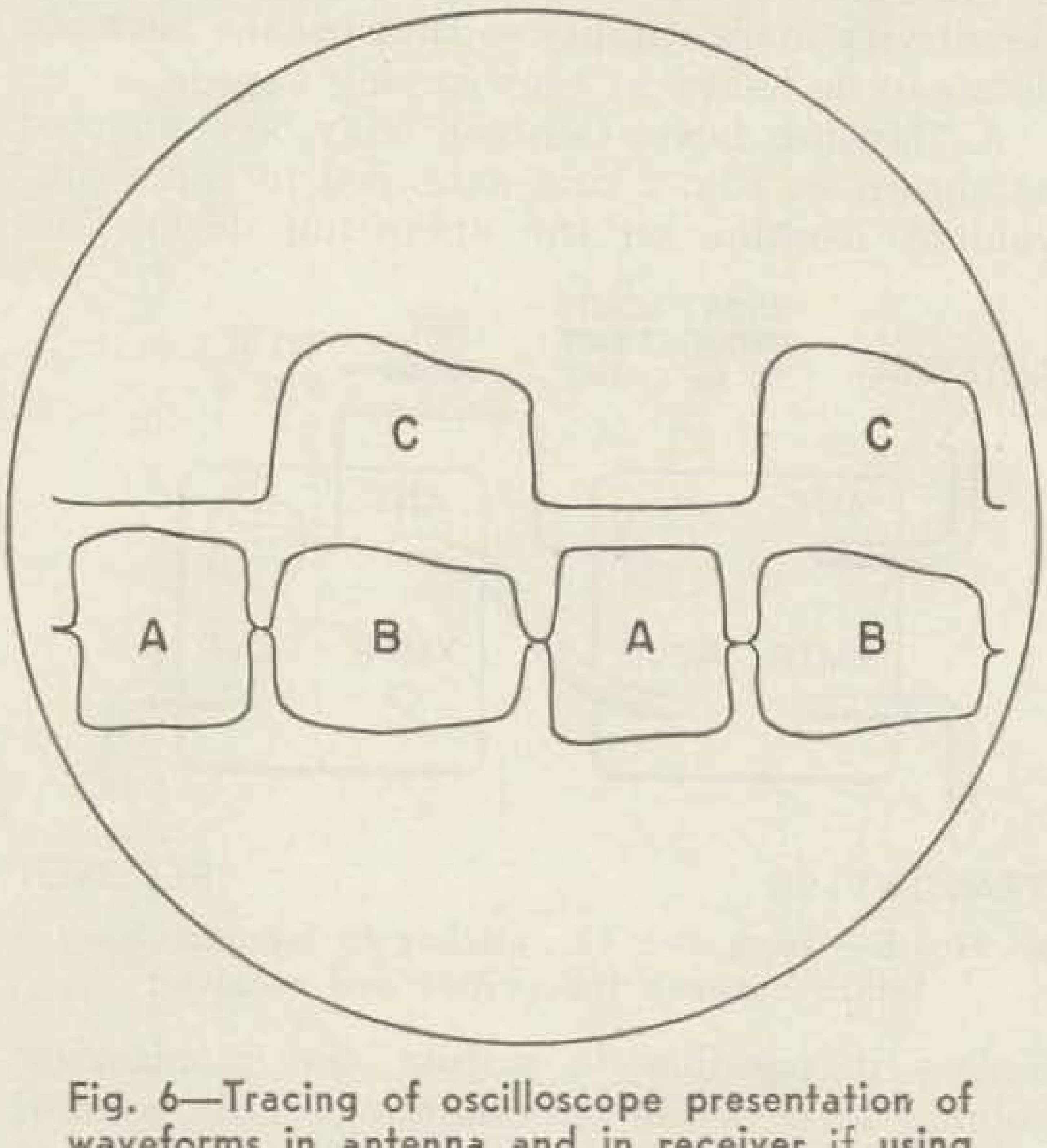


Fig. 6—Tracing of oscilloscope presentation of waveforms in antenna and in receiver if using the deluxe transistor break-in circuit. An electronic switch was used. The upper trace is from a demodulator probe at the transmitter output. The lower trace is from the receiver if with the receiver tuned to a steady carrier. The transmitter was keyed with steady dots at 18 dots per second (45 words per minute). The incoming carrier heard in the receiver is marked "A". The monitored signal in the receiver is marked "B". The transmitted dot in the antenna is marked "C". Note that the signal in the if drops to zero then returns to full sensitivity between dots.

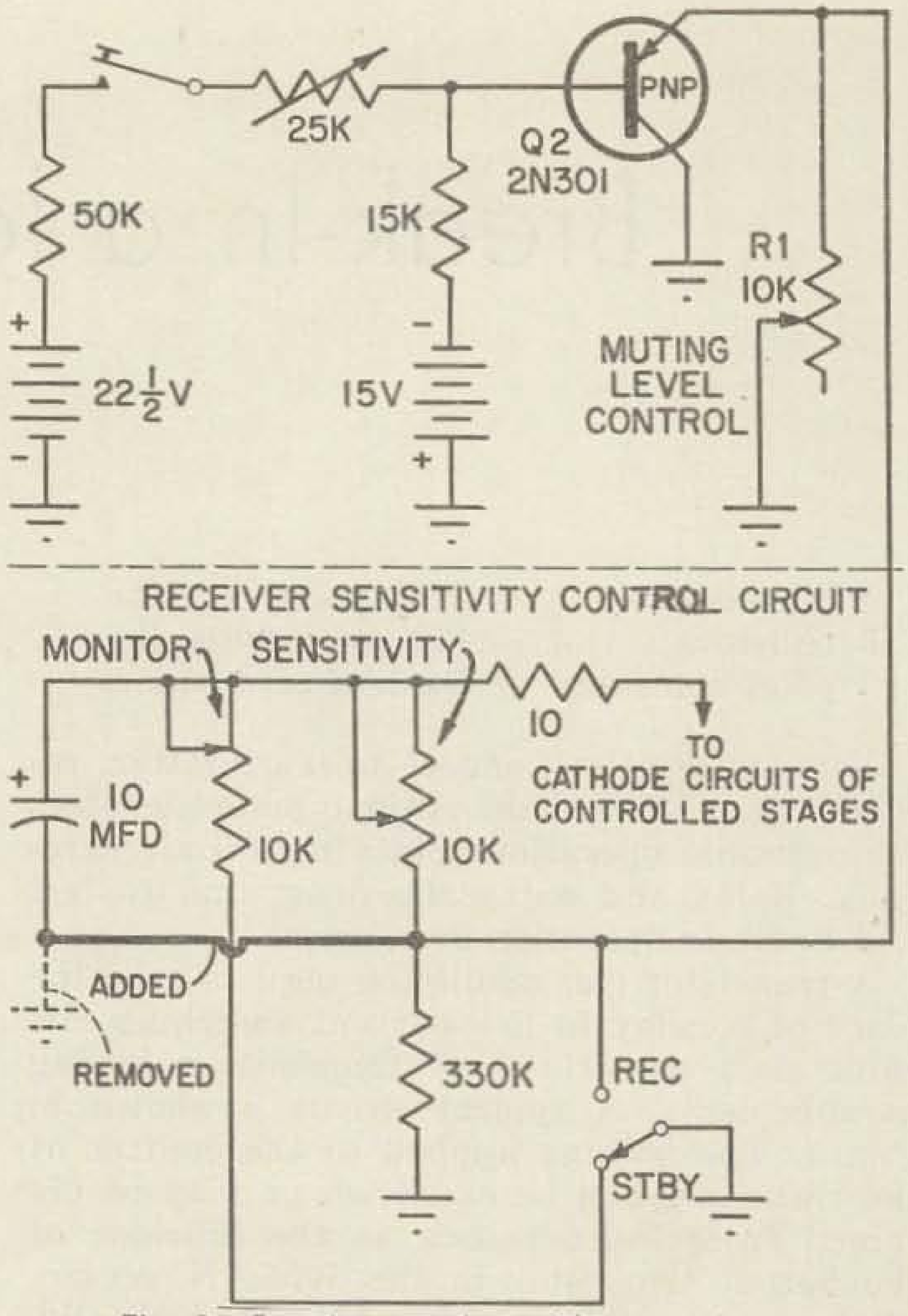


Fig. 2—Receiver muting with a transistor.

to reduce the level of the signal reaching the receiver from the transmitter through the TR switch, this can be accomplished with another transistor and use of the negative potential supply as a source of cut-off bias for the TR switch. See Fig. 4 and 5. The key-down bias may be insufficient to adequately cut off the TR switch and help reduce keying thumps. If this is the case the bias voltage at the TR switch grid can be increased by adding a second transistor as in Fig. 4a.

With high power it may be necessary to introduce more attenuation between the transmitter and receiver. In this case, two TR switches can be used. They should be connected in series and blocked simultaneously as in Fig. 5.

We now have an integrated break-in system using no relays. Breaks between dots can be heard at speeds in excess of sixty words per minute. The transmitter sounds like some other station strong enough to override the noise. The volume of the monitored signal can be adjusted to any desired level by means of the muting level control. Any QRM which develops during the QSO can be readily noticed while transmitting. CW operation similar to VOX operation on SSB becomes a reality (if the other station is similarly equipped). And —there is no sound of relays clattering in the shack.

Adjustment: R1 is the muting level or monitoring volume control. R2 is adjusted for minimum clicks in the receiver when transmitting, consistent with good transmitter keying. R3 is adjusted to the lowest value which will give maximum receiver sensitivity with the key up.

Construction: All resistors shown in the diagrams are ½ watt. The potentiometers are volume control types and the capacitor can be rated at any value above 110 volts. The transistors may be placed in the circuits which they control or they may be mounted together with extension leads to the various circuits. At W7AXJ they are mounted in a small chassis with the electronic bug. There is no need for special construction practices except where there is excessive rf in the shack. In this case it will probably be necessary to shield the leads to the transistor bases where they are remote from ground. A better solution would be to shield the transmitter!

Use of transistors: Many words have been written on the theory and application of transistors. No attempt is made here to improve on the literature. Two simple precautions are recommended while experimenting with transistors in switching circuits. (1) Use a fairly high resistance in the base lead and (2) Limit the total current through the transistor to the amount specified by the manufacturer under "Characteristics for Switching Applications." Do this with suitable resistors in the emitter

Fig. 3—Break-in circuit using transistors in place of relays.

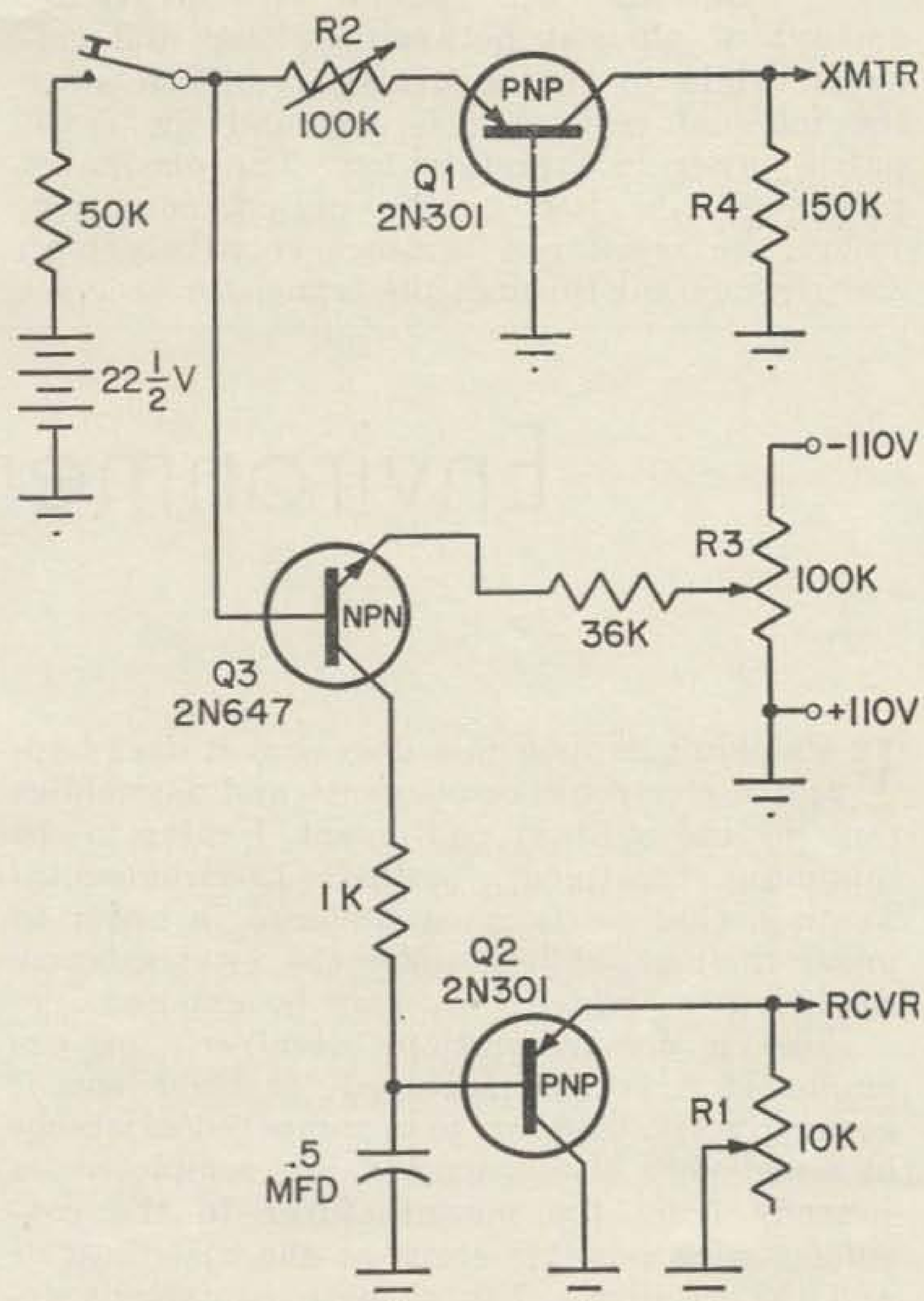
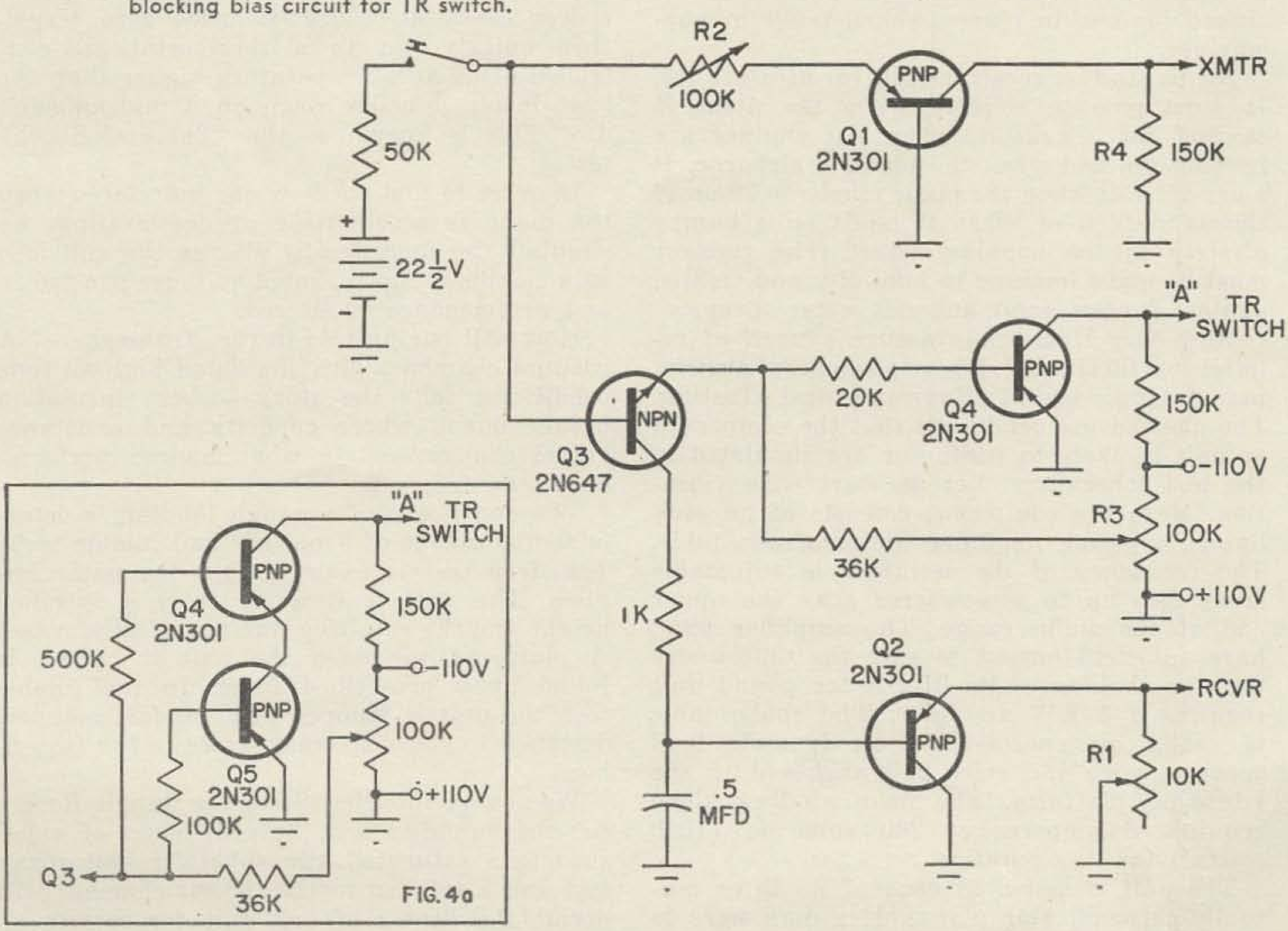


Fig. 4—DeLuxe transistor break-in circuit with blocking bias circuit for TR switch.



and collector leads.

A transistor will handle a surprising amount of current between emitter and collector while in the saturated condition since the internal resistance is low and the dissipated power is therefore low. The dissipated power is also low in the cut-off condition, where the resistance becomes relatively high and the current through the transistor becomes very small. In this condition it is necessary to be careful that the voltage across the transistor is not excessive.

The transistor types shown in the diagrams need not be used. Any similar type should be satisfactory. Buy yourself a handful and hook them up. You will be pleased with the results —but watch that base current!

. . . W7AXJ-K7DVB

Environmental Testing

Joseph Leeb, W2WYM
549 Green Valley Road
Paramus, New Jersey

It shouldn't happen to a dog—but it *does* happen to electronic components and assemblies that go into military equipment. I refer to the inhuman treatment, called Environmental Testing, that parts must undergo in order to prove their reliability under the most extreme conditions to which they may be exposed.

Take a communications receiver, for example. If it is manufactured for home use, it generally settles down to a pampered existence in somebody's shack, once it has completed its journey from the manufacturer to the consumer, with possible stops at the distributor's and the retailer's. Not so with equipment designed for use in planes, ships, tanks or submarines.

Let us study a receiver built for aircraft use. It must operate reliably when the plane is taxiing for a takeoff, when the engines are revving up, and when the plane is airborne. It must not fail when the plane climbs to 30 or 40 thousand feet, or when it lands on a bumpy airstrip in the burning desert. The receiver must be made immune to humidity and treated against fungus, sand, and salt water spray.

How does Uncle Sam assure himself of reliable performance? By means of exhaustive, painstaking, brutal Environmental Testing. The most severe conditions that the component or unit is likely to encounter are simulated in the test laboratory. Let us start with vibration. Here the equipment consists of an oscillator, a power amplifier and a shake table. The frequency of the oscillator is adjustable from zero up to somewheres near the upper end of the audio range. The amplifier must have sufficient output to give the unit under test the shaking of its life. A ten pound unit requires a 5 KW amplifier. The shake table is really an enormous electrodynamic loud speaker, with the voice coil anchored to the vibrating platform. The field winding alone requires 5 amperes at 200 volts dc (1000 watts!) for its excitation.

The unit is tested in each of its three mutually-perpendicular planes. If a man were to be given a vibration test (let's hope it will never come to that!) he would be shaken first standing up, then on his back, and, finally, lying on his side. In each position he would be securely anchored to the shake table.

Now comes the "search". The oscillator dial is swung slowly back and forth to determine the resonant frequency, or frequencies, of the test unit; in other words, the point or points on the dial where it vibrates most violently. While vibrating thus, the unit is fed rated voltages and its performance is monitored.

To make sure our unit will not conk out it taken to a place like the DEW line, it is put in a deep freeze at 65 degrees below zero, tested, then quickly put in a thermostatically-controlled oven, at a temperature higher than the heat inside a boiler room on a midsummer's day. This is known as the "Thermal Shock" test.

In order to find out how our unit fares when the plane is accelerating or decelerating, we simulate the condition by placing the unit in a spin chamber. Again, rated voltages are fed in and performance monitored.

How will our unit do in the stratosphere? A vacuum chamber, with simulated high-altitude conditions, tells the story,—where insulation breaks down, where capacity and resistance values change, and in what manner performance may drop off.

The end result of a rough landing is determined by means of drop, jolt and jumble tests. The drop test is exactly what the name implies. The unit is dropped from a specified height and the resulting damage, if any, noted. A platform, to which the unit is bolted, is jolted by a prescribed force. In the jumble test, the unit is bumped in a random manner, designed to show up weaknesses in the fastenings.

We now go into the "Steaming Jungle Room" for the humidity test. Several hours of exposure to a saturated atmosphere, a salt spray test and a sojourn in the fungus chamber will decide the fitness of our unit for service on a tropical isle.

Before the unit is subjected to the aforementioned treatment, the individual components must prove their worth. Capacitors are carefully checked for leakage, breakdown voltage, power factor and dissipation factor, under various environmental conditions. Resistors must prove themselves within specified limits of ohmage, and current-carrying capacity under extreme heat and cold. Fuses must blow within the specified number of milliseconds after application of current, as measured by an electronic counter. The hermetic seal on the ferrules must permit no moisture to leak in at high altitude or pressure. How do we detect the presence of a droplet of moisture hardly bigger than a molecule? Test fuses are dropped into a beaker of fluorescene solution, and the beaker placed in a vacuum chamber. After taking the fuses up to the required altitude or pressure and back to sea level pressure, the components are rinsed in running water and examined under ultraviolet, or "black" light. The most minute particle of fluorescene will glow brightly under this influence.

Hookup wire is checked for insulation resistance and breakdown voltage, in addition to resistance per foot and mechanical dimensions.

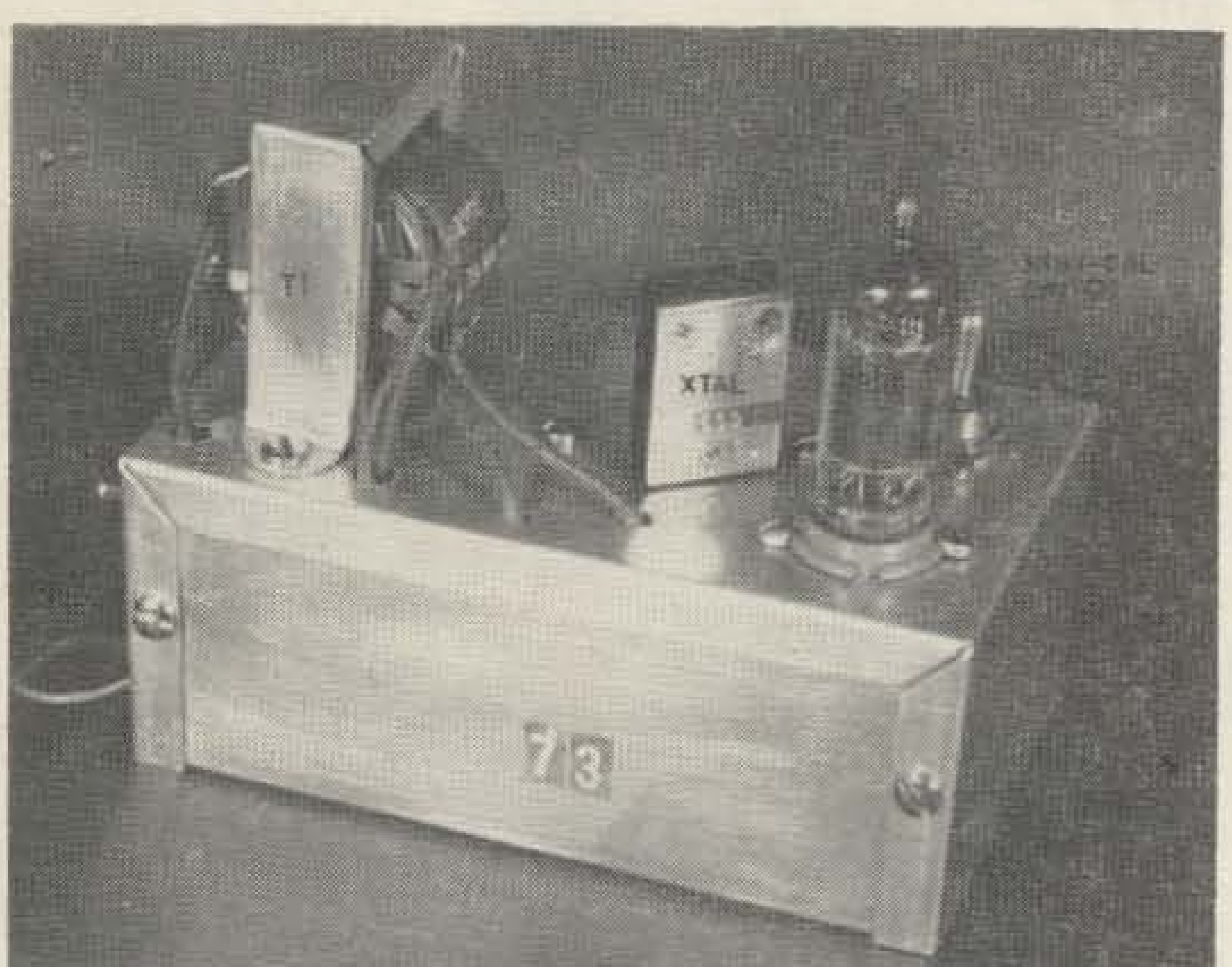
Connectors are checked for insulation resistance, voltage breakdown at high altitude, and contact resistance, among other things. In the contact resistance test, rated current is passed through each pair of mating contacts and the millivolt drop is recorded. This calls for a 4-wire hookup—two wires for feeding the current into the connectors, and two wires from the millivoltmeter to specified points on the connector contacts.

If the unit is to operate near combustible gases, it must be made explosion-proof. Every pair of make-and-break contacts must be bypassed with capacitors or Zener diodes, to completely eliminate arcing. Elaborate grounding must be employed if the unit contains moving parts that might generate static electricity. Connectors must have hermetic seals.

A sufficiently large random sampling of a production run is made for environmental test purposes to ensure reliability of the end product. For example, the specification may call for the testing of 10%, or a minimum of 50 pieces, out of each lot, regardless of how small the lot may be. It frequently happens that the entire lot must be destructively tested, if the lot happens to be a small one.

So—next time you buy a piece of surplus equipment, treat it with respect—it has been through fire and was not found wanting.

. . . W2WYM



All Band Band Edge Marker

Charles Berner WA2HRZ
125 Navy Walk
Brooklyn 1, New York

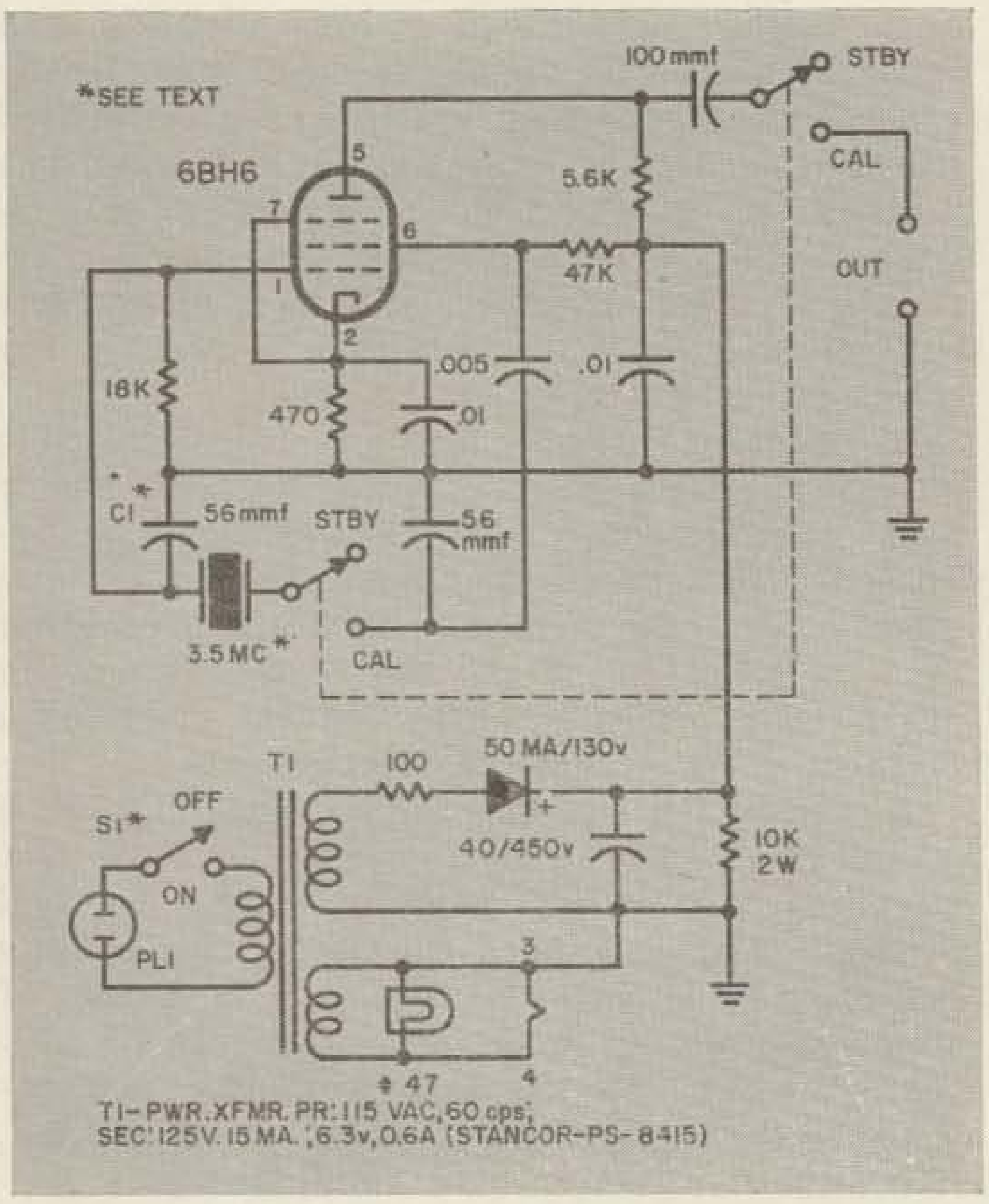
Photo taken by S. Blechman

A while ago, the editor of this magazine gave some advice to teenaged hams concerning the writing of articles for 73. I took this advice and, after hocking my switchblade, bought the necessary parts for this undertaking with the money raised from this sale.

I had a commercially made 100 kc xtal calibrator whose performance didn't satisfy me at all. I reasoned that since the ham bands are harmonically related, why not use a 3.5 mc xtal to obtain the marker signals. Table 1 shows that the higher you go in frequency, the higher the multiple of the fundamental. As the multiple increases, the signal strength decreases, and by the time you get up to 10 meters you have practically nothing. Not so with a 3.5 mc marker; the eighth harmonic will place you right on 28.0 mc, while the 280th harmonic is needed with a standard calibrator. This makes some difference in signal strength! This unit has been tested on 1¼ meters and works quite well.

Believe it or not, the total cost of this gem is only about $11. In fact it cost me exactly $11.79, including the confounded 3% city sales tax. This nominal investment shows that by homebrewing your equipment, you can double the performance of a commercial unit at half the cost.

This calibrator is complete with its own ac supply, eliminating the need for taking power from the receiver. If ac outlets are at a premi-



um at your shack, the on-off switch and the line plug can be eliminated and the ac line connected across the receivers ac input so that the calibrator comes on whenever the receiver is turned on. A high density selenium rectifier was used and this contributes greatly to the compactness of the unit. The whole thing runs very cool and even after 24 hours operation, still isn't hot.

Wiring isn't too critical, but keep all leads short and direct. Using an octal socket for a xtal holder lets you use the unused pins as tiepoints and is recommended.

A Petersen type Z-2 xtal was used because it has a tolerance of .002%. This is one reason why no provision is made for "zeroing" the calibrator against a standard. The other is that there isn't any such standard as WWV for use. However, if this provision is desired, C1, the 56 mmfd capacitor, connected to pin 1 of the 6BH6 thru the 18K resistor, can be made variable. Also, if band edge markers are wanted for 50 mc and up, a 5 mc xtal may be substituted when this function is wanted and C1 made variable for "zeroing" against WWV.

This gadget can also be used as a xtal activity checker by simply replacing the marker xtal with the xtal to be tested. Tuning your receiver should get you a strong signal at the xtal's fundamental if it is OK.

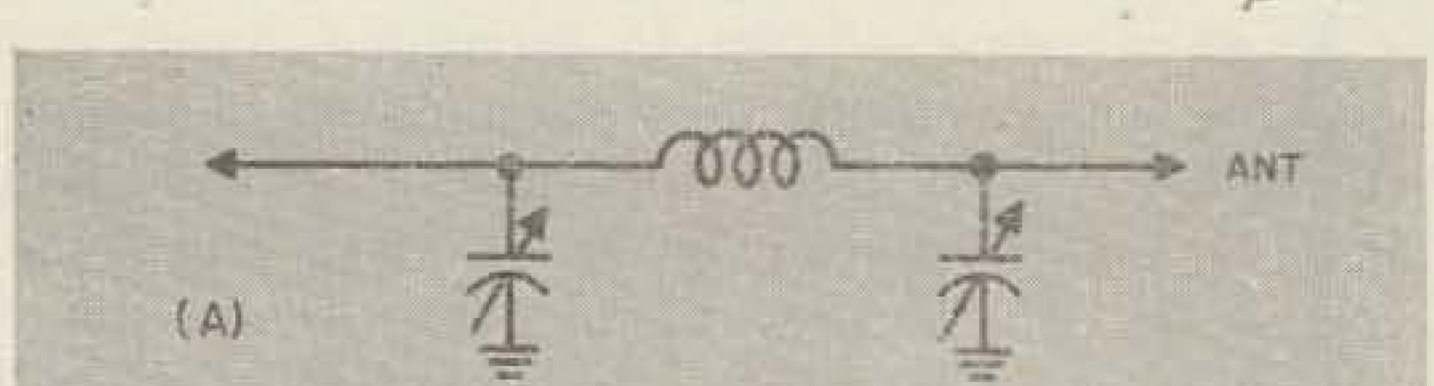
I would appreciate hearing from anyone who has come up with additional uses for this unit. Please send all letters to my home QTH as Wayne may think that they are bills and burn them. WA2HRZ

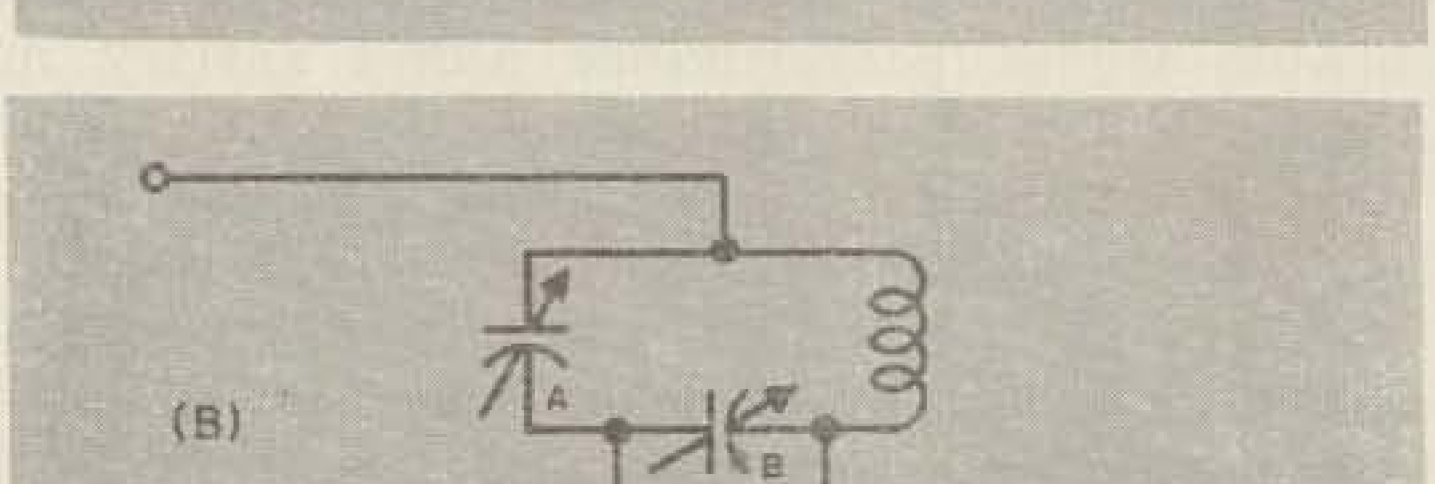
Table 1:

Band	Harmonic 3.5 mc	100 kc	Marker Frequency
80 meters	1	35	3.5 mc
40 "	2	70	7.0 mc
20 "	4	140	14.0 mc
15 "	6	210	21.0 mc
10 "	8	280	28.0 mc
6 "	15	525	52.5 mc
2 "	42	1470	147.0 mc
1¼ "	63	2205	220.5 mc
1¼ "	64	2240	224.0 mc

Pi

The Pi output circuit (A, above) has practically supplanted its predecessor the parallel tuned circuit in modern day ham transmitters, and is so-called because of its resemblance to the 16th letter of the Greek alphabet, π. The Collins Radio Company is generally given credit for first making extensive use of it and indeed it is still referred to in some quarters as the Collins coupler. The circuit can be redrawn as in B, above, to permit comparison with the more familiar parallel tuned circuit. "A" is the tuning capacitor and "B" the loading capacitor. With "B" at full capacity (minimum loading) the antenna connection point is practically at ground potential. With "B" toward minimum and "A" retuned to maintain resonance more and more power flows out the antenna as it is in effect disconnected from ground. . . . WØHKF





Tell The World

How to Get Free Publicity

Jim Kyle K5JKX/6
1851 Stamford Ave.
Santa Susana, Calif.

IF MY boss ever reads this article, I'm liable to find myself fired. Because by trade, I'm a newspaper reporter—and we're supposed to foil publicity attempts, not encourage them.

But if you follow the instructions I'm about to give you and come to see my boss, I'm not worried about the job coming to an abrupt end. If you do this, what you have to offer will be news, not publicity—and news is what we're paid to find.

Let's back off a little and start at the beginning. Why do we, as hams, want publicity?

That's not so easy to answer as it sounds. Too many of us just want to see our names in print, to have something to show off.

But the major reason, I hope—and the reason I'm writing this article—is that without good publicity, our hobby stands in serious danger.

Frequency allocations are valuable. As Wayne has been telling you repeatedly, while commercial interests are aware of the value of amateur radio in providing tomorrow's engineers, they forget about our value when they see all that space we take up—space that they want!

So far, we've done fairly well in keeping ourselves in existence. We've lost only two bands in as many years. But we have to keep at this business, and one of the best tools for doing so is publicity.

A former governor of the state of Oklahoma had a famous saying: "There ain't no such thing as bad publicity."

He wasn't completely right, but too many of us are shrinking violets when it comes to telling the world of our services and accomplishments as hams. And we're so afraid of bad publicity at times that we forget that any subject can be handled at least two ways. Even TVI can be made palatable with proper treatment.

So now you know that the aim of publicity is to promote the good name of ham radio rather than to blow the horn of any particular amateur. How do we go about doing this?

There's a simple two-part formula that will get you space in almost any publication or air time on radio and TV. It's this: 1—Do something worth while, and 2—Let the news media know about it.

Let's take a closer look at this. It may sound a little bit too simple to work out, but it's not.

By "doing something worth while," I mean something that John Q. Televisionviewer will think is worthwhile. You know and I know that it takes a tremendous amount of skill to work all states on 144 mc or to snag some rare DX. But is it worthwhile?

Not to old John Q., who thinks 144 megacycles means a gross of those things traffic cops ride on.

But any of your public service activities are horses of significantly different hues.

For example, in Oklahoma there's a storm warning net which operates on 3850 kc. These boys track tornadoes, and it's easy to show that their activity has saved a number of lives.

That's something worthwhile.

As a matter of fact, in the last two years I've written four feature stories about this same bunch of hams. Every one of these stories has proved to some 300,000 readers that hams are public-spirited citizens.

Or civil defense work. There's something worth plugging. There are all sorts of photo possibilities in the workings of a CD net, possibilities that any photo editor in his right mind, with a view to local news, will jump at.

You don't have to do anything big and ambitious, though. Nearly every one of us has, at some time or another, helped a fellow ham do something. Maybe the other fellow is paralyzed and can only communicate with the world via radio, and you've helped him get a new rig in place.

That's human interest, friend, and that's what the editors go into ecstasy over.

Or if you like to handle traffic, possibly you have taken messages from servicemen overseas on holidays or birthdays.

Actually, the list is nearly endless. Just remember, look at your accomplishment through the eyes of someone who knows nothing about the technical end of radio and cares less, and evaluate it from his viewpoint.

If it still seems interesting, brother, you've got a story. But if it only appeals to another ham, put it on the shelf and try again.

So you've decided you have a story; what do you do next?

First, here's what *not* to do. Don't, under any circumstances, call the editor just at deadline time and ask him, "How about some publicity for ham radio?" Not only will you get turned down flat, but hams' names will be mud with that particular editor from then on.

Instead, call him at a lull hour—for a morning paper, that's about 2 p.m., and in the case of an evening paper, about 3:30 to 4 p.m.—

and tell him you think you have a human-interest (or public-service) story possibility.

You might present it this way: "Mr. Smith, my name is Joe A. Hamm. I'm a member of a group of people here in Anytown which has organized to provide emergency communications for disasters or civil defense. There are 17 of us in the group—all local people—and we're working with the sheriff's office to help out whenever they need us. We're having a meeting Friday night, and I thought you might like to get a story about our public-service activity. ,

With that kind of presentation, he's not going to turn you down cold. Even if he can't get a reporter out to cover your meeting, he'll be interested in hearing more about your activities.

And you've got the foot in the door toward good relations with the press.

An even better approach, actually, is to locate a friend who's a friend of the editor. Through the mutual friend, get acquainted with the editor on a personal basis. If you can't work it with the editor, get a reporter instead. The idea is to know somebody in the news room.

Then, when you have the editor or reporter hooked, get him interested in what you're doing. Follow the ancient secret of the female race and let him chase you until you have him where you want him.

Plant your human-interest or public-service possibilities in his path, but let him think he's discovered them for himself. He'll be a lot more enthusiastic about them if you do.

And don't ever expect friendship to keep him from printing any bad publicity. That seldom happens. The way to avoid bad publicity is to prevent unpleasant incidents from ever happening in the first place. If it happens, and the newsman is worth his pay, he's going to print it.

An important point in this business is to let the media know in advance, wherever possible, what you're doing.

If you have a CD drill, for instance, and wait until it's all over before telling about it, you'll be lucky to get a two-paragraph item listing the names of those present.

But if you plant it in advance, then the editor can send out a writer and a photographer and make a major feature out of it. And in the newspaper or TV news business, good local features are worth their weight in gold. They're rare.

Be prepared for what seem like stupid questions. Chances are the reporter who handles the story will know from nothing about radio. He's going to ask some foolish questions. If he doesn't, he's not getting your complete story. You just be ready to answer them in language he—and his readers—can understand.

Ham talk is full of abbreviations. U cn see hw odd it is at times, but when ur in QSO both you and the guy on the far end are talking the same lingo.

The reporter won't know the language, unless you're lucky and find another newspaper office with a ham in it.

Don't think he's stupid just because his questions sound that way. Would you know what to do if someone told you to: "Put a set of dingbat lines on that four-column and rush it up, I need it for the first!"?

If you take a little time to make sure the reporter understands exactly what you're up to, you'll get a better story out of him, and the publicity will achieve its purpose.

But don't go too far and try to tell him how to write the story, or ask him to let you go over it after he's through.

Any newsman worth his pay is a specialist. He knows at least one thing well, and that's how to write. Most of them spend most of their time writing about things which are foreign to them, and they're pretty good, as a rule, in this matter of getting the details correct.

He'll be touchy about you going over the story. To him, that means you want to censor his work. As a matter of fact, he even hates for the editor to check his writing when he turns it in!

But if he seems completely confused, it won't hurt to offer—*not ask*—to go over the piece with him when it's finished to catch any possible errors or mistakes in detail. If he's really mixed up about what you're doing, he'll appreciate the help.

If this happens, be careful. Don't say a thing about his writing or his approach to the story. Just watch out for technical goofs such as a transmitter on the "one-kilowatt band" and leave the writing style alone. That way, you'll get along fine with the writer.

And as a final word, don't try to work the newsmen to death. About one good story every three months or so is all any one medium can take on any subject. Editors have long memories, and if you call much oftener than that you'll get the reputation of being a publicity hound—and that will be the end of your efforts.

Of course, he can take a public service story now, and a human interest yarn then, if they involve different hams. And any activity that ties in with other news stories—March of Dimes telethons, floods, brush fires, missing-persons searchers, etc.—is nearly always good for a news story on the ham angle alone. Just be sure to let him know right then—not a week later.

For in the news business, there's a saying: "There's nothing deader than yesterday's story." When you're involved in something timely, take a minute to call the editor and let him know. Otherwise, let him know in advance. That way, you'll tell the world.

K5JKX/6

An Argument for a New Type of Radio Communication

Zero-Shift Keying

Jim Kyle K5JKX/6

ARE you an experimenter, looking for the opportunity to pioneer new fields? Then maybe this article is for you.

Let's admit right off that it's theoretical; although it includes several schematics, none of the equipment has been built or tested—which means that the system may have a number of hidden bugs. However, all the component parts of the system have been used in other branches of electronics with success—and there's no apparent reason why they won't do as well here.

Even if the entire system had been built, it couldn't be tested on the air (except at microwave frequencies, which offer their own problems) under present regulations—which means that if it works for us in our bench test, we'll have to petition the FCC for permission to use this type of modulation on the more-popular ham bands.

But, if it works, getting permission to use it should pose no problem, because the gadget is a high-speed RTTY system requiring virtually zero bandwidth. It's also almost impervious to interference, noise, or other disturbances, and utilizes present equipment with less modification than is necessary with present-day RTTY gear. Only one attachment is necessary at the transmitter, containing a single stage, and another at the receiver.

The entire system is based on the fact that RTTY is basically a binary pulse-code modulation system, in which groups of five pulses convey each letter. Most RTTY activity today uses frequency-shift keying, in which one frequency is transmitted to indicate the presence of a pulse and another frequency is sent to indicate pulse absence. These are known as the "mark" and "space" frequencies.

Commonly, mark and space frequencies are separated by 850 cycles (the value is a carryover from landline teletype operation) although regulations allow us to use any shift between 0 and 850 cycles.

Now, let's back off a minute and look at the situation from the viewpoint of a digital computer engineer. His hardware operates with strings of binary pulses which are either there or aren't there, too. Instead of mark and space, he calls them "one" and "zero", but it's the same situation. To him, a teletype transmission is simply a chain of 5-bit pulse trains.

One of the larger problems facing computermen today is that of transmitting data from one computer to another cross country, and they've put a lot of study into it. They've analyzed almost every possible form of modulation from the standpoint of easy separation of "ones" and "zeroes", and the system we're describing is based on this study.

Take a flow of direct current. Its polarity may be either positive or negative. This provides a binary representation, which in fact has been used in the trans-Atlantic cable.

However, it's difficult to transmit dc over the air, so let's turn our attention to a sine wave. It, also, may be either positive or negative. That is, the sine wave may be either in phase with a known reference, or 180 degrees out of phase with the reference. This, too, provides a binary representation.

In other words, "mark" can be represented by an rf sine wave of any desired frequency and "space" would then be a sine wave of the same frequency but 180 degrees opposed in phase. Since frequency would remain unchanged, bandwidth of the system would approach zero (actually, in FM terms the signal would have infinite bandwidth every time the phase changed and zero bandwidth in between. However, energy content at any one frequency of a signal of finite power spread over an infinite band is infinitesimal and can be ignored).

To accomplish this in an actual transmitter,

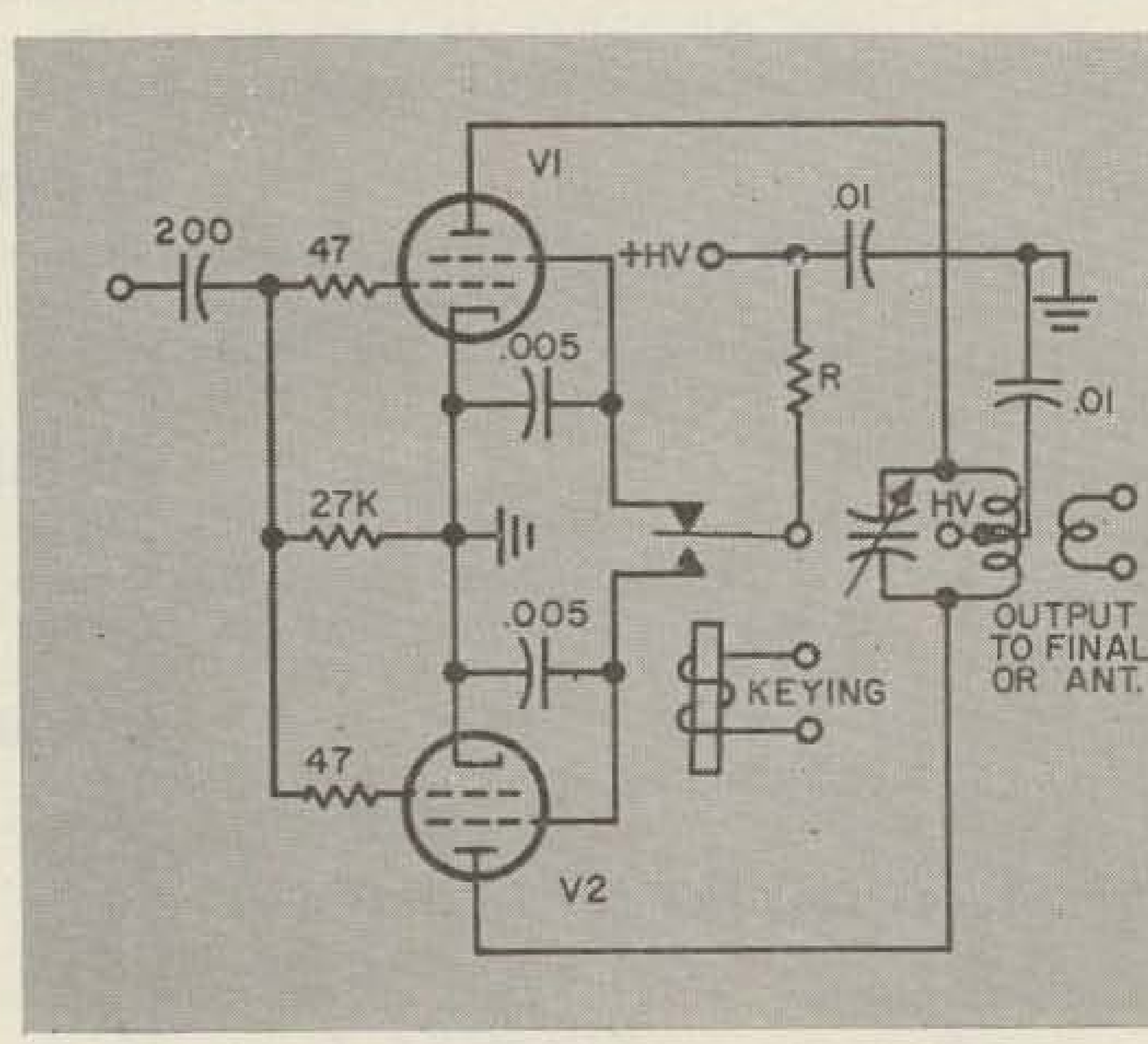
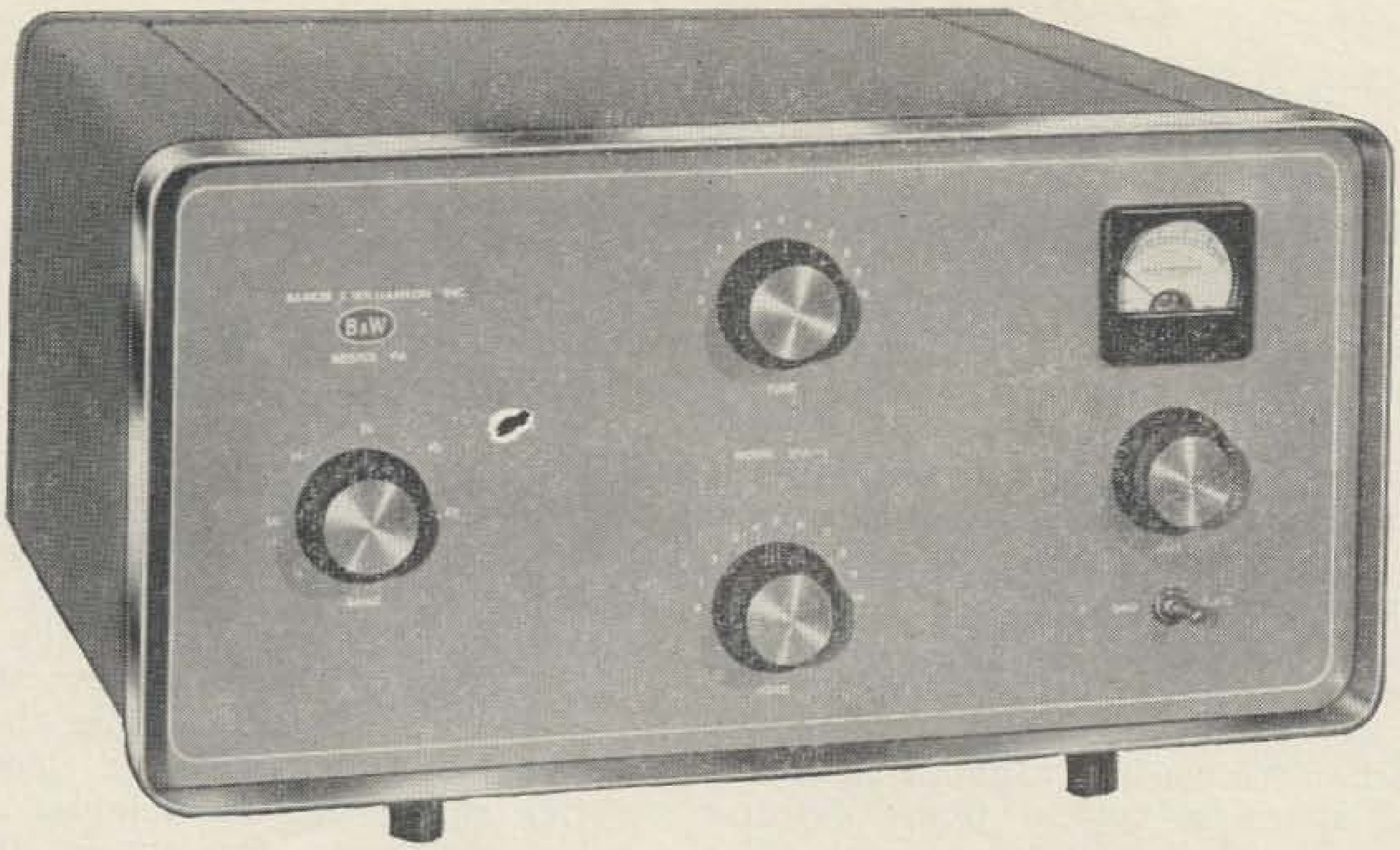


Fig. 1



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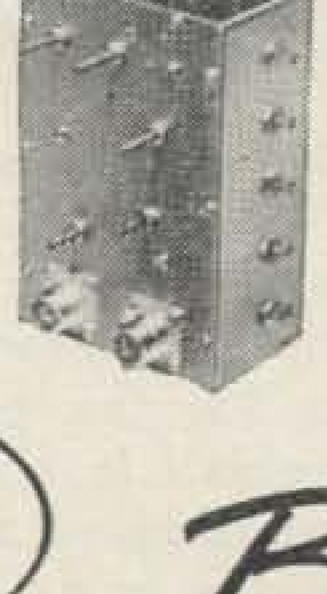

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the keying unit shown in Fig. 1 could be inserted at any stage operating at the output frequency, preferably just before the final.

This unit is a balanced modulator such as is used in sideband, but it's fed from a dc source. The tubes conduct only if their screens are connected to positive voltage. Relay K1 assures that only one conducts at a time. If V1 is conducting, the output phase will be 180 degrees away from that of the input, while if V2 is conducting, the phase will be unchanged. Thus keying the relay changes phase of the output signal by 180 degrees.

At this point, we have a signal going out which contains all our information in zero bandwidth, but we have no way of detecting it. That's what we need to examine next.

Figure 2 shows a typical phase detector which compares the incoming signal to a reference and gives one polarity output if incoming and reference signals are in phase and the opposite polarity if they are 180 degrees opposed. With such a detector at the end of the receiver's *if* strip, we could use the polarity changes to operate either a sensitive polarized relay or a dc amplifier circuit to key the printer — if we had a stable reference source.

The best reference source is the incoming signal itself. If we double its frequency in a multiplier, the phase shifts will disappear. We can then use this as a reference voltage to phase-lock a frequency divider, ending up with a phase-stable reference voltage which is either in phase with the original reference or 180 degrees out. If it's 180 degrees out, the result will be the same as being tuned to the wrong side of zero-beat in a present FSK system, and the cure is also the same—switch to the other side using a reversing switch.

A complete unit fed from the grid of the receiver's final *if* stage is shown in Fig. 3. Power supply for the adapter is not shown, but a separate power supply should be built for it since most receivers can't stand being robbed of so much filament current as the adapter would require.

In addition to the saving in spectrum space achieved by going to zero bandwidth, this system would be much easier to tune than the

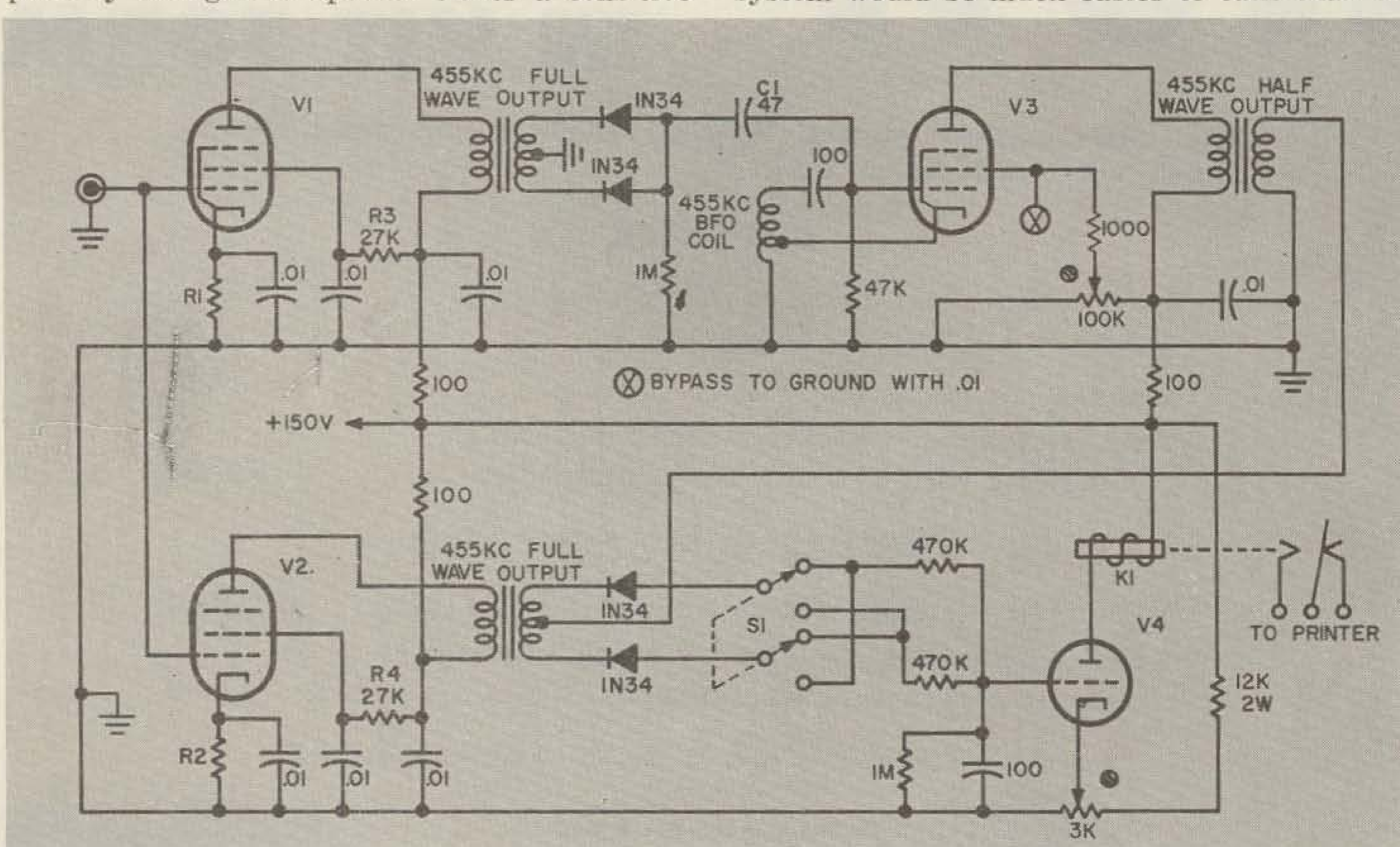


Figure 3. Zero-shift RTTY Reeceiving Adapter, Schematic Diagram. All transformers are replacement-grade 455-kc *if* transformers. Suitable units are made by Miller and by Stancor, among others. V1 and V2 are isolation amplifiers; the input connection is to be taken from the grid of the receiver's final *if* tube. V1 feeds a full-wave frequency doubler, which removes phase information from the incoming signal and then, through C1, synchronizes reference oscillator V3 in perfect phase with the incoming carrier. If the value of C1, R1, and R3 is correct, when the receiver is tuned to an AM station and the output of V3 temporarily coupled back to the regular detector, the beat note will jump to an absolute lock (thereby disappearing) as it reaches 2 to 3 kc. V2 feeds the incoming signal directly to the phase detector, where it is compared in phase with the reference derived in V3. Switch S1 corrects for the possible 180° misphased condition which is analagous to being tuned to the wrong side of zero beat in conventional FSK. V4 is a relay-driver stage. The 100K pot in the screen of V3 adjusts strength of the reference voltage with respect to incoming-signal voltage at the phase detector. The 3000-ohm pot in the cathode of V4 adjusts bias on V4 for proper on-time-off-time conditions at the relay while receiving an "RY" series.

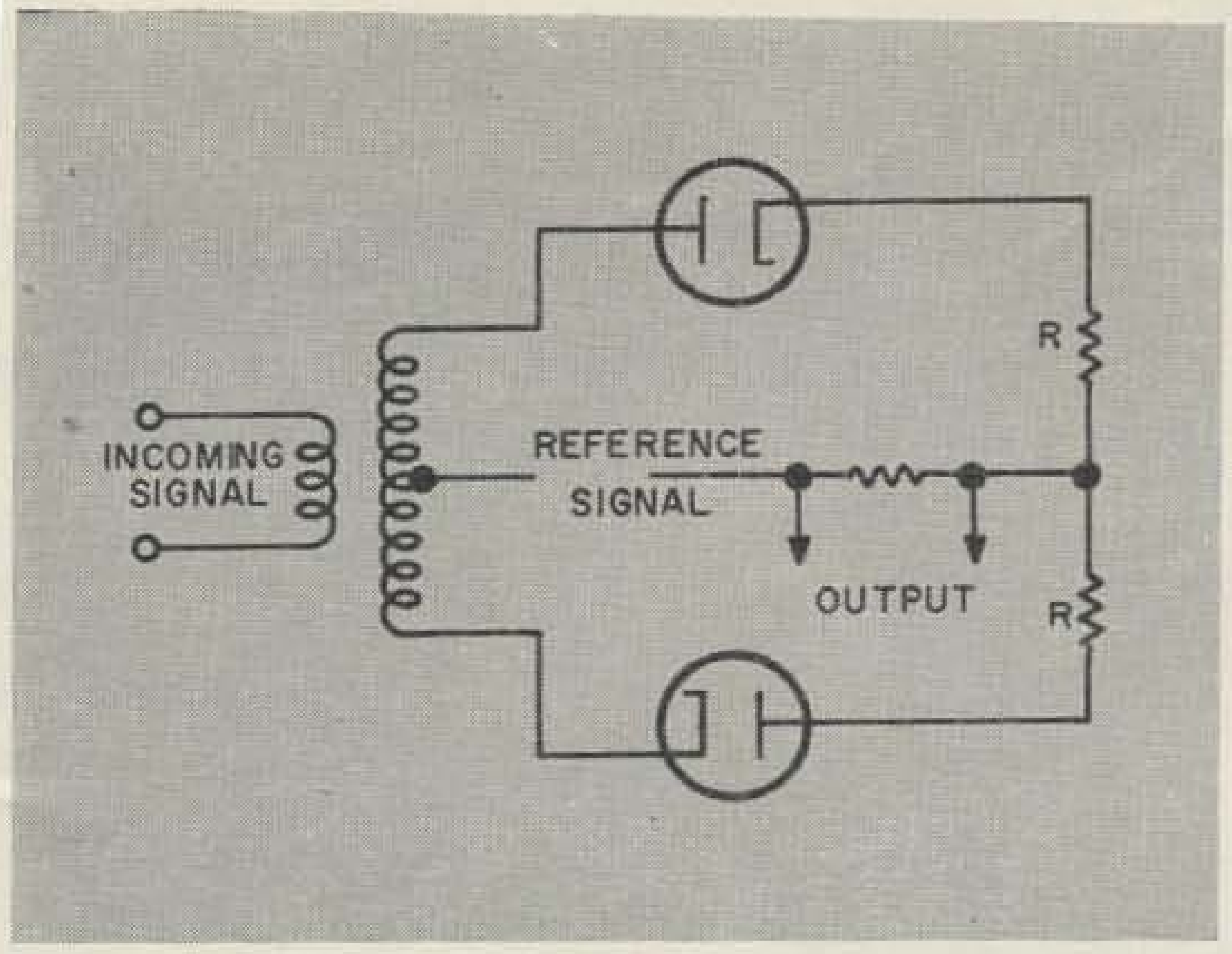


Fig. 2

present FSK technique. In the absence of a strong interference which might capture the phase-reference generator, the only requirement for a solid copy would be that the incoming signal be somewhere in the receiver passband. By using only the polarity of the received and detected signal as the indicator of information, slight phase shifts and beats caused by interference are made insignificant. Computermen report an average increase of 3 db in usable-signal-noise ratio as compared to FSK for this system; this means that the signal can be 3 db lower in the noise level for the same accuracy of copy.

The advantages have been listed, but there are a few disadvantages too. The largest is that this system is incompatible with present FSK RTTY. A station equipped only for zero-shift could not communicate with an FSK station, and vice versa. The situation is somewhat analogous with the wideband FM vs. AM, or AM vs. SSB, dilemma on the phone bands. In addition, as mentioned at the start, this is only a theoretical system in its application to RTTY and has not been tested at all. Hidden bugs might appear in widespread tryouts.

However, if you're an experimenter, looking for the opportunity to pioneer new fields, then maybe here's one for you. What do you think?

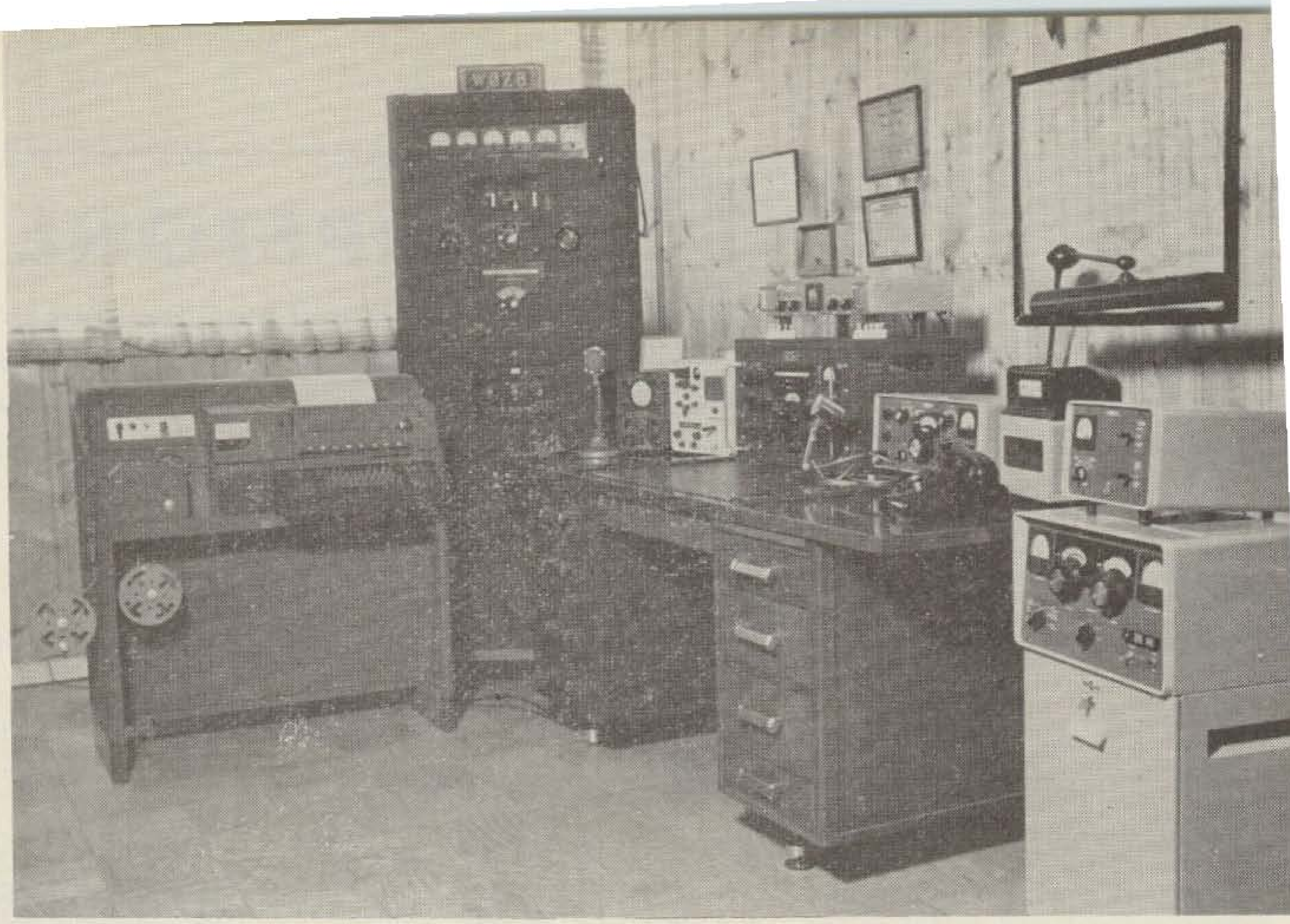
Diagram Clarification

Those little buttons near the pots in Fig. 3 are our cryptic way of indicating that they should be the screw-driver adjustable type and need not protrude from the panel for use. The top 1N34 in the V4 grid circuit is shown connected backward. This probably won't affect you since the likelihood of your building this circuit is rather remote. . . . K5JKX/6

Bibliography

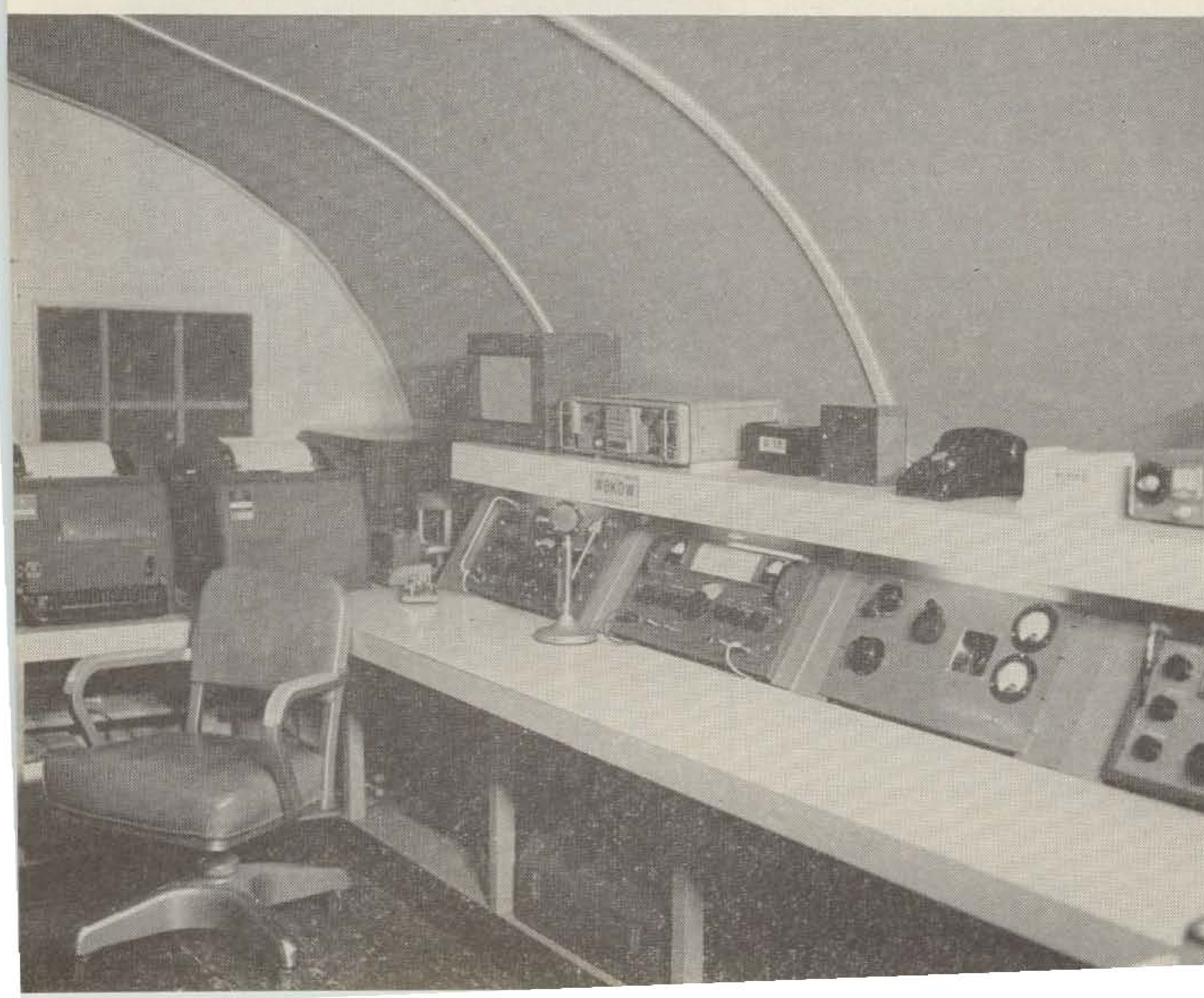
Weir, J. N., "Digital Data Communication Techniques," Proceedings of the IRE, Special Computer Issue, January 1961, pages 200 and 201.

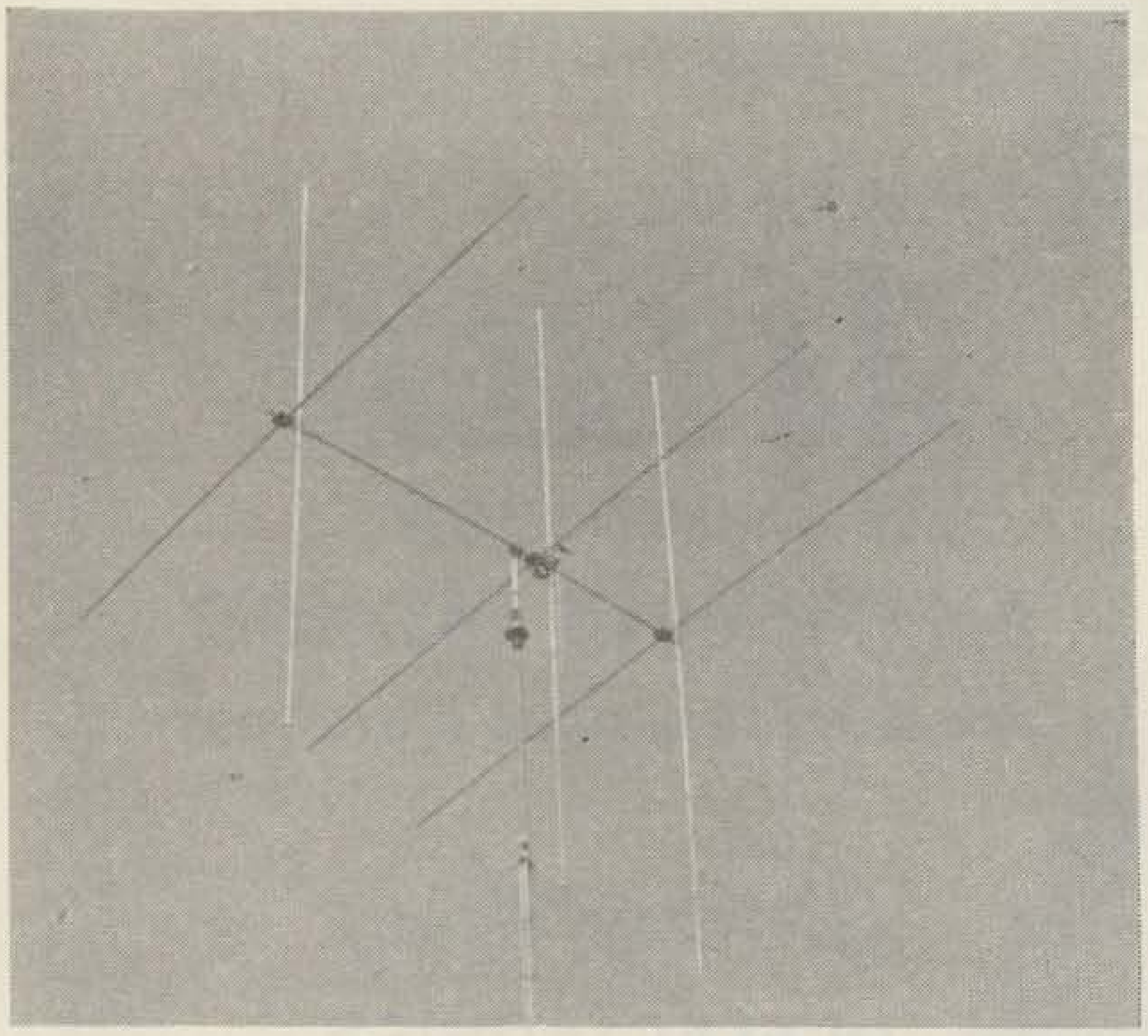
Green, W. and B. Kretzman, The RTTY Handbook, Privately Published.



Typical 73 Subscriber Ham Shacks

Two of our RTTY ops sent in photos of their shacks, which you can see are quite normal. Les Benson, WØZB of St. Louis has a Model 28 Teletype, a KW-1, and a few minor items of Collins lineage. Ray Nuss W8KDW of Doylestown, Ohio has a couple Model 15's and a Model 14 Teletype, plus the Collins 51J4 and 32V3 into a HOMEMADE linear.





A new antenna design concept

George Messenger K6CT
603 S. Lark Ellen
West Covina, California

Polarization Diversity

QSB appears to be one of the worst factors in reducing the readability of signals. W6ZGC and I checked the 10 meter band for a 12-month period during 1958 and 1959, Using dual installations, one having a horizontally polarized antenna and the other vertical, and found that *QSB due to polarization shift caused about 80 percent of the total of QSB present in received signals.* The 20 percent balance consisted of QSB caused by the signal swinging in azimuth, over or under jumping, and polar flutter. An antenna system capable of receiving in both planes simultaneously was obviously worth working on.

The usual method of getting diversity reception is to use two separate antennas, spaced well apart, and feed them into two receivers. Obviously this arrangement was not for ham radio. We wanted to work up something that was simpler and generally usable without a lot of expense or dither. We wanted to solve the problem the "ham" way, not the commercial way.

I will gloss quickly over all of the mistakes we made along the way and cut short the suspense. Since you are reading an article you will not be surprised to know that we solved the problem rather neatly. The result is a six element Yagi, with three elements vertically polarized and three horizontally polarized. It is fed with 52 ohm coax, permitting me to keep the low-pass filter in the line (and me in the neighborhood). The Brown Turnstile feed system was chosen, being real simple.

The project evolved along normal ham lines. Lacking a tower for preliminary tests we put it up as best we could and rigged up horizontal and vertical field strength meters. Even though it was so low that passing cars made the SWR meter jump like a radar speed meter we found that signal reports were already unbelievable. This tempered the home climate a bit and I "gave" my wife a tower for her birthday, pointing out that this was a small enough sacrifice for science and besides that was the only money I had.

Once we had it up on her tower the signal reports were even more incredible. Running only 135 watts to a Viking II I polished off the following Q5-S9 contacts consecutively: CX1VD, LU1NH, ZS3L, ZS6AST, ZE7JV, JA3AVD, JA1BYM, LU3ACA, W1NCX, ZL1LY, VKøWH, and ZL3BL. On all contacts I checked the new beam against my quad, operating at the same height above ground, and found that the signal was always much higher on the new beam. The average difference ran from 3 to 5 db above the quad! Stations, one after the other, reported that my signals didn't have the QSB they were hearing on all other signals.

Many an operator has thought his station to be outstanding, only to be crushed during a DX contest. I battled through the 1960 CQ WW DX test and racked up 8190 points on 10 phone. The next highest score was old contester W6NAT with 4026 points. I had more than doubled the score of the runner-up in the sixth district, which you'll have to admit is the toughest there is. The final results aren't in for the 1961 ARRL DX test, but I managed 8280 points on 10 phone.

In normal operating you notice the difference in that stations almost invariably come back to you when you call. They all report a lack of QSB on the signal. They usually mention that I have the loudest signal from my area and that my signals are the first in and the last out. Many report calling me for an hour or so before their signals were able to come through in the opposite direction.

After much testing we have measured the front-to-back ratio as 46 db and the front-to-side as 66 db. Since this is regardless of incoming polarization it is phenomenal to use.

As more and more stations became aware of what was going on I got more insistently peppered with questions about the beam. As KR6CR said, "Please send the dope . . . all the talk out here is about your antenna. You come through from Stateside when we don't hear anyone else."

Though you can probably duplicate my beam pretty well from a look at the not too clear photo in this article, I'll be along with the details for you in Part II next month. If you can't wait (ahem, here comes the commercial) then you might check the obscure little ad on page 41. . . . K6CT

Letter

Dear Wayne:

Just mailed in my renewal to "73." That ought to shake u up. I was looking for a low powered 2 meter transmitter. I read your article on page 34 of April "73," and bought the Heath Twoer. I had no trouble with the construction or alignment. I made a simple modification and now I have a 4 watt 2 meter base transmitter and a 2 meter portable rig.

Parts required: 1 phono plug; 6 inches of wire. Install the phono plug on the rear apron between the fuse holder and the regeneration control, run the six inch wire from the phono plug to contact number 10 of the rotary switch (Z). This brings the antenna out to the newly installed phono plug. I feed this into my "International 2 Meter Crystal Converter" and into my Hallicrafters SX101. The 6BS8 preamp. detector must be removed from the Twoer or the radiation from the oscillating detector will block the receiver.

Martin Rexsen W2FEI

SX-101A

In the S meter circuit of the SX-101A the 6BA6 tube can be replaced by a 5749, which proves to be much better. This will add up to 10 or 15 DB's more on each S meter reading. Nothing has to be done to the receiver since these tubes are interchangeable. Since this tube makes the meter more sensitive, the S meter must be re-adjusted a little. This tube will make for truer signal reports.

Jeff Gilbert WA2NYO

Staff

Crystal Oscillators

OSCILLATORS are important gadgets to us hams. Even aside from their uses in receivers, the ever-present oscillator is a necessity for any transmitter. For CW use, the entire transmitter might be made up of an oscillator and a power supply—and in any other rig, at least one oscillator must be included to generate the carrier frequency.

Since the oscillator *is* such an important device, it has undergone thorough study by many researchers. As a result, literally hundreds of oscillator circuits have been published. Choosing the best circuit for your own use from this mass of material becomes difficult, and many otherwise worthwhile circuits have become almost lost simply because not enough people have learned about them.

We're going to explore the entire subject of vacuum-tube oscillators, including several circuits which haven't seen much use as well as some of the old standards of the field.

Since there are so many different circuits, though, we're going to divide the field between crystal-controlled oscillators and those oscillators whose frequency is continually adjustable (or, in other words, VFOs) and cover each part in a separate article. This article deals strictly with crystal oscillators.

The crystal of a crystal oscillator is a small plate of Brazilian quartz, ground to precise size and thickness. The physical dimensions of the rock determine its natural resonant frequencies. In the proper circuit, these natural resonance frequencies determine the frequency of operation of an electronic oscillator—and since the crystal's resonances are determined by physical means rather than electronic elements, the frequency remains much more stable than would otherwise be possible. Frequency stability as great as one part in ten billion (that's 0.00000001 percent) is possible with the proper crystal circuit and construction.

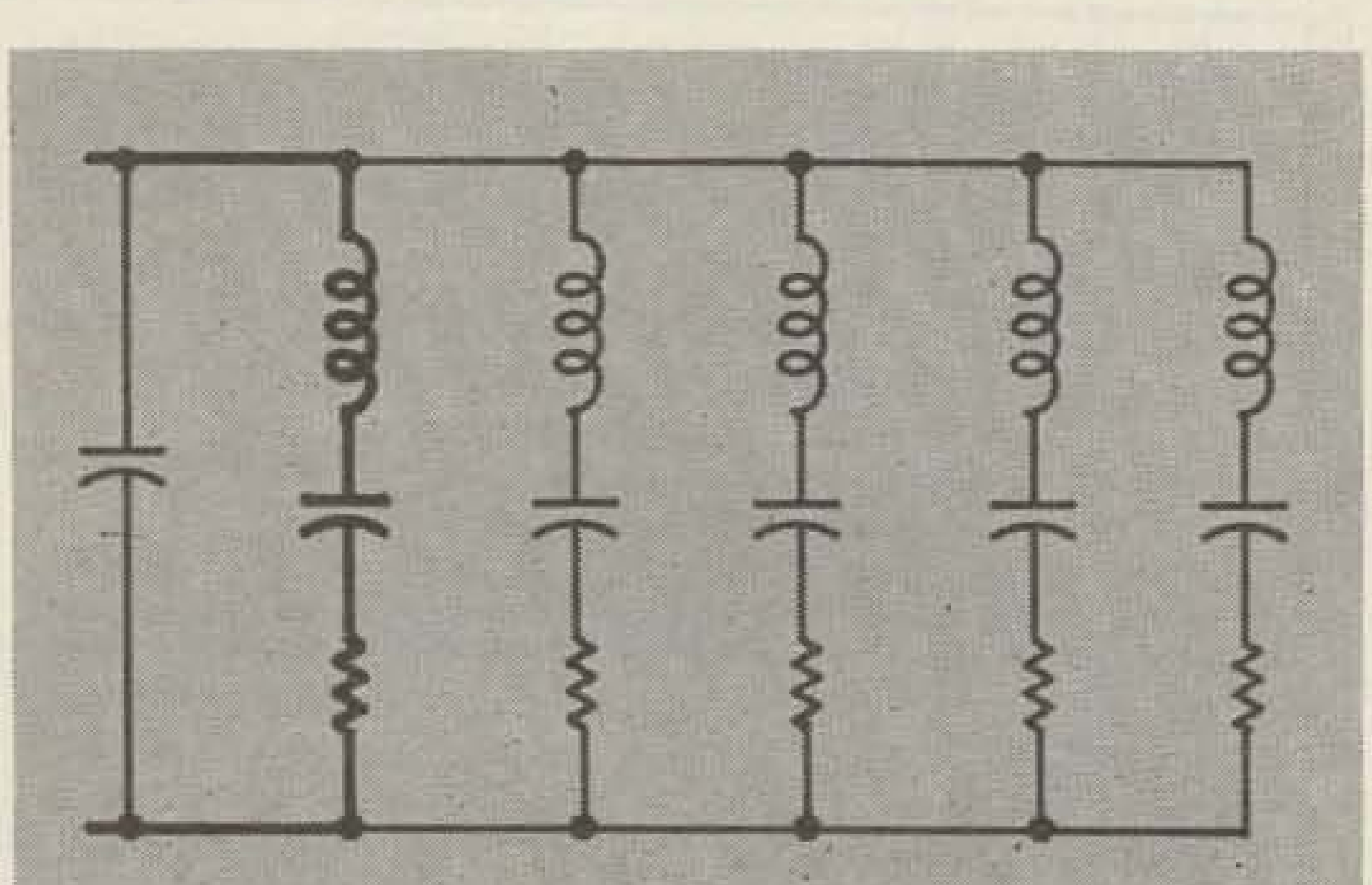


Fig. 1

You may have noticed that all through that last paragraph we were talking about the crystal's resonant frequenc*ies*, although only one frequency is marked on any commercial crystal. That was no mistake; all quartz crys-

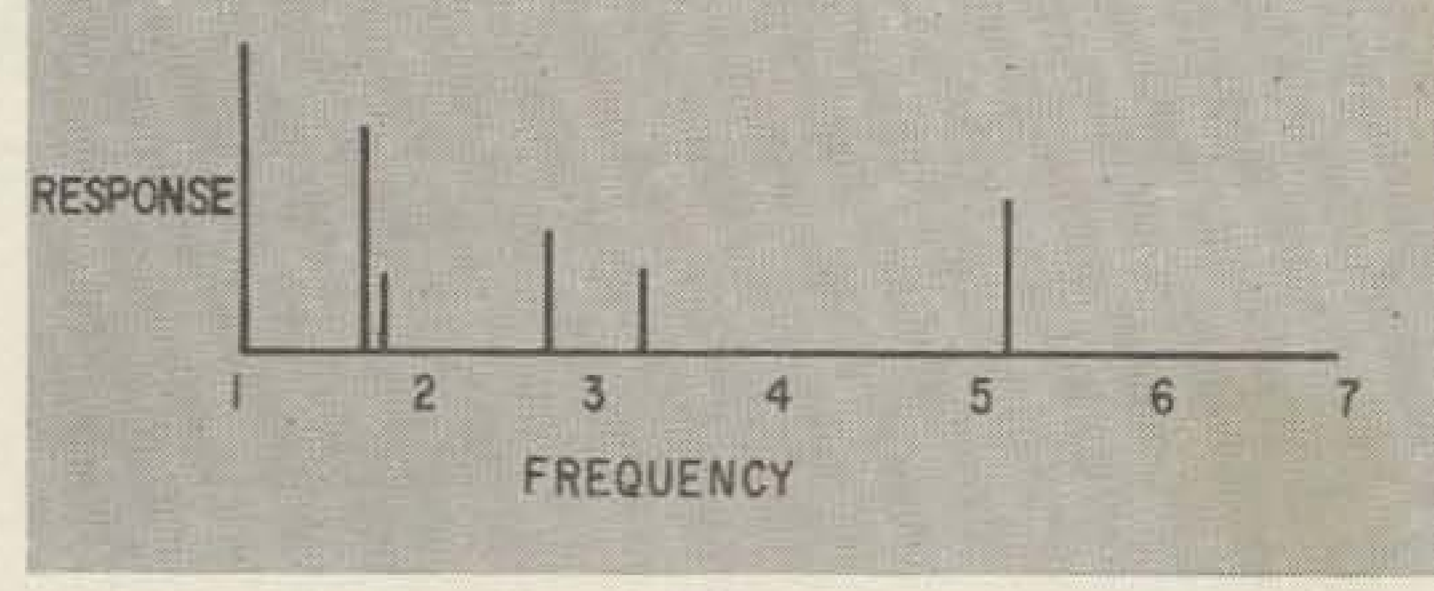


Fig. 2

tals exhibit multiple resonance. The marked frequency is the one at which the rock is intended to operate, but operation at any of the other resonances is usually possible. One of the best examples of multiple-resonance operation is the conventional overtone crystal, which operates at the third harmonic of the basic fundamental frequency through proper circuit design. Frequently, these crystals, may be coaxed into operation at other overtones as well.

One way of grasping the idea of a crystal's operation is to examine its equivalent circuit, shown in Fig. 1. This is what a crystal looks like, electrically, to the circuit. You can see that the several series-resonant circuits also form parallel-resonant circuits at other frequencies. This multiple-resonance quality of a crystal is shown in Fig. 2 as a frequency spectrum for a typical unit.

At this point, let's concentrate on just one of the series circuits shown in Fig. 1—the one shown in heavier lines. This is the primary resonance of the crystal, the one at which it will oscillate or transmit most readily. It's drawn separately in Fig. 3, along with the shunt capacitance of the electrodes which make contact with the two sides of the rock itself.

You can easily see that at one frequency, C1 will be almost a short-circuit which leaves only a parallel-resonant tank circuit, while at some other frequency Ch will be almost an open circuit which leaves only a series-resonant arrangement. In practice, these two frequencies are usually within a very few kc of each other, which leads to the crystal impedance curve shown in Fig. 4.

It's important to remember that every crystal has both series-and parallel-resonance at its primary frequency; at its other resonant frequencies this way not be so, since the effective values of inductance and capacitance may be so far different. However, in fundamental-frequency operation some circuits use series resonance and others employ the parallel or antiresonant condition. This makes the same rock operate at two slightly different frequencies, depending on which type of circuit it's used in.

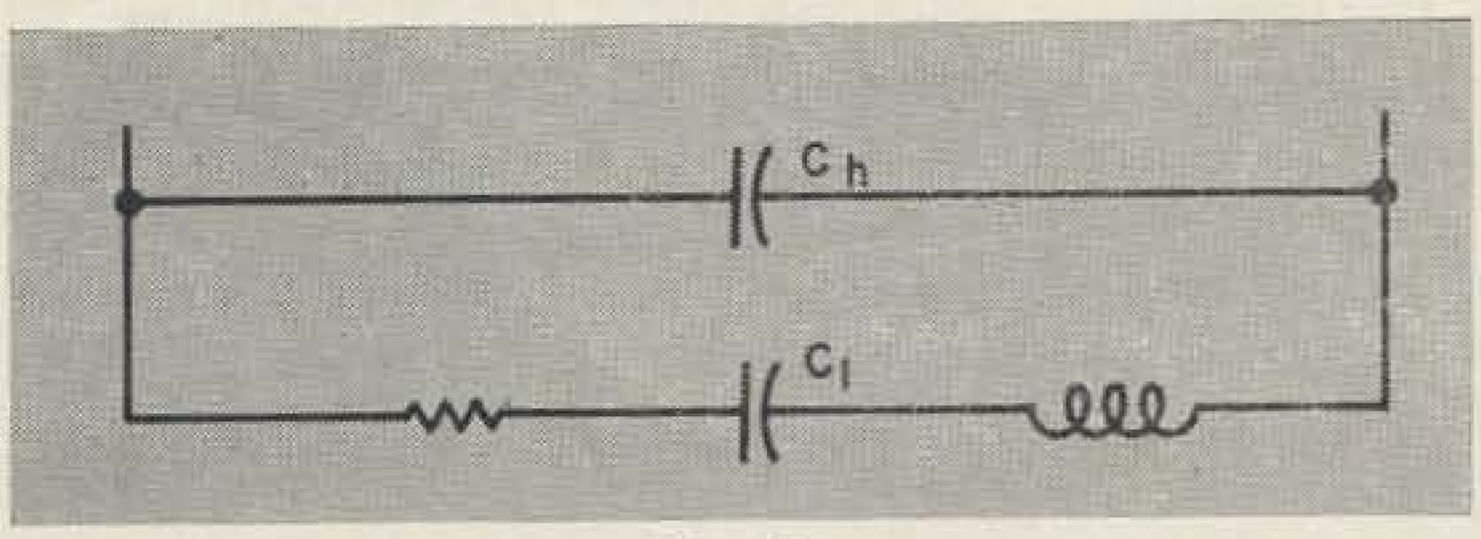


Fig. 3

In addition, external circuit capacitance or inductance will also reflect back into the equivalent circuit of Fig. 3, which causes slight changes of frequency with changes of external elements.

This can bs used as an aid to getting precise spot-frequency results, especially at VHF, by connecting a trimmer capacitor across a crystal which is operating in parallel mode or in series with a series-mode crystal; however, it can also be a hindrance if you don't make allowance for it in building any equipment which will use a crystal oscillator.

Enough about the crystal itself; let's look at some practical circuits.

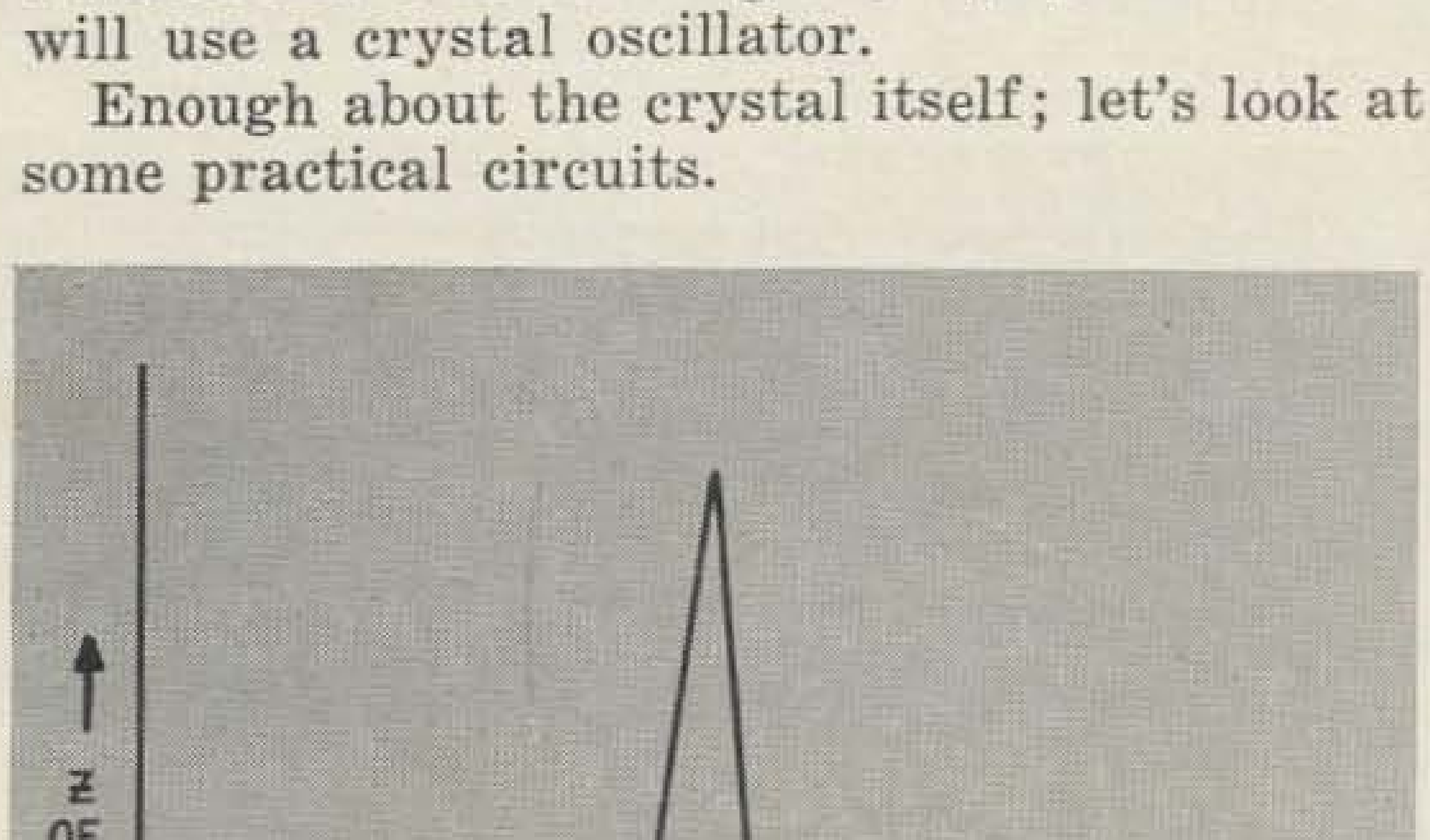


Fig. 4

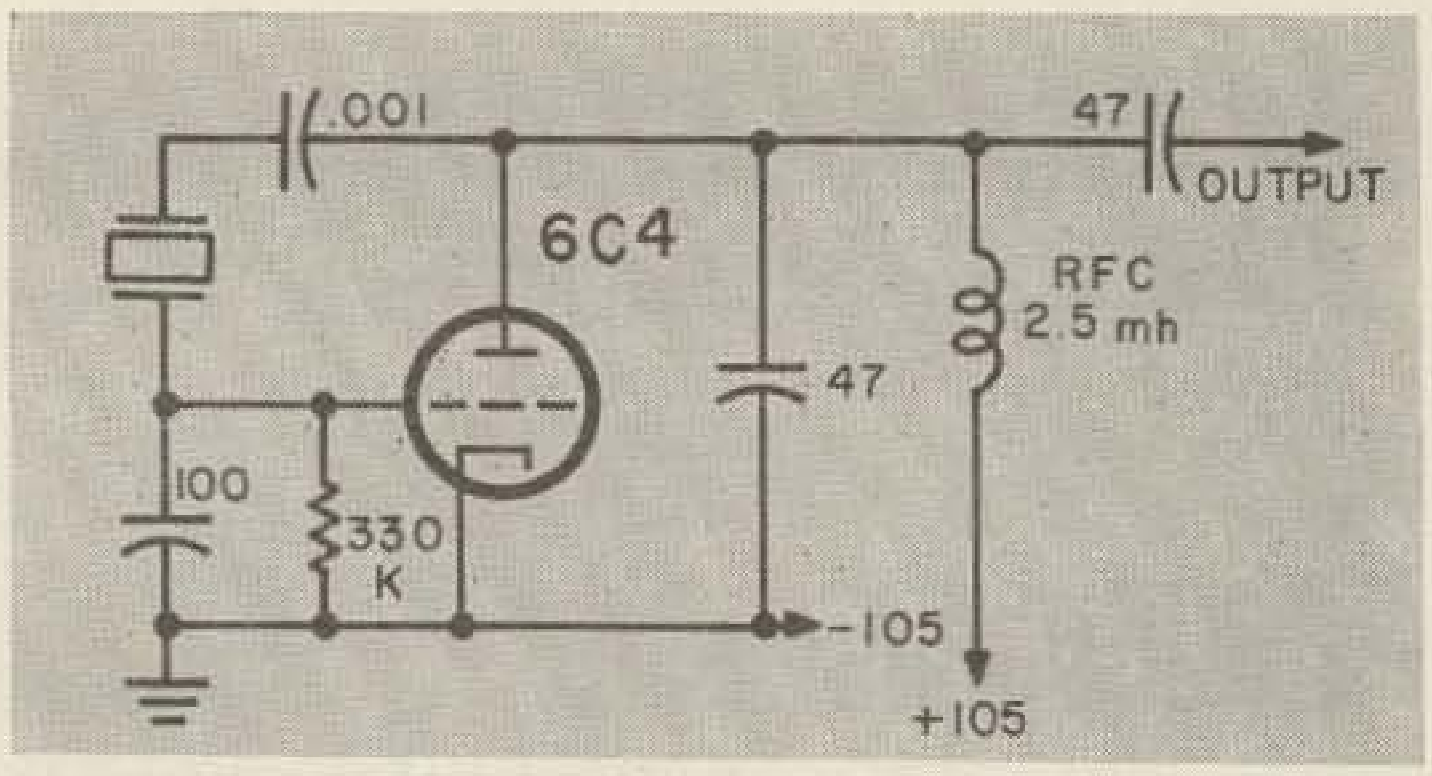


Fig. 5

One of the simplest of all crystal oscillator circuits is the Pierce, shown in Fig. 5. While this circuit, at first glance, looks as if it would use series-resonance to feed back energy from the plate circuit to the grid and cause oscillation, such is not the case. It actually uses the parallel resonance of the crystal to establish a rather complicated network from plate to grid circuits.

Because of its simplicity, many hams appear to have the feeling that the ancient Pierce oscillator can't be very good. Actually, it is as stable as any other crystal oscillator circuit in general use. Its only major disadvantage (shared by many other circuits) is that it's easy to overdrive the crystal and damage it. For best results, any crystal oscillator should be run at minimum power input. Its purpose is strictly to establish the frequency; power buildup should be reserved to later stages. If the Pierce is used in this manner, its performance is equal to any normal crystal oscillator.

Advantages of the circuit are its simplicity and its versatility; this is the only common oscillator circuit which requires no readjustment at all when changing frequency, regardless of the difference in frequencies. It will oscillate at the primary parallel resonance of any crystal put in the socket.

Another well-known fundamental-frequency oscillator is the Miller circuit of Fig. 6. It's

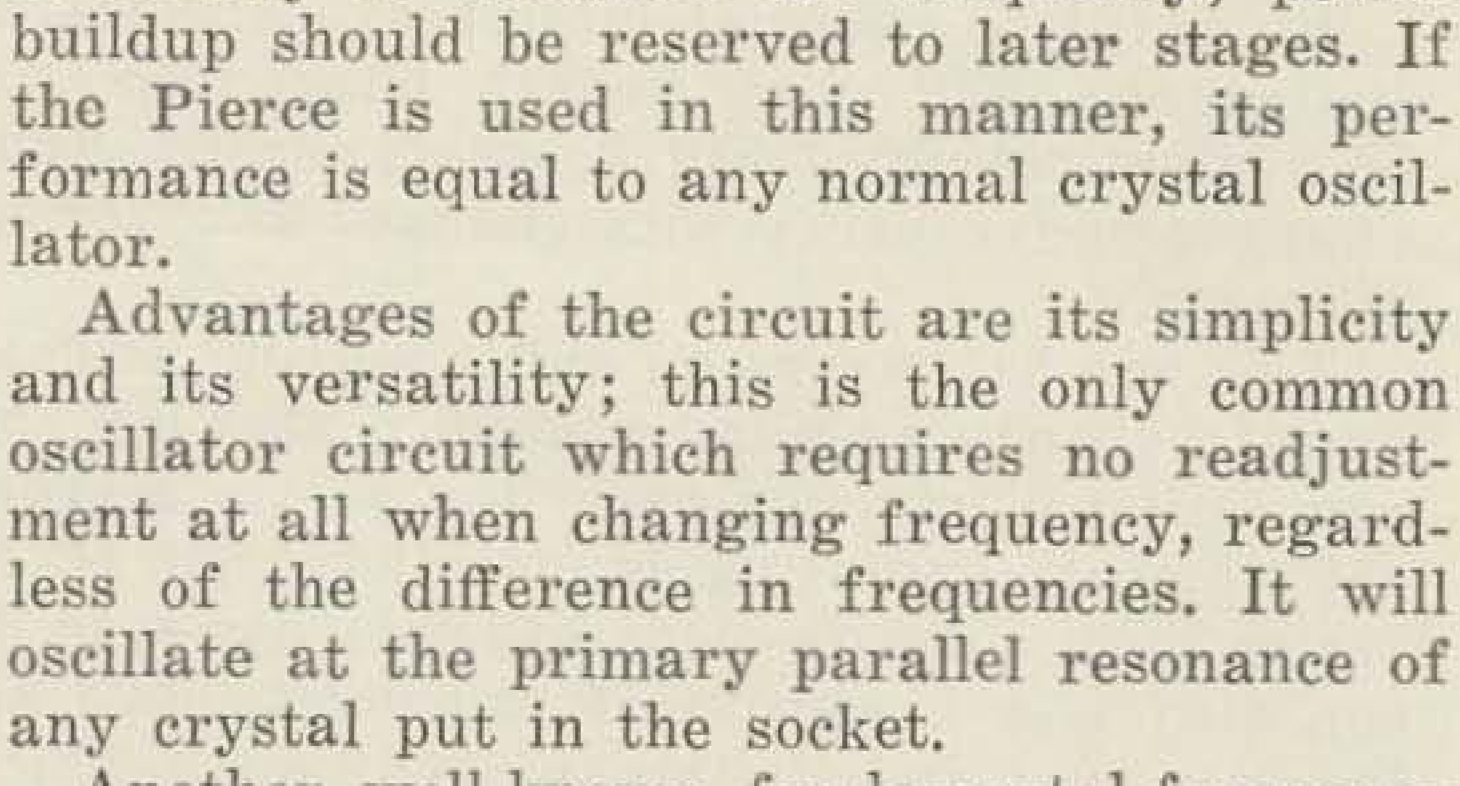


Fig. 6

almost as simple as the Pierce, especially since capacitance C is usually furnished by the tube's internal capacity. Like the Pierce, it provides output only if a crystal is present, but unlike the Pierce it requires a fairly critical adjustment of the plate inductance whenever frequency is changed.

If you don't mind an additional knob to twist at tuneup time, this is no disadvantage, but it does introduce some slight shift of frequency from that stamped on the crystal holder. If you're not multiplying you'll never notice it, but if the Miller circuit is used at the fundamental for multiplication to VHF, you can almost use the plate tuning adjustment to make the oscillator's frequency variable over an effective 100-kc range!

Crystal dissipation in the Miller circuit is considerably lower than in the Pierce, since the rock gets only the grid voltage across it (in the Pierce, full output voltage was impressed across the crystal terminals). In practice, this means that a Miller circuit can be used to develop enough power to drive the next stage without harming the crystal—an important point when building portable or mobile equipment. However, frequency stability is not as good as that of the Pierce circuit, because any changes in tube characteristics during use are reflected back to the crystal.

Both the Miller and the Pierce circuits make use of parallel resonance; let's look at some of the series-resonance circuits. Before we do, though, let's investigate this business of overtone oscillators a bit.

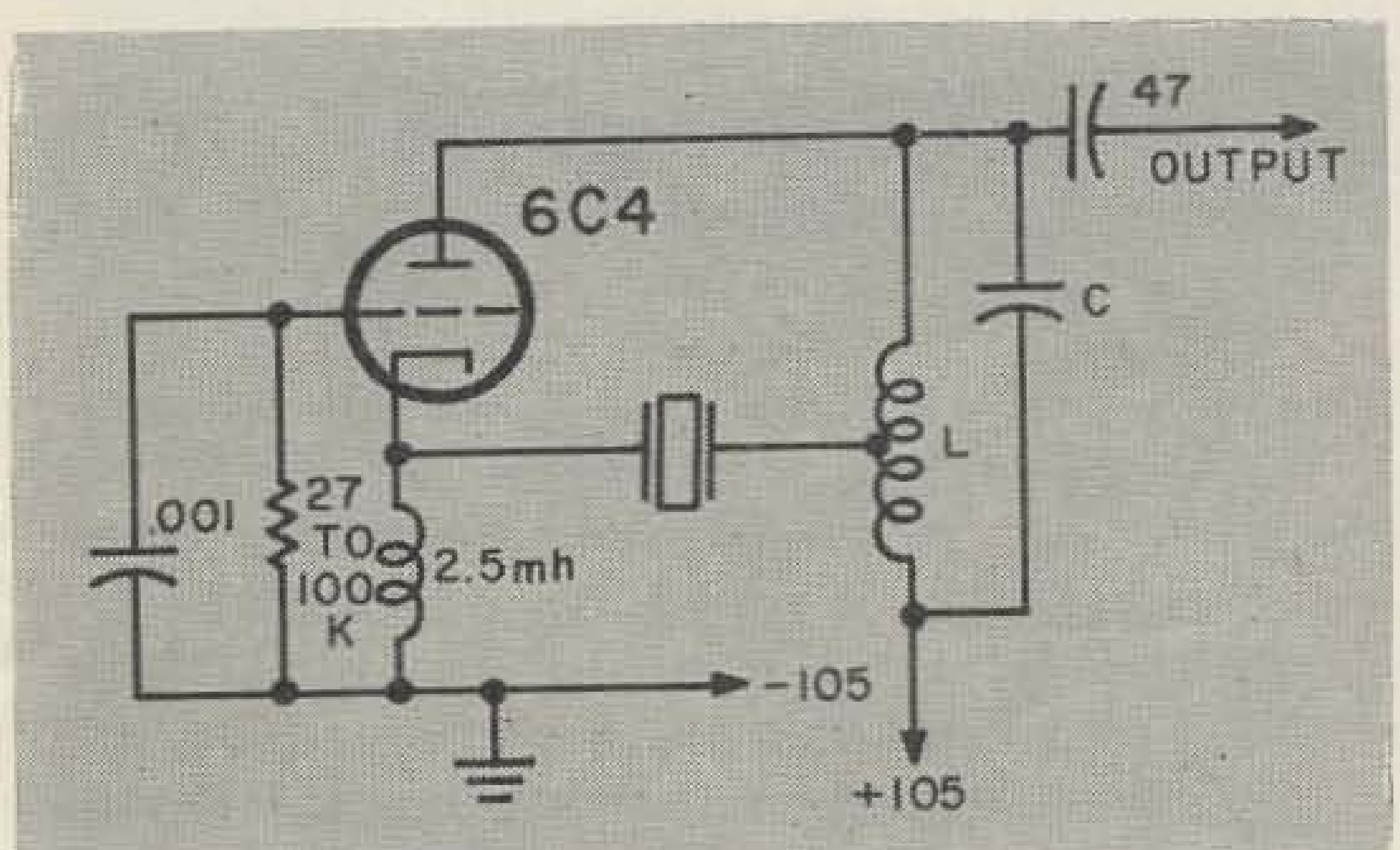


Fig. 7

Earlier, we pointed out that every crystal has a number of resonances. Some of these resonances are located near the third, fifth, seventh, and higher odd-order harmonics of the primary resonance. Notice that we said *near*, not *at*, because they're never located at exact multiples of the primary resonance. The most active of these resonances are the parallel mode at the third harmonic and the series modes at the fifth and seventh overtones.

Since the growth of interest in VHF, there's been considerable interest in "overtone oscillator" circuits. A number of circuits have been developed primarily for this use—but there's nothing about these circuits which would stamp them overtone circuits. Most of them are merely series-mode circuits with the resonant circuits tuned to the appropriate overtone.

"Overtone crystals" are especially processed to yield higher output on a selected higher-order resonance, but the greatest advantage to the use of special overtone crystals is that they are calibrated at the operating overtone frequency. For example, a 10-mc rock may be operated at its fifth overtone, and the output will be somewhere near 50 mc. A fifth-overtone 50-mc crystal, on the other hand, will give output right at 50 mc but if operated at its fundamental will only be somewhere near 10 mc.

Now, back to the series-mode circuits. Remember, they operate at the fundamental or the fifth or seventh overtones equally well, depending entirely on circuit constants.

One of the simplest series-mode circuits was developed by Butler and is described in Edson's "Vacuum Tube Oscillators" as "The Grounded-Grid Circuit." It's shown in Fig. 7.

In operation, output of the tube is fed from the plate back to the cathode at the crystal's series-resonant frequencies. Just which frequency is effective is determined by the tuning of the LC circuit.

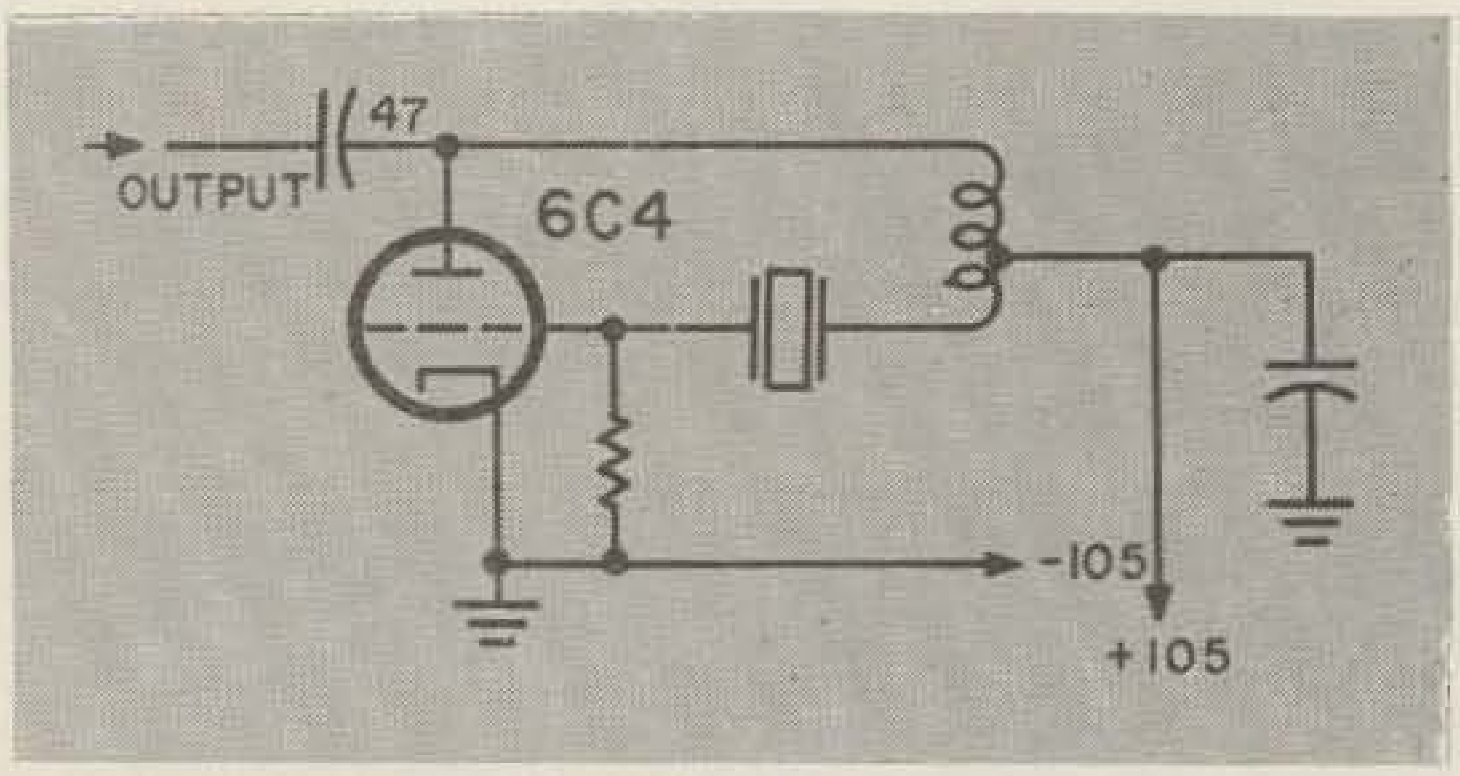


Fig. 8

This circuit will work well with most any crystal, since the input impedance of the tube's cathode is low. This means any current which gets through the crystal will go into the cathode circuit rather than to ground. If tube gain is great enough, the crystal can be extremely sluggish yet still provide good input.

A similar circuit was described several years ago by W8CBM, who called it a "grounded cathode Hartley." His version is shown in Fig. 8. The major difference is that the tube is fed at the grid rather than at the cathode, and consequently fewer parts are required.

Either of these circuits will oscillate on its own if the tap is too high on the coil; to determine if the circuit is under control of the crystal, touch the crystal terminal with a screwdriver while listening to the output signal on a receiver. If the crystal is controlling the signal, frequency shift will be extremely small—possibly even so little that you can't tell it. If the oscillator is taking off on its

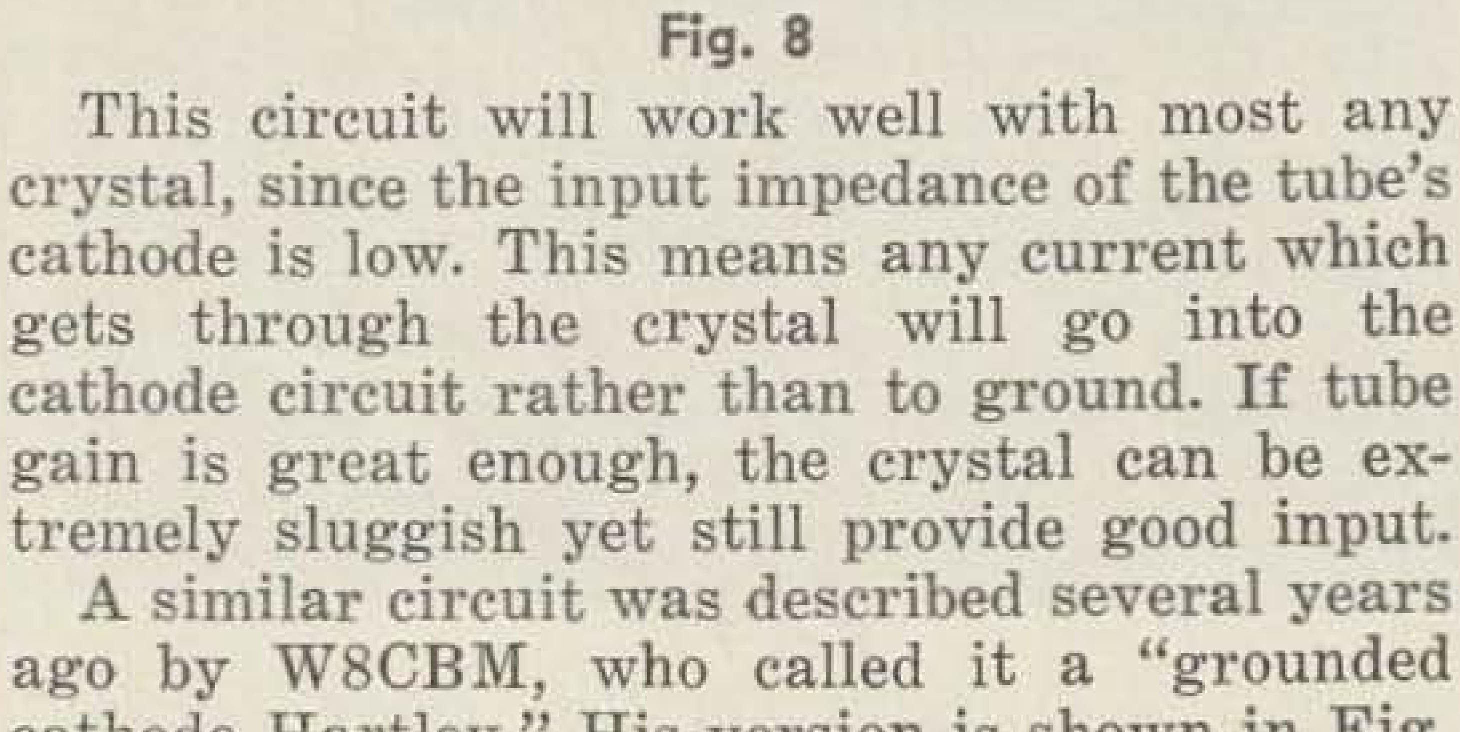


Fig. 9

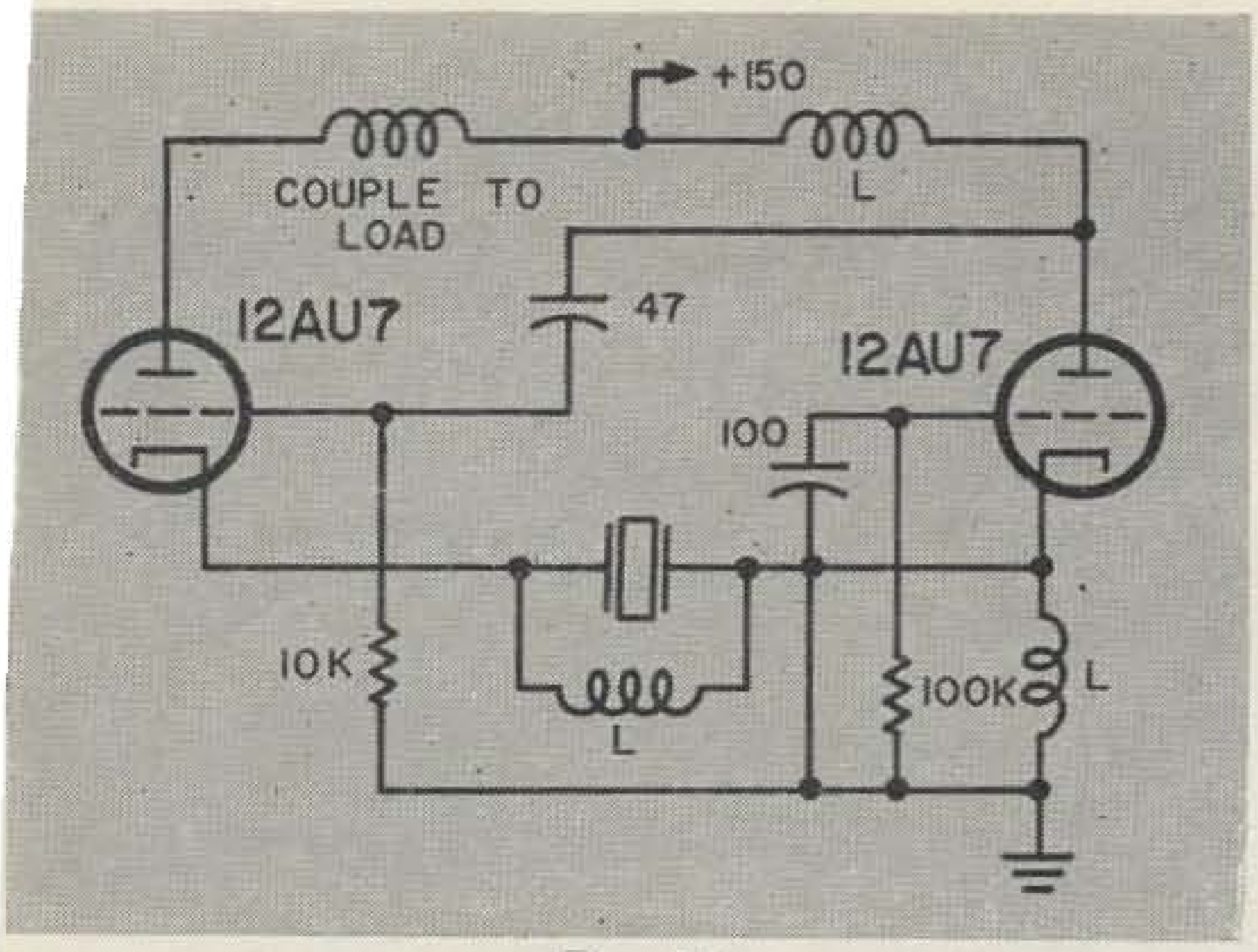


Fig. 10

own, the signal will jump out of the receiver passband with this test.

Still a third version of this circuit has been developed in the 73 labs in connection with a low-plate-voltage converter which refused to operate properly with conventional crystal oscillator circuits. It's shown in Fig. 9. The difference here is simply in the cathode return circuit; frequency is still determined by the crystal's series resonance.

If you're familiar with the Hartley VFO, you'll recognize the preceding three circuits as the Hartley, with ground returns for rf made at the grid, cathode, and plate respectively. Each has its own advantages and disadvantages for specific applications, but in general there's little to choose from between the three. For instance, only the circuit of Fig. 9 is suitable for mixer use, since it's the only one having the plate at rf ground. On the other hand, the circuit in Fig. 8 is least susceptible to hum modulation from the tube's heater, since the cathode is grounded for both rf and dc.

Another series-mode circuit widely used for

(Turn page)

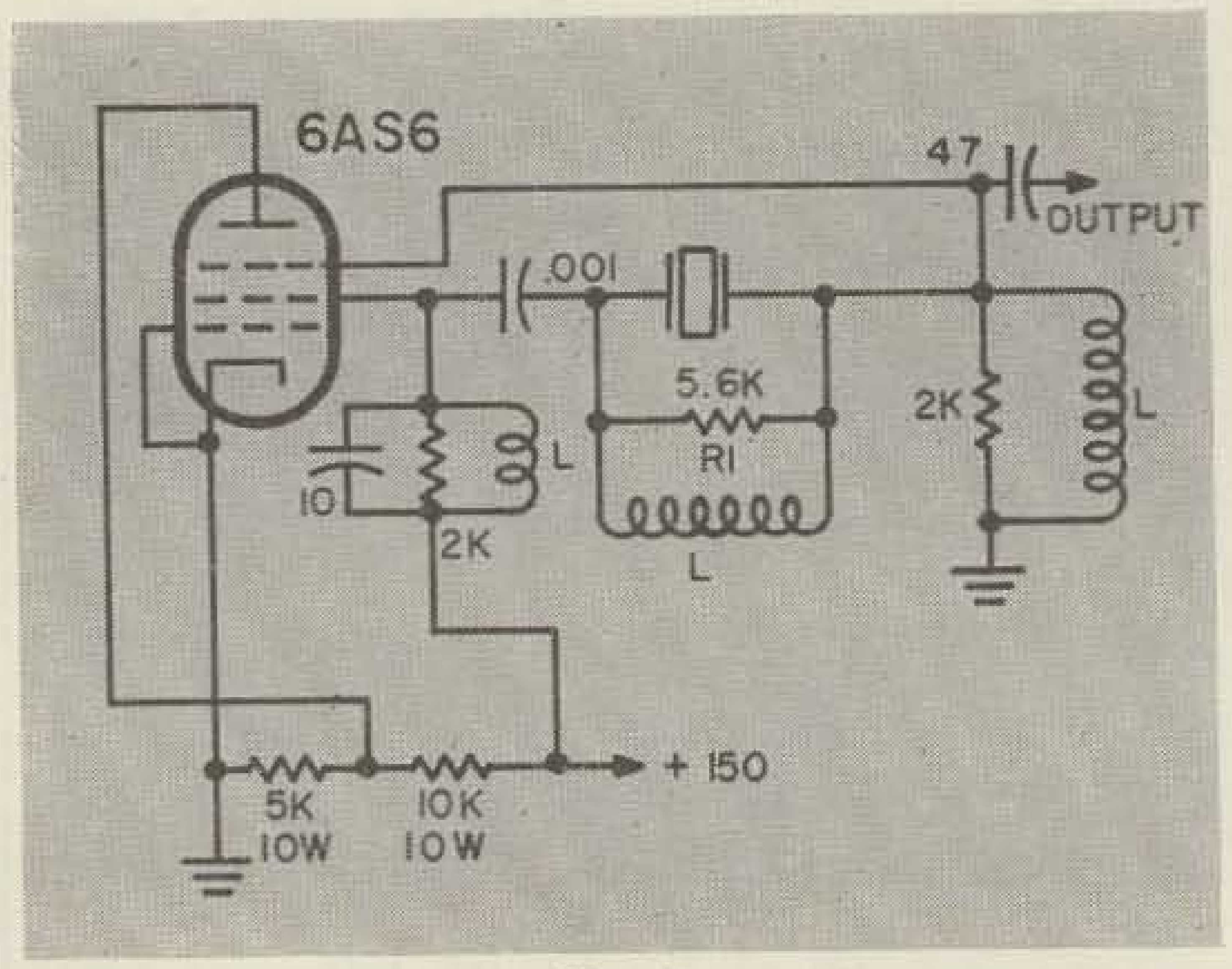


Fig. 11

overtone applications is that shown in Fig. 10. It's known as the cathode-coupled oscillator.

This circuit, though it uses two tubes instead of one, offers almost complete isolation between the crystal itself and the load circuit. In addition, it is capable of considerably more power output than other series-mode circuits.

However, the circuit does not perform well with low-resistance crystals, and in most situations a single-tube oscillator followed by a buffer amplifier will outperform the cathode-coupled circuit in both the power-output and frequency stability departments, according to Edson.

A series-mode circuit especially suited for use with high-impedance (or sluggish) crystals is shown in Fig. 11. Originally described in a 1938 German publication by K. Heegner, it is also shown in Edson's book (which is the virtually complete work on all types of oscillators).

Edson calls the circuit the Transitron, because it operates in a manner similar to the Transitron VFO. If you remove the crystal from the circuit and replace it with a capacitor of value equal to the crystal's shunt capacity, you'll have a Transitron. However, because the resistances are chosen for crystal-only operation, the circuit won't oscillate.

When the crystal is replaced, the circuit is unchanged except at the crystal's series-mode resonant frequencies. At one of the frequencies (which one is determined by tuning of the LC circuits, which are not critical) R1 will be shunted by the crystal's internal resistance, which is much lower. This upsets the non-oscillation balance originally established without the crystal, and the circuit takes off at the crystal frequency.

The Transitron is good up to 160 mc, allowing direct crystal control on 144 mc. No other widely known crystal circuit is capable of operation at such high overtones.

However, a relatively unknown circuit called the capacitance-bridge oscillator can go as high as 219 mc, using the *73rd* (no pun intended!) overtone of a 3 mc crystal.

You have to pay a price for this extra-high operating frequency; the version of the capacitance-bridge oscillator which gets to this astronomical (for crystals) frequency requires not one but three tubes for operation. However, it should be a natural for 220-mc converter use to avoid birdies. The circuit is shown in Fig. 12.

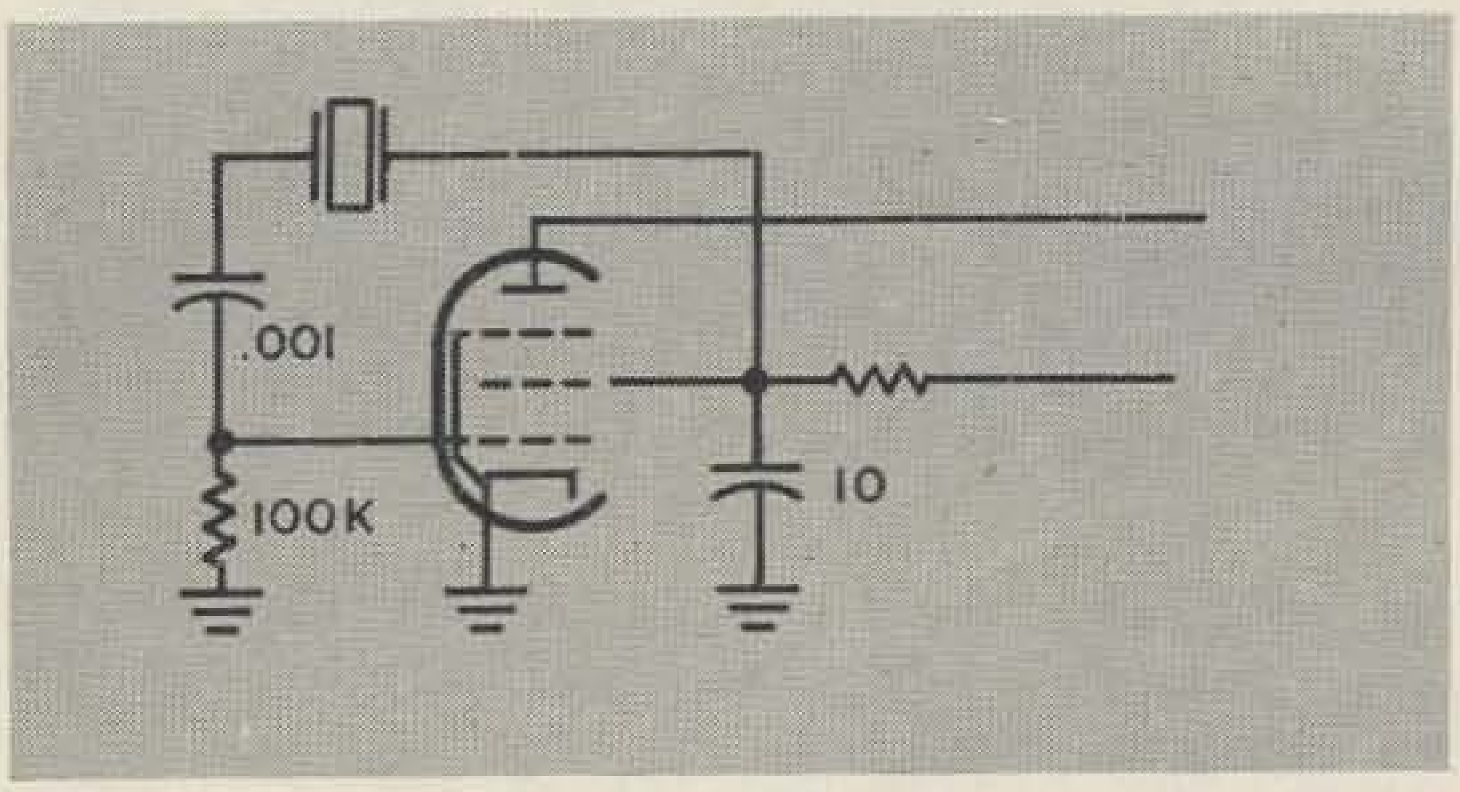


Fig. 12

Here's how it works: The bridge containing the crystal is initially balanced by adjusting C3, with C2 and C1 tuned well away from the desired operating frequency. This eliminates all feedback through the crystal shunt capacity. Then, C1 and C2 are tuned to the approximate frequency desired. The two-stage amplifier circuit then has high gain at this frequency, and since phase shift around the complete loop is 360 degrees the circuit will oscillate if any energy is fed back.

However, the only route through which feedback energy can travel is through the crystal, and this route is open only at a series-resonant frequency. As a result, the circuit oscillates at the nearest series resonance of the crystal. With a high enough fundamental-frequency crystal, the series resonances will be spaced widely enough that you will have no doubt as to the operating frequency.

This circuit requires complete shielding between stages, and long insulated shafts on all capacitors to eliminate unbalance caused by hand capacity. To achieve operation in the

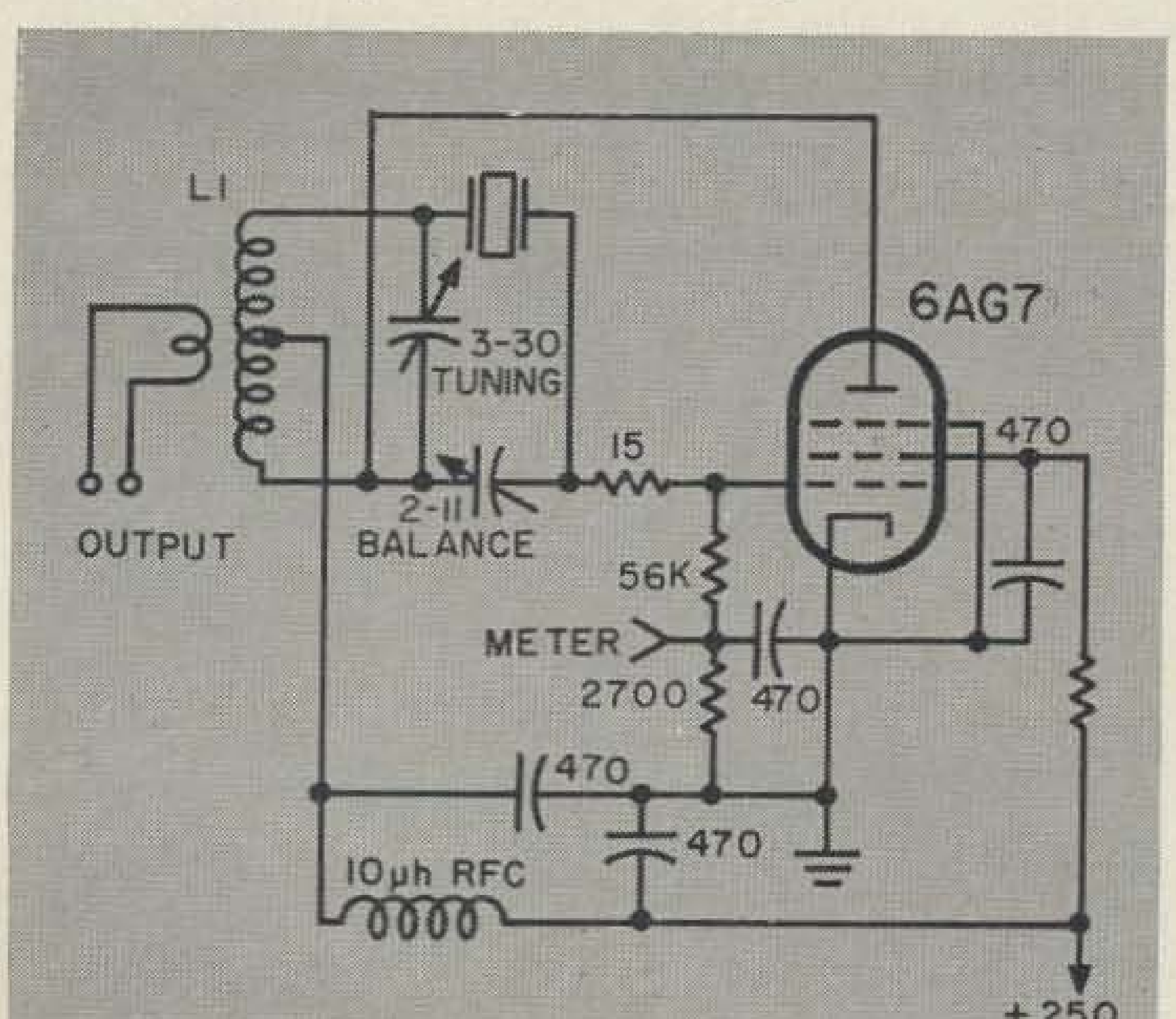


Fig. 13

200-mc region, the push-pull portion must be accurately balanced both in the bridge and in the amplifier, and leads must be short. The oscillator is also rather more voltage-sensitive than most, so plate supply voltages should be regulated with VR tubes.

At lower frequencies, the capacitance-bridge circuit makes possible construction of an overtone power oscillator which is crystal controlled. Stability is poorer than in other circuits, but for compact portable or mobile equipment operating on 6 or 2 meters the advantages of getting a full watt output from a single-tube oscillator stage more than outweigh lowered frequency stability—particularly when the stability is still greater than most VFO circuits achieve.

The circuit for the high-output oscillator is shown in Fig. 13. Measured output from this one is one watt of rf at 50 mc, operating on the 5th overtone of a 10-mc crystal, and ⅓ watt output at 80 mc. The circuit output falls off rapidly above 80 mc, primarily because of the large physical size of the 6AG7 tube. Substitution of a 6CL6 or a 6AH6, possibly with some change in circuit constants, would probably raise its upper frequency limit nearer the 2-meter band.

This oscillator drives the crystal too far beyond its rated limit, but researchers working with the circuit report that they have never damaged a crystal in this circuit despite the overload condition.

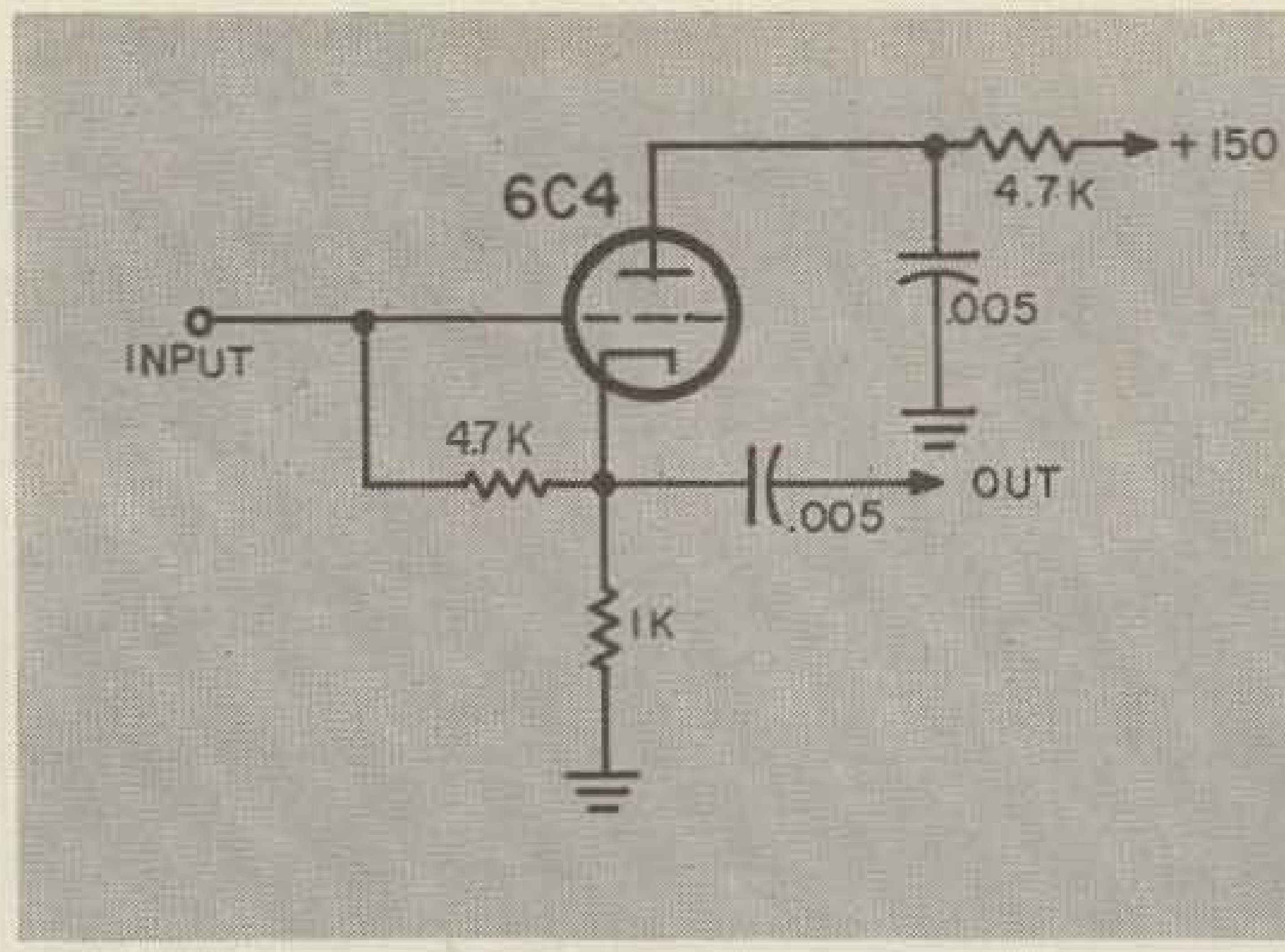


Fig. 14

Both these capacitance-bridge circuits are described more fully in a little-known government publication, "Handbook of Piezoelectric Crystals for Radio Equipment Designers," which is the result of an extensive Air Force-sponsored study of all possible crystal circuits. It's available from the Department of Commerce (see bibliography).

So far, we've been talking primarily about basic oscillators, in which output is taken directly from the oscillator circuit.

Usually, this isn't a good way to get the output, since it means that any variation in loading will be reflected back directly into the oscillating loop and may change the frequency. One way to isolate the oscillator from the load is to add a cathode-follower buffer amplifier, such as the circuit shown in Fig. 14. It connects directly to the point marked "output" in any of the other diagrams.

However, a simpler way of doing it if your oscillator circuit has its plate grounded for rf is to use an electron-coupled oscillator.

This circuit, which is applicable to any of the diagrams in which the plate is at rf ground, makes use of the screen grid of a pentode as the plate of a virtual triode. In other words, simple use the screen as the plate of the triode which is shown in the diagrams. Suppressor connection is normal, and

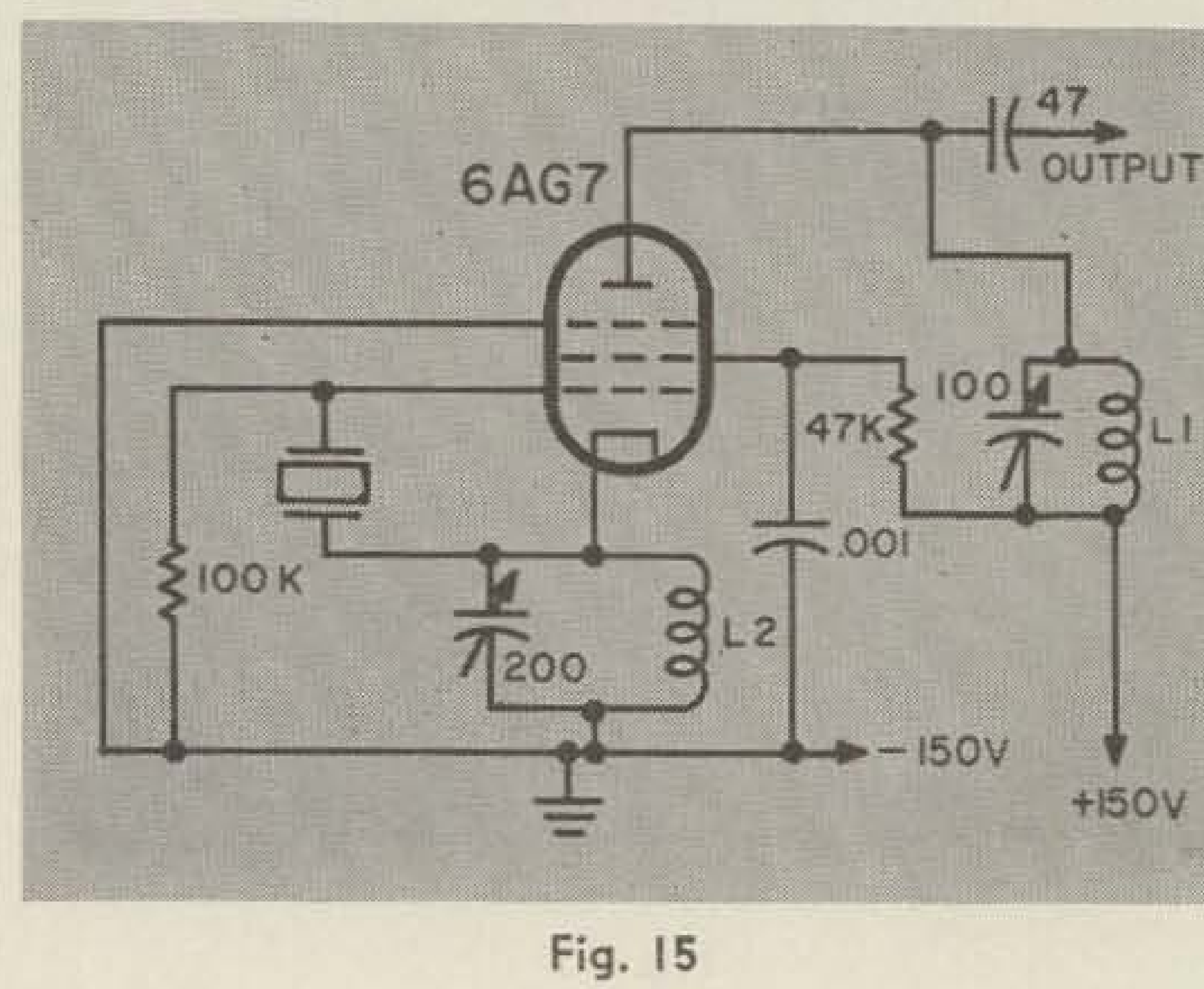


Fig. 15

tput is taken from the plate circuit by either
: or capacitor coupling.

In operation, the electron stream from cath-e to the screen grid is carrying the oscillat-g current, but the screen doesn't intercept l the oscillation current. What misses the reen flown on to the plate and from there the external load.

Since the load circuit and the oscillating op are coupled only by the electron beam om plate to cathode, the circuit is called elec-on-coupled.

In addition to the oscillators already dis-ussed, several types of circuits are possible nly with the electron-coupled arrangement. uch a circuit is the "Tri-Tet" or electron-oupled Miller circuit, shown in Fig. 15. This

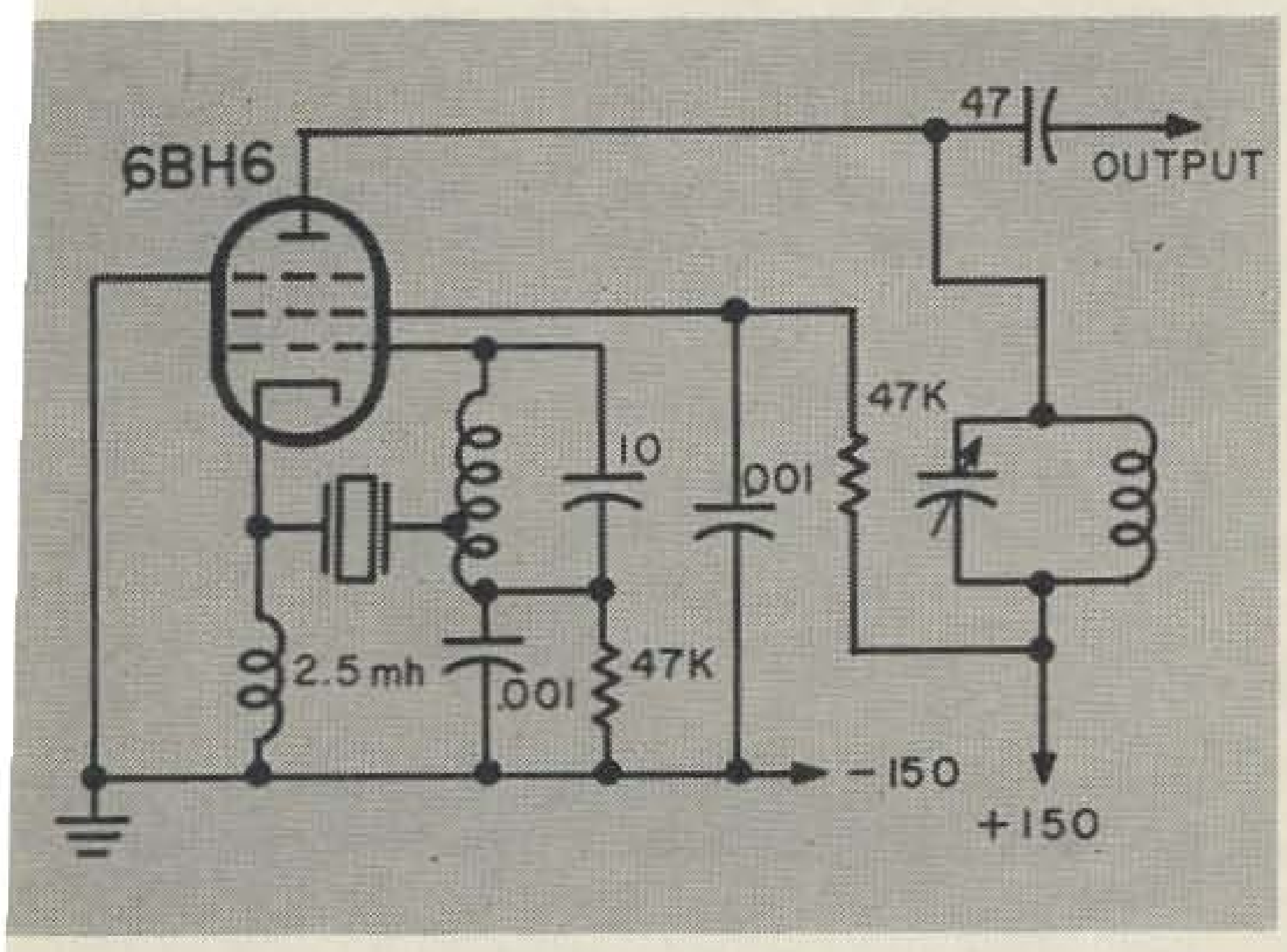


Fig. 16

circuit is capable of delivering a large power output with good frequency stability; its major drawbacks are that the plate circuit must never be tuned to the fundamental frequency of the crystal (too much feedback might damage the crystal) and that there are two controls instead of one to adjust when changing crystals.

Another electron-coupled circuit, described by Edson, is the series-mode grounded-plate oscillator shown in Fig. 16. Good operation is claimed, with "relatively large" power output at either fundamental or harmonic frequencies.

An excellent electron-coupled circuit which operates equally well at fundamental or harmonic frequencies is shown in Fig. 17. Originally described several years ago in a P-R Crystal advertisement, where it was dubbed the "grid-plate" oscillator, the circuit is also known as the Colpitts crystal oscillator.

The crystal is used in its parallel mode, at primary resonance. Feedback is established by capacitors C1 and C2. While either of them may be made adjustable, values shown in the diagram have proven satisfactory in practice. Almost any tube may be used; good results have been obtained with the 5763, the 6CL6, the 6AG7, and (in the non-electron-coupled version) the 12AU7, despite warnings that only the 6CL6 and 6AG7 were suitable for the

(Turn to page 61)

Radio Bookshop

Look over this list of books you should have and pick out one or two that you've been wanting. The way to have a good reference library is to build it up a little at a time. We pick over all the latest books carefully and list only those which are of real interest to amateurs. They're on hand ready to ship, postage paid.

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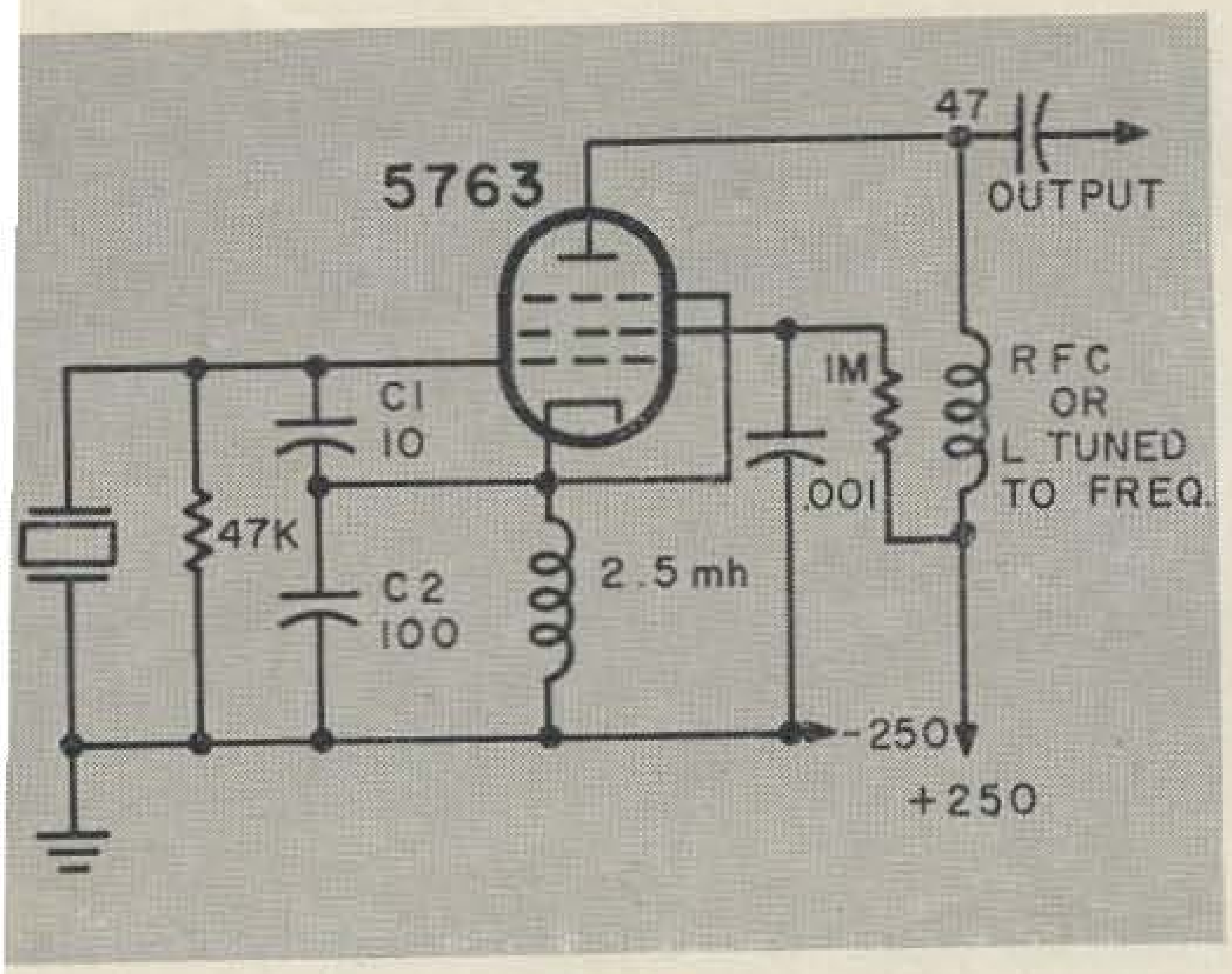

Fig. 17

rcuit.

Tuning of the output circuit is relatively road; it needs only to be peaked at the center f the operating range. Since the output and scillating circuits are separated, output tuning has almost no effect on frequency. This ieans that, like the Pierce, no adjustment of ie oscillator is necessary when changing rystals. In practice, this circuit has been ound to deliver approximately the same output as a Tri-Tet when used with the same ubes and crystals, at a net saving of two djustments per crystal change, as well as alowing fundamental operation when desired.

Some circuits recommend by crystal manuacturers haven't been discussed yet; these are ll variations of circuits already shown. For nstance, International Crystal recommends he circuit shown in Fig. 18 for use with its undamental-type crystals. This is a Pierce lectron-coupled circuit, with capacitors added rom each side of the crystal to ground to naintain circuit capacitance at 32 mmfd (International's design value).

The same manufacturer recommends the ircuits of Fig. 19 and 20 for overtone use vith third- and higher-order crystals, respecively. The third-order circuit is simply a basic Miller, while the higher-order oscillator is a very slight modification of the Butler grounded-grid circuit.

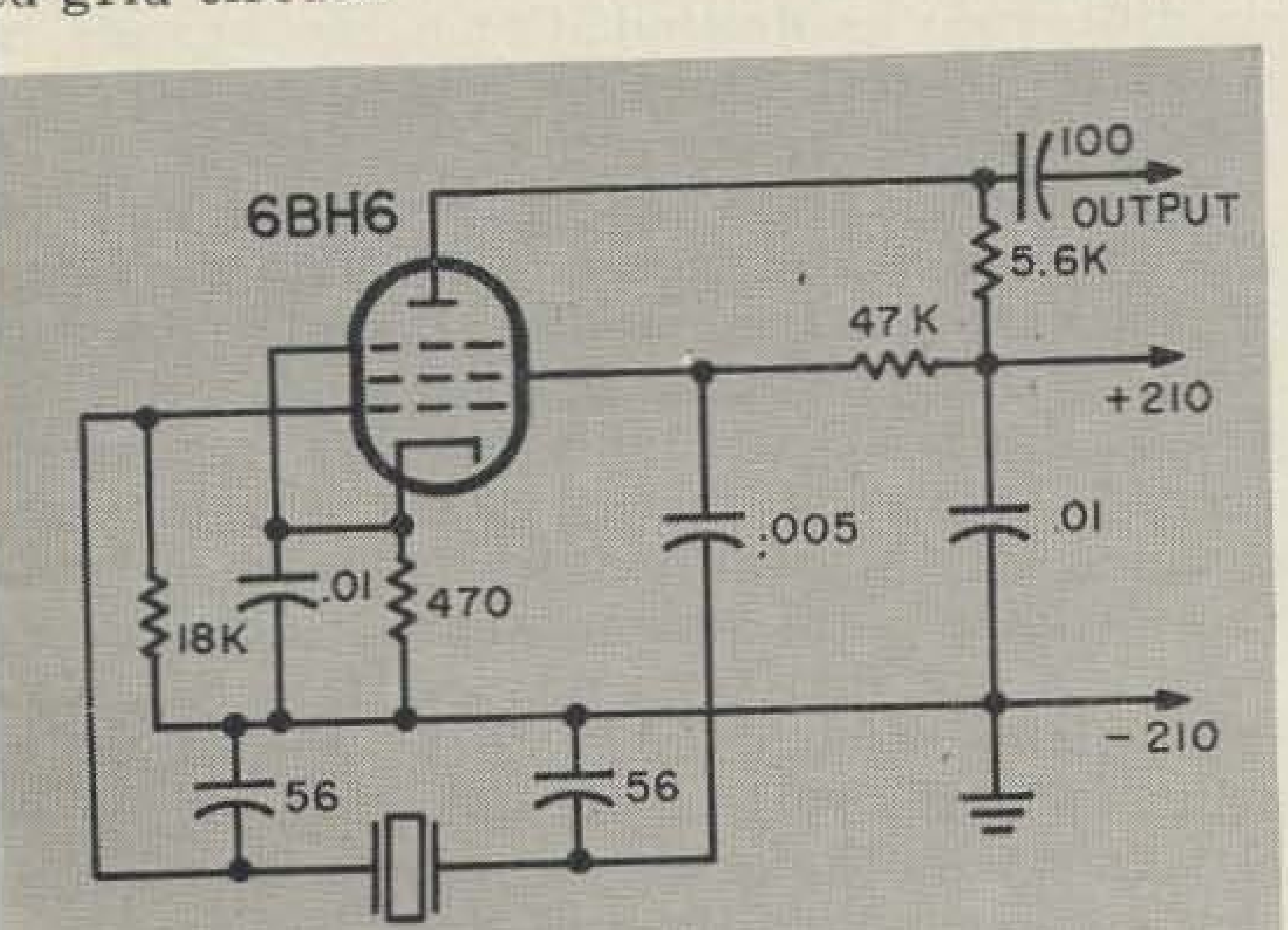

Fig. 18

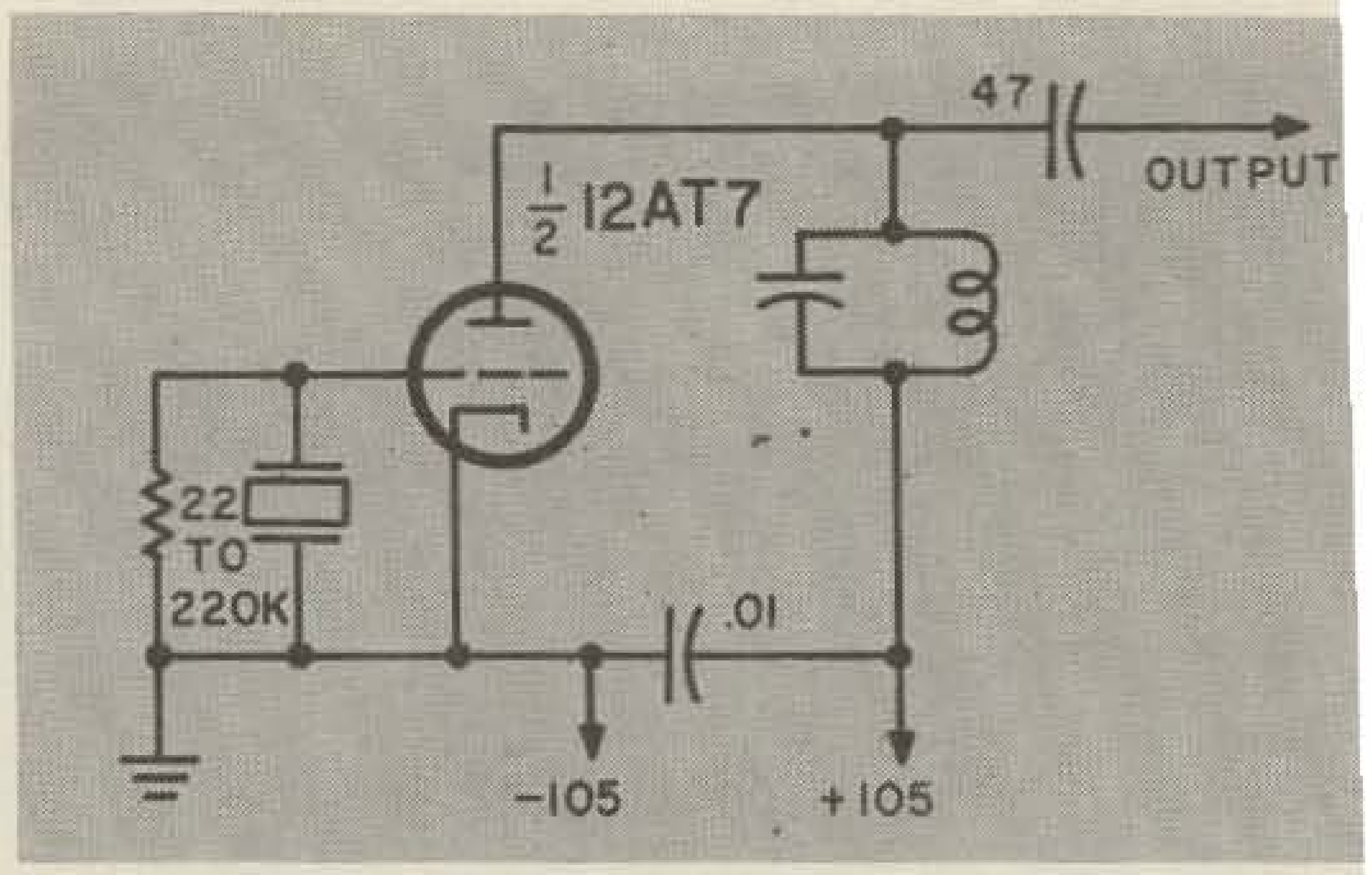

Fig. 19

All the crystal oscillator circuits described so far have one thing in common—they're single-frequency affairs. That is, they provide spot frequencies determined by the individual crystal in use rather than continuous coverage over a ham band. Continuous coverage, most people feel, is the province of the VFO; they reserve the crystal for spot frequencies where stability is important. However, the crystal oscillator *can* provide much of the flexibility of the VFO if properly used. One method has already been mentioned; this is the method of attaching a trimmer capacitor to the circuit to "bend" the crystal's frequency a little. The amount of variation obtainable depends both on the individual crystal and on the amount of frequency multiplication which follows the oscillator. For instance, W9KLR has used this trick to obtain 30 kc adjustable range on 2 meters, starting from a 4 mc crystal. A more extreme case is reported by W4KXI, who uses a special 8-mc crystal in a unique circuit to obtain a full megacycle of frequency swing on 144 mc. Details of the circuit are given in his article; it's too long to reproduce here.

Another approach to variable-frequency operation with crystals is the "frequency synthesizer," a device which uses a number of crystals (sometimes as many as 30) to obtain spot frequencies one kilocycle apart over all ham bands up to 50 or 144 mc. These devices work by mixing two crystal-controlled frequencies together, then selecting either the sum or difference as desired. Often the process is repeated several times to come up with the proper output frequency.

Like all multiple-mixing processes, use of a frequency synthesizer is subject to the bugs of spurious mixing products; they show up here as outputs at undesired frequencies in addition to the desired output. However, when properly designed, one of these gadgets can combine all the best features of both crystal and variable oscillators in a single unit.

Such a unit has been described by W2JKH (see bibliography) and others are also in print. All share the disadvantage of complexity; that's the price you pay for flexibility plus extereme stability and reset accuracy.

By combining both the frequency synthesizer and the "rubber crystal" trick, you can achieve

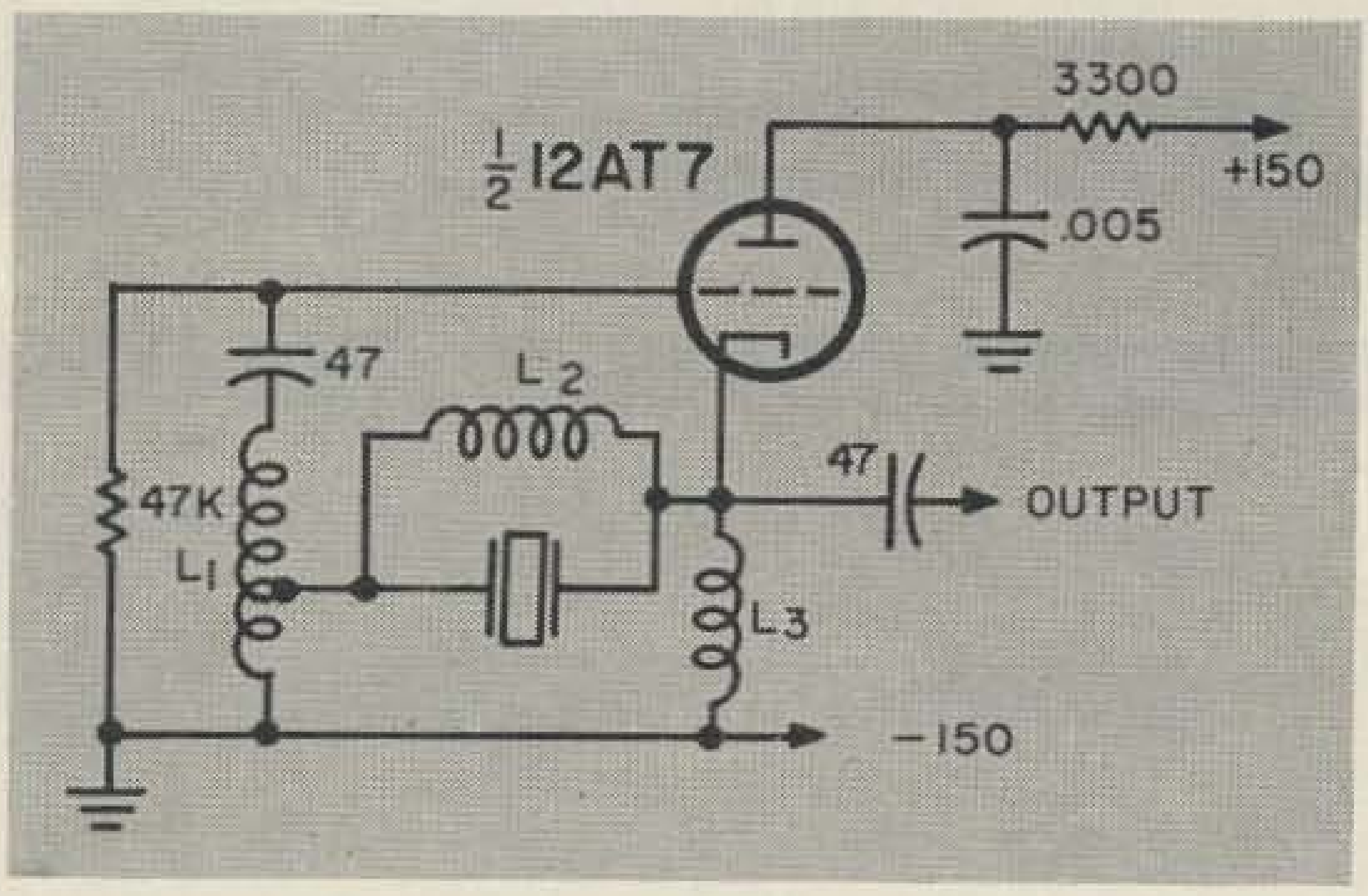

Fig. 20

complete coverage with no blind spots, on every ham band. However, at a slight sacrifice in stability and reset accuracy and an enormous gain in construction simplicity, you can do the same thing with a VFO—and that's the subject of our next technical article.

BIBLIOGRAPHY

American Radio Relay League, **The Radio Amateur's Handbook.**

E. B. Blett, W8CBM, **FM and TV Interference on the VHF bands,** CQ, December, 1957, page 46.

Warren H. Clark, W6COK, **Crystal Frequency Comparator,** QST, December, 1959, page 53.

Buchanan, John P., **Handbook of Piezoelectric Crystals for Radio Equipment Designers,** WADC Technical Report 56-156, October, 1956 (available through the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for $7.00).

William A. Edson, **Vacuum Tube Oscillators,** John Wiley & Sons, Inc., New York, 1953, pages 113, 205, 208-218, and 224.

Henry G. Elwell, Jr., W2JKH, **A Crystal Synthesizer,** CQ, November, 1959, page 34.

Jim Kyle, K5JKX, **Crystals,** Popular Electronics, April, 1960, page 83.

Henry J. Saborsky, W4KXI, **A VHF Variable Frequency Crystal Exciter,** QST, November, 1960, page 27.

Herman Shall, W3BWK, **VXO—A Variable Crystal Oscillator,** QST, January, 1958, page 11.

F. E. Terman, **Electronic and Radio Engineering,** Fourth Edition, McGraw-Hill, New York, 1955, chapter 14.

Edward P. Tilton, W1HDQ, **Shifting Frequency With Crystal Control World Above 50 Megacycles,** QST, August, 1956, page 61.

Letter

Hi! Wayne:

Allright wise guy, what did you do with page 72 of the August issue? I desperately need that K2PMM KW to complete the portable rig I have in mind. It includes a minibox sized 75A4, 50 foot portable collapsible tower and new solar/terra (combining solar power with the plentiful ground currents) transistorized power supply. Publish it right away or I'll tell everyone that you secretly write articles for and subscribe to QST.

Wm Magee W2CDJ

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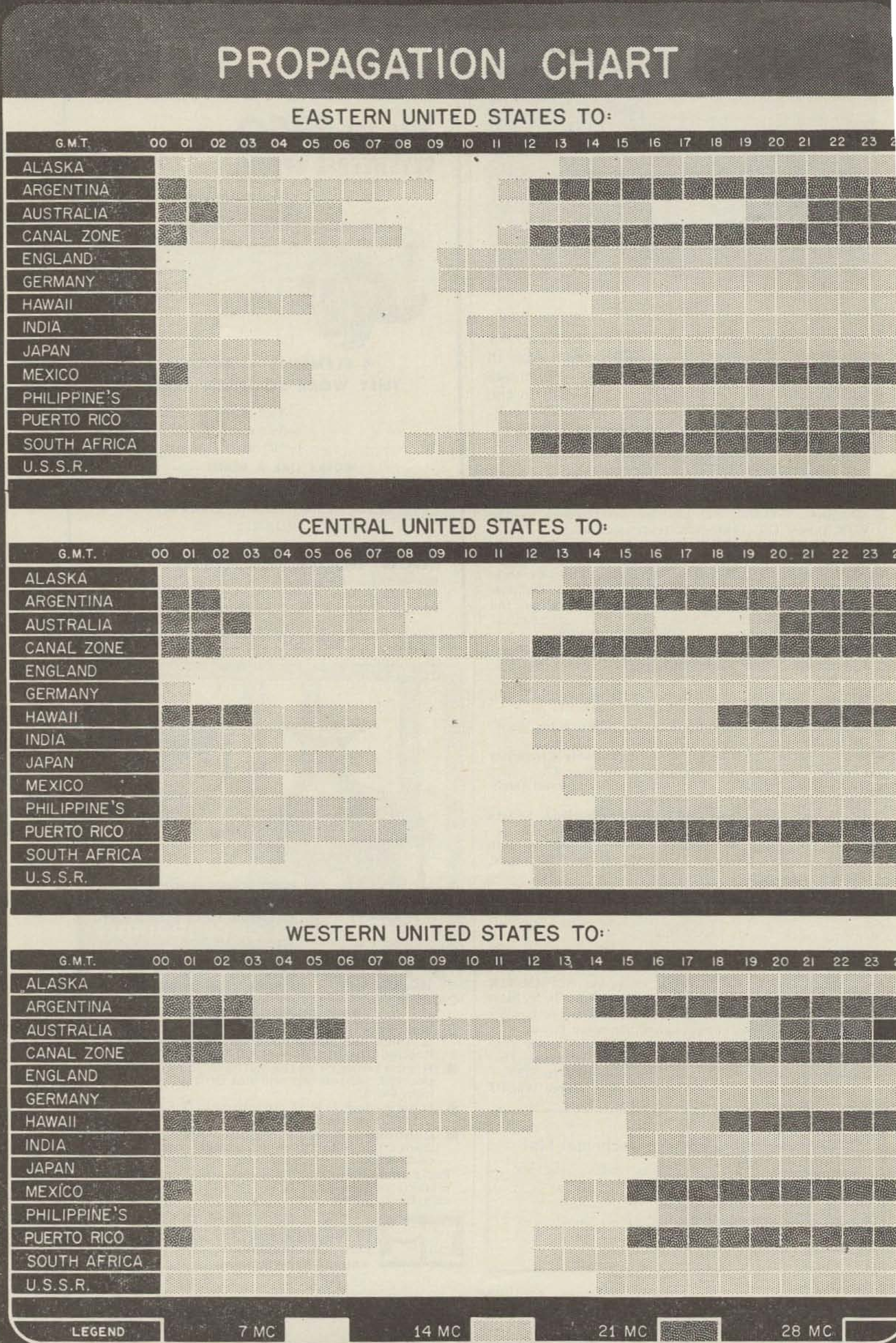
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28 MC

Propagation Charts

David A. Brown K2IGY
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Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

Advanced Forecast: September 1961

Good: 6-20

Fair: 4-5, 21-24, 27-29

Bad: 1-3, 25-26, 30

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HGF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a monthly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

HAMS HELP BLIND PEOPLE

(Toronto Daily Star.) When a group of 30 blind people began to look farther afield for more chess competition, VE3TC and VE3AEO came to the rescue. Both hams provided communications for the sightless players who are members of the Canadian Institute For The Blind Chess Club. It was hoped that the first 73 move game would provide inspiration for other hams to take up the call and lend their radio time to other CNIB players.

(Philadelphia Inquirer, submitted by J. Rosewald Jr.) A photographic description of a series of earthquakes in San Jose, Costa Rica, was given to a Philadelphia radio ham recently. William Weisbord, 57, was talking to a fellow ham in Costa Rica when the quake hit and forced the station to go off the air.

Weisbord learned from another station in Costa Rica that no serious injuries had occurred although considerable property damage resulted. The same night other stations were monitored and they also reported earthquakes in their areas.

New Books

You know, you could do a lot worse than keep up with the Rider Electronic Technology Series of publications. The latest in this series are two books by Dr. Alexander Schure, one on **Transformers** (#166-37 @ $2.00) and one on **Filters and Attenuators** (#166-36 @ $2.25). The books give you a thorough treatment of the theoretical and practical aspects of these circuit elements. These books cover each element of electronics with care that could never be used in a single book.

Locate and Eliminate Interference

How To Locate and Eliminate Radio & TV Interference, Rider #158, $2.90, is the second edition of this book—covers the subject quite well. It explains what makes noises, what you use to track them down, how you go about finding some of the more difficult ones, and what you do about them after you've located the misery.

Citizens Band Radio

Citizens Band Radio, Rider #273, $3.90, is more handbook than anything. It gives all the rules, covers just about every piece of available equipment and its application, the antennas, power supplies, kits, servicing, etc. Hams, whether they themselves like CB or not, are expected to be experts on the subject. This book will make you an expert.

Transistor Substitution Guidebook

The new Rider (#276, $1.50) **International Transistor Substitution Guidebook** for direct transistor substitutions has been badly needed. It lists over 4500 direct substitutions of American, Japanese, British, Dutch, French, Italian and German transistors.

Basic Mathematics

A lot of fellows, as a result of the terrible teaching methods being used in many schools, have gotten the idea that math is not for them. Since math is so fundamental in our hobby it stands to reason that this trauma should be repaired if possible. This book (Rider #268-1, $3.90) certainly should get almost anyone over the idea that math is hard to understand.

Letters

Dear Wayne:

Just flipped the back cover of August 73 closed with my usual smug grin of satisfaction, but this time you have hit an article that really takes my fancy. I refer to the article about the KW transistor mobile transmitter on page 72. You have finally hit on what I've been looking for for years and I am starting to build it immediately; that is just as soon as I can find the parts in the catalogue. Can't seem to find some of them. Had the same trouble finding the parts list in the article. You really have to look this one over close as it tends to elude you. Hope I don't have too much trouble identifying the parts when they come.

For years I've wanted to put a mobile rig in the family bus, but the XYL always complained that it got in the way of her knee's. Now I can have a gallon right under her nose and she won't even know it's there. She may think I've finally blown my gasket when I start talking to someone but that's alright because she thinks I'm nut's anyway, so that won't be anything new. My one big hope is that it will be as inconspicuous in the car as it is in the magazine. I wonder if you have any idea's for an invisible whip to go along with the rig? The regular whip may give me away. I thought I might be able to use a throat mike instead of a hand mike, then I could crank up the gain and just mumble, my wife says I mumble all the time any way so she will be used to this and may never catch on. I can hardly wait.

So listen close on 20 meters in the near future Wayne and when you hear a large clear spot of beautiful dead silence you will know I'm on the air. By the way I have heard a lot of guy's around town grumbling; seems the printer's left this article out of their magazine. Well I'll loan them mine when I finish the rig. Wonder what you have for next month. . . .

Earl Spencer K4FQU

Dear Wayne:

I just finished reading Frank Merritt, Jr's fine article "The Drake Receiver" in your August issue. There are a few points however, which I feel require some clarification. First, all 2-Bs have a fast AVC decay time of .025 seconds rather than the .05 second figure mentioned in the article. While it was true that the 2-A has a .05 second decay time, this figure was reduced in the 2-B to permit greater ease in operating break-in CW. The first audio amplifier stage consists of the triode section of an 8BN8 tube. The two diode sections in this tube are used as bias rectifier and AM noise clipper respectively. This arrangement is common to all 2-Bs as well as many 2-As.

There have been no significant modifications in the 2-B since production began, so a modification service on it is not available nor necessary. Because of the expense involved and the chassis alterations which would be required, we do not feel that it would be practical to modify earlier 2-A receivers to include noise limiter circuits and are not offering such a service.

It is also worth noting that the 2-B combines the advantages of a "ham band only" receiver with the capabilities of extended coverage. It is equipped with five accessory bandwidth positions which permit the addition of five 600 KC tuning ranges between 3.5 and 30 mc by merely adding the appropriate crystals to the respective socket. This feature is particularly useful for "MARS" coverage and would prevent it from becoming obsolete in case changes were made in amateur band frequency allocations.

All of us here at the R. L. Drake Company were well pleased with the article and we would like very much to congratulate Mr. Merritt on a job well done.

James F. Waits, Engr. Dept.
R. L. Drake Company

ar Wayne:

Oops! is doubly appropriate for yer July issue. Don't z know a dipole from a vertical ground plane either? Hi. (Page 8.)

Would you please inform our readers that they should oss out "18 inch elements and two of the" in the ghth sentence below the picture of the "Tinker Toy iree Element Beam" on page 10. Otherwise they would d up withsix quarter wave segments in the driven ement. Thought I marked that "delete" on the oofs.

My only other complaint, Wayne, is that you really it your readers on the spot in asking them to vote for e best articles each month. There are so many good ies in this month that a fellow could develop some rt of complex in attempting to make such a weighty ecision. Keep up the good work.

Bill K8LFI

(W2NSD from page 4)

July Votes

July was the nip and tuckiest month yet, otewise. The Two Meter Nuvistor Line Ampli-ier nudged out Tinker-Toy for Two by only welve votes out of over 1500 for each! We'll ontinue to run Nuvistor articles in spite of RCA's complete indifference to 73 as an adver-ising medium. We have several more good Nuvistor articles being prepared for publica-ion, including a fine 220 mc converter.

Our big Pandaptor was in third place by nly seventeen more votes. Nine votes behind vas our Big Technical Article on power sup--plies, and tied with it was W7CSD's article on AM systems. That was quite an issue. Be sure o send in your vote for articles you like best in this issue as this helps me to decide what to publish in the future and pays off the winning authors with an extra 50% pay.

August should be a light month for votes, but they are coming in hot and heavy. The Nu-vistor converter seems to have a strong lead so far, but a sudden surge of votes for the Impedance Bridge or the Deviation Meter could change the order. You may have noticed that there was a place to vote for the most interest-ing ad on the card too. I had in mind giving maybe a 50% rebate for the ad which wins this vote each month. The purpose of this would be to encourage companies to put a little more effort into their advertising and eventually make the magazine more interesting to read. The Drake ad is leading so far, with Clegg Laboratories not far behind.

Renewals

With several thousand subscription renewals all coming due this month I was a bit worried about how hard a time we would have in get-ting the fellows to re-subscribe. I needn't have worried. With still one more issue to go there are now less than 500 who have not renewed! If your stencil ends in 91-01-N1-D1 then your subscription is running out. Send money.

Advertisers

25 YEARS with PR!

■ Adolph Schwartz, W2CN, is celebrating his 25th year as sales representative for PR Crystals. But W2CN was a ham operator long before that. His original ham license was dated April 12, 1916 . . . Commercial First Class License dated 1917. Before and after World War I, Adolph had call letters 2AFT and 2ASK. He has always been an active amateur, and his present license is Amateur Extra First Grade.

■ Here is W2CN at his rig. Rx-Collins 75A4. Tx-Johnson KW Final. Driver Johnson Pacemaker. Antennas: 40M, inverted vee dipole. 20, 15, 10 M, 3 separate 3-elem. beams. W2CN is active on SSB, AM, and CW, on 40, 20, 15 and 10 meters. He likes to chase DX and has over two hundred confirmations. Give him a call sometime.

■ Top Row: 1916 Ham license; renewal 1917 Commercial License; Bill Eitel and W2CN. Lower Row: First Class Commercial License, 1921; 1919 Ham License 2AFT; U.S. Army Discharge; W2CN tied to ball and chain.

■ PR Crystals have been the standard of quality since 1934. It was their outstanding performance and dependability that first interested Adolph Schwartz. In March 1936 he started using PRs in his rig at W2CN. He was so impressed by PR Crystals that he immediately asked to be their sales representative in the New York territory. Says W2CN: "It is a pleasure to sell PR Crystals because they are quality products that operate without trouble to their owners."

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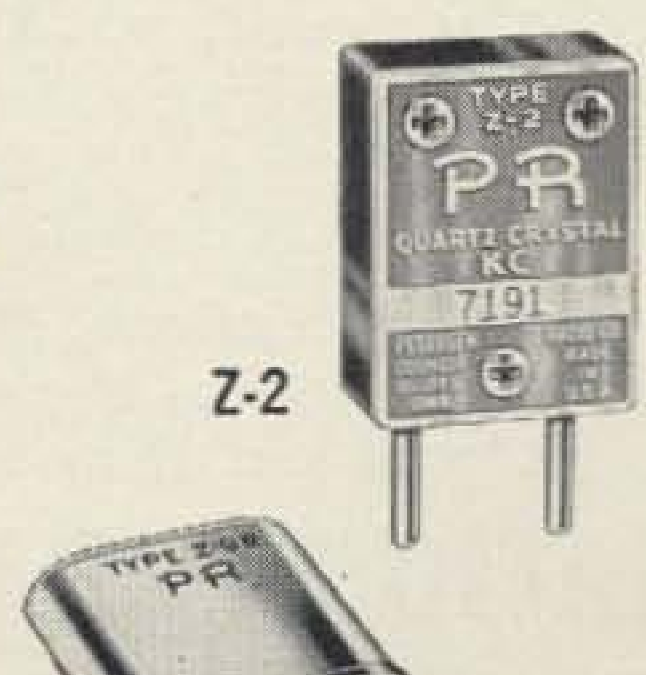

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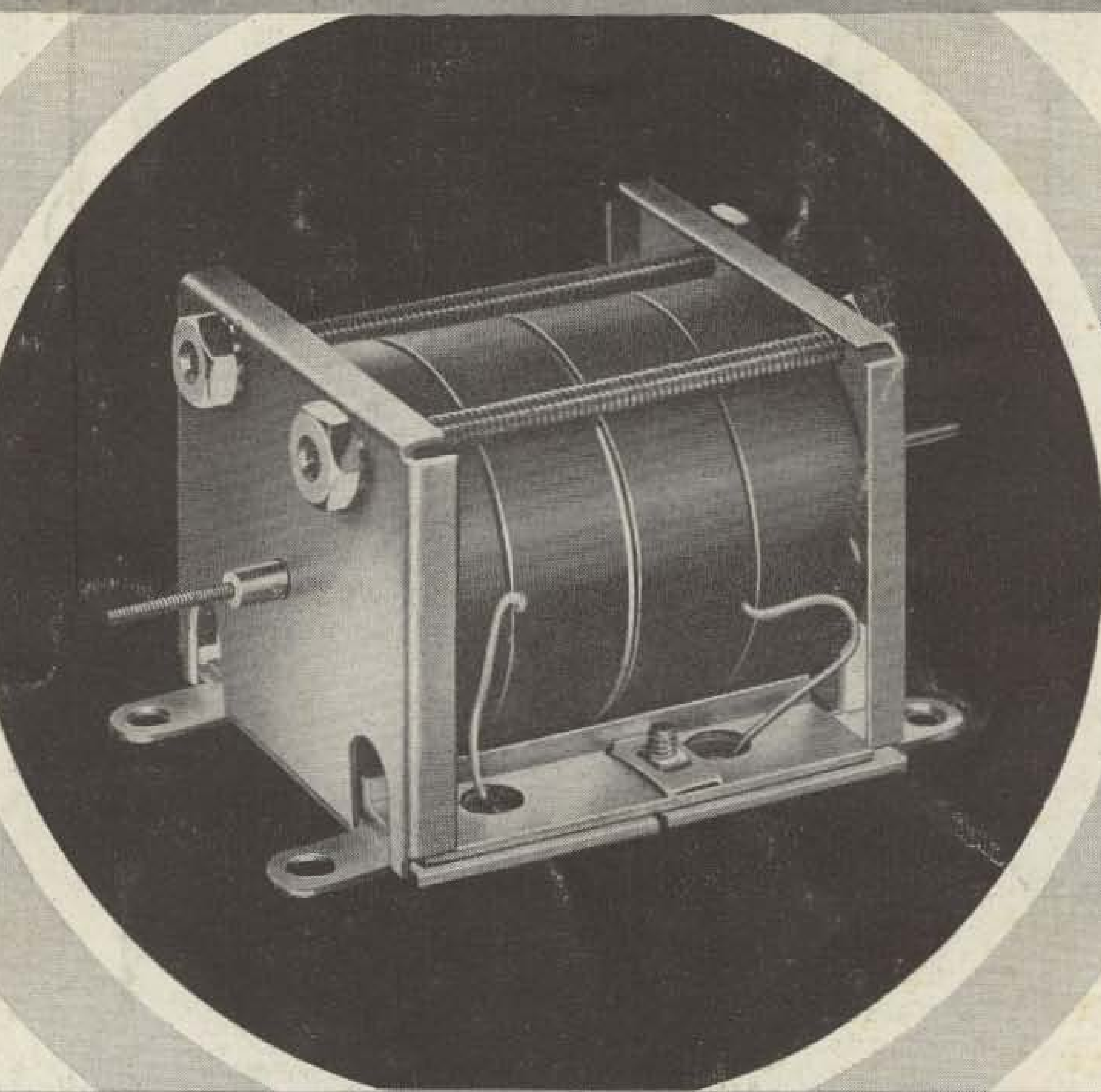

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