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The Radio Amateur's Journal

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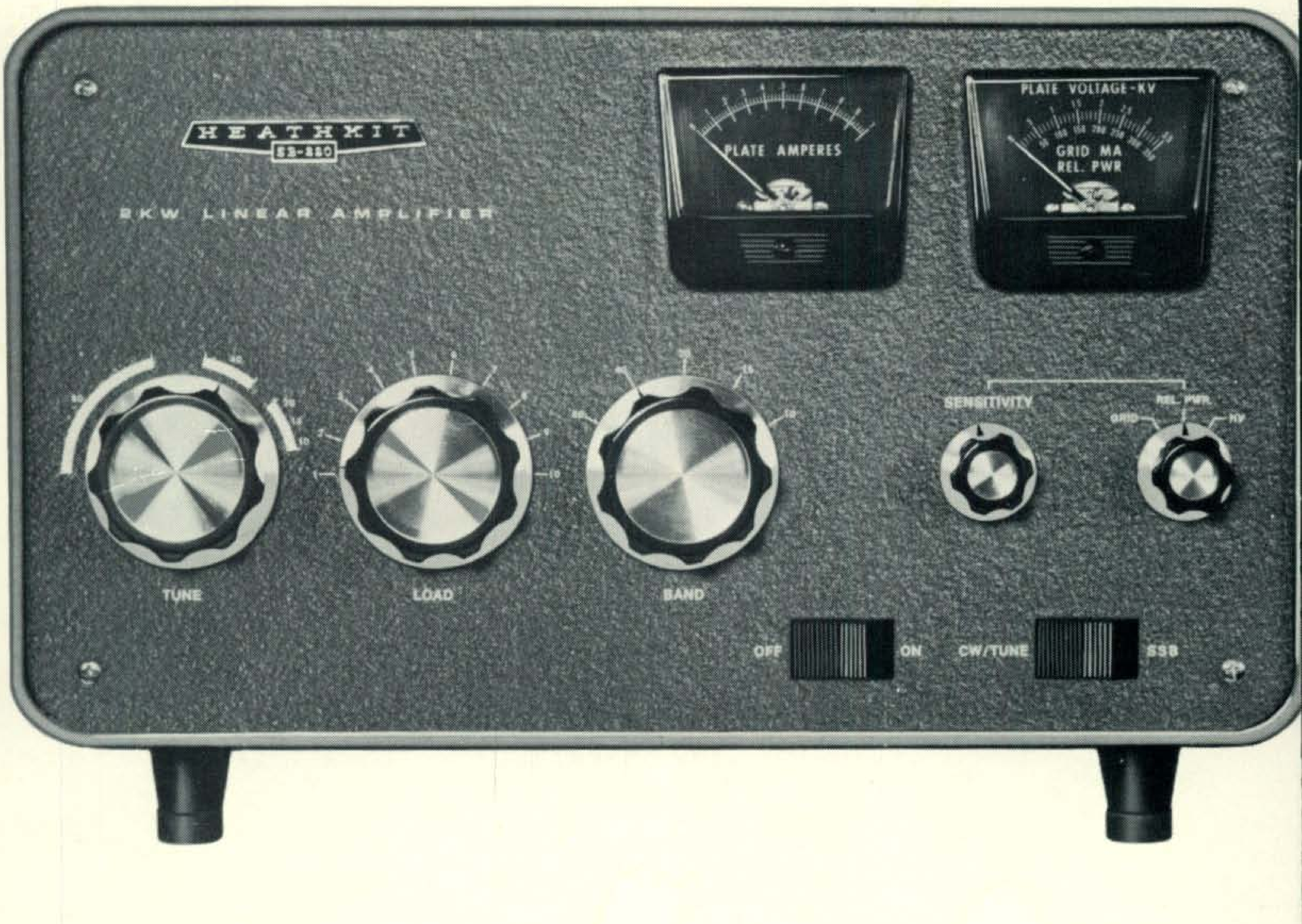

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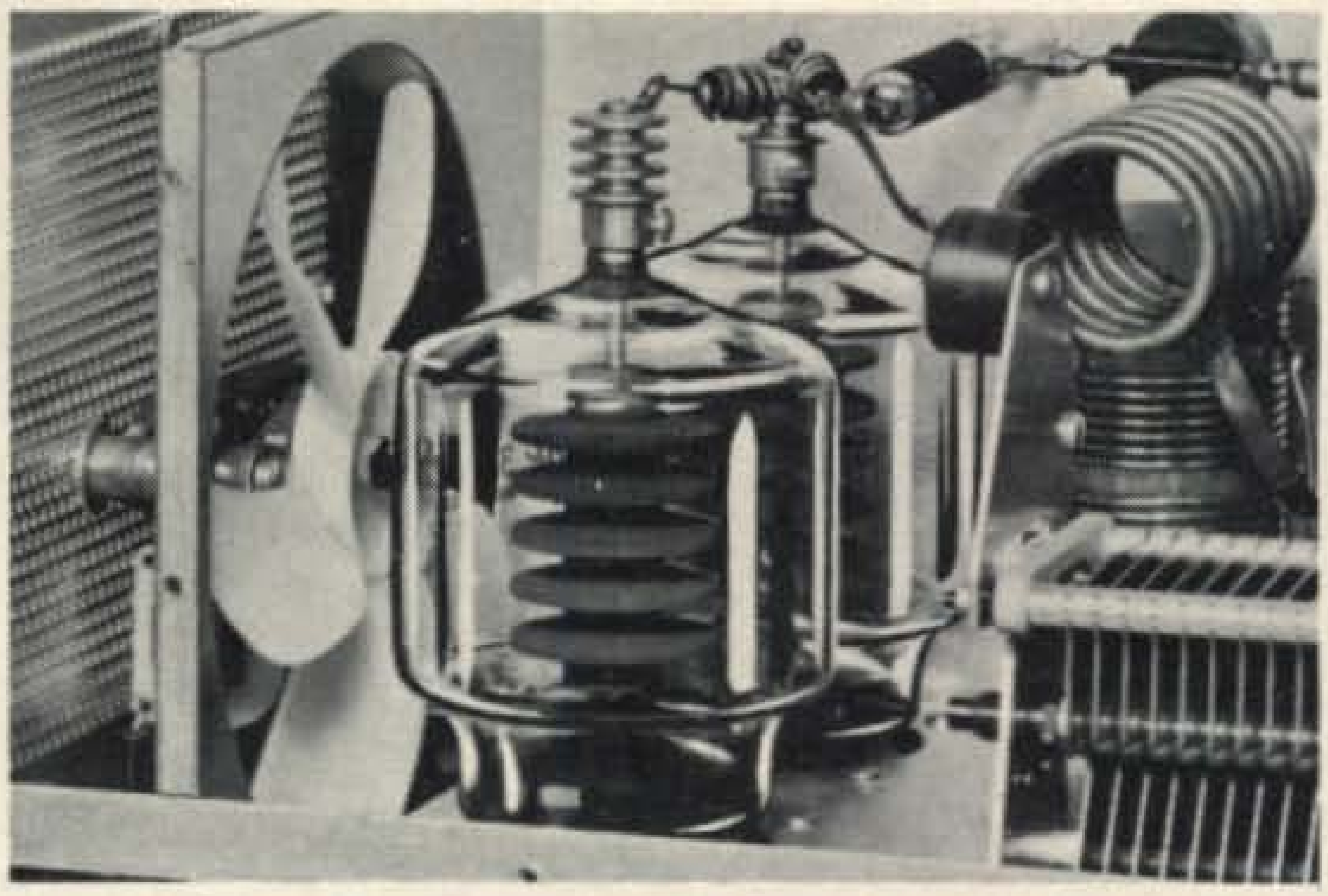

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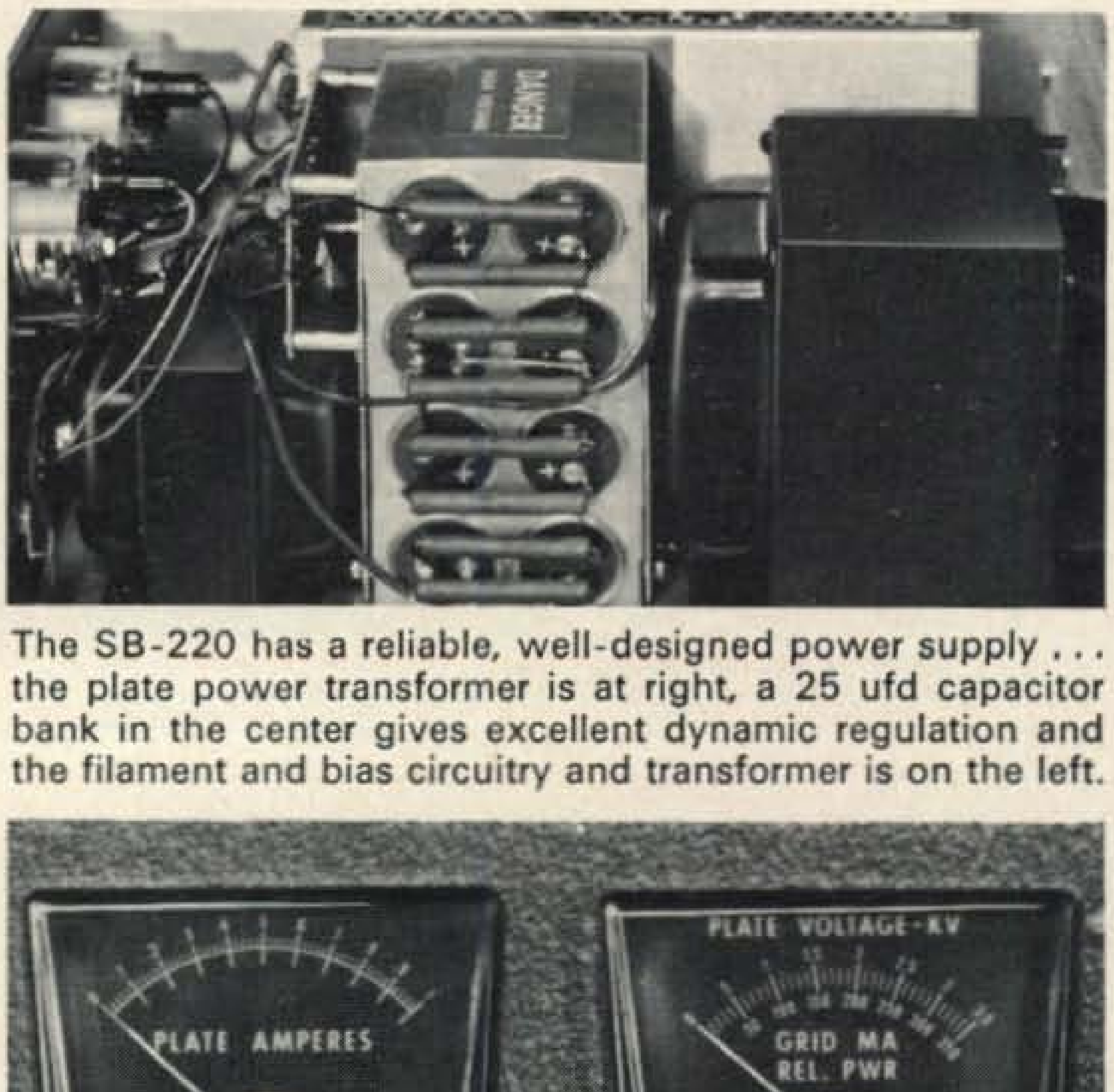

The SB-220 has a reliable, well-designed power supply . . . the plate power transformer is at right, a 25 ufd capacitor bank in the center gives excellent dynamic regulation and the filament and bias circuitry and transformer is on the left.

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JANUARY, 1970 VOL. 26, No. 1

The Radio Amateur's Journal

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DEPARTMENTS

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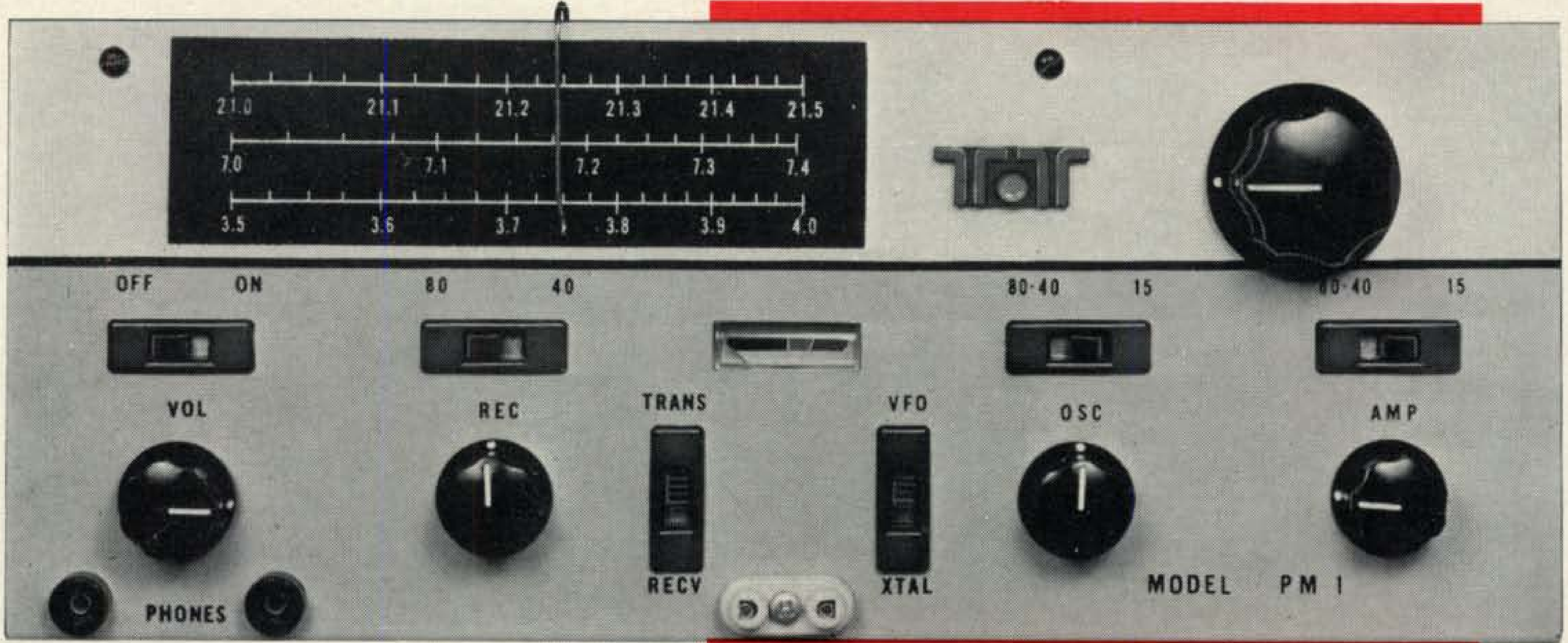

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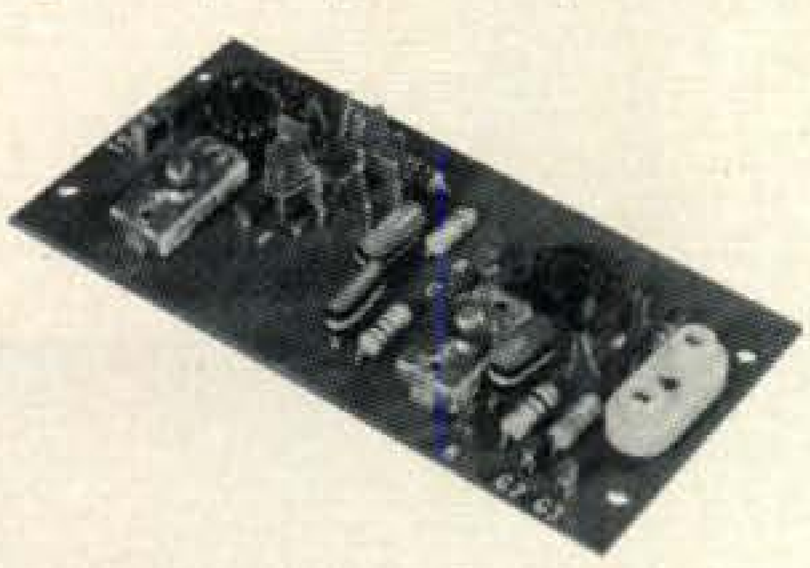

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ZERO BIAS

IT isn't very often that the publisher gets an opportunity to make his voice heard in *CQ*, since our policy has always been to leave the editorial prerogative with the editor, and to keep our cotton-pickin' hands off the bias control. Be that as it may, this issue is a milestone for *CQ*—an honest-to-goodness twenty fifth anniversary issue—and that calls for a slight break from tradition.

CQ has seen its ups and downs during the past twenty five years, struggling to survive in the late forties, prospering in the fifties, sagging with the industry in the early sixties, and once again, back on top as we look forward to the seventies. As we look back, we can point with a bit of pride to some of *CQ's* accomplishments that have left their mark on amateur radio. The Novice license, for example, was a *CQ* brainchild, and despite all the efforts of the old League hierarchy to prevent this license from coming into being, the Novice is with us to stay. No single factor has contributed more to the growth of amateur radio.

Single sideband was another innovation that found its first support in *CQ*, as were RTTY and v.h.f. f.m. repeaters. In fact, digging through some back issues we find that *CQ* was the first ham magazine to enter the space age, with strong devotion to Project OSCAR, when amateur radio satellites were merely a dream of a few West-coast faithfuls. It's hard to keep from blowing our own horn, but strangely enough, during the past twenty-five years, practically *every* major step forward in amateur radio has been introduced or advocated by *CQ*.

We've had some pretty capable people on the *CQ* staff, when you think about it; men like Larry LeKashman, now a top corporate executive, and Perry Ferrell, now editor of a much larger magazine. And some fine engineers like Gene Black and Doc Hayes. And one or two we're not so proud of. Oh, well! You can't win 'em all.

Come to think of it, some pretty well-known people in the electronics industry have written regularly for *CQ* over the years, long before they became famous. A few names that come to mind immediately are Bill Orr, Don Stoner, Sam Harris, Byron Kretzman, Frank Jones, and of course, our own irreplaceable Bill Scherer.

Over the years we've been accused of being anti-League, pro-League, anti-c.w., radical extremists, and ultra-conservatives. We've been accused of being too outspoken by some, and too middle-of-the-road by others. One irate reader wrote us last month to complain about off-color jokes told by the editor of a competitive publication at a recent hamfest, stating that unless *CQ* did something about it he would cancel his subscription. We do lose a few that way...

But on the whole the years have been good to *CQ*, and it's been fun growing up along with Amateur Radio. Like everything else these days, the hobby has its share of politics, and it's pretty darned hard trying to take a path that won't step on someone's toes at least once in a while. So we try a bit harder, and we tear out a few more grey hairs.

And as we go to press with this twenty-fifth anniversary issue of *CQ*, one thing is most gratifying; more active hams will be reading *CQ* than *any* other amateur publication. It's been a long hard road to the top, and we're grateful to our readers who have helped us get there. We only hope that we can continue to contribute our share in the next twenty-five.

Richard A. Cowan, WA2LRO
Publisher, *CQ*

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OUR READERS SAY

Value of High Speed C.W.

Editor, *CQ:*

It is my hope that you might include the following comments relative to incentive licensing in the OUR READERS SAY column of a forthcoming issue of *CQ*.

Relative to the progress of Extra class licensing, I have a thought which has bothered me for some time and which I would like to get off my chest. The article entitled, "The Amateur Q" by W4GF appearing in the August (1969) issue of *QST* shows that the number of Extra Class licensees have almost doubled in the last two years. The figures cited still represent only a small percentage of the entire amateur populace. It is my feelings that this percentage could have been much greater if the 20 w.p.m. code speed had not been imposed.

Why is 20 w.p.m. a requisite? There are literally thousands of amateurs who now have General or Advanced licenses and who possess adequate knowledge to pass the Extra class exam provided the code speed requirement was held at 15 w.p.m. Under emergency conditions we know that c.w. gets through when practically everything else fails and therefore it has its place in the communication modes. Through the years I have experienced a few emergencies where c.w. had to be restored to mainly for the lack of primary power availability. One of these emergencies resulted from the September 1938 hurricane. Even though all our net personnel was able to handle 20 w.p.m. or better, we resorted to more comfortable (less nerve racking over long periods) speeds in the neighborhood of 15 w.p.m. We accomplished our mission admirably. Furthermore, it is my conviction that for most amateurs, young and old, c.w. is considered an antiquated method which is giving way to phone or other more venturesome forms of communications. Even though I still believe c.w. still has its place in ham radio, I do not believe it should be made a prime factor and one of the most important aspects of Extra class licensing. We started out with the idea of incentively motivating the amateur fraternity to improve its technical abilities and thus gradually erase the nickname of appliance operator." This is a noble and constructive idea, but, what does 20 w.p.m. code speed have to do with technical ability?

Those who wish to pursue c.w. and improve their code speed to great heights, let them do so and, in fact, encourage them. It's fun. But. to be practical, why not reduce the speed requirement in the Extra class licensing to 15 w.p.m.? This idea by no means would be the final answer to sufficiently increase the number of Extra licensees but I'm sure it would be a great help.

C. B. Gardner, W1FE
Peace Dale, R.I.

[*Continued on page 101*]

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Announcements

Paramus, N.J.

The East Coast VHF Society's 12th annual dinner will be held Saturday, March 21, 1970 at the Neptune Inn, Rt. 4, Paramus, N.J., starting at 7 P.M. W4FJ, Ted Mathewson will talk on VHF—Past, Present and Future. Awards will be given by W1HDQ, Ed Tilton, including awards for highest single and multi-operator station in the September VHF contest. The menu will be Prime Ribs of Beef and tickets will be sold for $7.50. Group reservations are available in blocks of 5 to 10. Ticket deadline is Wednesday, March 11th. For tickets and reservations write the East Coast VHF Society (WA2WEB), P.O. Box 1263, Paterson, N.J. 07509.

Gary, Indiana

The Lake County Amateur Radio Club, Inc., announces its 17th annual Banquet to be held at Teibel's Restaurant, U.S. 30 & 41 (near Schererville, Ind.) at 6:30 P.M., CST, February 14th. Chicken dinner, entertainment, speeches. Tickets $5.00 each from Herbert S. Brier, W9EGO, 385 Johnson St., Gary Ind. 46402. Positively no tickets sold at door.

Medinet

Medical Information Network is the new name of the Public Health Service Emergency Radio Network. The network was organized a year ago by the Division of Emergency Health Services, Health Services and Mental Administration, to provide communication during health emergencies when downed telephone lines have closed normal communication channels.

MEDINET's most vital function is to provide rapid communication among health officials at the local, State and Federal levels during disasters. When normal communications channels are closed, MEDINET steps in to insure the fastest possible response to the health needs of disaster areas. Participation in MEDINET is voluntary. It is undertaken as a public service by the HEW employees involved.

Presently MEDINET is meeting on the air every Monday at 12:00 noon and every Wednesday at 5:00 P.M. EST. MEDINET Control, K3-YGG, operates on 20 meters at 14280 kc and 40 meters on 7260 kc simultaneously at these times.

Lawton, Oklahoma

The Lawton, Fort Sill A.R.C. Hamfest will be held at the National Guard Armory on February 22, 1970. For further information contact the Lawton, Fort Sill A.R.C., P.O. Box 892, Lawton, Oklahoma 73501.

Wheaton, Illinois

WCRA announces their 8th Annual Midwinter Hamfest on February 15, 1970, at DuPage County Fairgrounds, Manchester Road, Wheaton, Ill. Open 9 A.M.-4 P.M. Tickets $1.50 at the door. For further info write P.O. Box QSL, Wheaton, Ill.

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SCRATCHI

Feenix, Ariz.

Deer Hon. Ed:

Christmas are grate time of yeer, but it also time when Scratchi are driven crazy over the Xmas presents I getting. My Hon. Uncles and Ants are always–and I meen always–sending me hankercheeves or ties.

This may not sounding to bad, but I are now having enuf hankercheeves to supplying hole city of Feenix, even if everybuddy having running cold at same time. And the ties–well, you not buleeving the colors I getting. They making Arizona sunset looking like faded pichure on black and white tee-v.

So, this Xmas, my Hon. Brother Itchi desiding to try sumthing. He riting all Hon. Relatives and telling them if they wanting suggestshun on what to sending Scratchi, they should remembering that I am a ham radio operator.

After letters going out, I sitting back thinking of nice things I going to be getting. Maybe some of relatives going together and pooling money to getting me some nifty ham geer. At least I should be getting useful presents this yeer.

Well, packages are showing up and we stacking them under the Xmas tree. I looking them over pretty carefooley, and being fairly satisfied. Not one box look like it containing hankercheeves or neckties. Boy oh boys, I thinking–maybe this Xmas will be diffrunt!

Christmas morning coming and we opening presents. Hon. Ed., this Christmas it was diffrunt.

First box I opening is from Hon. Uncle Teraki. It having nice pen and pencil set in it, and a note, telling me to using these when keeping track of QSO's. Well, that not bad for a start.

I having eye on hevvy box from Hon. Cousin Sashi, so trying it next. It hevvy all

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rite—it having eleventeen pound cooked ham in it. Cousin Sashi never was to brite. It least it better than cupple loud ties like I usually get from him.

Hon. Ant Fuji also sending me interesting box, which kinda hevvy. Hon. Ed., you'd never guess. It containing dozen cans of Spam. Ant Fuji is the one with week eyes, and maybe she not reeding Itchi's letter to well.

Scratchi getting little desprit about now, so opening small package next. It's a book—on how to go about getting your amchoor radio license. At leest Hon. Uncle Hatanobe reeding Itchi's letter. Besides, I been making mental note to getting license one of these days and stop bootlegging.

Next I trying envelope with lotsa Xmas seals pasted all over it—maybe it having check in it! Nope, just a block of four of the amachoor radio commemorative stamp. Hah. Ok, so I can using them when riting thank-you letters.

Hon. Uncle Kobe sending me present. Opening it and finding it all packed with cotton. Thinking it being pretty important, I go thru box carefooley. Nothing in it. Looking again, and still finding nothing in it. Teering cotton apart, and still finding nothing.

Just then noticing note in box from Uncle Kobe. It saying: "Deer Scratchi, maybe this cotton will help you if you stuff it in your ears when you have that terribul QRM you always talking about." Hokendoki Hackensaki —a hankercheeve would have been better!

Then I opening present that making some sense. It containing one box of No-Doze Tablets. I guess they for when I staying up late working dee-x.

Hon. Ant Tooki having similar idea. She sending me box of candy—"so you don't get hungry while you staying up all nite talking to those other nice amchoors."

I not boring you with detales of rest of presents. At leest Hon. Brother Itchi coming thru. He giving me five yeer subscripshun to you Hon. Magazine. That is reely grate gift. It saves me having to buy used cupple months old copies at Joe's Triple-Dip Hunky-Dory Ice Cream and Used Magazine Parlor.

So, it was a good Xmas after all. I didn't get any hankercheeves or ties, I can reed Hon. Seek-You for five yeers for free, and all's rite with the world. Have a prosperous 1970.

Respectively yours,
Hashafisti Scratchi

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Galaxy hit the bull's-eye!

THE BEAUTIFUL NEW R-530 BY GALAXY $695.00

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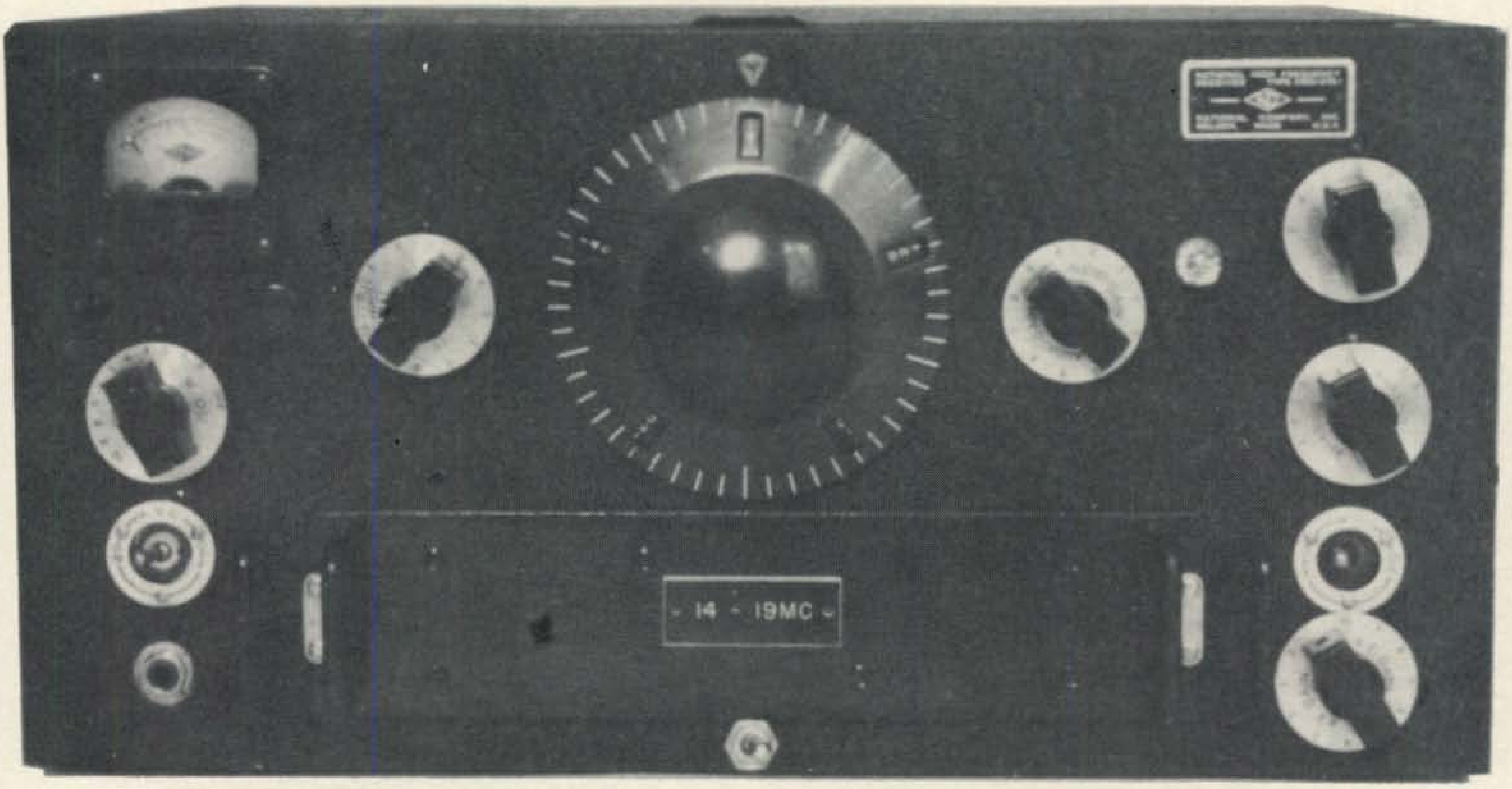


SOUPING UP THE OLD RECEIVER

BY FRED BROWN,* W6HPH

Part I

A great deal can be done to upgrade the pre-1960 receiver to meet today's standards. Part 1 of this article deals mainly with the design philosophy of "QRP operation" wherein low power consumption advantages are realized without the disadvantages of transistors.

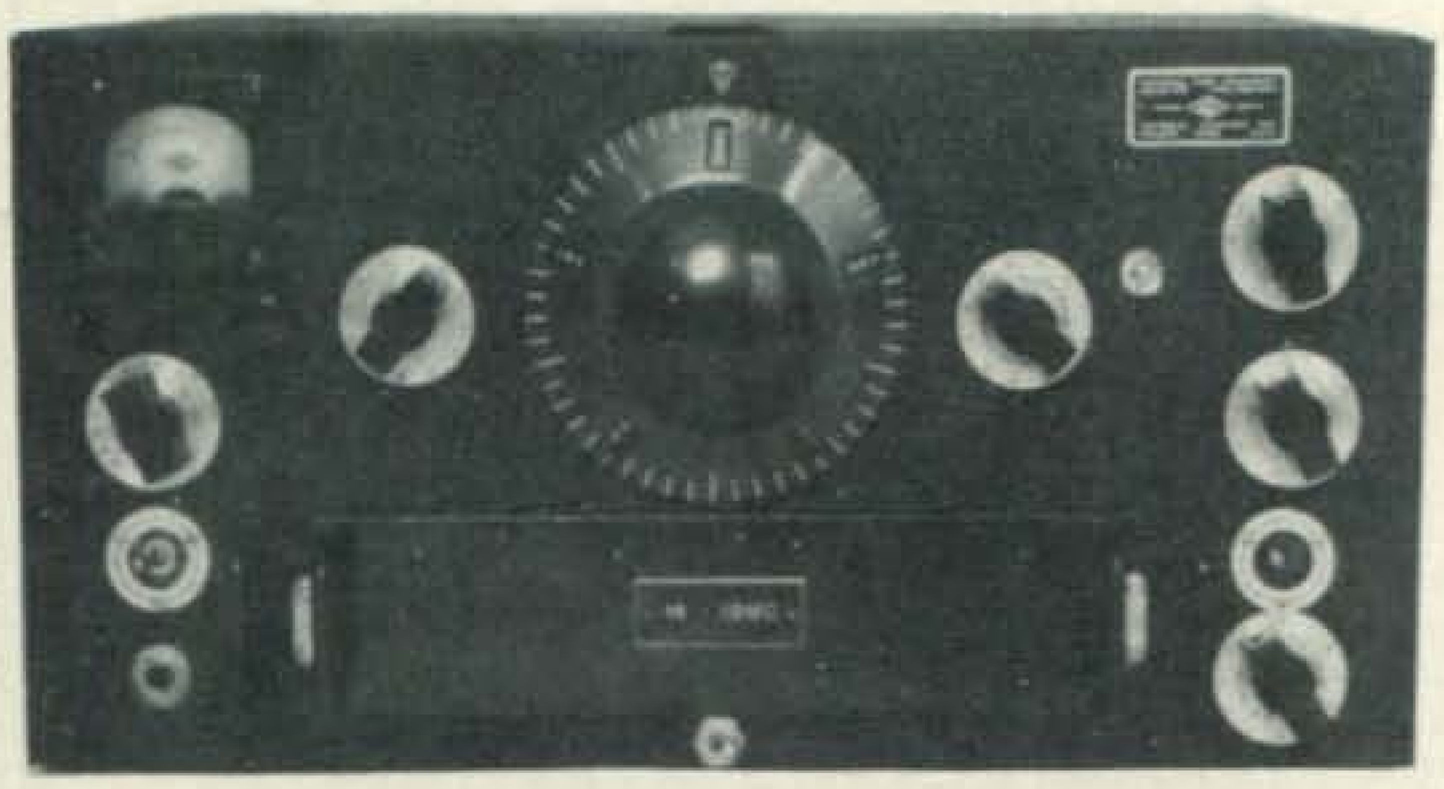
THE current market for used receivers is definitely a buyer's market. Ten to twenty-five year old models are going for prices that would be unthinkable even a few years ago. With a little knowledge of receiver circuitry the enterprising amateur can modernize these unprecedented bargains to equal, or even exceed, the performance of newer models selling for many times the price.

Old receivers do not wear out in the same way as old automobiles, and even those components that do fail can be easily and inexpensively replaced. About the only exceptions are the tuning and band-switching mechanisms. When buying a used receiver, be sure these mechanical systems are in top-notch working order. Usually anything non-mechanical is easy to fix.

Although this is the story of one particular HRO, most of these ideas are applicable to vacuum-tube superhets in general. Now that high-performance FET's are coming on the market my receiver will probably end up completely transistorized someday; but in the meantime I was interested in seeing just how far I could go with the old-fashioned vacuum-tube. It turned out to be quite a ways. There really is still no solid state equivalent of the remote cut-off pentode vacuum tube in terms of high output impedance, low feedback capacitance, large signal handling ability, a.v.c. control characteristics, and temperature immunity.

Since practically every circuit in the receiver has been rebuilt, you might well ask, "Why not just start from scratch and build a receiver?" One answer is that I saved myself a good deal of sheet-metal working drudgery. Also it is very doubtful that I could have duplicated the excellent tuning mechanism and plug-in coil arrangement of the HRO. In addition, since the receiver was rebuilt one circuit

*Pine Cove, Idyllwild, California 92349.



Front view of the modified HRO. Despite the many changes, this unit retains its classic appearance. The plug-in coil set shown is used mainly for v.h.f. converters, its 5 mc tuning range making the dial direct reading.

Type	Miniature	Octal
Remote cutoff pentode	6BJ6	6SS7
Sharp cutoff pentode	6BH6	—
High-mu triode	6AB4	6SZ7
Medium-mu triode	6C4, 9002	6L5-G
Power pentode	6AK6	6G6-G
Duo diode, Hi-mu triode	6AQ6	6SZ7

Table I—Typical 150 ma heater tubes.

at a time, it was never long off the operating table and consequently could be used as the station receiver even while being rebuilt.

This particular model was an HRO5TA1, purchased a few years ago for $65 complete with power supply, speaker, and plug-in coils for 100 kc to 30 mc. In its day (1946), is was one of the highest priced receivers on the market and regarded by hams and communications engineers alike as the Cadillac of the industry

Heat

One of the main shortcomings of old receivers is the large amount of heat they produce. In the old days, advertisements touted "powerful superhets." Perhaps this was because they were built like transmitters. Practically every stage usually runs at two or three times the power necessary for good performance.

The resulting heat is very undesirable for a number of reasons. Most obvious is frequency drift and reduction in component lifetime. Some models use ventilated cabinets to get rid of the large amount of heat generated; hot air from tubes and resistors then rises and passes out vent holes near the top of the cabinet.

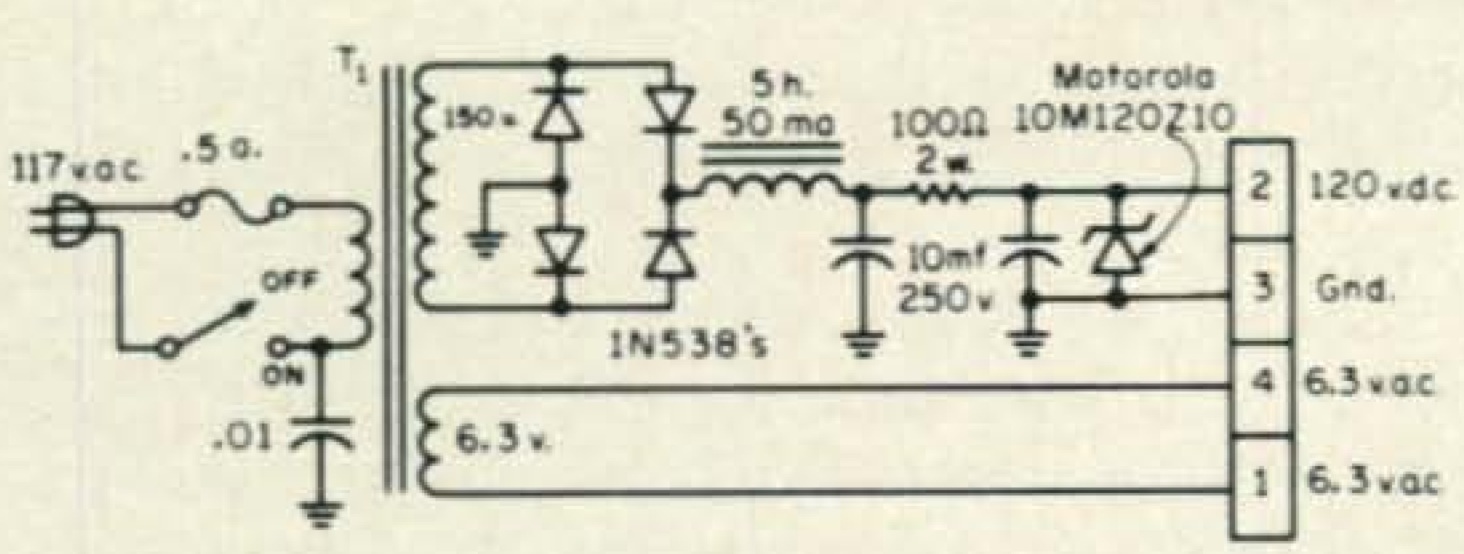


Fig. 1—External power supply for the modified HRO. Transformer T_1 provides 150 volts at 70 ma and 6.3 volts at 1.5 amperes. The zener diode regulates at 120 volts and is discussed in the text.

This air is replaced with cooler air sucked in through vent holes below the chassis. Convection cooling of this sort would be all right if air were perfectly clean, but it's not. A substantial part of the dirt in the air is left in the receiver. Take a look inside any old TV set for a very dramatic demonstration.

Dirt, needless to say, is very harmful. It gets into controls, switch contacts, tuning capacitor bearings, etc., making them noisy and eventually intermittent in operation. It also affects alignment and Q of tuned circuits. There is much to be said for a receiver that is totally enclosed, even though it means somewhat greater warm-up drift.

The best thing to do about heat is to avoid producing it. The transistor, of course is the ultimate solution; but even with vacuum tubes, proper design can easily cut the amount of heat generated to 1/2 or 1/3. Warm-up frequency drift will be reduced a corresponding amount, of course. You will even have a smaller power bill—a consideration of you leave your receiver on all the time. In this receiver total power consumption was reduced from 42 watts to less than 15 watts with no loss of performance. Here's how it was done:

Tubes

The average run of the mill receiving tube has a heater consumption of 6.3 volts at 300 ma; about 2 watts just to light it. Although not generally appreciated, there is available a complete series of receiving tubes that run on 1/2 this current, only 150 ma. Total heater consumption can be cut at least in half if the tubes are simply replaced with 150 ma versions. (In many cases even socket connections are the same). Table I gives representative 150 ma heater types, both octal and mini-

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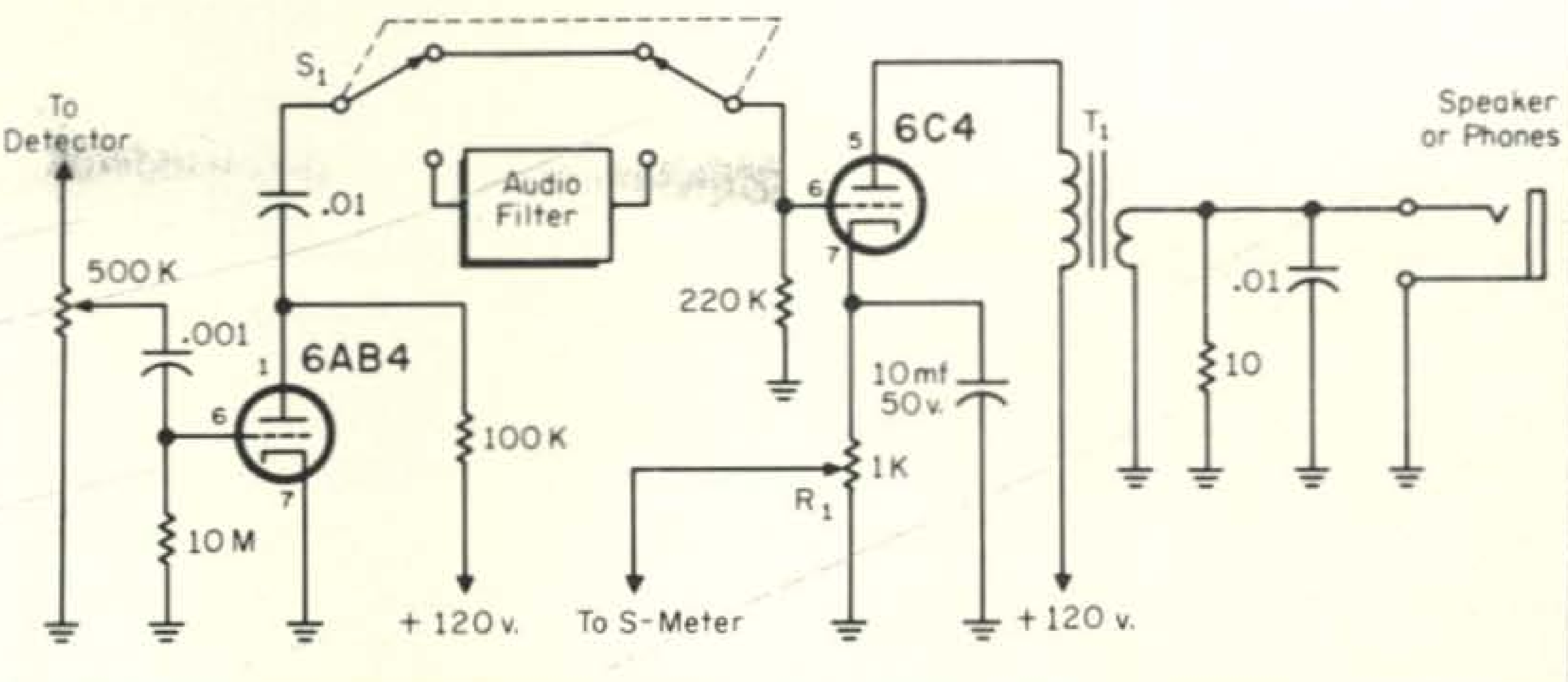
Fig. 2—Audio portion of the modified HRO. Transformer T_1 is a standard 10K to 3 ohm output type. The 10 ohm resistor across the secondary provides a load when high impedance earphones are used. The audio filter will be discussed in Part II.



ature. There even exist 150 ma equivalents of some of the old double-ended metal tubes such as the 6K7. (Replace it with a 6S7.)

I've replaced all the old octal tubes in this HRO with miniature 150 ma heater types, except for the 6AS6 mixer which pulls 175 ma. The octal sockets, of course, had to be replaced with miniature ones. This was acomplished by mounting the miniature sockets on small aluminum plates and then bolting the plates over the original octal-socket holes.

Plate Voltage

Plate dissipation (all of which appears in the form of heat) is the product of plate voltage and plate current. Transconductance, on the other hand, depends mainly on plate current, which in turn is governed primarily by control-grid and screen-grid voltages. Plate dissipation, therefore, can be reduced simply by lowering plate voltage; receiver operation will not be affected if plate current remains approximately as it was. This technique is used to some extent in the Collins 75S-3.

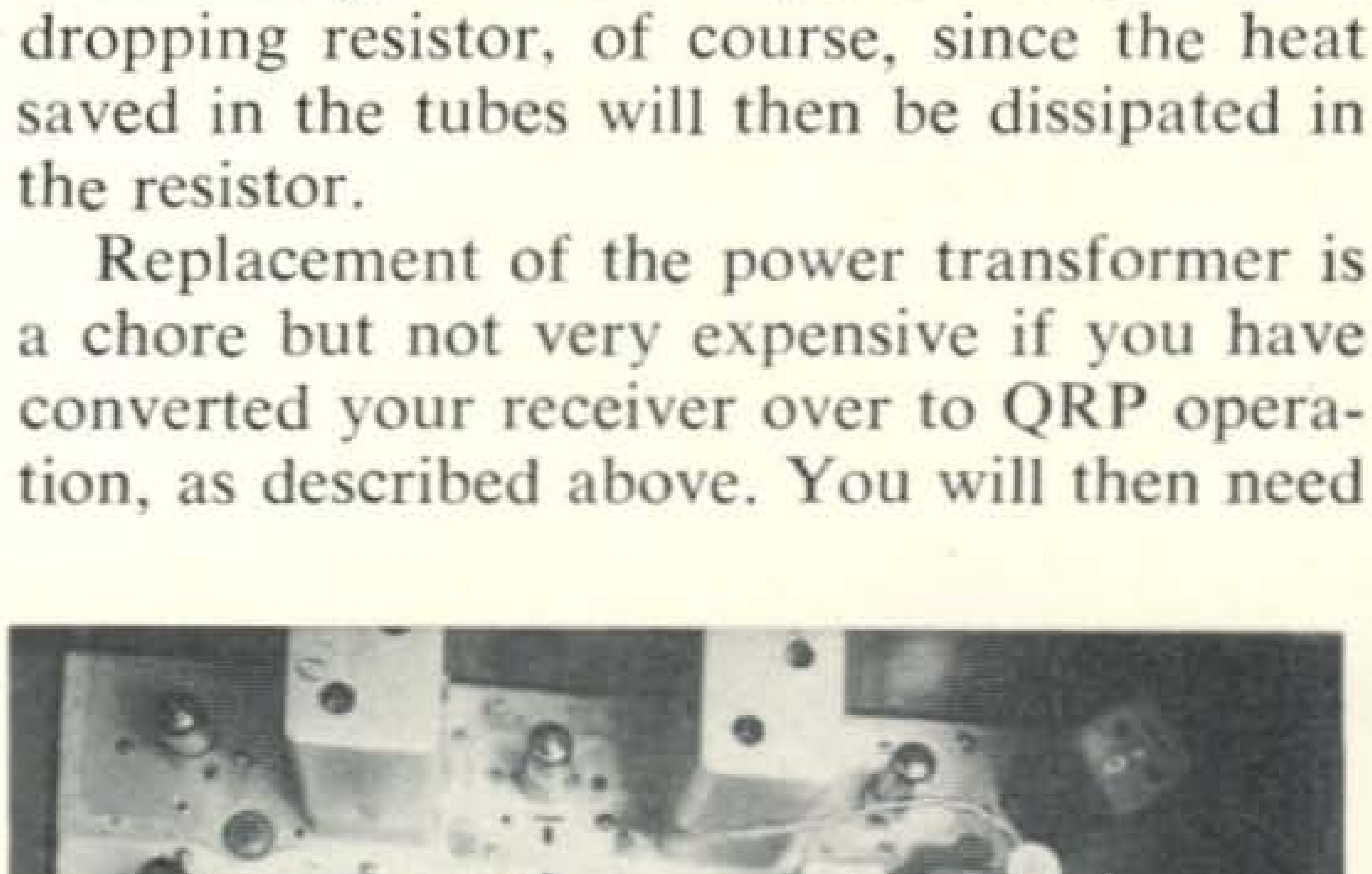
Plate voltage should not be reduced below screen-grid voltage, however, as this would result in excessive screen-grid current. It's a good idea to run plates and screens at the same potential, typically 120 to 150 volts; that way the screen dropping resistors (another source of heat) are eliminated. Also taken care of is the problem of regulating screen voltage with respect to r.f. gain control variations.

There's another advantage to low plate voltage: noise pulses are clipped by the tubes themselves. For this reason I have never felt the need for a separate noise limiter—although admittedly living in a very quiet location has been a contributing factor. With a v.h.f. converter ahead of the receiver and a.v.c. turned off, there is more than enough gain for limiting to occur in the last i.f. stage. This has proven to be a very effective noise limiter. Possibly performance as a limiter could be enhanced by a potentiometer to control last i.f. stage screen grid voltage, but I haven't tried this.

Power Supply

Unfortunately, a reduction of plate voltage will usually call for replacement of the old transformer, although some decrease can be had by changing the filter to choke input. (Another filter choke is added between the rectifier and input-filter capacitor.) Choke input provides better regulation and filtering in addition to dropping the output voltage. It does no good to lower plate voltage with a dropping resistor, of course, since the heat saved in the tubes will then be dissipated in the resistor.

Replacement of the power transformer is a chore but not very expensive if you have converted your receiver over to QRP operation, as described above. You will then need



Top view of the modified HRO shows the miniature tubes mounted on aluminum plates. The right side of the chassis contains the components added for control of bandwidth. This will be covered in Part II.

only a very small transformer; the one I used cost $1.59. This also frees the old transformer for a more appropriate application, such as a transmitter power supply.

Another big source of heat is the old-fashioned tube rectifier. It should be replaced with a pair of modern silicon diodes. It takes ten watts just to light a 5Y3.

The HRO was one of the last factory-made receivers with an external power supply; although most of those new-fangled s.s.b. transceivers are made that way. All things considered, I think the merits of such an arrangement outweigh the shortcomings. It makes for easy adaption to a mobile or emergency power source; and, of course, it eliminates all power supply heat from inside the receiver cabinet.

The power supply I am using is shown in fig. 1. I happened to have a 120 volt, 10 watt zener diode and used it for regulating B plus voltage. Since the entire receiver pulls only 33 ma plate current, the zener does a good job of regulating under all conditions of line voltage and r.f. gain control variations. As a result, no separate regulation of local oscillation plate voltage is needed inside the receiver, thereby eliminating still another source of heat.

Audio Output

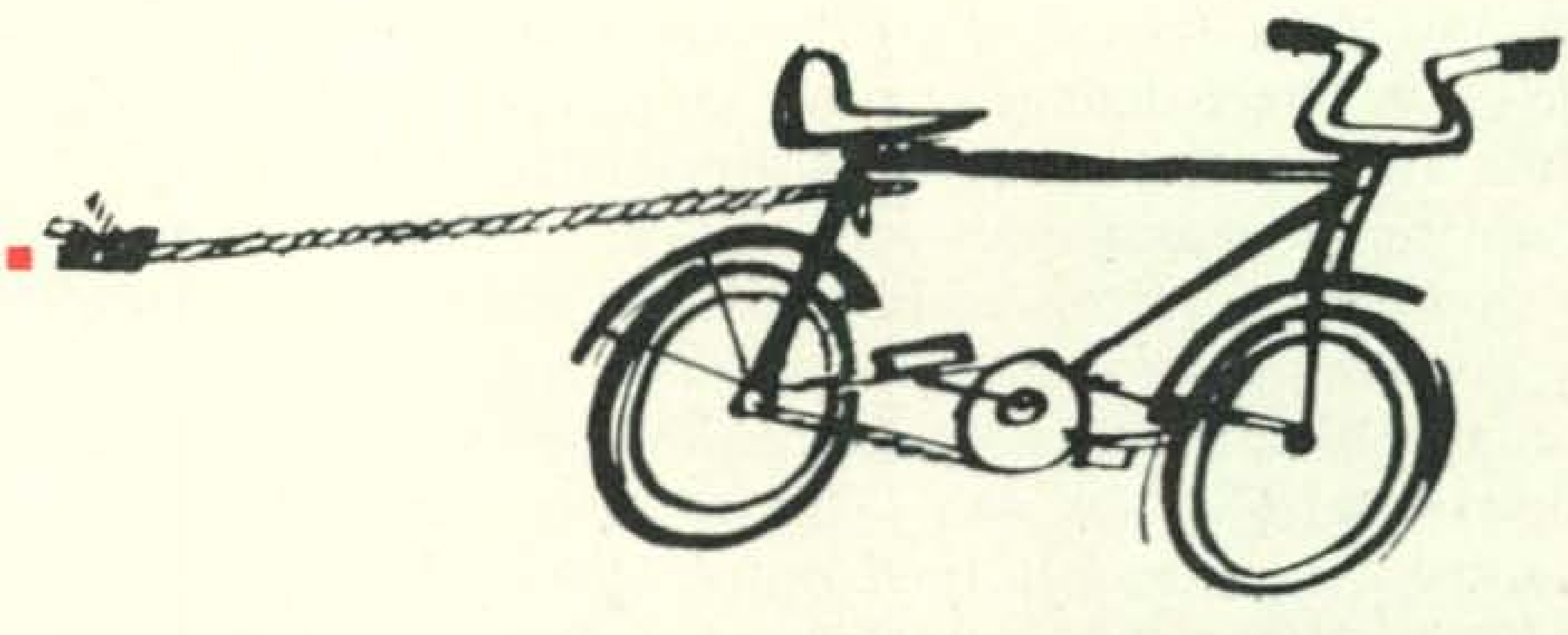
The most horribly over-powered part of all is usually the audio output stage. If you are deaf or if you use the receiver as a public address amplifier, you may need those push-pull 6V6's. Otherwise, it is sensible to replace the output stage(s) with something running around a half watt or so input. This should give you a clean 100 milliwatts of audio output with no perceptible distortion. One hundred milliwatts may not seem like much but it is *loud*. Try dumping that much audio power into a speaker sometime. You'll find out.

The 6C4 used here (fig. 2) delivers more than enough audio power for comfortable listening even running only 4 ma at 120 volts. Another advantage of a low power audio output stage is that noise pulses and strong signals are automatically limited to something less than ear-splitting levels before they reach the speaker.

Part II of this article will deal with the changes made in the i.f. and r.f. circuitry.

(To be continued)

BY THE WAY...



GORDON Young, WB6NKJ, takes to the road without having to worry about his ignition noise. The idea started when a storm blew his 4 element beam down at home and since he didn't have a car, bicycle mobile was the only immediate solution to staying on the air.

The bike is a girls model which offers a long back tray and a basket up front. An HW-32A is tucked in the basket along a log and speaker. The rear tray holds a 12 volt battery and feeds the d.c. supply (the battery requires recharging after about 4 hours of operating). So far he has worked 25 states and 10 countries with this rig and a Hustler antenna mounted on the back. He gets consistent 5/8 and 5/9 signal reports into Australia. ■

See page 110 for New Reader Service

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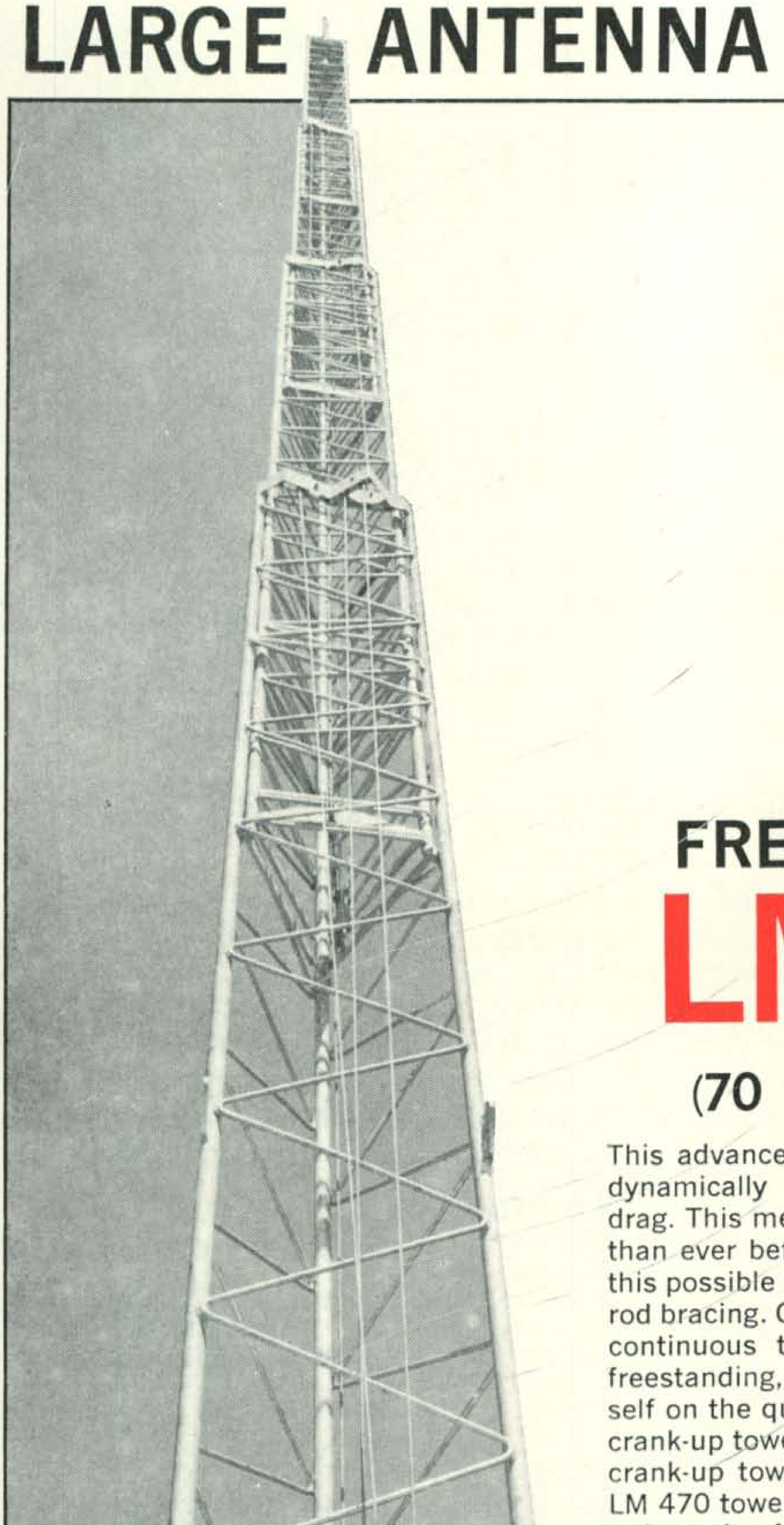

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See page 110 for New Reader Service

Radio Row - Japanese Style

BY RICHARD A. GENAILLE,* W4UW

As a boy, just getting started in radio, I used to make many excursions to New York's Cortlandt Street to spend a few hard earned dollars on radio parts and much time window shopping. I would imagine that there are many thousands of persons actively engaged in electronics today who can remember the countless hours they spent on "Radio Row" looking, touching, and buying parts for their pet projects. Well, New York's old "Radio Row" and the "Radio Rows" of many other cities have all but disappeared and even given way to the ever popular mail order house catalog. Like New York City, and many of the larger American cities, Tokyo, Japan has its own "Radio Row". It's a busy, exciting place, something like a beehive, and open seven days a week.

Not too long ago several of my business associates returned from trips to Japan with stories about a "Radio Row" in Tokyo that was something just short of being fantastic. Fortunately, I too was able to make several trips to Tokyo and, of course, had to visit Akihabara, the "Radio Row" section of Tokyo. What nostalgia, but with an Oriental flavor. I thought that you might like to know that "Radio Rows" are not indigenous to the U.S.A. and what the "Radio Row" of the most heavily populated city of the world is like.

Akihabara is a section of the city some few kilometers from the central business district of Tokyo. It is easily reached by elevated railway from almost anywhere in central Tokyo. The "el" cost from central Tokyo is about 35 yen or 10 cents. Cab fare from the popular hotels is around 260 yen. A dollar expands in a hurry in Tokyo with the exchange rate of 360 yen for one dollar.

Most tourists and business people visiting Tokyo are probably not aware that Akihabara exists much less being aware that it is Tokyo's "Radio Row". Those making purchases of electronic equipment such as tuners, amplifiers, tape decks, and other hi-fi components will usually make their purchases in the hotel lobbies or in the large department stores on the Ginza. Those who enjoy bargaining and the excitement of exploring a foreign country will find that they can save themselves a considerable amount of money by shopping at Akihabara. The cost of comparable units at Akihabara, after a bit of dickering, will usually be about a third less than the going prices "uptown" in the hotel shopping arcades.

Akihabara's "Radio Row" area consists of several square blocks of stores selling everything from washers and ironers to the parts for the construction of electronic equipment. There is a building, occupying one city block, that is really the heart of "Radio Row". Inside the building, on the ground floor, is a maze of passageways about 4 or 5 feet wide, lined with hundreds of small shops that are, at best, 8 foot cubicles. Many of these shops specialize in loose parts and are patronized by radio enthusiasts holding lists of parts for the various and sundry projects they plan to construct. The faces are different and the

The entrance to Akihabara Station as viewed from one corner of "Radio Row."

*719 Quarterstaff Road, Winston-Salem, N.C. 27104.

A busy corner at Akihabara.

It's even money that TV sets are sold here.

Even schoolboys are intrigued by the bargains.

language strange but the action is the same as back home.

My first trip to Akihabara was taken on a Sunday. The underlying thought was to try to find my way by elevated railway on a non-business day so that I could retrace my steps without trouble during one of the weekdays. When I arrived I found that virtually all of the shops were open and the place was teeming with people. I couldn't figure this out for awhile until I realized that Sunday does not necessarily bear the same importance in the Buddhist religion as in the Christian faith. As a matter of fact I discovered later that most of the main business section of the city is pretty well shut down on Sunday probably due to the influence of the work week observed by the western world. The popular Ginza, with its multitude of shops, seemed to be quite busy on Sunday however.

The typical method, and most convenient one, of getting to Akihabara is to hail a cab in front of your hotel and tell the driver Akihabara. You can't massacre the pronunciation too badly and if you do there is always the doorman who can give the cabby the instructions and get you on your way. The ride on the left hand side of the road in an economy size cab is something else, especially when you are used to the right hand side of the road driving done in the U.S. You should, of course, have some idea of what you wish to purchase before you head for Akihabara unless you plan to just browse around. I armed myself with a number of brochures which contained pictures and descriptions of the items of interest to me. I also knew what the going prices were for the items if purchased from the hotel shops. Another handy thing to carry around is a currency conversion chart. Also lots of yen! With the brochures, conversion charts, price information, and money you are in an excellent position to do some dickering.

There are, as mentioned previously, hundreds of little shops within the "Radio Row" building complex. Most of the shops specialize. You will find many handling loose parts, some dealing in hi-fi equipment, and others selling ham gear and test equipment. No matter what it is electronically speaking that you may desire you can find it at Akihabara. I was particularly interested in an Aiwa Cassette Tape Deck for use with my Sansui Stereo Tuner and Amplifier back home. I went from shop to shop, the ones specializing in tape decks, to do my bargaining. Due

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to the limited amount of space in an 8 foot cubicle you won't always find the unit you are looking for on display. Don't be dismayed. Show the proprietor your brochure and ask him how many yen. Tell him you want an export model too because if you don't you may wind up with a unit which will work properly only on 100 volts and 50 cycles. The proprietor sits in a little corner of the cubicle, with just about enough space to turn around, and shares a telephone with the owners of other adjacent cubicles. He will pick up the telephone and call someone, whom I suspect is his distributor, and apparently ask for a quote. In short order he will figure out his mark up and will quote you a figure. If this shop is the first on your itinerary tell him *"Domo arigato"* (Thank you) and go on to another shop. After you repeat the procedure a half-dozen times you will have a low quote and are ready to consumate a deal. With the maze of alleyways you may have a little difficulty finding the shop that gave you the low bid but don't despair, you will eventually find the place. Tell the proprietor that you want the particular item by pointing to it in your brochure again, quote the number of yen previously stated, and say *"Dozo"* (Please). He will again pick up the telephone, make a call, and in mediocre English ask you to wait a few minutes. After a short wait someone will show up with a package under his arm and deliver it to the shopkeeper. The shopkeeper will unpack your merchandise for you to examine. If the item also works on batteries the batteries will usually be supplied with the unit and you can check the item out. My tape deck was strictly an a.c. model for 60 cycles use and so I had to rely on faith in making my purchase. Of the various items purchased that could not be checked before purchase none gave any trouble when I finally plugged them in at home.

If you are satisfied a nod of the head to the shopkeeper will get your purchase re-packed, covered with a sheet of paper, and provided with a handle for you to carry the package back to your hotel. On your way back to your hotel you can feel pretty good about the bargain you got. You have saved yourself quite a few dollars by knowing how to shop at Akihabara. Despite the language barrier and the fact that you may not have the opportunity of trying out the item before you buy you will find that the Japanese shopkeeper is quite reputable. Your chances of buying defective merchandise are negligible

Coca Cola is Coca Cola even at Akihabara.

You name it, we got it.

A busy alley in Akihabara. These shops seem to specialize in vacuum cleaners, lamps, hot plates, ad infinitum.

See page 110 for New Reader Service

Another alleyway cluttered with tape decks and tuners.

as far as I can determine. I would not hesitate to repeat the process in the future if the opportunity to visit Tokyo ever presents itself again. By the way, if you buy loose parts, especially dials, nuts, bolts and the like remember that the Japanese are on the Metric System. I learned that a vernier dial for use with a 5 millimeter shaft can be reamed out slightly to fit a standard (U.S. type) 1/4″ shaft.

One interesting sidelight to my wanderings through Akihabara was meeting a gentleman from India who was trying to purchase various units of ham equipment for his brother, a ham in Bombay. This fellow was fortunate in that he had a Japanese friend acting as an interpreter which made it considerably simpler to effect his transactions. He had quite a list of items to buy and these items ranged from sideband exciter units to filters, crystals and other odds and ends for the construction of sideband transmitters. I jotted his brother's call down somewhere and mislaid it. Perhaps he will read this article and let me know if the counsel I provided helped him to get the equipment he wanted.

From my exploration of Tokyo's "Radio Row" I would say that radio rows certainly are not indigenous to the U.S.A., nor are radio enthusiasts. The little shops at Akihabara seem to do a thriving business in whatever electronic equipment they sell. The customers range from schoolboys up to old timers. The shopping lists look the same as the ones I used to carry to Cortlandt Street years ago only the language is different.

Anytime one thinks we Americans have the corner on enthusiasm in regard to radio and electronics in general he ought to visit Akihabara in Tokyo. It's an education.

Sayonara

(photos by B. W. Smith)

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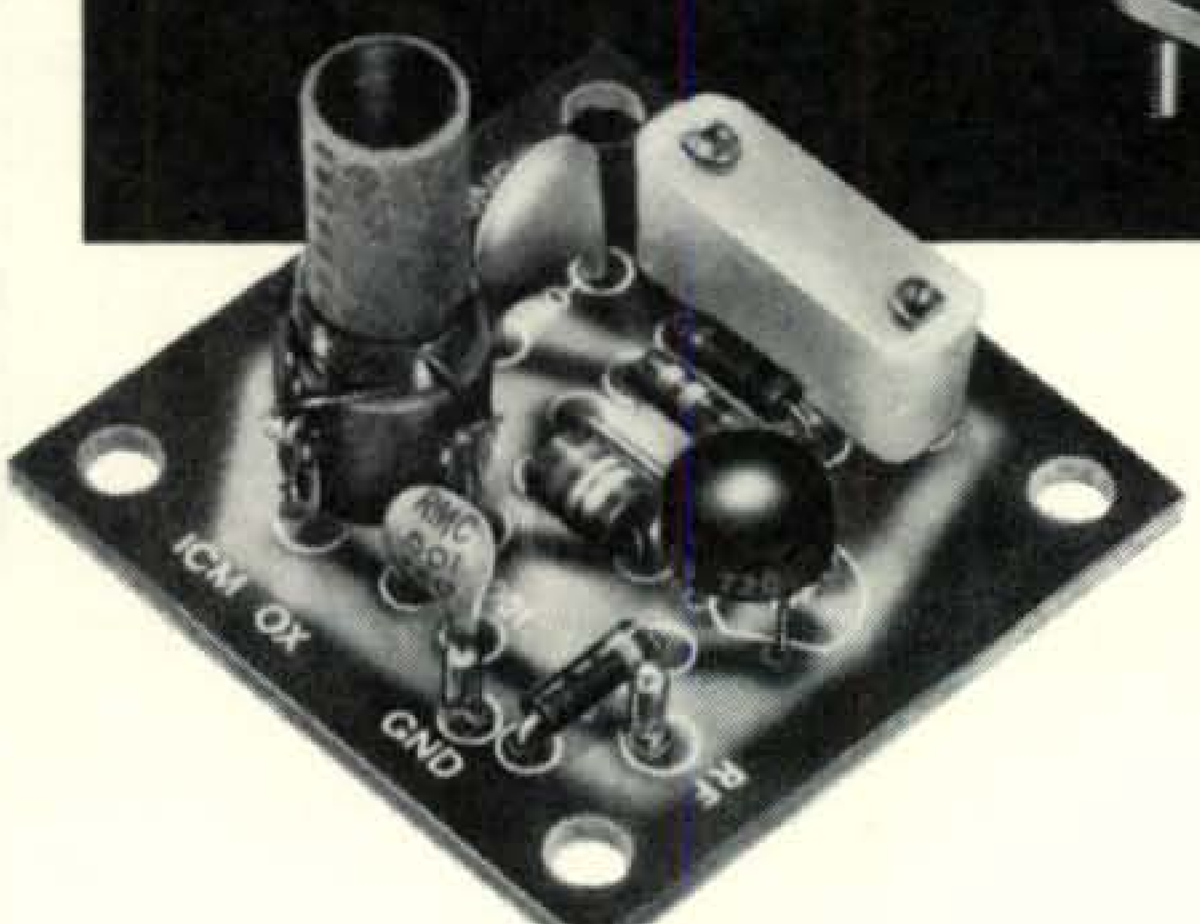

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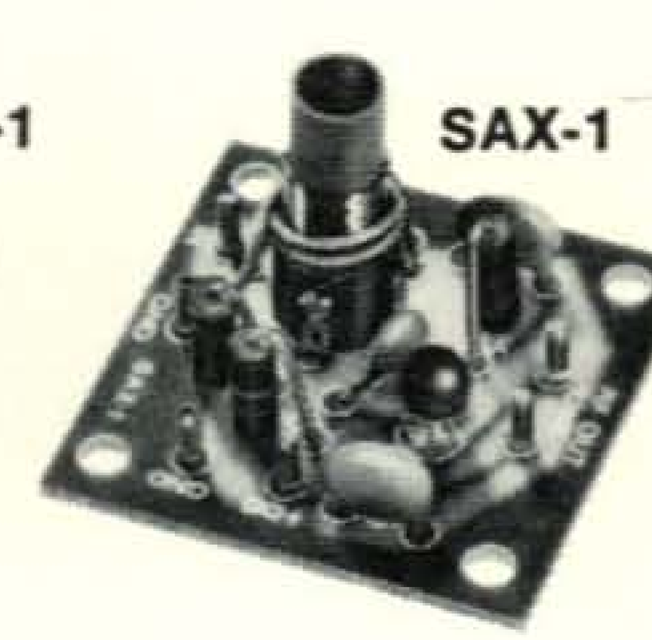

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FIELD EFFECT TRANSISTORS

BY MALCOLM M. BIBBY,* GW3NJY

Part II

Part II of this two part series covers FET characteristics, biasing, circuit configurations, dual gate FET's and FET applications.

In order to work with FET's effectively the parameters used by the manufacturers must be understood and are covered below.

Device Characteristics

For depletion mode FETS the manufacturer will refer to three parameters. These are (1) pinch-off voltage, V_p, (2) the zero-bias drain current, I_{DSS} (3) the zero-bias forward transconductance, g_{mo} or Y_{fso}. These can be shown to be related by equation (1):

$$g_{mo} = \frac{2\,I_{DSS}}{V_p} \qquad (1)$$

A simple circuit is shown in fig. 9 for measuring g_{mo} and I_{DSS}. The best method for determining V_p is to construct a graph of the square root of the drain current versus gate voltage. This graph is essentially a straight-line and the value of gate voltage when $I_D = 0$ gives a value for V_p. Figure 10 illustrates this measurement.

The relationship between drain current and gate voltage for depletion mode FETS is given by equation (2):

$$I_D = I_{DSS}\left(1 - \frac{V_{gs}}{V_p}\right)^2 \qquad (2)$$

where V_{gs} = gate-source bias voltage.
I_D = drain current at V_{gs}.
I_{DSS} = drain current at $V_{gs} = 0$.
V_p = pinch-off voltage.

*2748 Juno Place, Akron, Ohio 44313.

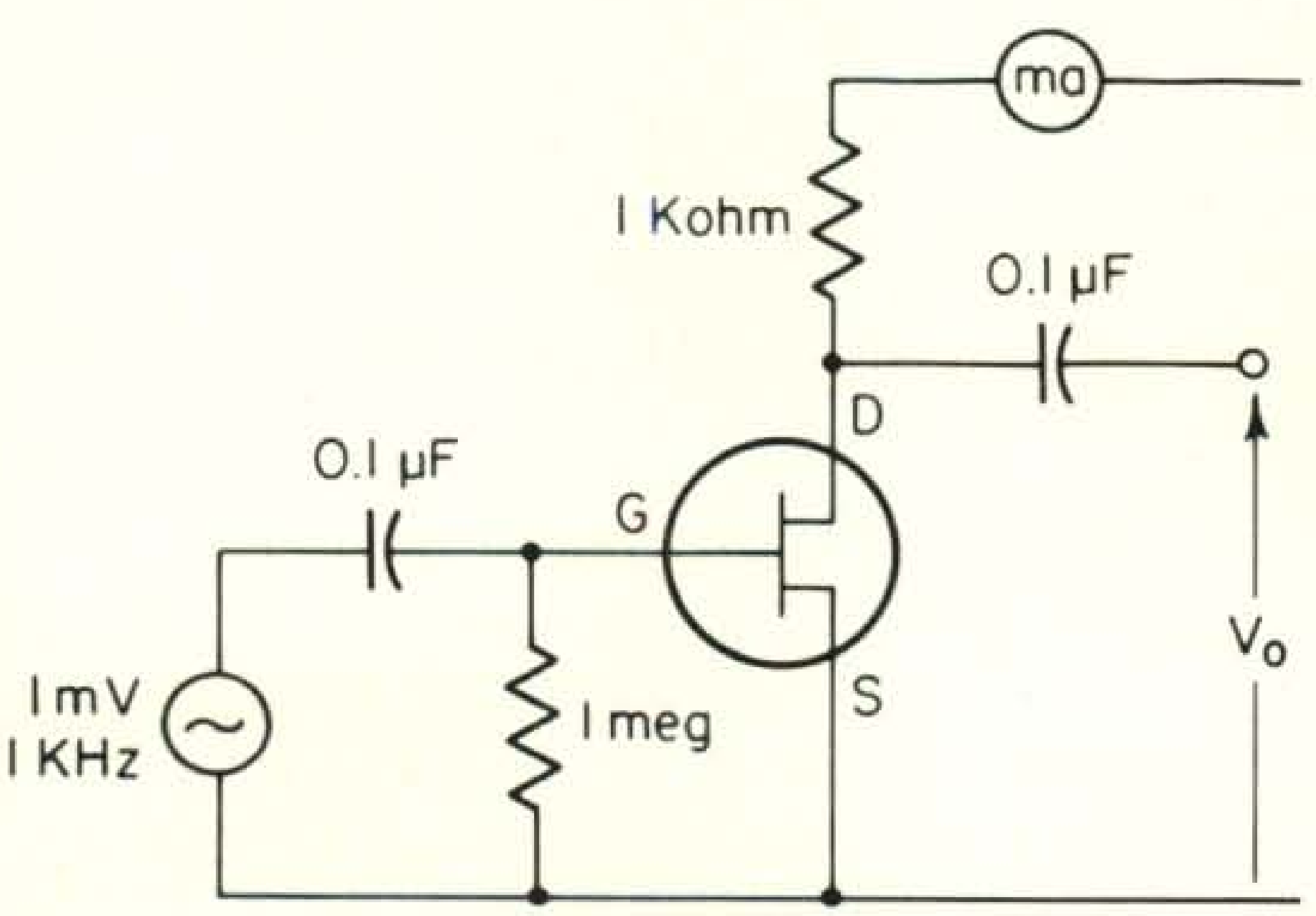

Fig. 9—A simple circuit for measuring gmo and IDDS. The a.c. voltage, Vo, in millivolts equals the gmo of the device expressed in ma/volt.

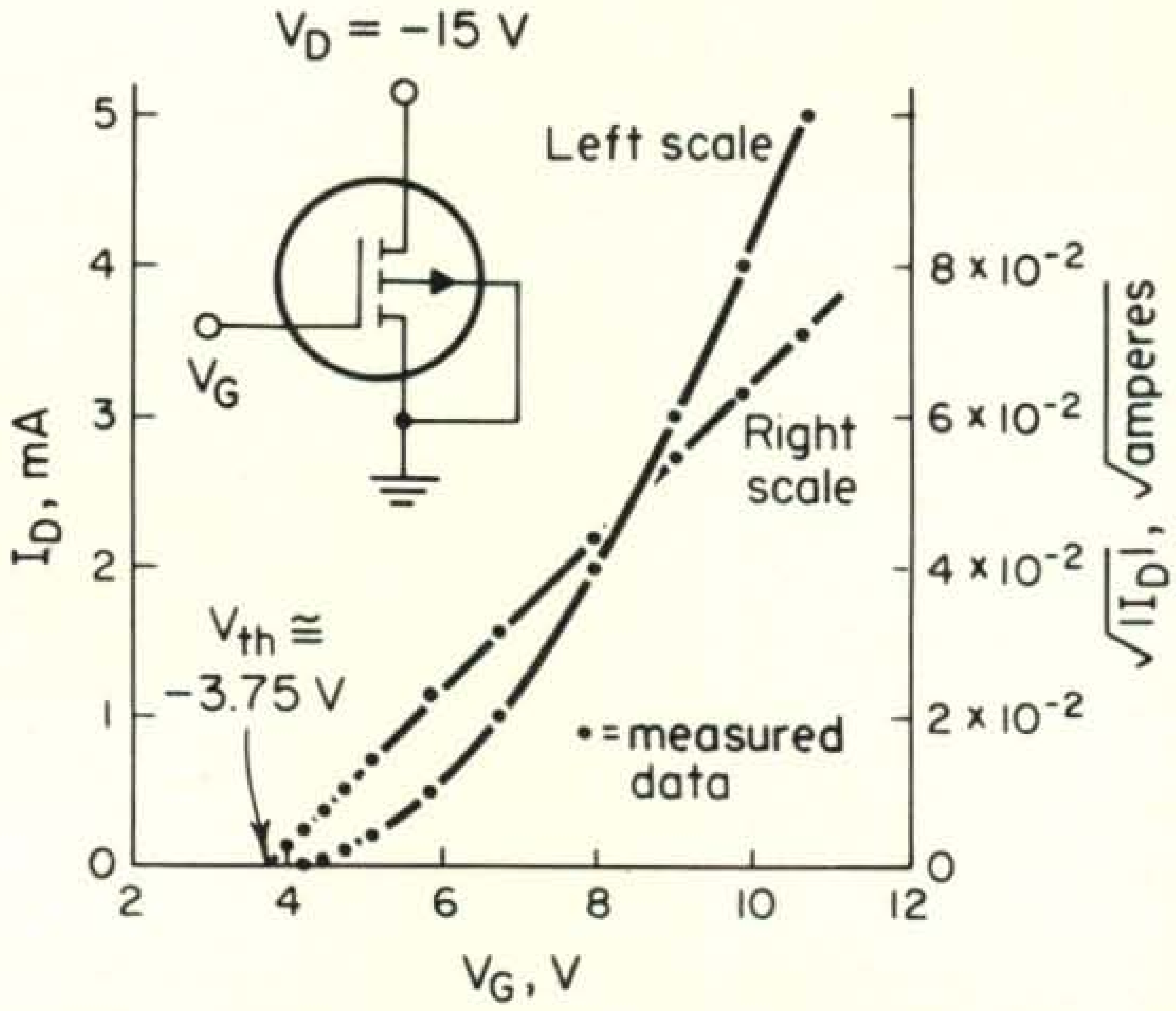

Fig. 10—Here the threshold voltage of a P-channel enhancement IGFET is determined. A similar graph for a depletion mode device would provide Vp.

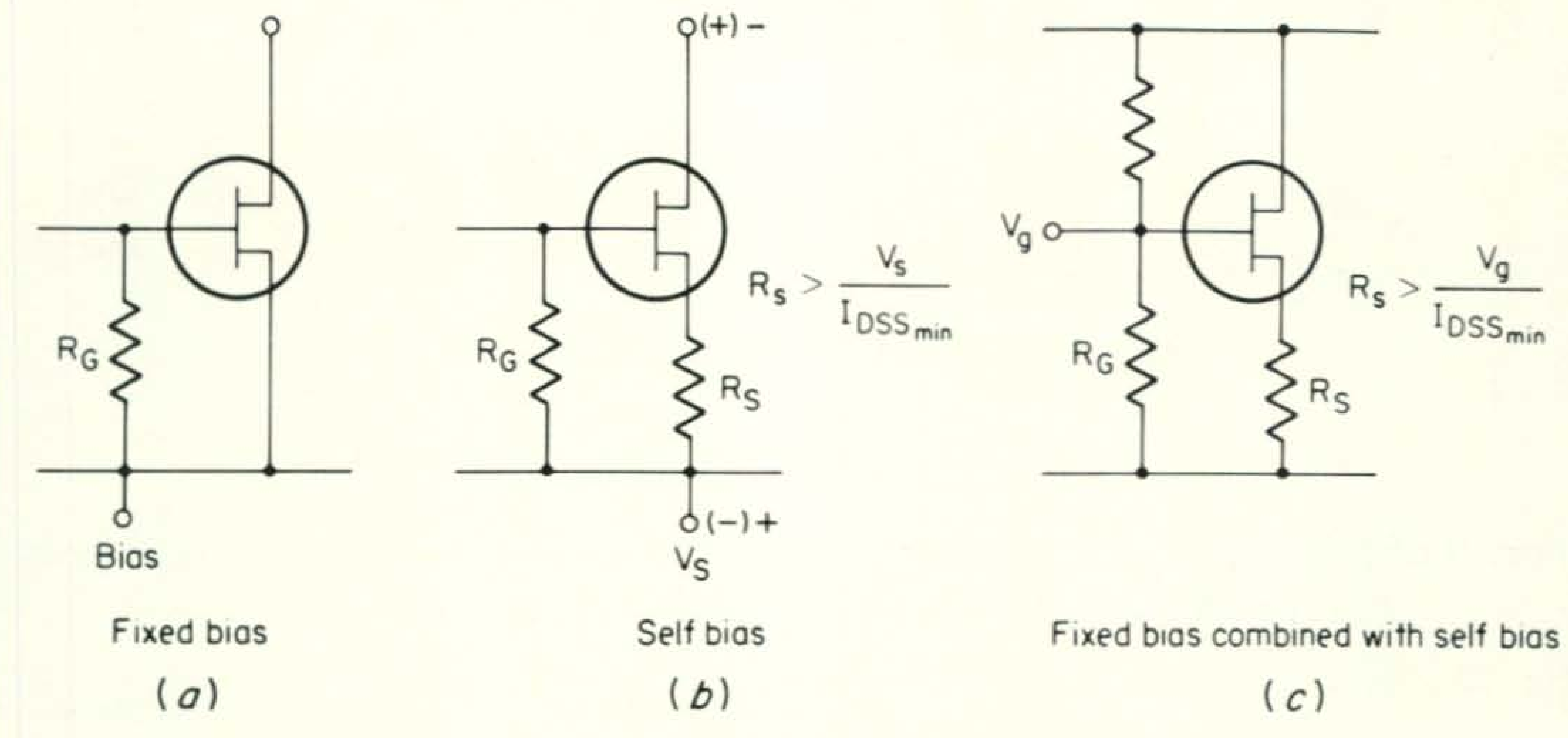

Fig. 11—The three basic methods of biasing FET's.

This equation is a very good approximation to reality and is one reason for preferring FET's in mixer circuits where a 'second-order' device is essential.

Due to an inability to control the FET manufacturing process as closely as they desire, manufacturers of FET devices will quote a fairly large range in their device specifications. These should be carefully noted, as they effect such things as gain, bias point and even cross-modulation performance.

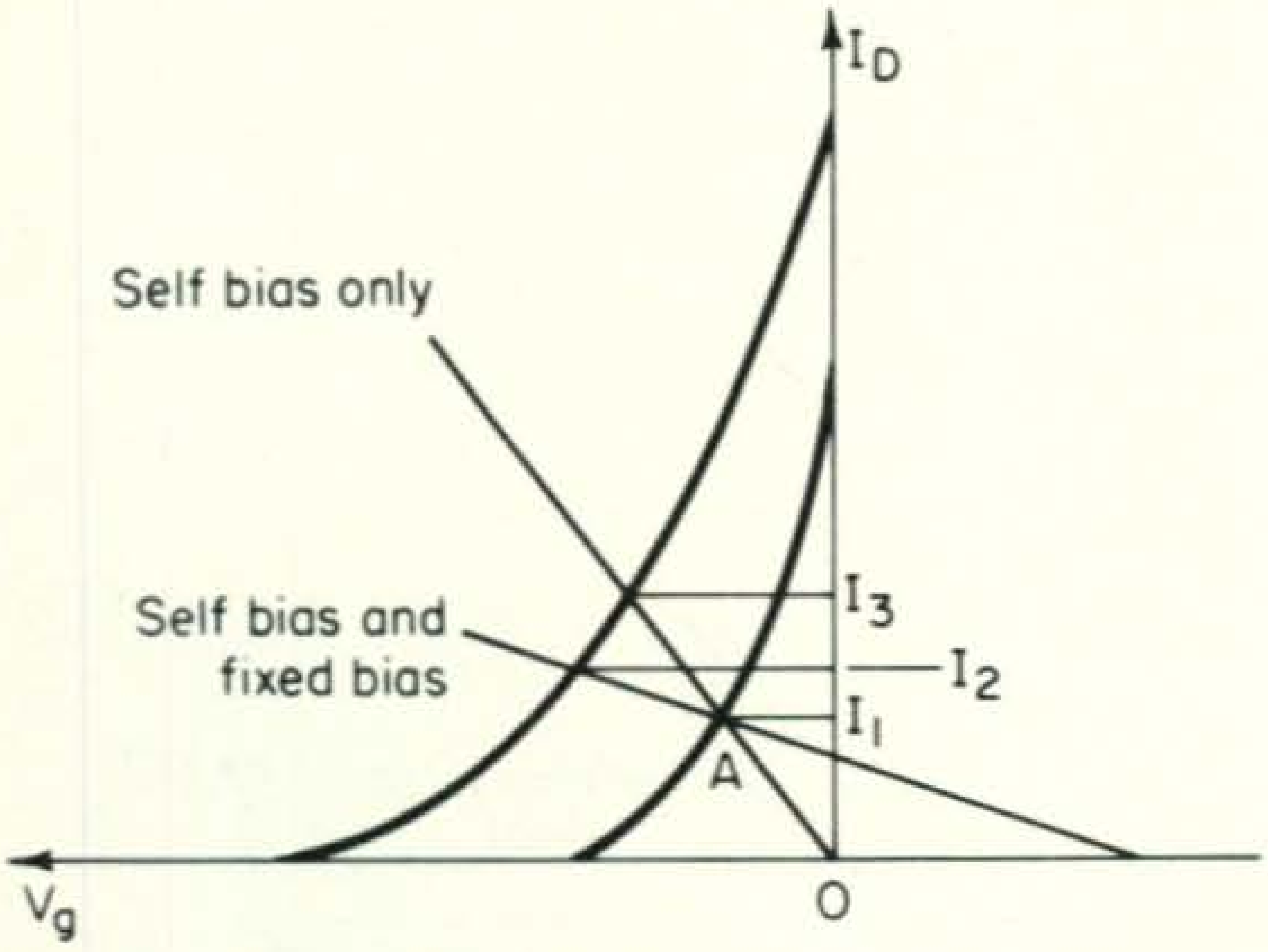

Fig. 12—By using a combination of self and fixed bias the spread in drain current for different devices can be reduced. In the above diagram the bias circuitry is designed around point A. The reduction of the drain current (I_3 to I_2) for another FET is easily seen.

Biasing The FET

In fig. 11 we see the three possible bias circuits for use with a FET operating in the depletion mode. Circuit (A) is well known; circuit (B) is useful in source followers, source coupled amplifiers, *etc.;* notice there is a minimum value for *R*s. Circuit (C) is again useful in source follower circuits and is often used in commercial circuitry to overcome difficulties brought about by the spread in the FET parameters. This result can be understood by referring to fig. 12. Here the value of *R*s was adjusted to the desired operating point, A, on the lower curve. However in practice an FET with a characteristic similar to the upper curve may be used in which case a different drain current flows. The difference in drain currents, and hence device dissipation, can be seen to be reduced when a combination of fixed and self bias is employed. To bias an enhancement mode FET either circuit (B) or circuit (C) of fig. 11 must be used.

Usage Classification Of FET's

Switching Applications—FETS in this category are for use in choppers, multiplexing circuits, phase detectors, *etc*. Their features are high off-to-on resistance ratios and low feedthrough capacitance. They can also be used as voltage controlled attenuators.

General Purpose Amplifiers—These are FET's primarily designed for amplification

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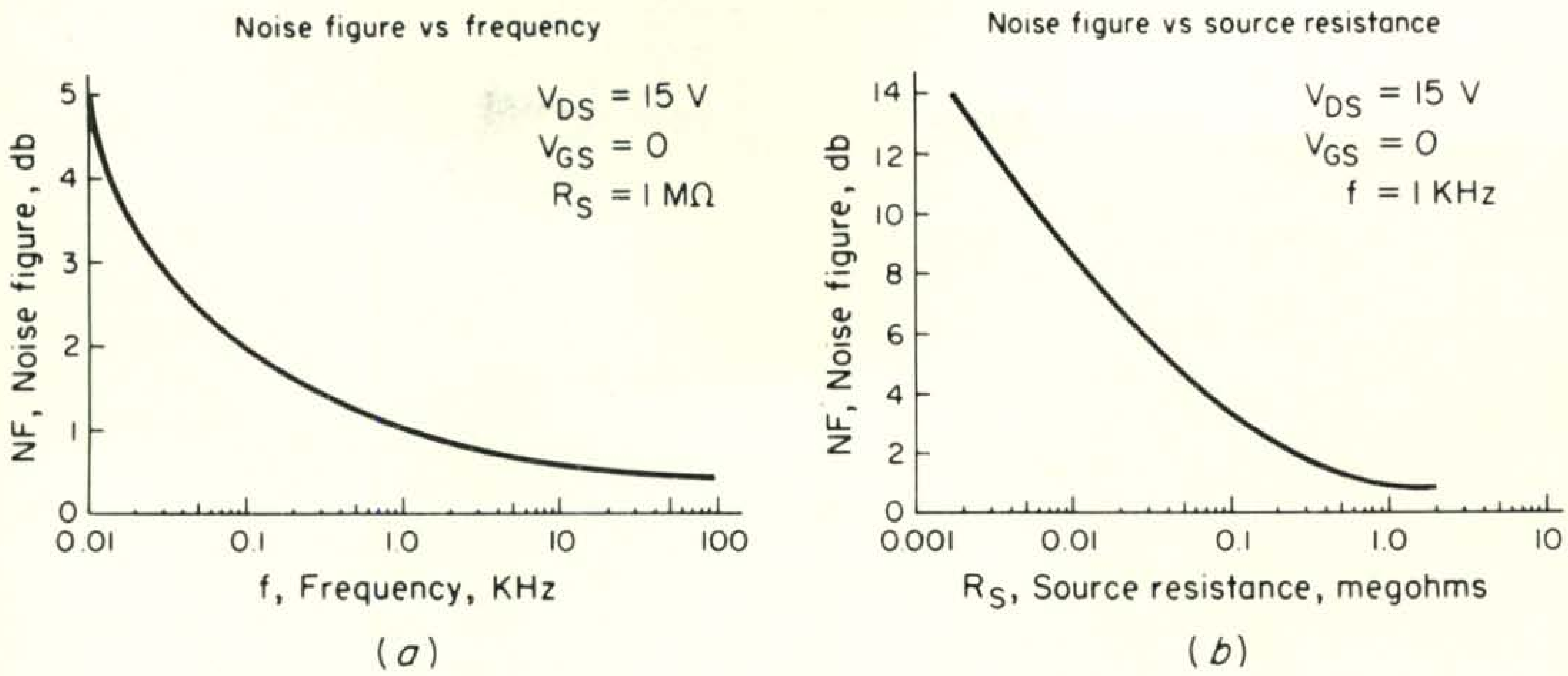

Fig. 13—The Motorola 2N4222 JFET illustrates the excellent l.f. noise performance of modern FET's.

from d.c. to 1 mc. They feature low noise figures with high input impedances as shown in fig. 13. Intermodulation products are smaller than those found in corresponding bipolar circuits. They also have a much lower 'corner frequency' than do bipolar transistors, *i.e.* the low frequency response extends to lower frequencies before the noise figure begins to seriously deteriorate. This makes them very useful for input stages in a.f. amplifiers.

High-Frequency Amplifiers—FET's in this category are designed for use above about 1 mc and are used as oscillators, mixers, u.h.f. amplifiers, *etc.* Because of the square-law characteristic the cross-modulation performance is at least an order of magnitude better than those of bipolar transistors and is often an improvement over vacuum-tube circuits. For best noise performance at v.h.f. the optimum source impedance drops from the 1 megohm of the general purpose amplifier to around 1 K at 30 mc and above. Reverse capacitance is critical in high frequency amplifier design; for stability requirements this capacitance should always be minimized.

Dual-Gate FET's

These devices developed from considerations of the well known cascade configuration and its ability to reduce the effects of the reverse (or feedback) capacitance alluded to

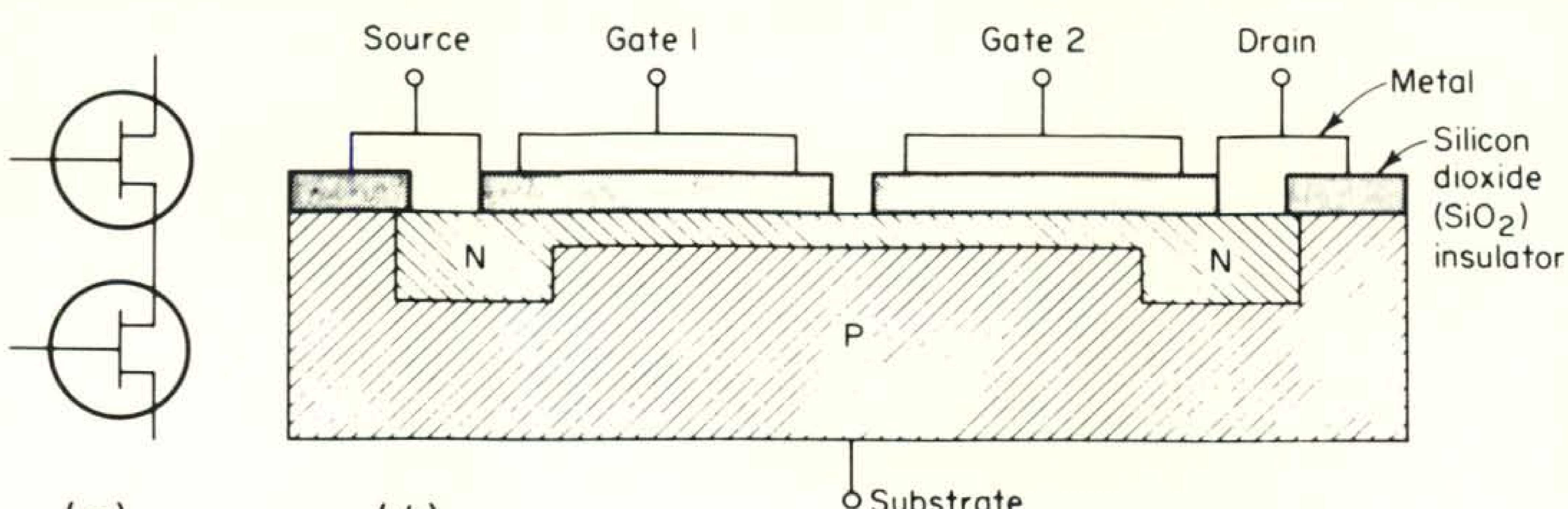

Fig. 14—The well-known "cascade" circuit (A), is 'integrated' to form the 'dual gate' IGFET shown in (B).

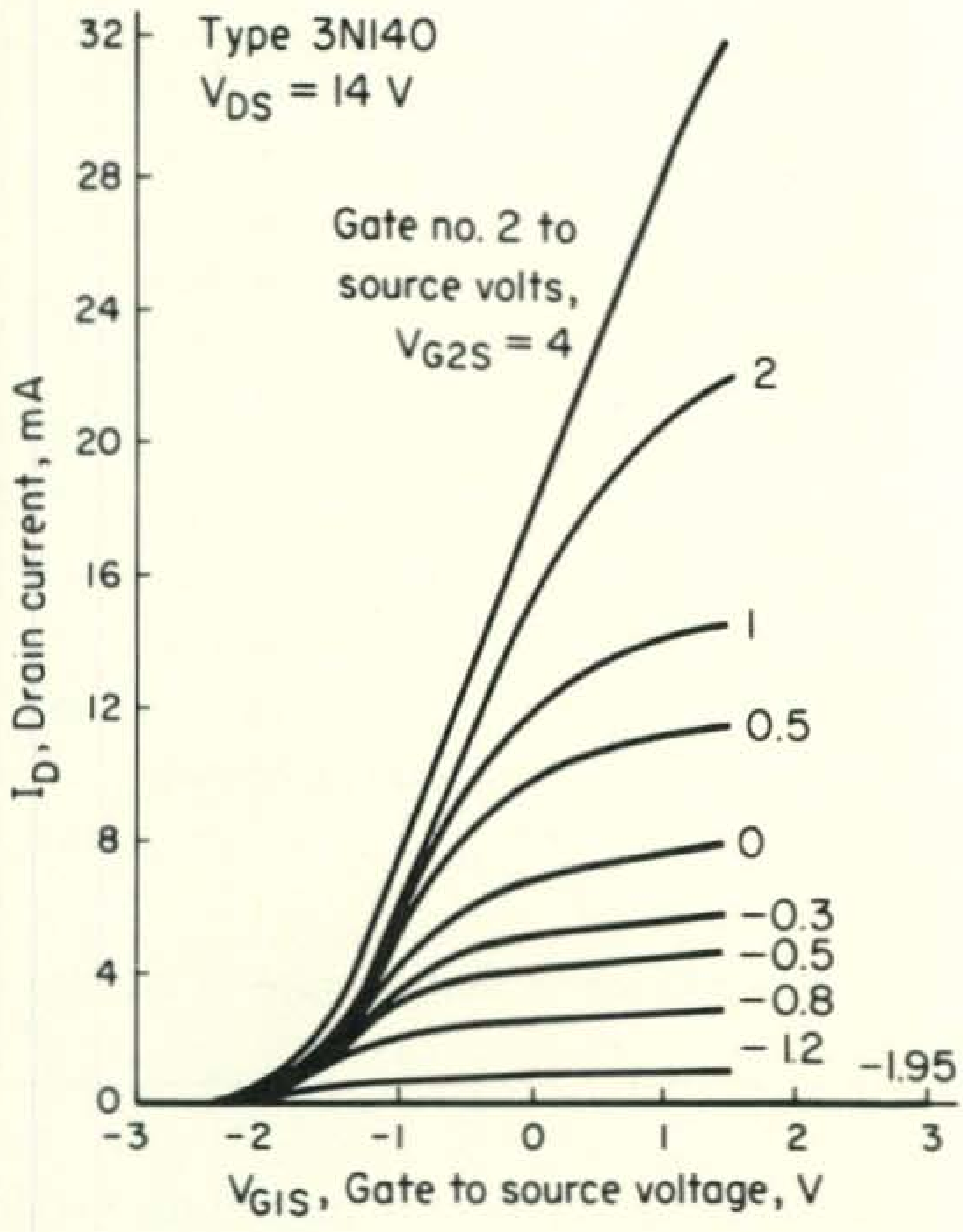

Fig. 15—Transfer characteristics of the RCA-3N140 dual-gate MOS field-effect transistor.

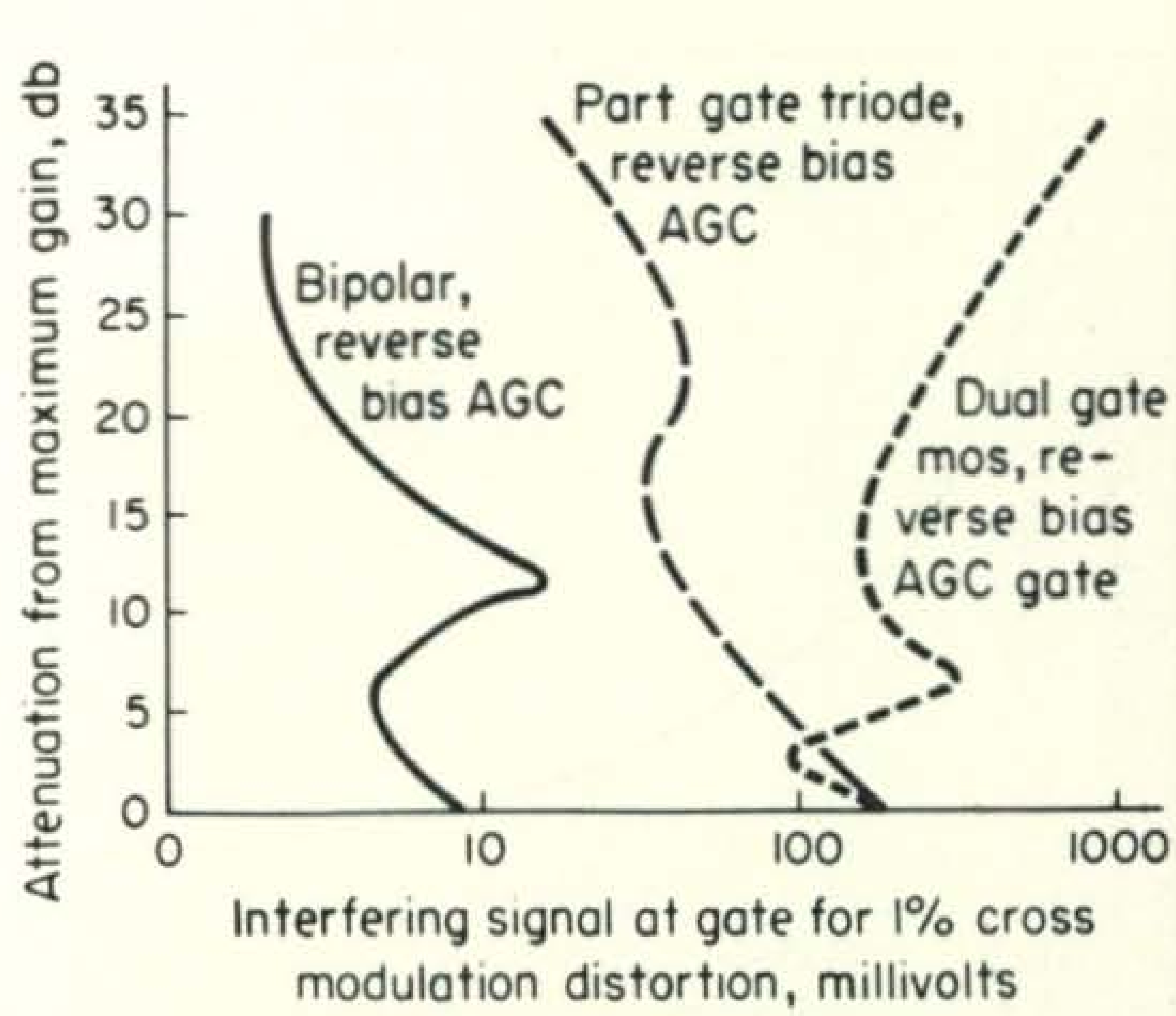

Fig. 16—These curves indicate that an interfering signal of greater than 100 mv can be tolerated over most of the 35 db attenuation range shown.

earlier. The two FET's in the cascade circuit of fig. 14 (A) were replaced by the one dual-gate FET whose structure is shown in fig. 14 (B). As Gate 2 operates at a.c. ground the feedthrough capacitance from the drain to gate 1 will be greatly reduced compared with the single gate variety. The most readily available dual-gate FET at present is the N-channel depletion mode MOSFET. A typical set of curves is shown in fig. 15.

Most manufacturers agree that the dual-gate device has the best cross-modulation capabilities (or more precisely the greatest ability for *avoiding* cross-modulation.). RCA has published a number of application notes to get this fact over. Figure 16 compares the performance of the bipolar transistor, a single gate FET and a dual-gate FET.

FET Amplifier Design

The three different modes of FET operation are indicated in fig. 17.

The Common Source Amplifier–In the common source configuration of fig. 17(A) the FET can exhibit high input impedance, high gain and a low noise figure. High generator and load impedances are required by the device for high gain. Both JFET and MOSFET single gate devices exhibit potential instability at r.f. in this mode although unconditional stability is possible with the dual gate cascade structure. Thus it is almost always necessary to employ some form of

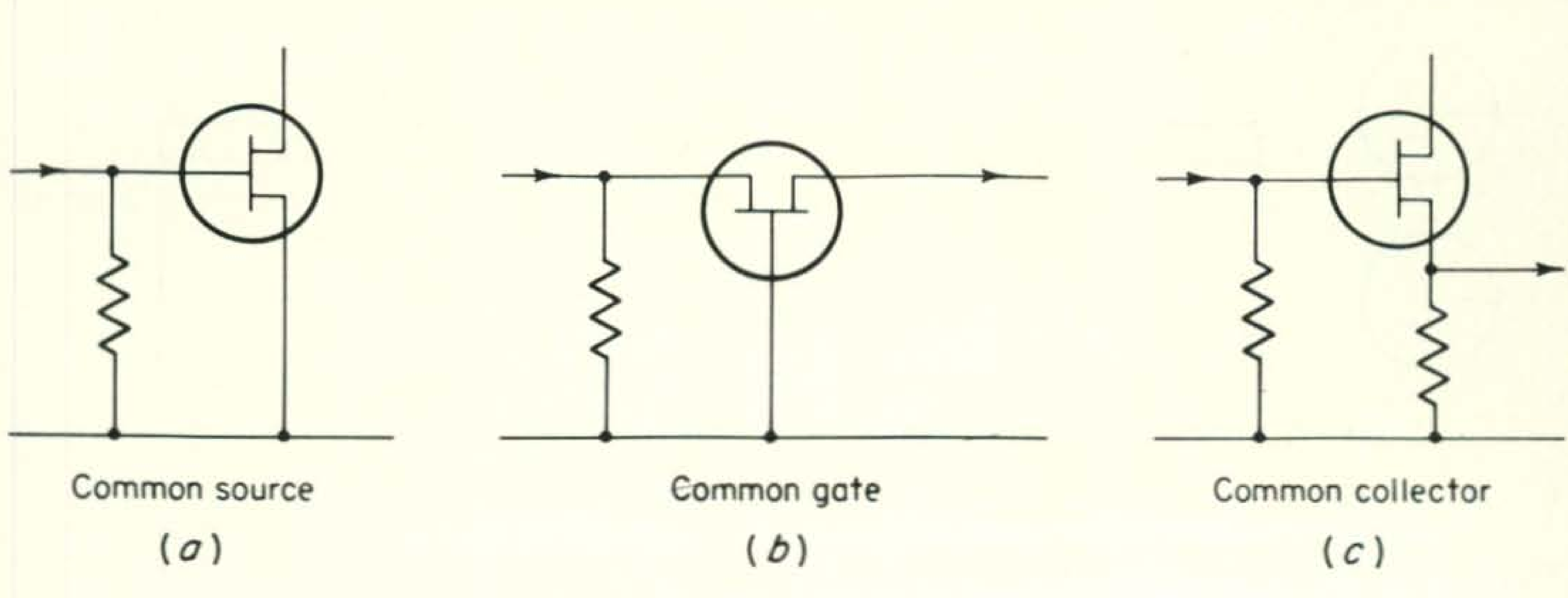

Fig. 17—The three basic modes of FET operation.

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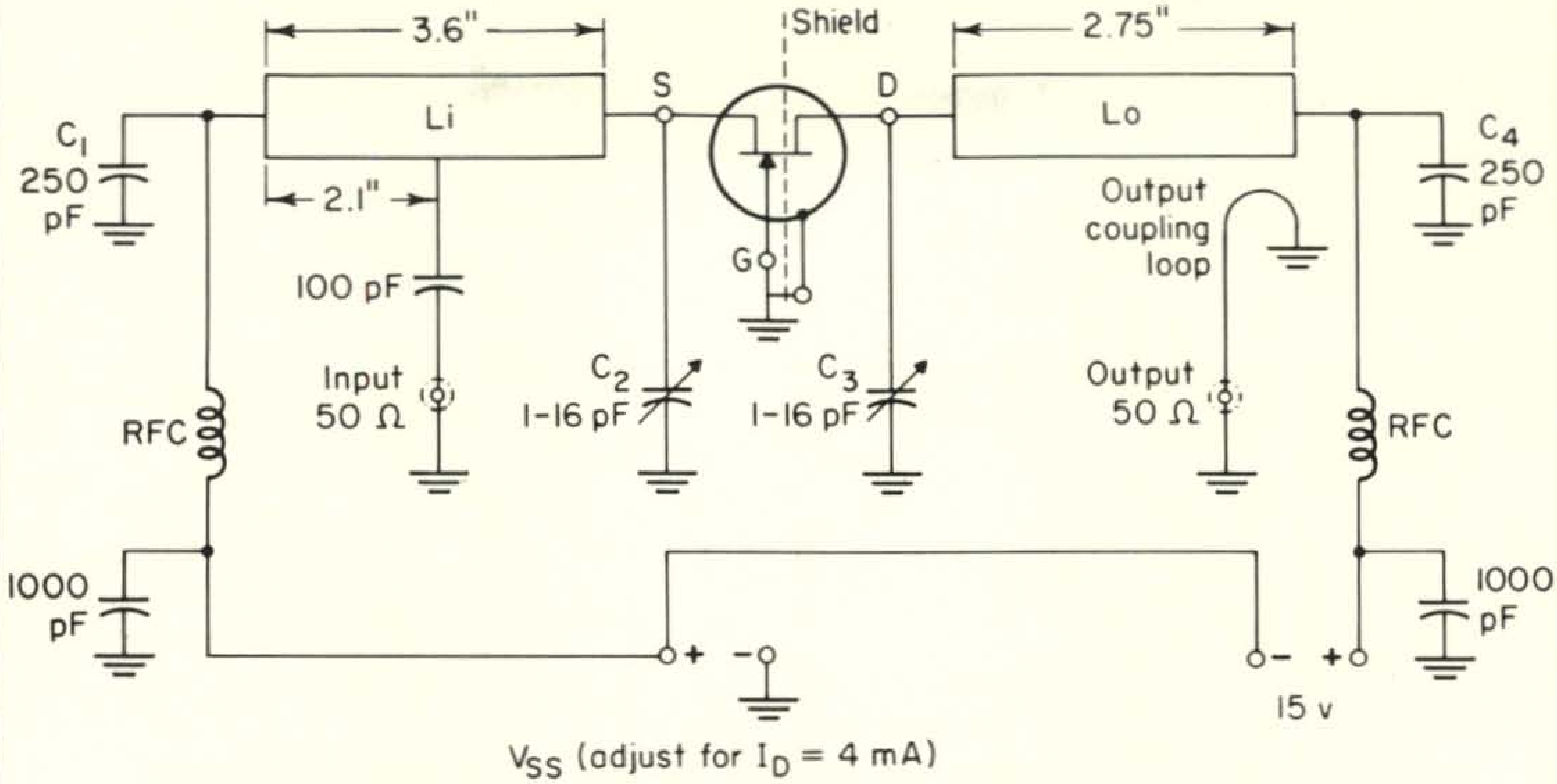


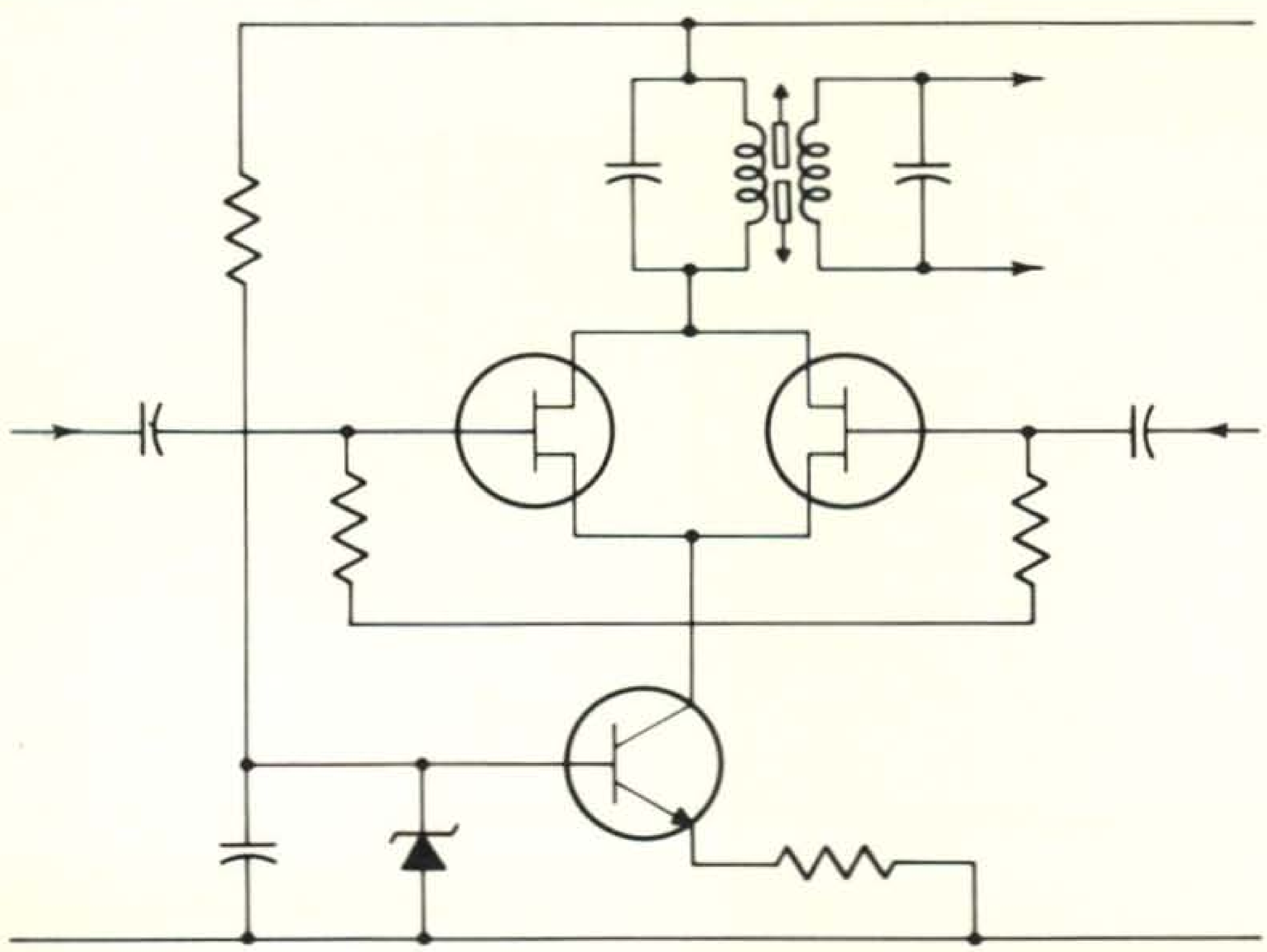
Fig. 18—A circuit suggested by Texas Instruments using their 2N3823 FET.

neutralization or to heavily load the input and output circuits to obtain a stable common source amplifier at r.f.

The Common Gate Amplifier—In the common gate configuration of fig 17(B) the FET exhibits low input impedance, high gain, high output impedance and noise performance comparable to that of the common source mode. Due to the low reverse transadmittance (feedthrough capacitance) in this configuration the circuit will often be found to be unconditionally stable. This configuration deserves more attention by amateurs for use in front end r.f. amplifiers because of its superior stability properties.

The Common Drain Amplifier—In the common drain configuration of fig. 17(C) the FET exhibits high input impedance and low output impedance making it useful as an impedance converter. At low frequencies the circuit power gain can be very high but when operated at r.f. the device gain drops considerably. The circuit is also potentially unstable.

Fig. 19—A double-balanced mixer circuit capable of low spurious output. This circuit is designed for N-channel depletion-mode devices.



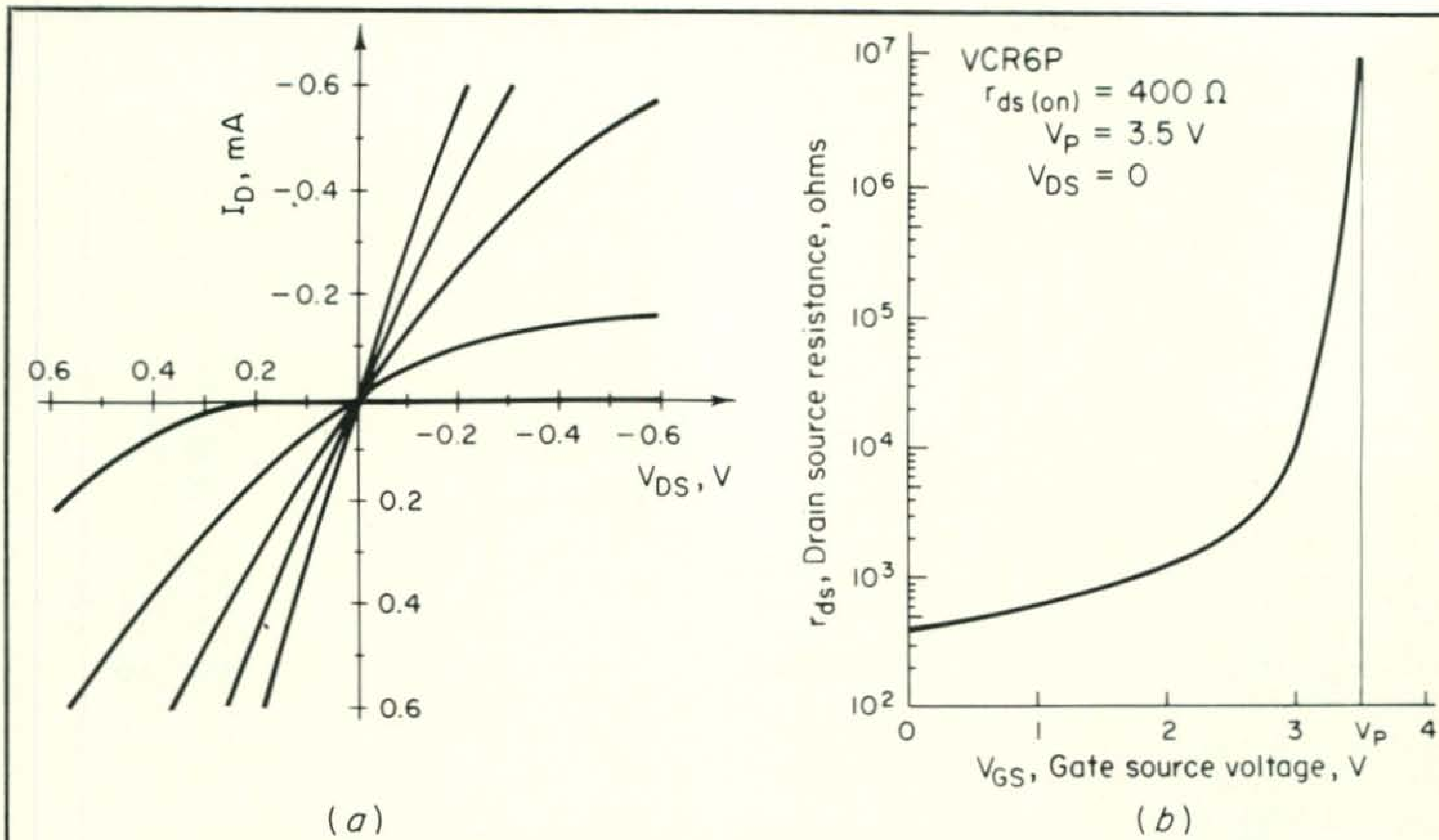


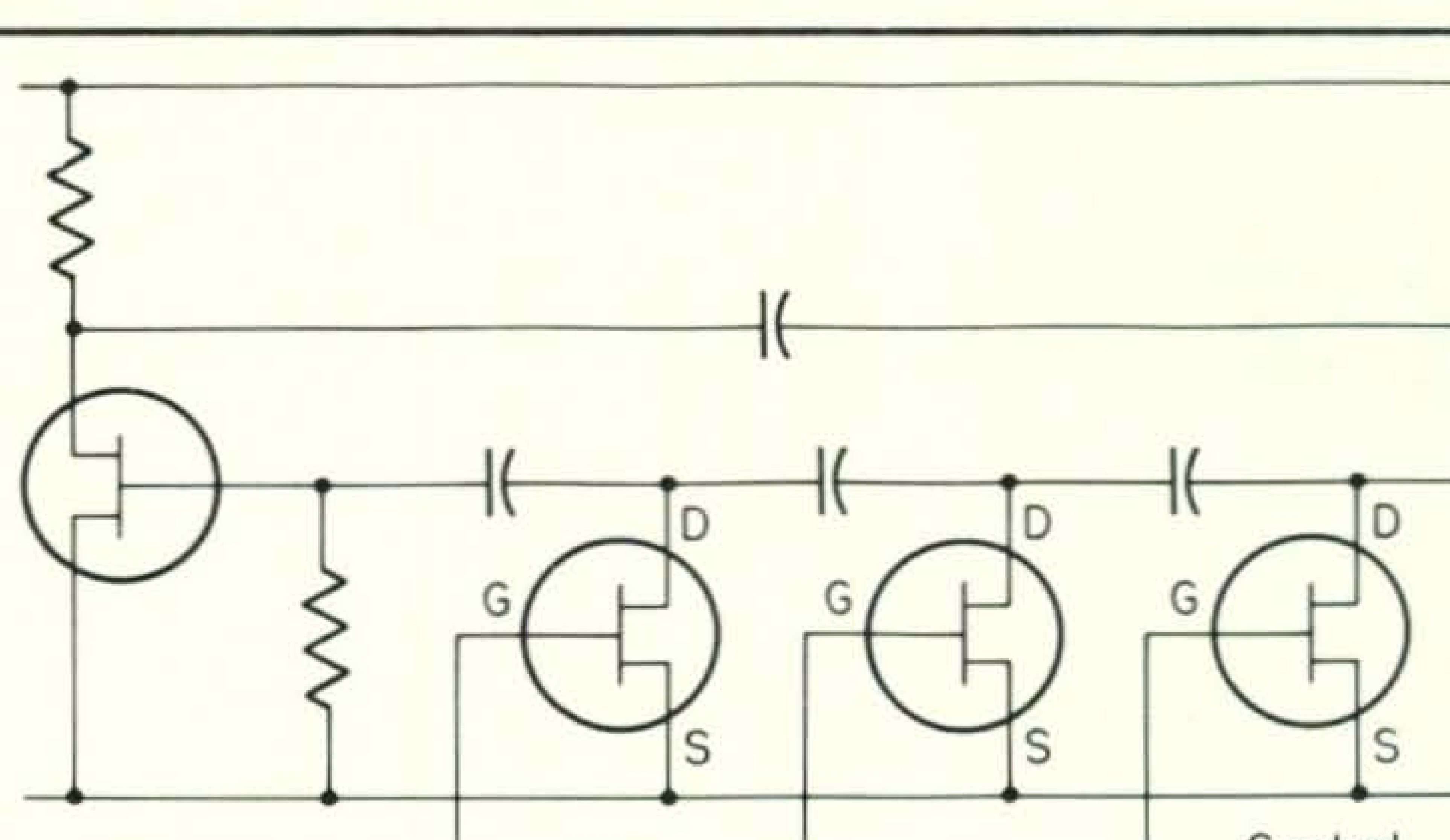
Fig. 20—These two diagrams depict the behavior of FET's as voltage controlled resistors.

Examples Of FET Circuits

432 mc Grounded Gate Amplifier—A Texas Instruments application note illustrates the use of the 2N3823 in a u.h.f. amplifier circuit which typically provides 11 db power gain and a 4.5 db N.F. The circuit is shown in fig. 18. This circuit is unconditionally stable provided there is a minimum of coupling between the output and input circuitry. Better performance could be obtained with the newer TIS88 and 2N4416's but these devices are not unconditionally stable and would require some neutralization. Alternatively the input/output circuits could be loaded if the consequent gain reduction would be acceptable.

Double Balanced Mixer—The circuit for a double balanced mixer using FET devices is shown in fig. 19. This will be recognized as a form of the 'long-tail pair' amplifier. The FET drains are connected together with the result that the input signals to either gate will cancel in the drain circuit as will all odd harmonics. However the sum and different frequencies (*i.e.* the i.f. signal) will add and are selected by the tuning of the i.f. transformer circuit. This circuit could find wide application in receivers as the spurious outputs are of a very low magnitude. The bias circuitry ensures that the FET's are not forwarded biased. The total drain currents can be ad-

Fig. 21—The outline details of a voltage controlled phase shift oscillator. For maximum stability the control FET's should be operated so that rds is fairly low.



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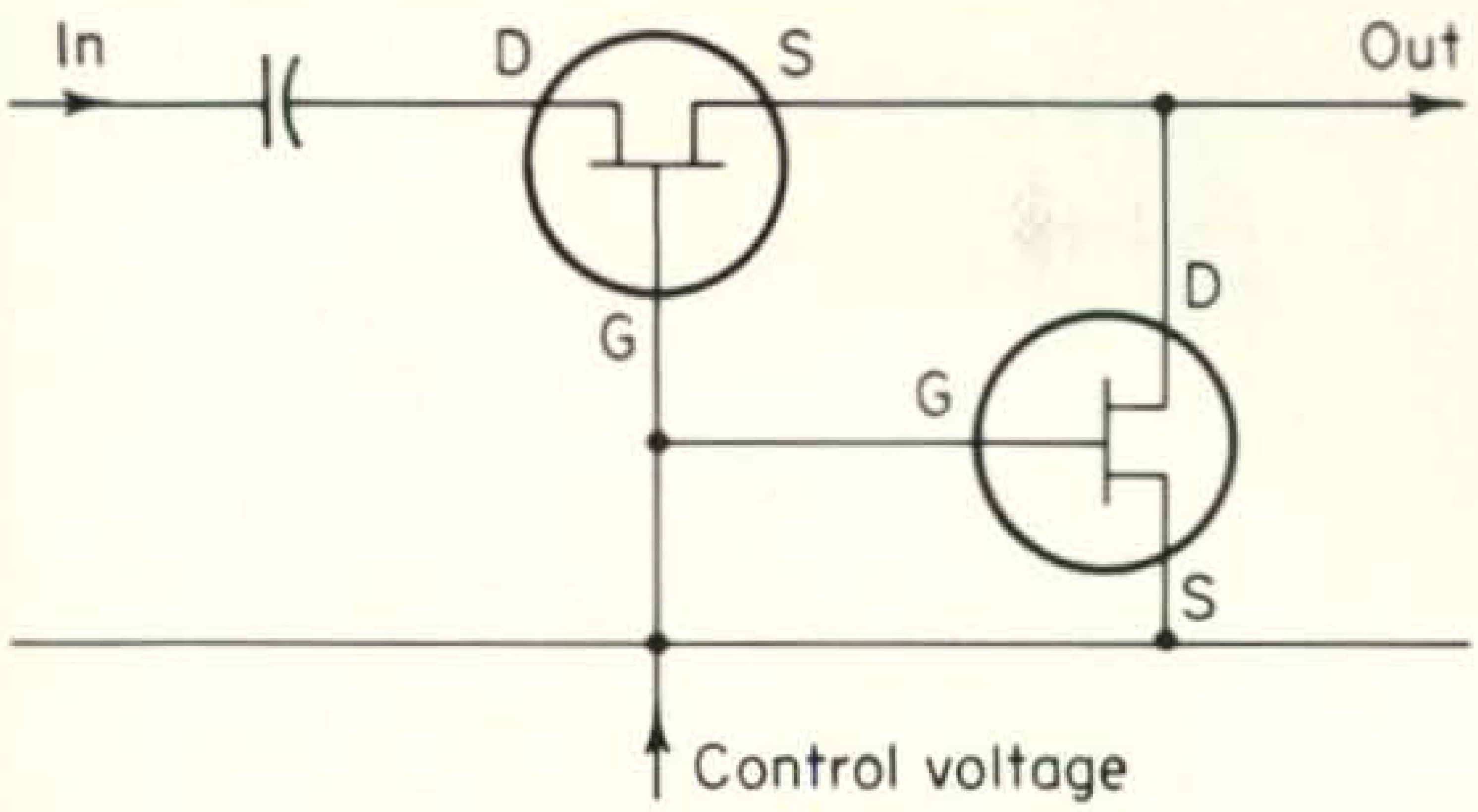

Fig. 22—This circuit, for use with compressors, should be fed from a low impedance source (i.e. a source follower) and fed into a high impedance circuit for optimum results.

justed by varying the value of the resistor in the transistor emitter circuit.

Voltage Controlled Resistors—All FET's can be employed as voltage controlled resistors and Siliconix in particular has developed a line especially suited to this application. Figure 20(A) illustrates the behaviour of a P-channel depletion mode around $V_{DS} = 0$. The curves are almost symmetrical, the result of the interchangeability of the drain and source. The slope of each curve represents the a.c. resistance at that particular bias voltage. Figure 20(B) shows how the drain-source resistance might vary with bias voltage. The drain-gate and gate-source must never be forward biased so that there is a limitation on the maximum a.c. voltage that can be applied across an FET, in the order of 600 millivolts. In fast if the FET must not distort the a.c. waveform then the input voltage should be kept below 50-100 millivolts due to the non-linearity of the $r_{ds}-V_{gs}$ curve.

These devices have applications in two interesting areas: voltage controlled phase shifters and voltage controlled attenuators. The outline details of two such circuits are shown in fig. 21 and fig 22. The phase shift oscillator of fig. 21 is immediately recognizable; the use of the voltage controlled FET's does away with the need for ganged potentiometers. The attenuator circuit in fig. 22 has applications in audio compressors. The series FET should be an N-channel depletion type and the shunt FET a P-channel enhancement type, so that when a negative voltage is applied to the gates the attenuation of the circuit is increased due to the r_{DS} increase of the series FET and the r_{DS} decrease of the shunt FET. Each device should be capable of 40 db attenuation; thus the circuit should provide 80 db total attenuation range. ■

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AN S-METER FOR THE SB-34

BY F. HELMUTH PEDERSEN,* OZ6LI

ACCORDING to an article on the SB-34 by John Schultz in the September 1968 issue of *CQ*,[1] an additional feature for this transceiver would be to use the incorporated meter for an S-meter. It was suggested that a relay would have to be used to switch the meter back and forth when changing from receiver to transmit.

I would like to contribute a method of adding an S-meter to the SB-34 that does not require a relay but merely a transistor and a few components. After the modification the meter will automatically show signal strength on receive and relative output when transmitting. The ANT-IP switch will work normally and the S-meter operates in the ANT position.

As shown in fig. 1, the drive to the S-meter transistor (OC1) is derived from the a.g.c. line. The OC71 acts as an S-meter amplifier and serves to isolate the low meter impedance from the relatively high impedance a.g.c. line.

The ECO1303 is a 3 volt low power zener diode and almost any type can be used. It serves to stabilize the OC71 S-meter amplifier.

The OA70 (or any similar diode) is added to prevent the S-meter amplifier collector current from flowing through the diode, *CR*22, a part of the relative power output meter circuit.

Drift

The presence of an S-meter in the SB-34 made it apparent that a certain amount of drift was occurring. The drift was due to the high temperatures generated by the use of tubes. The drift in the collector current of Q_3 can be neutralized by adding a 4.7K resistor in series with a negative temperature coefficient resistor of 10K ohms. The one used here is a Siemens R51-4/1/20, which drops to about 100 ohms when hot, but most other types will work as well. If a different type is used the value of the series resistor will have to be determined by trial and error. The value arrived at should assure that no drift will occur because of a temperature rise in the equipment. If the compensating resistor is placed above the printed board, a unit with a smaller rate of change should be used.

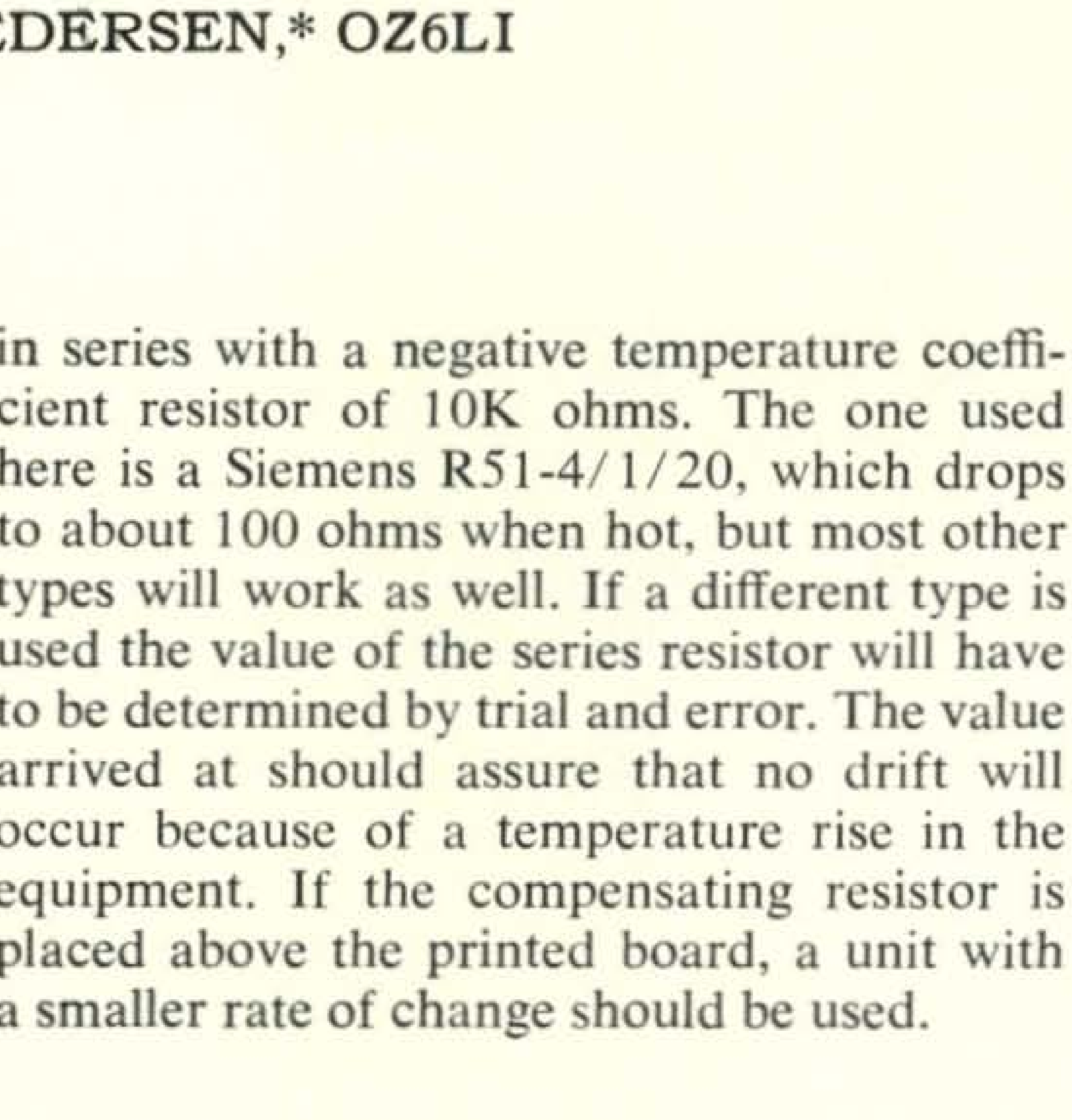

Fig. 1—Circuit showing the added components and wires (in color) to permit the existing meter of the SB-34 to show received signal strength. The OC71 is a PNP type of medium gain rated at 225 mw. A 2N1414 will substitute nicely. The AO70 can be replaced with a 1N295 or a 1N60. The ECO1303 is a 3 volt low power zener diode.

*Stenjerparken 2C, 6400 Sonderborg, Denmark.

[1]Schultz, J., "The SB-34 Transceiver, Expanded Coverage and Convenience," *CQ*, September 1968, p. 57.

A variable resistor should also be connected in series with a 68K resistor to the base of Q_3. The 50K pot should then be adjusted so that Q_3 draws current immediately on the application of audio from the loudspeaker, through the 6.8K to the base.

If Q_3 is replaced by a Texas Instrument 2N696 a slightly better a.g.c. action may be realized.

Modification

All components except the 4.7K resistor and the negative temperature coefficient resistor can be mounted on a small homebrewed printed circuit board placed perpendicular to the r.f. board and soldered in place. The 4.7K resistor and the temperature sensitive resistor should be located in the vicinity of Q_3.

Adjustments

To adjust the circuit tune the receiver to the 21 mc range and advance the A.F. GAIN control one third (clockwise). Be sure that no signals are tuned in and the circuit is not resonant. The 50K variable in the base of Q_3 is adjusted so that the S-meter reads zero under these conditions.

After this adjustment the receiver should be tuned up normally on 21 or 14 mc and advancing the A.F. GAIN will cause agitation of the S-meter due to background noise. For any accuracy in the measurement of signal strength the A.F.GAIN should always be set at this point. where noise agitation of the S-meter, particularly for signal strength reports.

After this, a very strong broadcast station should cause full scale deflection. If the deflection is not correct, adjustment of the 560 ohm emitter resistor may be tried to obtain close to full scale reading. The S-meter may be calibrated in the usual manner or a conversion chart may be drawn up with S-readings versus the existing scale. ■

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A GREAT BUY FROM ARROW —

THE GALAXY GT-550 TRANSCEIVER

TRANSMITTER: 550 watts PEP–SSB, 360 watts CW. Manual keying for SSB/CW, or VOX operation with accessory installed. Also, break-in CW with accessory VOX installed. Built-in audio side-tone for CW monitoring through speaker or headphones. Selectible sideband without 2 kHz jump when changing sidebands. Shifted carrier CW to prevent "leap-frogging" with another transceiver. Stable, −45DB carrier suppression. Unwanted sideband suppressed over −55DB. Sharp, 2.1 kHz filter with better than 1.8:1 shape factor. ALC circuitry automatically reduces gain level to prevent "flat-topping." High impedance microphone circuit (use −50/60 DB microphones) with PTT control circuit. Audio Response @ −6DB points approximately 300 and 2400 Hz. Adjustable Pi-Network antenna matching for resonant 40/100 Ohm loads.

RECEIVING: Nominal 50 Ohm input with relay control for antenna switching. Preselection coupled to exciter tuning. Sensitivity better than ½ uv for 10 DB S+N/N ratio. Selectivity 2.1 kHz with same, outstanding 1.8:1 shape factor for SSB/CW, or 300 Hz sharp selectivity with optional plug-in CW filter. Full AGC on receive modes with fast attack and slow release characteristic. Nominal 1 watt audio output with −6 DB points @ 300/2400 Hz. External 8 Ohm speaker required.

FREQUENCY COVERAGE: Crystals supplied for 3.5-4.0, 7.0-7.5, 14.0-14.5, 21.0-21.5, 28.0-29.0 mHz. Optional crystals may be installed for other 10 meter coverage. A solid-state VFO operates, without switching, in the range of 5.0-5.5 mHz at all times. Double regulation and temperature compensation makes this VFO extremely stable. An illuminated dial with over 12 inches of linear bandspread. Primary dial calibration marks of 5 kHz. Smooth vernier dial provides 72:1 vernier tuning for ease of operation.

BACK PANEL CONTROLS: Bias Adjust. "S" meter zero.

BACK PANEL JACKS: Antenna • CW Filter (three jacks) • PTT • External VFO (Power) • External VFO (RF in) • ALC (Input) • EXT. (For Linear keying) • Microphone • Power Plug (From AC-400 or G1000DC) • Key (For CW operation) • Speaker.

SIDE ACCESS CONTROLS: VOX Gain • VOX Hold Time • Anti VOX.

FINISH: Cabinet in mar-resistant black crackle finish. Front panel in two-tone brushed aluminum.

SIZE: 6" x 11¼" x 12½" (HWD)

WEIGHT: 17 pounds.

$475.00

R.F. CONSOLE RF550

The **RF550** contains a precision wattmeter with a high degree of accuracy in the range of 3.5/30.0 mHz. Calibrated scales are 400 and 4,000 watts full scale, switch selected for forward or reflected power. Also contains a switch to select 5 antennas plus a dummy load (not supplied), and all unused connections are grounded. SO239 coax-connectors. Approx. 7x7¼x6½" (HWD). Weight 5½ pounds.

$69.00

SPEAKER CONSOLE SC550

A matching speaker with headphone jack for the transceiver, complete with cable. AC400 power supply will mount inside the console. Size – approximately 6x10x9½", weight 6 lbs.

$ 25.00

REMOTE VFO RV550

A solid-state VFO like that in the transceiver, complete with simple plug-in cables. Function switch selects the remote unit to control Receive - Transceive - Transmit frequency independently. Gives about the same flexibility as a separate transmitter and a receiver with the GT-550. Approx. 7x7¼x6½". (HWD) Weight 4 lbs.

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Receiver Signal-Handling Capabilities

BY WILFRED M. SCHERER,* W2AEF

The most difficult receiver criteria to either explain or comprehend is ability to handle strong signals either on or off the tuned frequency of the receiver. Few standards for such measurements have been agreed upon, and even the best technicians admit to scant knowlege of the subject. The article below describes the various phenomena characterized as signal handling problems; next month's article will discuss measurement procedures.

RECEIVER characteristics such as sensitivity and selectivity are quite familiar, but when it comes to cross modulation, there appears to be misunderstandings as to just what this phenomenon is all about. This is particular so among amateur-radio operators, and often others as well, by whom "cross modulation," outside of inadequate selectivity, is blamed for almost any sort of interference or other effects from strong signals; whereas, the actual situation instead may be one of r.f. intermodulation, desensitization, blocking, spurious overload responses or a.g.c. takeover. These phenomena, as well as cross modulation, are characteristics of the *signal-handling capabilities of a receiver.*

We shall, therefore, attempt to clarify the picture by discussing these events, their associated effects and how they may be measured and related to a set of specifications for making comparative evaluations between different receivers.

Any discussion as to the causes for the various phenomena will be limited to generalities, one of which is that the signal-handling capabilities of a receiver mainly depend on the linearity of one or more of its amplifier or mixer stages in the presence of strong signals.

R. F. Intermodulation

We shall start off with r.f. intermodulation (I.M.), inasmuch as it usually is the first undesired event to which a receiver is susceptable and which also is the one least recognized as such by most operators. The I.M. characteristics also provide a relative indication as to the other probable side effects of non-linearity.

I.M. is caused by two signals of a sufficiently strong magnitude that produces odd-order distortion products which appear above and below the frequency of the two signals and at multiples of the frequency separation between the signals. For example: the r.f. intermodulation from two signals, one at 14355 kc and one at 14400 kc, could produce I.M. products at 45 kc intervals (14400−14355). The first interval will be 3rd-order I.M., the second will be the 5th-order, the third the 7th, etc.

For the case in point, a 3rd-order I.M. product could appear at 14445 kc (14400+45) and at 14310 kc (14355−45). If the signals that produced these I.M. products were teletype transmissions, they would be heard in the 20-meter amateur phone band at 14310 kc! Sounds sort of familiar, doesn't it?

Similarly, two strong signals in the amateur phone band, one at 14280 kc and one at 14300 kc, could produce 3rd-order I.M. signals in the receiver at 14260 and 14320 kc, while 5th-order products could show up at 14240 and 14340 kc.

It thus may be realized that two or more removed undesired signals of sufficient strength can be responsible for I.M. interference at a desired-signal frequency.

Where two undesired fundamental signals

*Technical Director, *CQ*.

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are a.m. transmissions, any I.M. signals caused thereby likewise will be that of the two a.m. signals heard superimposed on one another at the I.M.-product frequency. This is *not* cross modulation, it only *sounds* like it.

I.M. caused by two c.w. signals will appear as unreadable c.w. signals heard only when the key is simultaneously down on both the undesired-signal transmissions. One a.m. signal and one c.w. signal will produce I.M. products that show up as an a.m. signal intermittently heard at the rate and duration of the keying for the original c.w. signal.

The most interesting and often confusing effect of I.M. products is caused by s.s.b. signals, in which case the I.M. appears only as splatter or noise spread out 5-10 kc around each I.M.-product frequency. It is no wonder then that many amateur operators complain of the QRM or of the band's being noisy on a busy weekend when a host of exceptionally strong s.s.b. signals are picked up by a receiver with poor I.M. characteristics. Also, as many might have experienced, such noises usually cannot be traced to any one particular signal for which one searches, thinking that the cause is splatter produced by a careless operator on whom the blame may be placed.

Cross Modulation

Cross modulation (C.M.) occurs in a receiver when a desired signal is modulated by a strong modulated signal removed from the desired-signal frequency to which the receiver is tuned. In other words, the modulation of the undesired signal is crossed over in the receiver to the desired signal.

C.M. is dependent on the linearity and selectivity of certain stages in the receiver, the strength of the undesired signal and the frequency separation between the desired and undesired signals.

It causes the a.f. modulation of an undesired a.m. signal to be heard on a desired c.w. or a.m. signal. That caused on these signals by an undesired s.s.b. signal will appear as undistinguishable crud, such as an s.s.b. signal heard with an a.m. detector without carrier re-insertion from the b.f.o. In either case, where the desired signal is an s.s.b. one, the C.M. will appear as splatter or noise.

Cross modulation also can be caused by an undesired c.w. signal that heterodynes with another undesired signal, in which case the resulting beat frequency will be heard on a desired c.w. or a.m. signal whenever the undesired signal is keyed.

Desensitization

Desensitization is a decrease in receiver gain caused by a strong signal removed from the frequency of a desired signal, with the result that the desired-signal level is depressed. The loss of gain is caused by rectification of the strong signal in a grid-cathode or base-emitter circuit that produces a bias which drives the involved stage toward cutoff. This bias also may be fed to the a.g.c. system and thus similarly affect other stages.

The effect may be noted when the receiver is clamped to a low level and appears to go dead during operation in the vicinity of a strong carrier from a local a.m. transmitter; or by the receiver's level changing with the keying or speech of a nearby strong c.w. or s.s.b. transmitter, causing the desired-signal level to accordingly fluctuate up and down.

In some receivers we've run across with high susceptability to desensitization, a strong teletype signal 5 kc outside of an amateur band noticeably decreases the receiver gain over the adjacent 10 kc or so of the amateur band. Desensitization also may be caused by a local signal on an amateur band other than that on which the desired signal is tuned in.

Adjacent-Channel A.G.C. Takeover

Another phenomenon that produces a desensitizing effect is a.g.c. takeover by an adjacent-channel signal. This type of desentitization is largely dependent on the i.f. selectivity at the a.g.c. detector. It can occur from less strong signals such as those encountered on a band under normal conditions. This is a common experience, particularly with s.s.b. signals.

What happens here is that the attenuation along the lower region of the selectivity skirt is not sufficient to prevent a strong undesired signal thereat from capturing the a.g.c. system and thus lowering the receiver gain.

This type of desensitization often can be recognized as such, inasmuch as the adjacent-channel signal kicks the S-meter higher than does the desired signal. It is further indicated when the effect is found to coincide with the adjacent-channel signal as can be determined by aural comparison with the undesired signal when the receiver is tuned toward it.

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Although adjacent-channel a.g.c. takeover primarily is a selectivity problem, it has been included in this discussion, since it often is misconstrued as "cross modulation".

Blocking

Blocking occurs when the desired signal overloads the receiver, depressing the receiver output level and introducing distortion. It usually is the result of the a.g.c. system's inability to hold the receiver gain down sufficiently to prevent overload of one or more stages.

Anyone who has attempted side-by-side mobile communications or that with another station in the immediate vicinity most likely has experienced blocking, resulting in a much distorted and sometimes unreadable signal.

Blocking also indicates the dynamic range of a receiver, as will be explained during the measurement procedures to be given later.

Desensitization also is sometimes called blocking however, in this case the cause and other effects are somewhat different than that of the blocking just described.

Spurious Overload Responses

Spurious overload responses are of the cross-over type. They are produced when the fundamental or a harmonic of an undesired signal mixes with the fundamental or harmonics of the local oscillator to produce a signal at the receiver's intermediate frequency.

The undesired-signal harmonics may be generated or accentuated to a high level due to overload or non-linearity in an r.f. stage; while both signal- and oscillator-harmonics may be similarly created in a mixer, particularly since this necessarily is a non-linear element.

The spurious responses which result, generally are most evident within a few hundred kc or so of the strong undesired signal. This may be noticed when a nearby transmitter overloads the receiver, producing "birdies" in many spots within the particular band.

This phenomenon may be easily demonstrated by birdies which appear when a receiver is overloaded by a g.d.o. coupled to the receiver antenna input while the b.f.o. is turned on and the g.d.o. is tuned back and forth across the receiver frequency.

Recognition of Phenomenon

In some cases, particularly those involving splatter or noise due to r.f. intermodulation or cross modulation where s.s.b. signals are concerned, it may be difficult to determine which phenomenon is taking place.

In these situations it should be kept in mind that at least *two* undesired signals are required to produce I.M. The I.M. may be observed regardless of whether or not a desired signal is present at the I.M. product frequency to which the receiver is tuned.

On the other hand, only *one* strong undesired signal is required to produce C.M. The C.M. can be observed only in connection with a *desired* signal which is tuned in on the receiver.

The other events described herein can more easily be identified by the related effects explained earlier in the text.

If the receiver is suspected of having inadequate signal-handling capabilities under particular signal-level conditions, as evidenced by any of the various effects just discussed, a simple check may be made by inserting about 20 db of attenuation with a pad at the antenna input. The adverse effect should disappear if the receiver is otherwise at fault. Data on a pad is given at fig. 1.

In this respect, it should be noted that many solid-state receivers are equipped with a variable antenna-input attenuator strictly for contending with the adverse effects caused by strong signals.

Reducing the r.f. gain, consistent with making it possible to still read a desired signal, also should minimize the signal-handling difficulties and provide a clue as to whether or not the receiver is to blame.

Where such difficulties persist, it might be well to also follow some of the suggestions presented under "Antenna Sense" in the Q & A Column on page 87 of the March 1969 issue of CQ.

Measurement procedures for the various signal-handling characteristics will be covered in Part 2 to be presented next month. ■

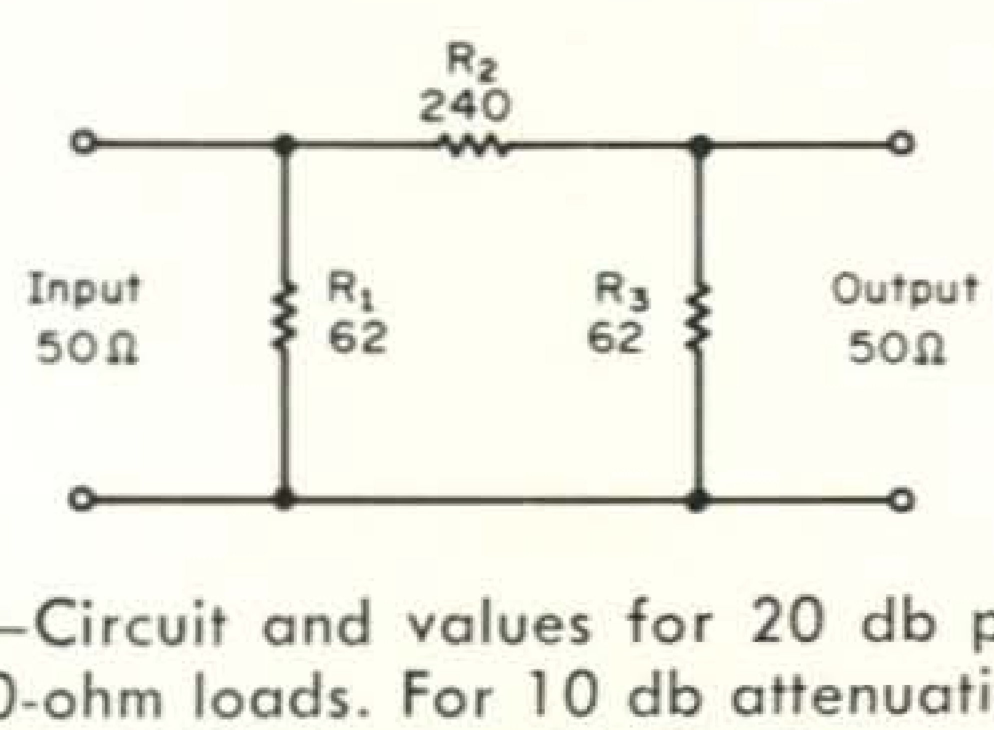

Fig. 1—Circuit and values for 20 db pad used with 50-ohm loads. For 10 db attenuation make R_1, and R_3 100 ohms and R_2 75 ohms.

THE EQUALIZER

(Hy-Gain's Balun turns a 52 ohm unbalanced system into a 52 ohm balanced system.)

Hy-Gain's ferrite Balun provides a way to couple a 52 ohm unbalanced transmission line into a 52 ohm balanced antenna system.

And it works on either a doublet or beam! The Hy-Gain broad band Balun improves the transfer of energy to the antenna eliminating stray RF from the feedline and supporting tower.

When a beam or dipole antenna is fed directly from a coaxial line, there is an unbalanced condition, due to the currents flowing down the outside (shield) of the coax. These currents radiate and thus affect both the pattern and the front-to-back ratio. In addition they cause TVI and drain away effective power.

The electrical principal of operation is similar to that of a 1:1 transformer. It is frequency independent, mechanically superior, and will operate over all ham bands. Hardware is furnished to mount on the beam boom or to be used as center insulator in a doublet.

Get the Hy-Gain Balun at the best distributor under the sun (he carries all Hy-Gain products).

SPECIFICATIONS

Mechanical

Weight	1 lb.
Dimensions	3¼ x 6¼"
Input Receptacle	SO-239
Output Receptacle	Standard Terminal Lugs
Weather Protection	Internally Sealed with Moisture Relief Hole
Housing Material	High Impact, Injection Molded, Cycolac Plastic

Electrical

Bandwidth	3 through 30 MHz Continuous
VSWR	1:1 (when terminated with a balanced 52 ohm load)
Power Rating	1 KW DC-AM
Impedance Transformation Ratio	1:1 at 52 ohms
Input Connector	SO-239
Insertion Loss	Negligible
Feed-through Loss	Negligible

The Balun from Hy-Gain

FOR THE STRONGEST SIGNAL UNDER THE SUN!

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THREE BANDS, ONE BOOM: ANOTHER APPROACH

BY JIM GREEN,* W1GT

A 3-element yagi for 14 mc, and a 2-element quad for 21 and 28 mc in a single compact assembly.

THE success of rotatable beam antennas in improving signal strengths over long distance paths has led to their increasing acceptance since the early 1940's This success, particularly on the 10, 15, and 20 meter bands, has encouraged a number of different attempts to secure the advantages of a rotatable beam antenna in a configuration which would work at maximum efficiency on all three of these principal frequency bands. Certainly the most successful and most widely applied solution to this problem is the so called "tri-bander." In this configuration, series resonant traps are located in the driven element, in the reflector, and in the directors to shorten the effective lengths of these elements so that they will resonate properly at each of the bands. It is unquestionably a good compromise engineering solution to the problem. It does, however, leave something to be desired from the point of view of the perfectionist who demands optimum performance from his antenna.

Element spacing in the "tri-bander" can be optimized for only one of the frequency bands to be operated. Further, the series resonant traps act as inductors when the beam is operated on the lowest frequency band. These inductors shorten the physical length of the antenna at resonance and insert ohmic losses. Both effects tend to decrease the overall efficiency of the antenna. Finally, the impedance presented to the driving transmission line will not be the same on all three bands and therefore the matching network used again represent a compromise.

*Packard & Burns Electronics, 103 Fourth Ave., Waltham, Mass. 02154.

Despite these shortcomings, the "tri-bander" is still an excellent compromise solution and only the purist need read further.

Log Periodic Antenna

Perhaps one of the most theoretically satisfying solutions to the problem is the LPA, or Log Periodic Antenna. This antenna has the interesting characteristic of not only performing well on three bands, but on being able to perform well on any frequency over a range of approximately ten to one. Despite this startling advantage, it has found a little favor with amateurs and probably will not fare much better in the future, and for a very basic reason.

In general, the gain of a directive antenna can be expected to go up with the square of the transmitted frequency if its physical size is held constant. If a beam antenna will give a gain of 6 db on 20 meters, or 14 mc, a properly designed beam of the same physical dimensions operated on 28 mc should give a gain of approximately 12 db. The Log Periodic obtains its broadband characteristic by effectively decoupling portions of the beam as the frequency rises. Thus, in effect, the size of the beam diminishes as the frequency goes up and the frequency gain of the beam remains approximately constant over the entire frequency range. The performance on the highest frequency band is, therefore, far below what can be achieved with a properly designed structure of the same size.

Interlaced Elements

A more appealing approach is the one which has been described in great detail by Sam Parker in the November and December

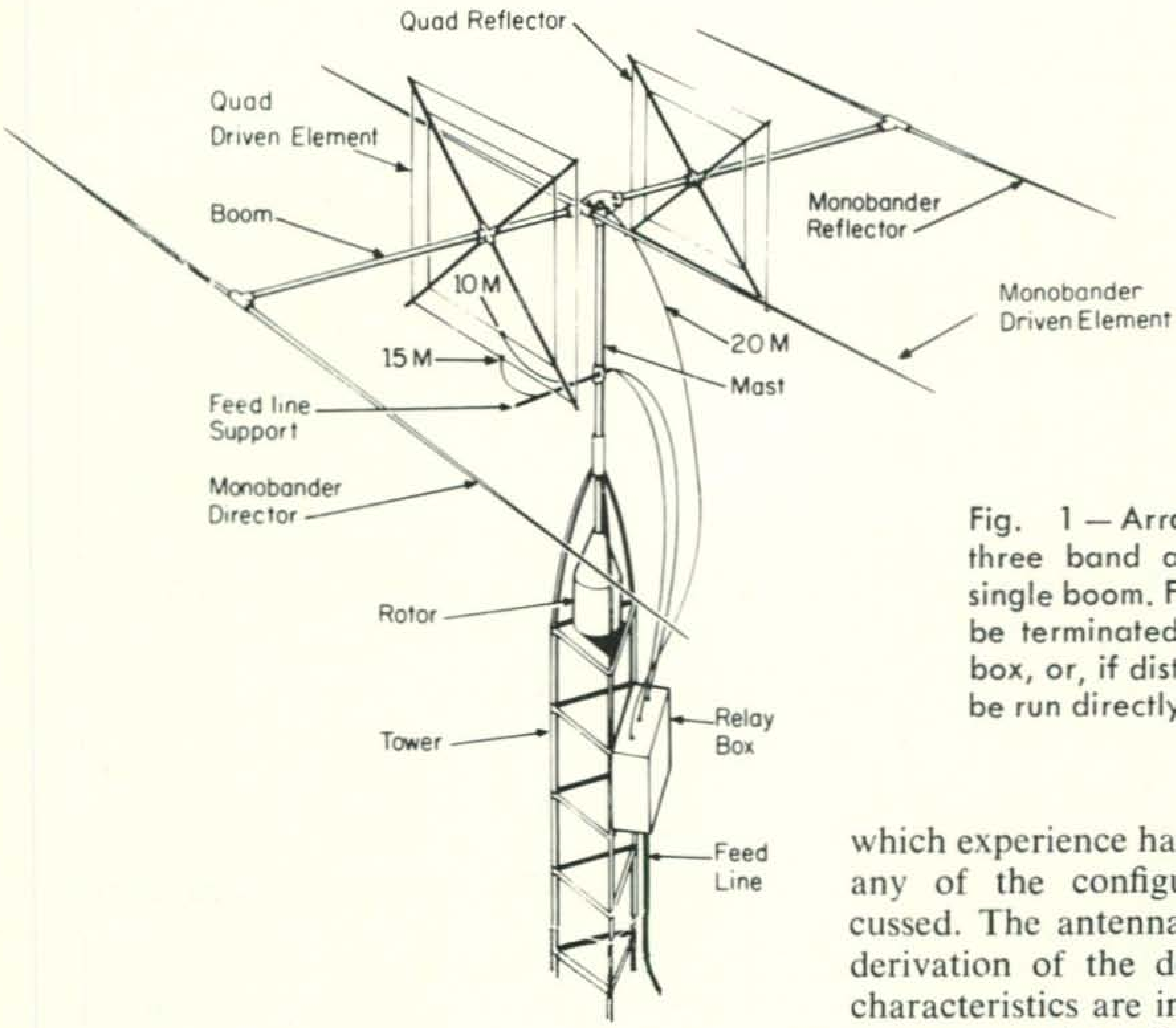

Fig. 1—Arrangement of three band antenna on a single boom. Feed lines may be terminated at the relay box, or, if distances permit, be run directly to the shack.

issues of *CQ* magazine.[1] In his approach, Parker interlaces the elements of three separate Yagi Antennas on the same boom. This permits each of the three separate antennas to be designed with optimum element lengths and optimum element spacing. It represents a refinement of the more standard approach of mounting three separate antennas, one above the other, on the same mast. Surprisingly the amount of interaction is tolerably small and each of the beams can be tuned separately with only a modest amount of interaction. It does, however, tend to be a bit "fussy" for many applications. I also feel, personally, that feed system proposed by Parker leaves something to be desired. He uses decoupling filters to permit the use of a single feed line to drive more than one of the beams. While such filters can be designed and built, the calculation is somewhat tricky and the resulting filter has many of the objectionable characteristics of the traps which are present in the "tri-bander" configuration. Losses occur and it is difficult to obtain a good match on all three bands.

Yagi-Quad

The author has constructed and had in service for the past six months an antenna which experience has shown to be superior to any of the configurations previously discussed. The antenna is shown in fig. 1. The derivation of the design and the operating characteristics are immediately obvious. The antenna consists of a standard three element monobander for the 20 meter band with two element quads for 10 and 15 strung on standard spiders attached to the same boom as the Yagi. Adequate room is available for the installation of a third spider, thus permitting the quads to operate as three element arrays. The next model of this antenna will be so configured.

It is immediately apparent that this configuration permits us to avoid most of the pitfalls pointed out for the three configurations previously discussed. The three element monobander for 20 meters can easily be adjusted for optimum element length and optimum element spacing. The elements of the 10 meter and the 15 meter quads are likewise independent and their lengths can be suitably adjusted for optimum performance on each of these two bands. It is also possible to obtain optimum spacing between the quad elements by running light dowels between the spiders, but here our desire for perfection gave way to a more practical desire to use standard and readily available components to assemble this first model. We expect to try this refinement in the next version. Finally, the interaction between the three beams is completely negligible. Essentially no effect on the tuning of one beam is noticed when the element length of either of the other two beams is varied. All of these advantages would of course be shared by a

[1]Parker, S., "Experiments With Three Arrays On One Boom," *CQ*, Part I Nov. '69, p. 78, Part II Dec. '68, p. 43.

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full "tri-band" quad. It was our personal preference, however, to adopt the configuration shown in order to decrease the overall size of the array.

Feed Lines

The approach to the feed problem used is as direct as is the approach to the problem of reducing interaction between the three beams. Separate feed lines are brought to the mast where a remotely controlled coax switch is used to connect the proper beam to the transmission line. The switching arrangement is shown schematically in fig. 2. This switching system is assembled from available s.p.d.t. relays. A single pole, three position relay, which is perhaps more suitable, is also available from the Dow Key Company. It would also be possible to bring the three feed lines into the shack and use a manual coaxial switch to select the proper antenna if the distances involved make this a practical solution.

One other aspect of the feed system may also be of general interest. The monoband beam is supplied with its own balun. Each of the quads was fitted with its own balun. These baluns were fabricated by slipping standard shielded braid over the outside of the coaxial feel line and connecting as shown in fig. 3. This type of construction has proven, on this and other beams constructed by the author, to be both simple and effective.

Summary

This approach to the construction of a three band directive antenna system is so uncomplicated and straightforward that I hesitated for some time before preparing this note describing it. It seemed almost inevitable that others had or soon would independently arrive at the same result. I am still convinced that such must be the case. Nevertheless, from a rather cursory review of the literature, and from talking to many of my friends, I can only conclude that everyone else must be holding back as I was since nothing has, to my knowledge, appeared in print.

The antenna described has by a substantial margin been the most satisfactory of many designed, constructed, and operated at my present or previous locations. The satisfaction stems from the ease of construction, the ease of operation, and the close match which can be achieved between predicted and observed performance characteristics. It is equally obvious that many attractive variations can be conceived and easily implemented. The three element monobander could be replaced by a four or five element array. The quads can likewise have additional elements added. It is hoped that this discussion of the basic principles involved will encourage others to develop even more effective combinations. ■

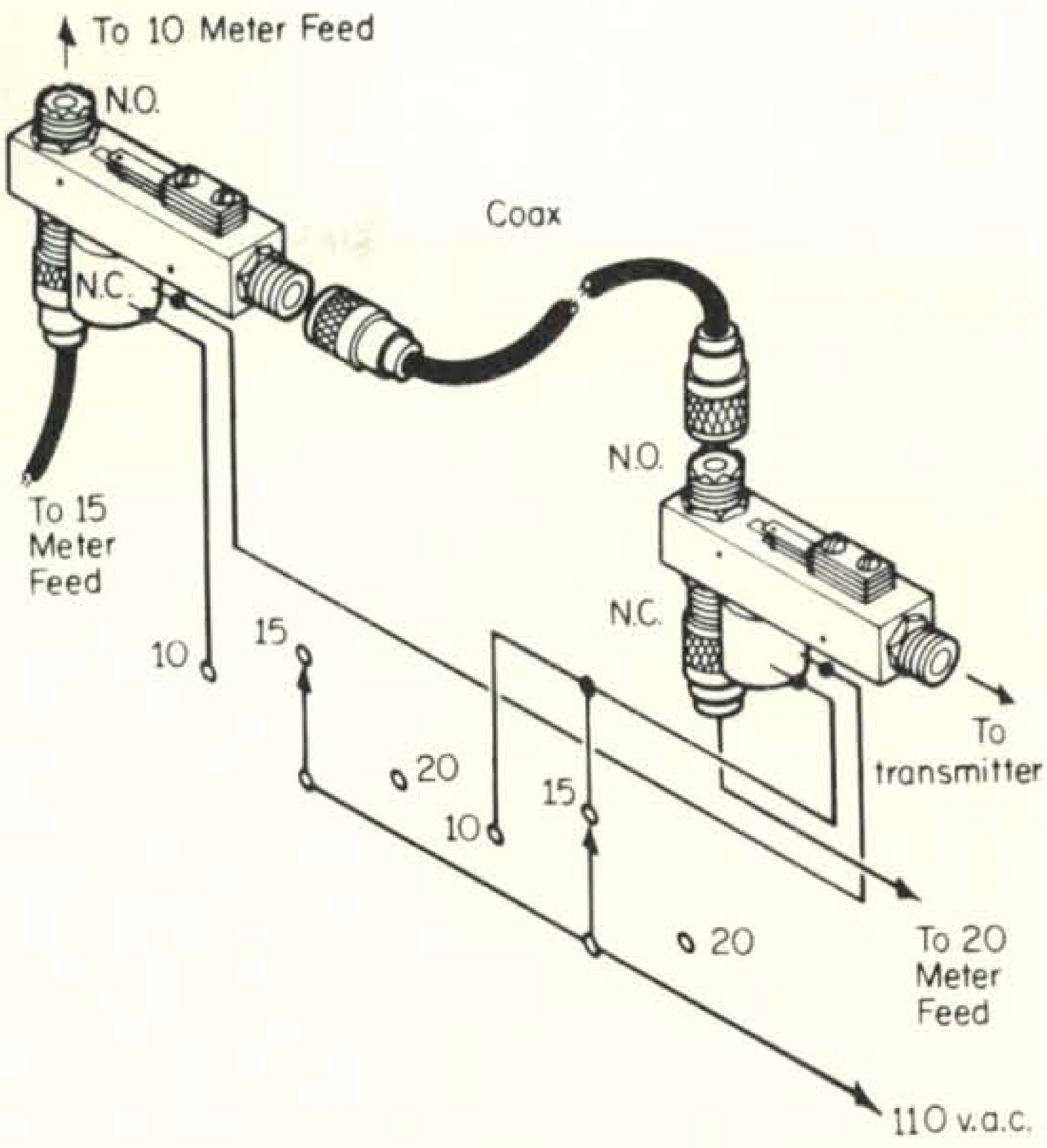

Fig. 2—Switching system makes use of two s.p.d.t. coaxial relays as shown above. If local electrical codes prohibit 110 v.a.c. wiring in other than conduit, low voltage relays may be used.

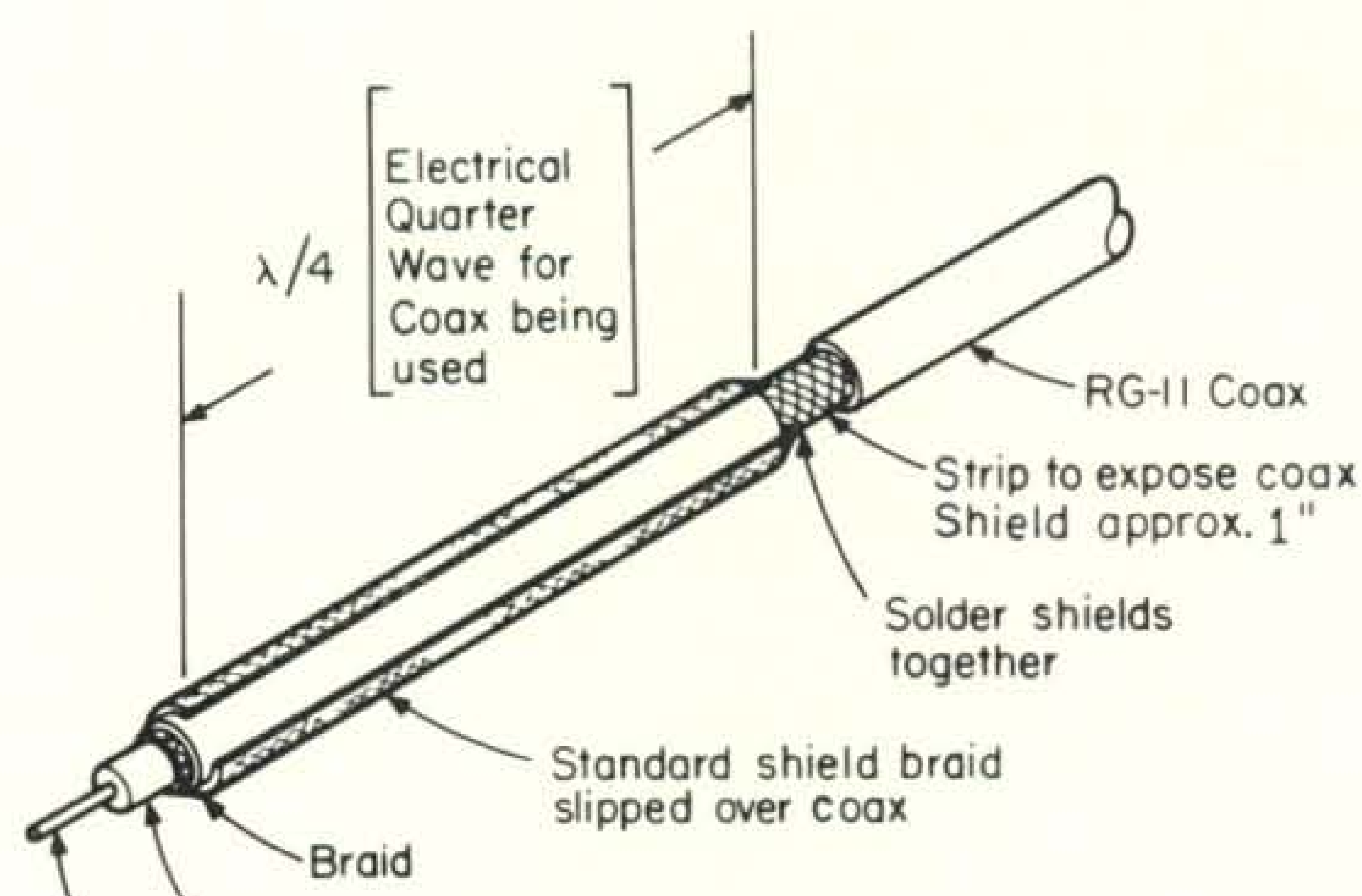

Fig. 3—Details of a simply constructed balun that is used for each quad antenna. The same type can also be used for the 20 meter yagi.

NEUTRALIZATION

BY JOSEPH TASCHETTA,* W8IZH

EVERY time I decide to build a transmitter, I run into a nightmare, neutralization. Paging through much that has been written on that subject tends to be confusing. I decided, therefore, to take time out and approach the problem in a logical way. To do this I broke it up into four main categories:

1-Definition of neutralization.

2-Steps to take before neutralization.

3-How to neutralize a given circuit.

4-Neutralization procedure.

Since many hams shy away from neutralization, it's hoped this article will help them understand this phase of electronics better.

What is Neutralization?

In an unneutralized r.f. amplifier, there is a feedback of energy from plate to grid. This is because of the plate to grid capacitance within an amplifier tube. Because of this interelectrode capacitance it is necessary to neutralize an r.f. amplifier to prevent self oscillation regeneration. A neutralizing circuit, therefore, is one which will nullify (or balance out) the effect of this capacitance, *C*gp.

One of the objectives of this article is to show how the *C*gp can be cancelled by taking signal voltage from the plate circuit and feeding it back to the grid in proper phase and amplitude to balance the regenerative feedback.

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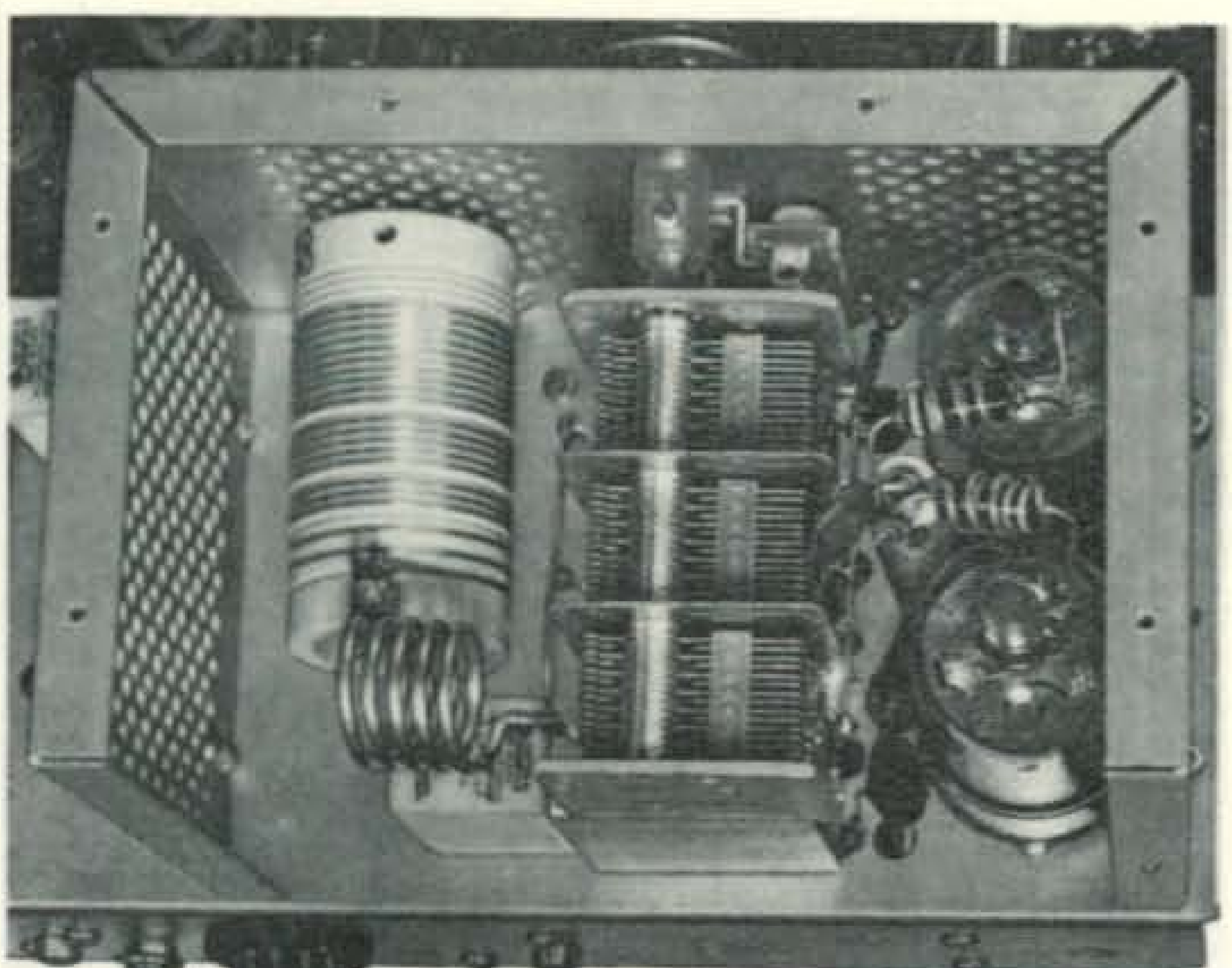
Steps to Take Before Neutralization

Several preventative measures should be taken when designing an amplifier in order to stablize it. In r.f. power amplifier circuitry, where the problem is most obvious, achieve the following first:

1. All r.f. leads should be as short as possible. Be sure the layout is well thought out before applying the soldering iron. Figure 1 shows the upper and lower chassis of an HW-100 final. The final cage contains two 6164's, the plate tank coil for all the bands, and the two tuning capacitors. Note how short the leads are in the cage and under the chassis for the final tube wiring.

2. Use complete shielding between the input and output circuits of the final and driver stages. If oscillation occurs after following these two basic steps, it might be necessary to load the grid circuit in order to prevent regeneration.

The grid circuit can be loaded by two basic



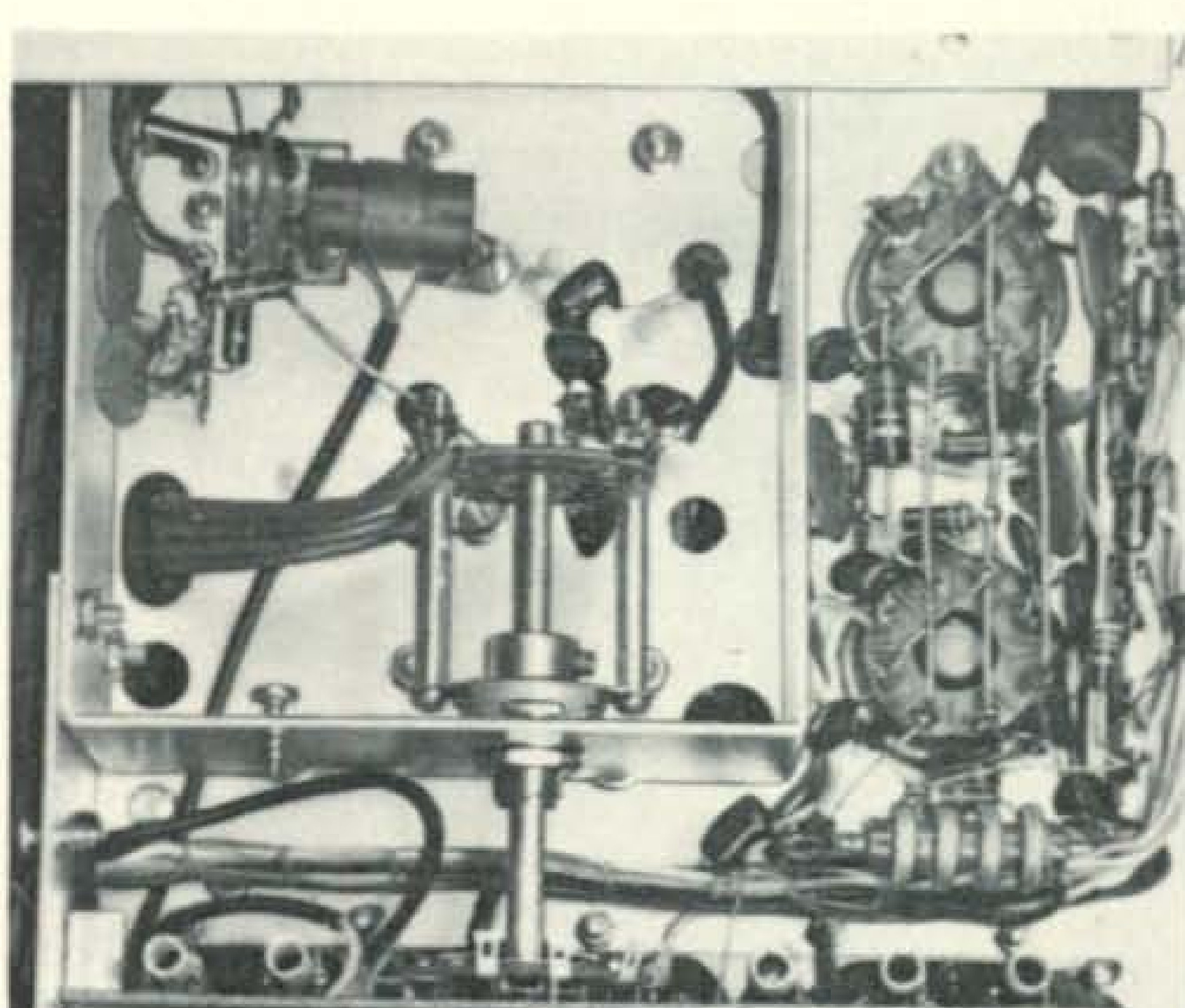


Fig. 1—Top and bottom views of a Heath HW-100 final amplifier. The short leads and tight shielding help to assure stability.

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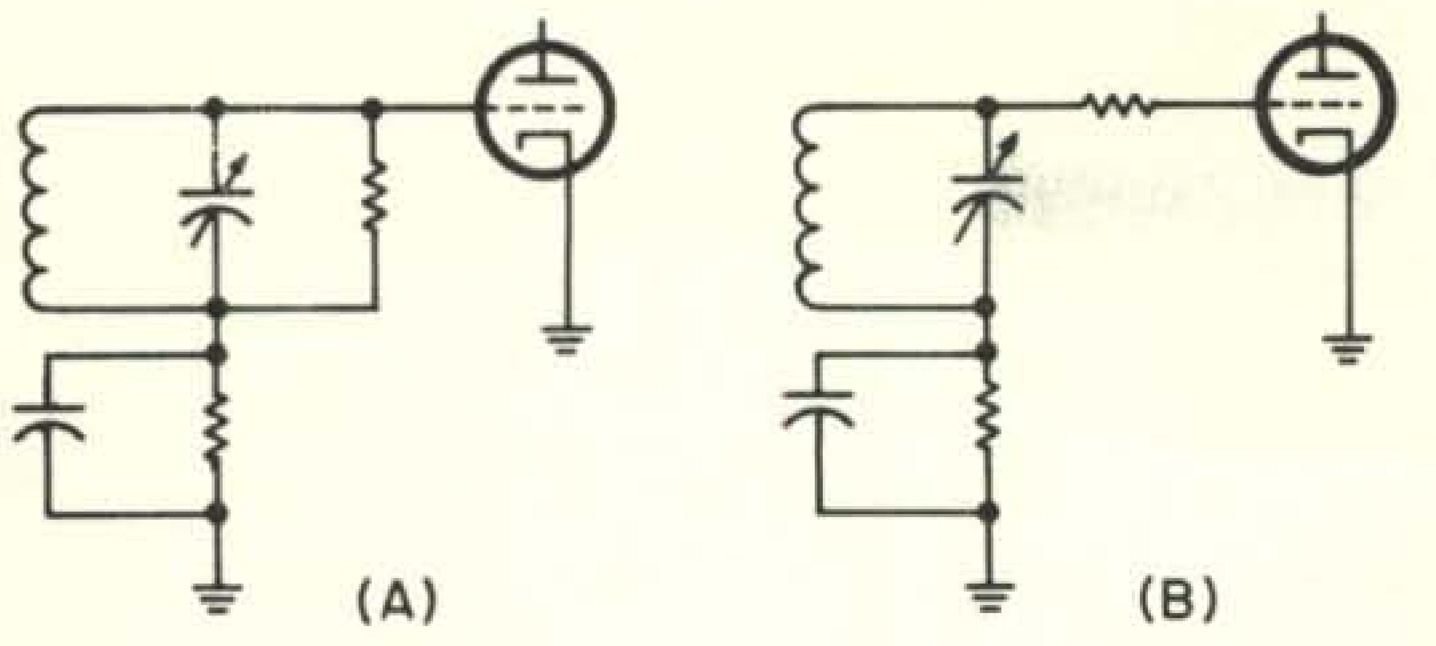

Fig. 2(A)—Simple approach to the prevention of oscillation is the addition of a resistor across the grid tank circuit. (B) A second approach is the insertion of a resistor between the grid and the tank.

methods. The first would be to place a resistor in parallel with the grid tank circuit. (See fig. 2(A).) This will lower the Q of the tank circuit thereby making it less prone to oscillate. Usually a resistance value of about 10K to 15K is sufficient. The lower the resistance the greater the loading, the lower the Q and the less tendency there is to oscillate.

The second method of reducing the tendency to oscillate is to place a resistor in series with the grid and tank circuit with a nominal value of about 47 ohms, as illustrated in fig. 2(B). This method does not lower the Q of the tank but attenuates signal to grid.

How To Neutralize a Given Circuit

If the above suggestions are tried and the amplifier still oscillates, neutralization will be in order. There are five basic methods of neutralization:

1. Coil neutralized amplifier.
2. Inductive link coupling.
3. Plate neutralization (Hazeltine).
4. Bridge for grid neutralization (Rice).
5. Grid neutralization, single ended (Bruene).

Coil Neutralized Amplifier

Figure 3 shows how a coil neutralized amplifier may be used. The capacitance Cgp couples the energy back from the plate to the grid. A triode amplifier is used in this example since its Cgp is high and it would *have* to be neutralized.

This circuit becomes neutralized when $X_L = X_{Cgp}$ because the inductive reactance and the capacitive reactance are of opposite sign. (i.e., $X_L = j\ L$, $X_C = 1/j\ C$.) In effect the amplifier will now have a high impedance tuned circuit from plate to grid opposing the transfer of r.f. Capacitor Cn is a small trim-

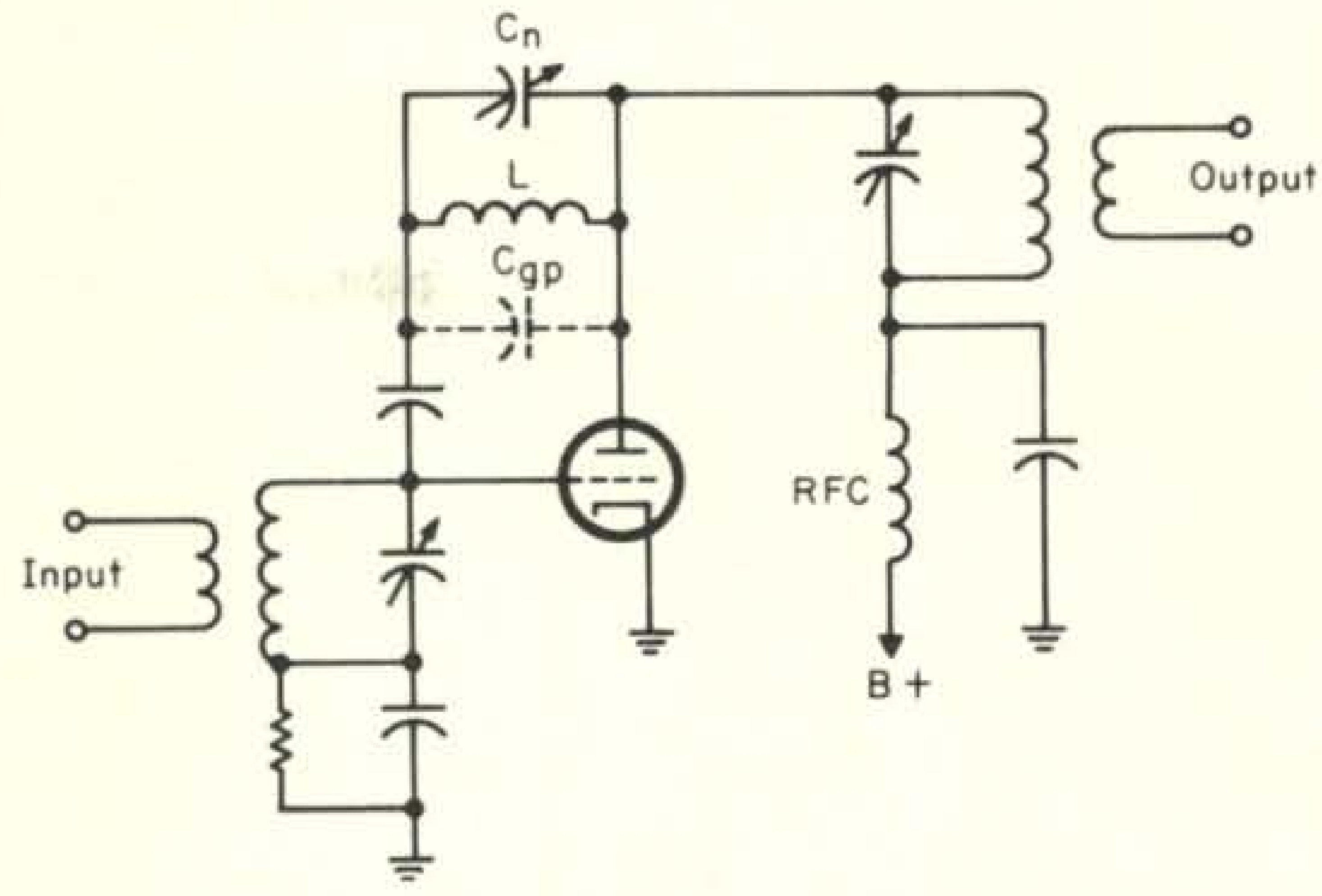

Fig. 3—A simple Class C, grid leak biased, triode power amplifier using coil neutralization.

mer to adjust this resonant circuit for maximum impedance at the operating frequency and thus provide maximum stability.

This type of neutralization is used often in v.h.f. circuits but must be retuned each time the frequency is changed. This is its chief disadvantage.

Inductive Link Line Neutralization

Figure 4 shows the use of inductive link line, coupling the input and output tank circuts in proper phase. Adjustment for neutralization can be obtained by changing the distance between the links, L_1 and L_2, and tank coils. If neutralization can't be achieved at the first attempt, reverse one of the links. Since oscillation of the amplifier is caused by the feedback signal through capacity from plate to grid (Cgp), the inductive links will cancel this feedback with an equal and opposite magnitude signal.

Plate Neutralization—Bridge Method

Figure 5 shows how any r.f. amplifier can be approached for plate neutralization. The

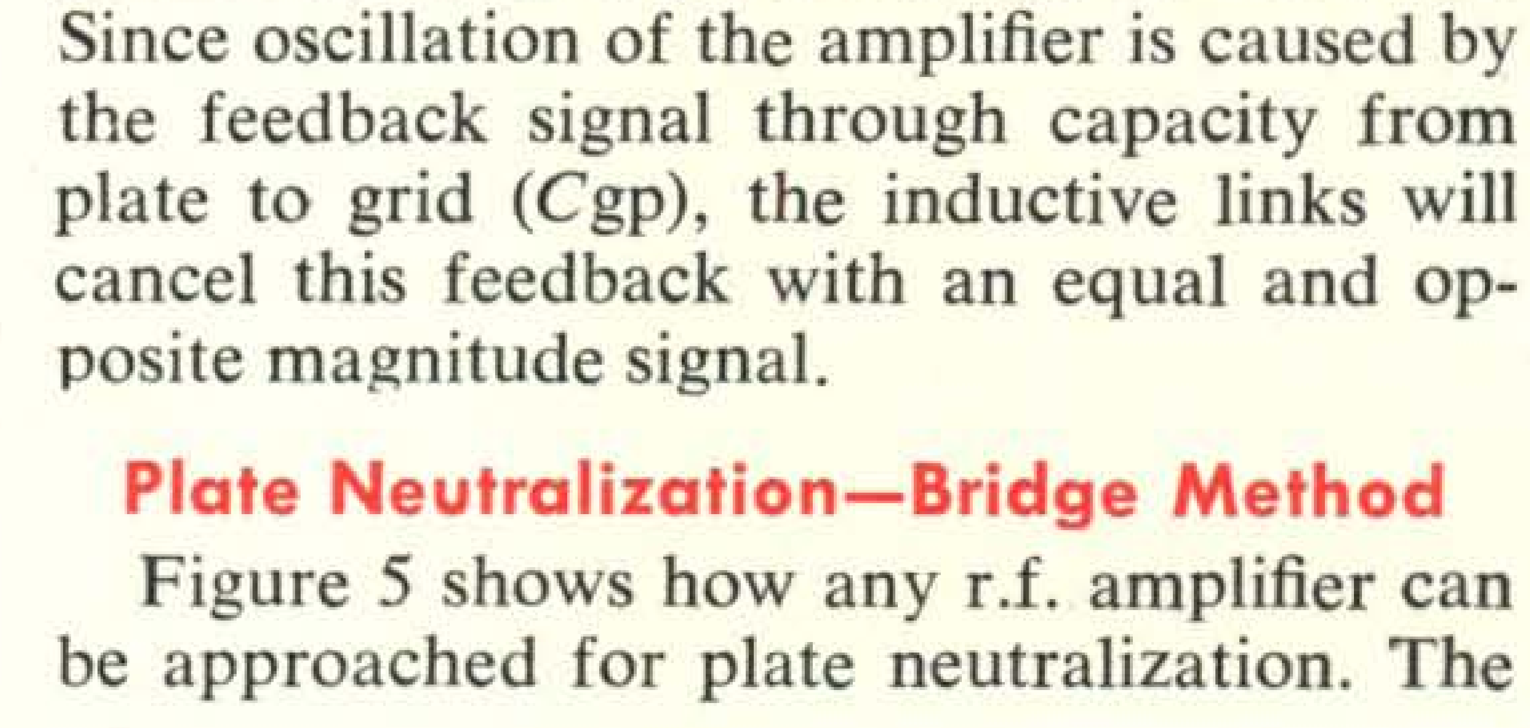

Fig. 4—Inductive link neutralization. Phase shift is gotten by reversing the feedline connections between L_2 and L_1, and the amplitude of the feedback signal is controlled by coupling between L_1 or L_2 and their corresponding tank circuits.

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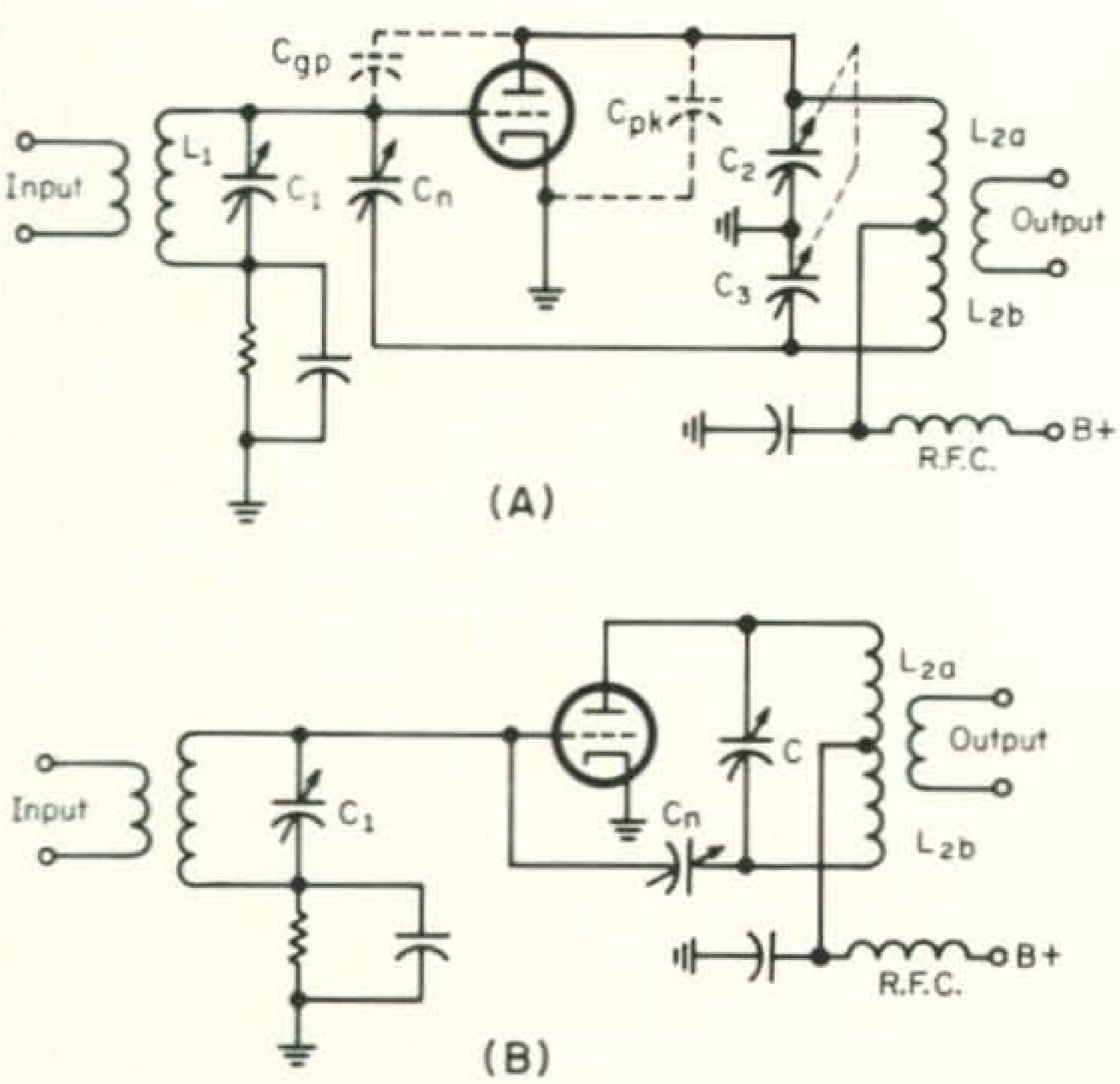

Fig. 5(A)—Circuit of a triode amplifier plate neutralized (Hazeltine) using a split stator tuning capacitor. (B) A similar circuit using a single tuning capacitor. Principle of operation is identical for both circuits.

two circuits are basically the same. Figure 5(A) uses a split stator capacitor and center tapped tank while 5(B) uses a single tuning capacitor with the center tapped tank.

The neutralizing operation of either circuit is based on the transformer action of L_2. Any signal at the plate end of L_2a will be induced into the lower half of the coil, L_2b, which acts as a secondary. Since the coil is center tapped and thus has a 1:1 ratio the only effect is to reverse the phase of the signal. Now the signal amplitudes are the same at the top and bottom of L_2 but 180° out of phase. Signal from the plate leaks through *C*gp to the control grid. Signal from the other end of L_2 leaks through to the grid through *C*n. If *C*n=*C*gp the two signals will be of equal amplitude, and, since the two signals are 180° out of phase, they cancel.

The bridge equivalents in fig. 6 show how balance occurs. If the bridge in fig. 6(A) is balanced, $Cgp/Cn = C_2/C_3$ and no feedback from plate to grid will occur.

Figure 6(B) is the bridge equivalent of fig. 5(B). In this configuration neutralization occurs when we have $Cgp/Cn = L_2a/L_2b$.

Grid Neutralization

Figure 7(A) and (B) shows the basic approach for grid neutralization. It is essentially the same as the plate neutralization circuit of fig. 5 except that the phase reversal circuit is in the grid. The bridge equivalent circuit shown in fig. 7(B) essentially is the same as the bridge of fig. 6. For the balance *C*n must equal *C*gp if the phase reversing transformer is 1:1.

The only advantage of grid neutralization as shown is that the phase inversion is being accomplished in a lower power circuit than the plate.

Single Ended Neutralization

Both the grid and plate neutralization circuits shown in fig. 5 require push pull tank circuits for phase inversion in the input or output circuit. Single ended stages can also be neutralized using a system such as shown in fig. 8, particularly suitable for pentodes. The bridge equivalent circuit for fig. 8(A) is shown in fig. 8(B).

This method of neutralization requires that C_1 be smaller than usual, so that the tank circuit is a bit above ground. Capacitor *C*n will work out to be larger than C_1 from the following relationship:

$$\frac{C_n}{C_1} = \frac{C_{gp}}{C_{gk}}$$

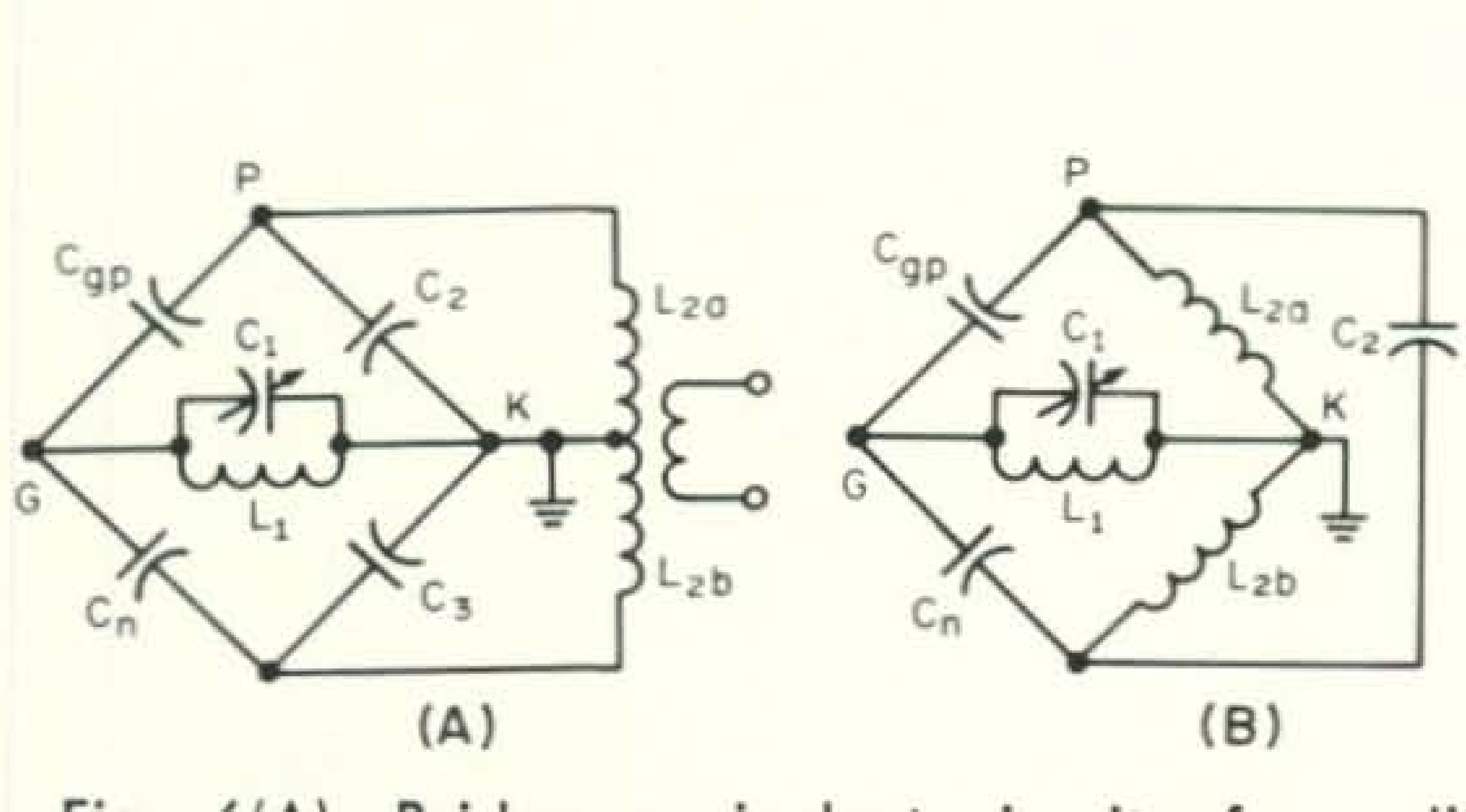

Fig. 6(A)—Bridge equivalent circuit of a split stator plate tank circuit of the plate neutralization type (Hazeltine). (B) The bridge equivalent circuit of a similar type but with a conventional plate tuning capacitor.

Calculating Cn

A typical single ended pentode circuit that is to be neutralized is shown in fig. 9 and is a copy of the final of a Heathkit HW-100. It contains two 6146 tubes paralleled. The cathode is considered to be at ground potential because of heavy bypassing (six .005 mf or 0.03 mf total). The value chosen for C_1 was 680 mmf which, in the range from 10 to 80 meters, places the tuned circuit a little above ground.

Since there are two 6146's in parallel, the values of *C*gp and *C*gk must be doubled to

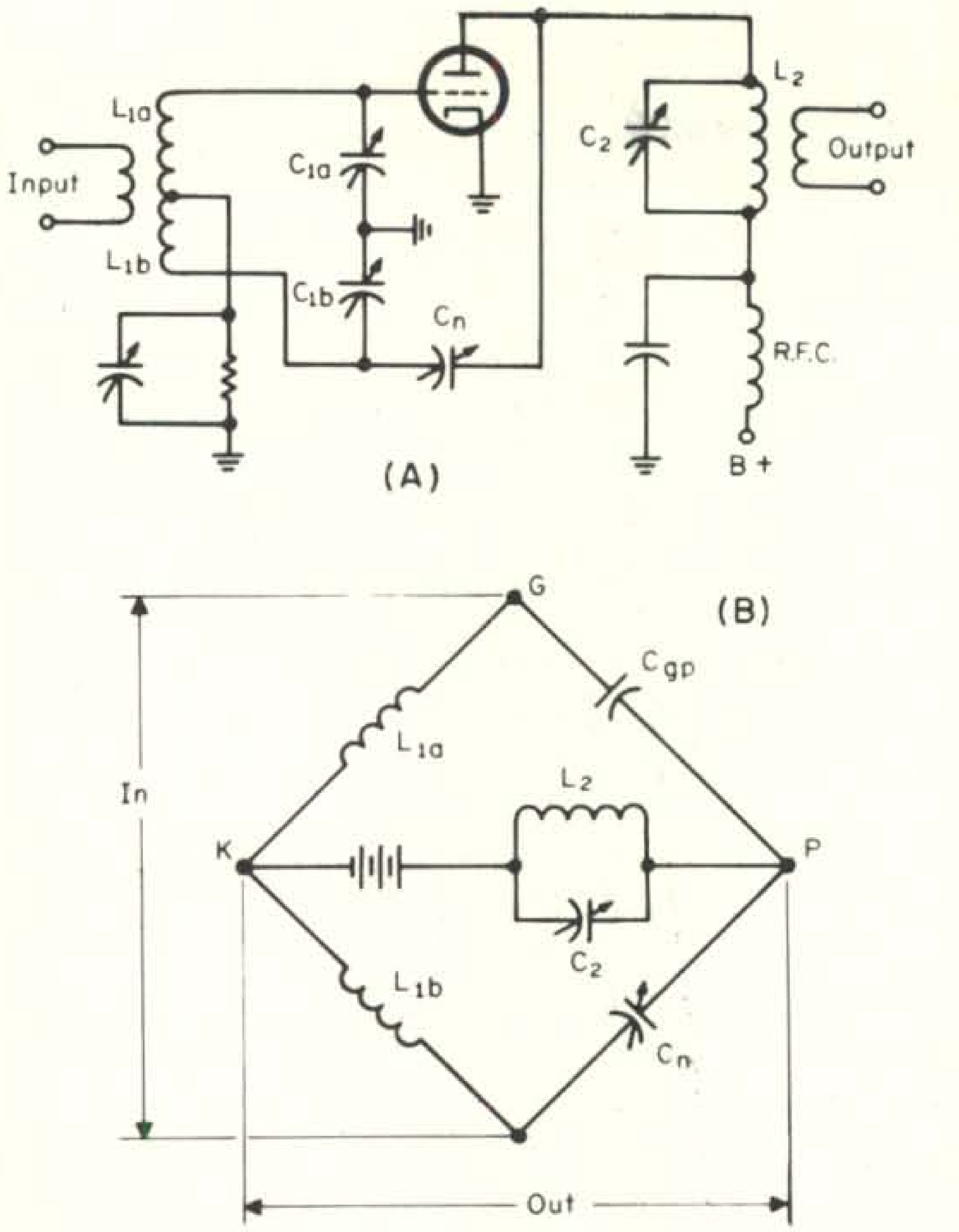

Fig. 7(A)—Circuit of a grid (Rice) neutralized amplifier and (B) its bridge equivalent.

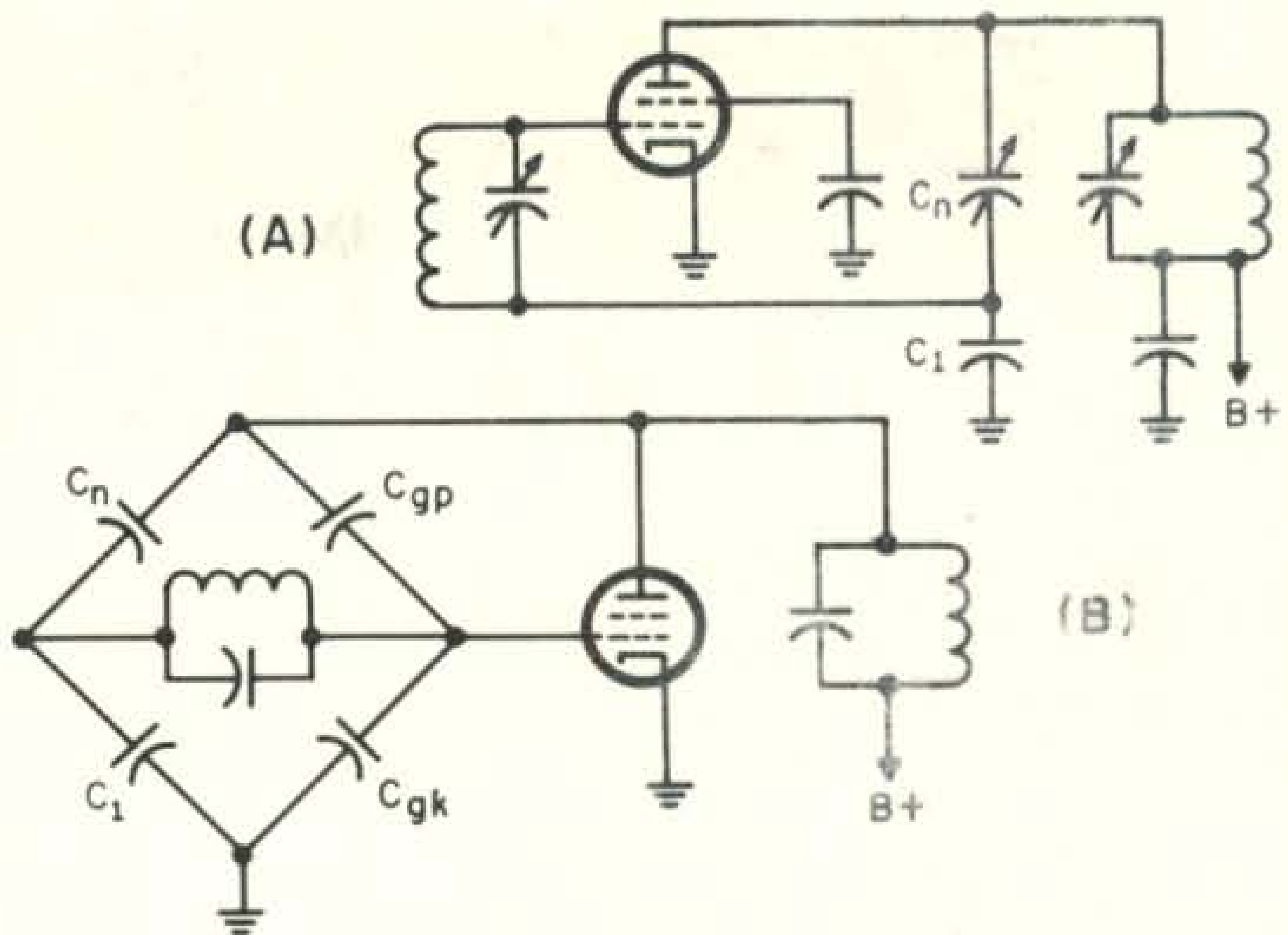

Fig. 8(A)—Single ended neutralization requires no phase inverter type tank circuit. This circuit showing only a.c. portions indicates the general arrangment. (B) Bridge equivalent for the circuit in (A).

achieve proper calculation. In this example, for 6146's: *C*gp total = 2 × 0.24 mmf = 0.48 mmf and *C*gk total = 2 × 13 mmf = 26 mmf.

Stray capacitances must be taken into account. The value of *C*gk must include all strays, even the capacitances of the tuning capacitor, C_2, stator to ground. The output capacitance, *C*pk, of the 6CL6 driver must also be added to the capacitance, *C*gk. In this case, the strays across *C*gk calculate out to be 12 mmf.

The total capacitances are:

*C*gp = 0.48 mmf
C_1 = 680 mmf
*C*gk = 26 mmf + 12 mmf = 38mmf
*C*n = Unknown

Using the formula developed for fig. 8, we have:

$$\frac{C_n}{C_1} = \frac{C_{gp}}{C_{gk}}$$

$$\frac{C_n}{680} = \frac{0.48}{38}$$

$$C_n\,38 = 0.48 \times 680$$

$$C_n = 8.59\ mmf$$

If an adjustable capacitor of approximately 2-10 mmf is available that will withstand the voltage found in this application, it can be used directly. If, however, a small mica compression trimmer must be used it should be placed in series with a fixed capacitor to reduce the voltage across the trimmer.

If, for example, a 3-30 mmf trimmer is available, to determine the required value of the series capacitor we resort to the formula:

$$C_T = \frac{C_1\,C_2}{C_1 + C_2}$$

Since *C*t is known along with the value of C_1 (the 30 mmf trimmer) the formula is rearranged to solve for C_2 as follows:

$$C_2 = \frac{C_1\,C_T}{C_1 - C_T}$$

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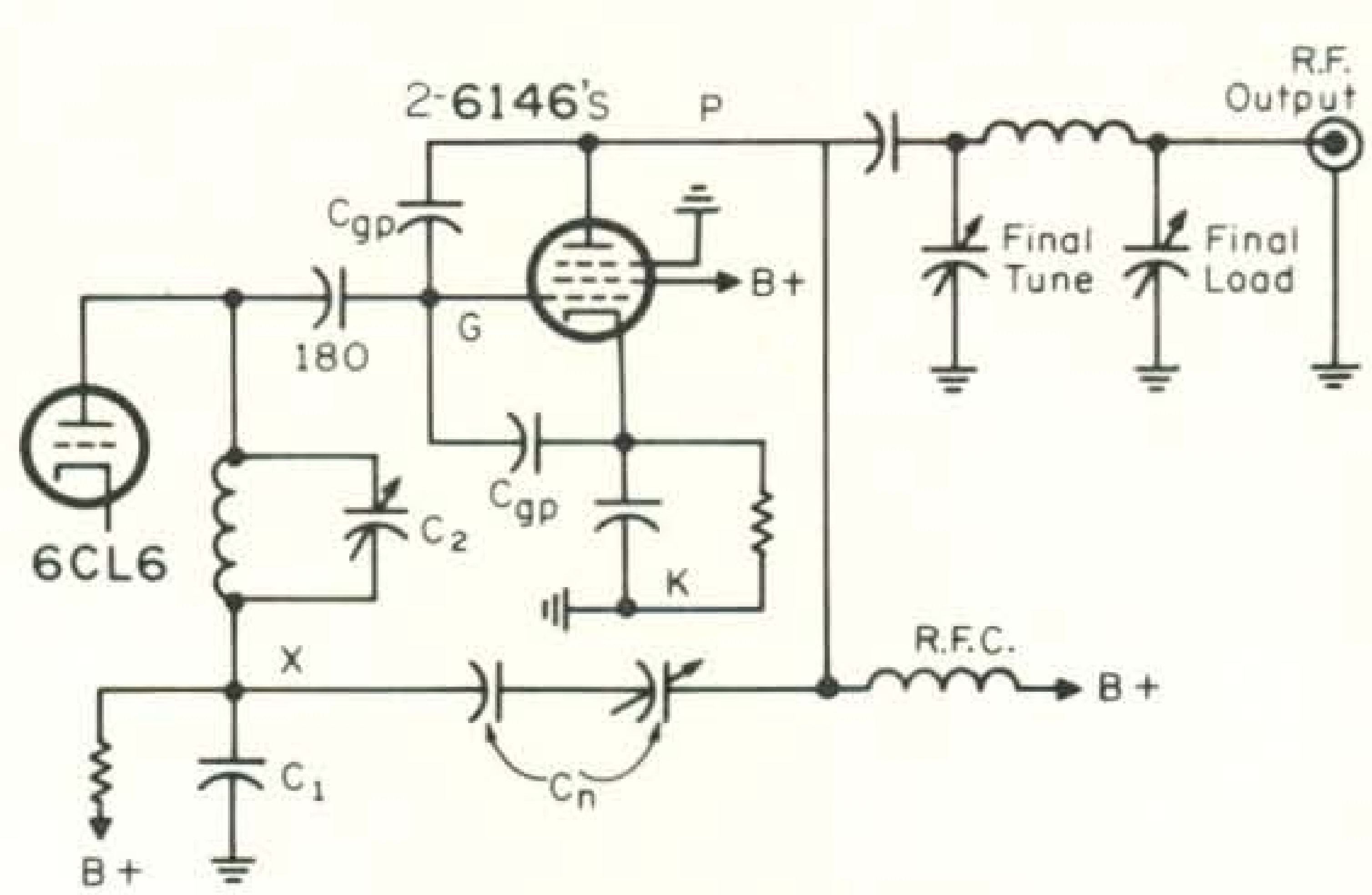

Fig. 9—Partial circuit of the HW-100 final showing the neutralization method of the circuit in fig. 8. The neutralization capacitor Cn consists of two series capacitors as explained in the text.

EFFECTIVE SPEECH TRANSMISSION

BY JOHN J. SCHULTZ,* W2EEY

Almost every amateur knows that limited frequency bandwidth, usually 300 to 3000 cycles/second, is sufficient for speech transmission. But why is this particular frequency range chosen? The author explores some of the factors concerned with choosing the most effective bandwidth for speech transmission.

THE attempt to derive definitive criteria for the effective transmission of speech has engaged many people in a variety of studies. The factors of power input being held constant and usage of the same speaker produces different results with different transmitters and receivers. If different speakers are used even more confusing results occur. Some transmitters seem to exhibit a certain signal "punch" and effectiveness under QRM conditions that other transmitters do not exhibit. Other speakers used with the same equipment result in the "punch" being considerably moderated.

To simplify the situation, let us assume that the factors which make for effective speech transmission are speech power and frequency response. Speech power does not mean simply loudness as far as a transmitter is concerned since the power input to the transmitter is limited. It relates to the peak to average power transmitted. In normal conversation, the average person seems to produce about an 18 db difference between his peak and average speech levels. Some persons produce greater differences and some produce smaller differences. All other factors bling equal, the latter person tends to have more speech "punch." His speech power may tend not to be pleasant to hear if he does not also vary his tonal range much but, nonetheless, it makes for powerful speech.

Fortunately, regardless of the amplitude range of a person's speech, the use of speech compressors and other circuits which raise the average to peak power in a transmitter under voice modulation conditions can effectively compensate for individual speech dynamic ranges although, probably, the fellow with a naturally high average to peak

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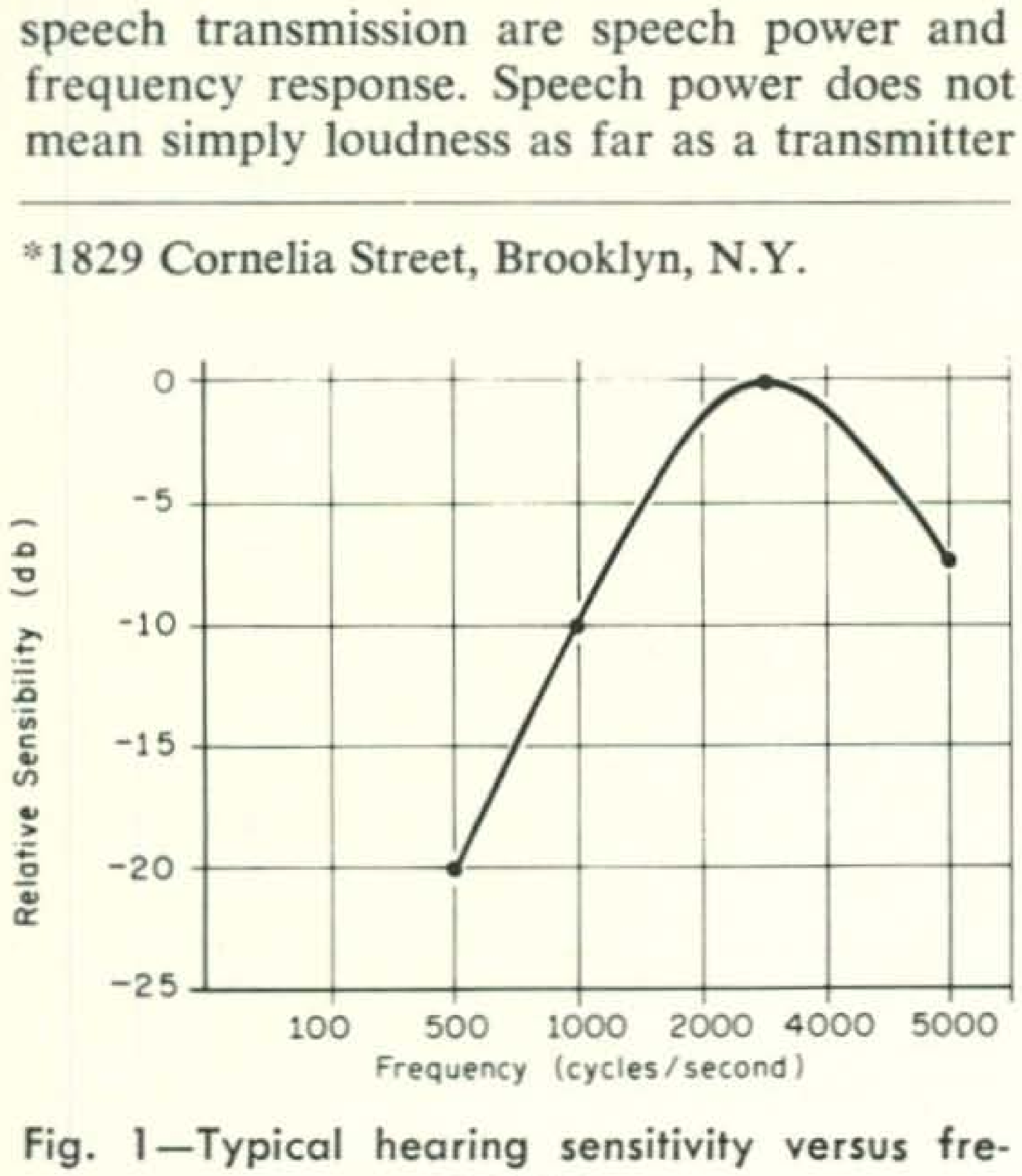

Fig. 1—Typical hearing sensitivity versus frequency.

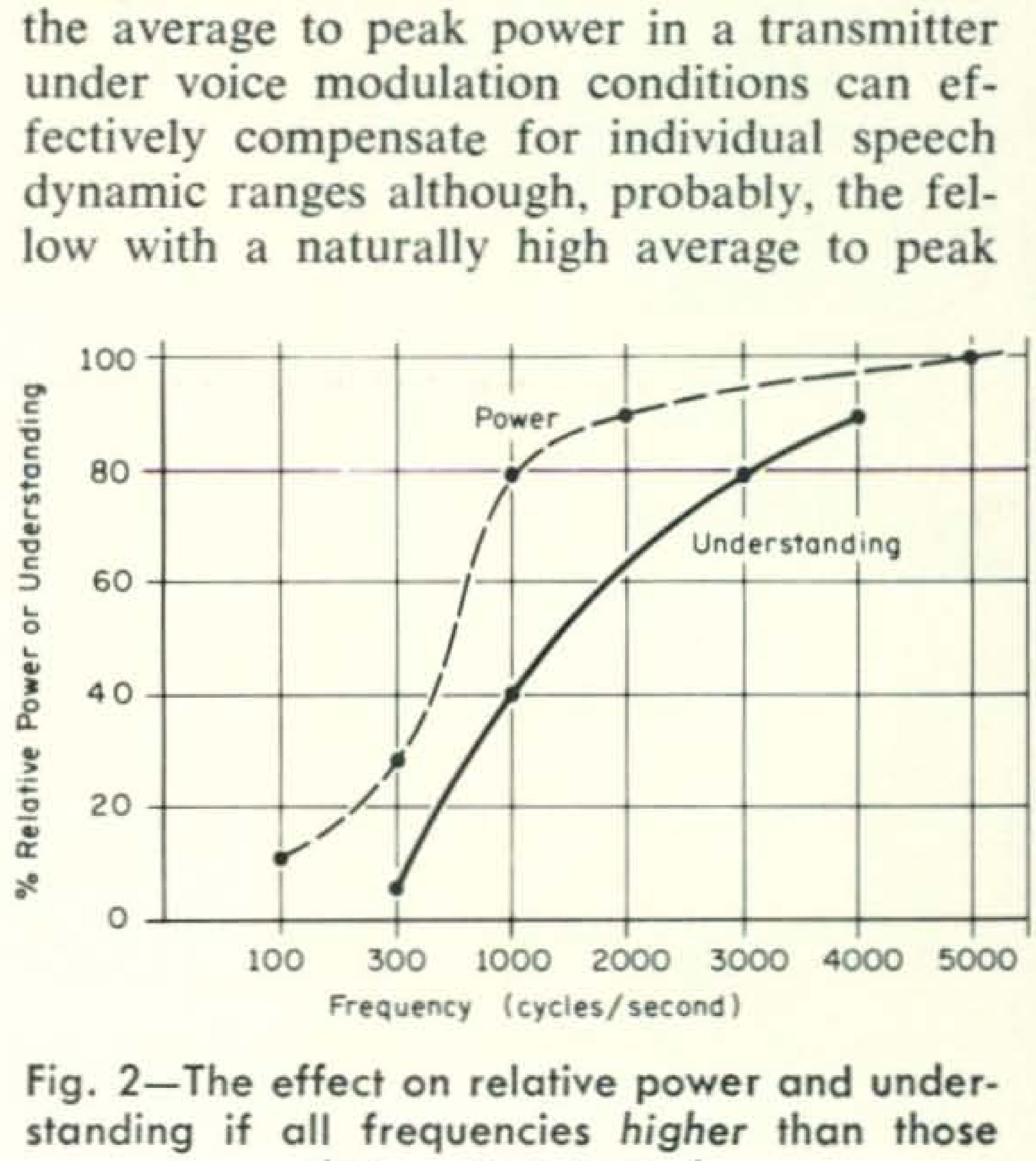

Fig. 2—The effect on relative power and understanding if all frequencies *higher* than those shown are removed.

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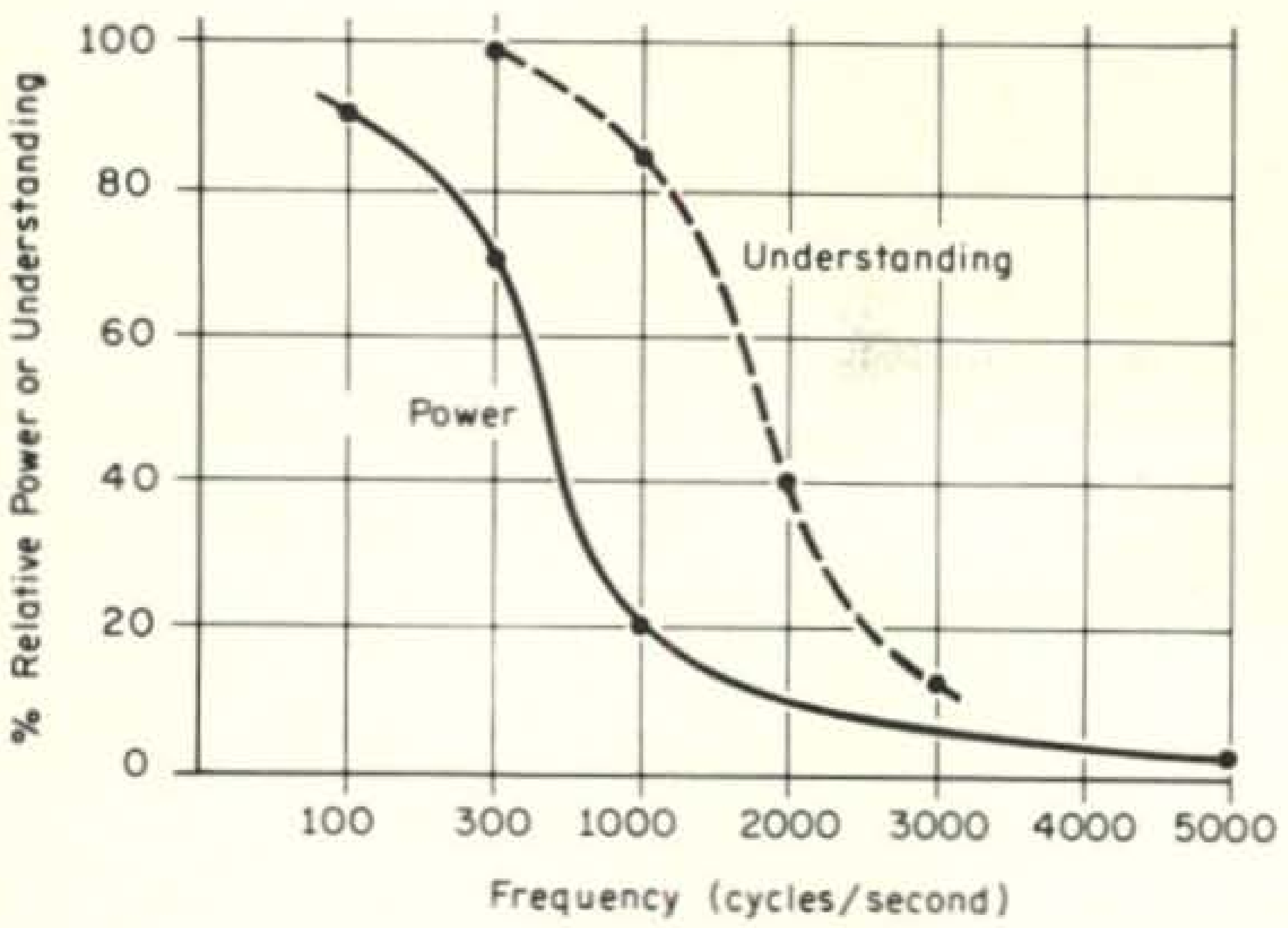

Fig. 3—Effect of removal of all *lower* than those indicated.

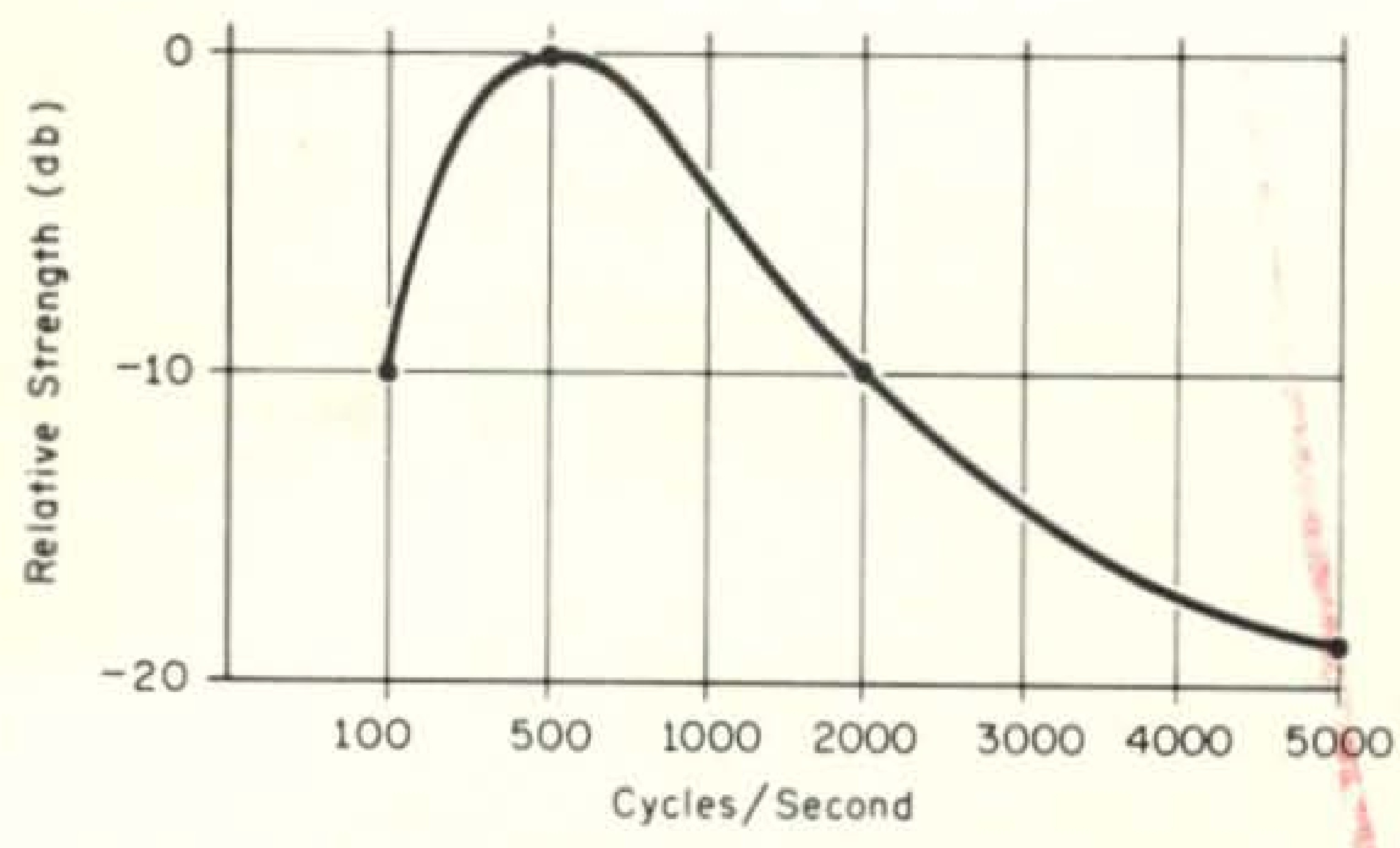

Fig. 4—Typical male speech frequency/power distribution.

amplitude voice quality will retain a few db advantage. The other factor, then, for effective transmission is frequency response and that is what this article mainly explores.

A Chain of Responses

Conveying speech information requires going through quite a chain of responses. Starting with the speakers voice, which definately has a distinctive speech response, the speech encounters a microphone, audio amplifiers, modulation circuits, r.f. amplifiers (once modulated), propagation effects, r.f. processing in a receiver, modulation detection, audio amplification, a transducer (speaker or headphones) and finally the human transducer on the other end. All the mechancal and electrical devices encountered along the way as well as the operator at the other end have specific frequency responses, some of which are fixed and some which vary with time or other factors. Since transmitter power, propagation, or other constraints restrict how much power can be delivered at the receiving point, the objective is not to use any of the available power in conveying frequencies which do not contribute to signal effectiveness.

It was mentioned before that compressors and similar devices improve the average to peak value of speech but they do not provide anything near absolute flat limiting. So the voice tones of highest intensity still determine the transmitter power limit point. That is, if a tone at 200 c.p.s. is of relatively high intensity and one at 1500 c.p.s. is of less intensity, the 200 c.p.s. tone pushes the transmitter to its peak input and is transmitted well but it may not be as useful for signal intelligibility as the 1500 cycle tone. To make best use of the transmitter power, the audio spectrum sent must be weighted for those frequencies which provide maximum intelligibility on the receiving end.

Actually, best use of the transmitter power is only one objective with speech spectrum weighting. The other two are producing "natural" voice sounds and keeping the transmitted bandwidth at a minimum. The latter objective is also automatically taken care of by the first objective of best use of transmitter power but naturalness and intelligibility are not always compatible and most often subjective factors according to the individual on the receiving end.

Specific Responses

Since the whole transmission objective is to maximize the understanding attained by the person on the receiving end, it might be best to study responses starting at that end. Figure 1 is the typical curve of hearing sensitivity versus frequency of a young man. Sensitivity is poor at the low frequencies, rises fairly rapidly to peak around 3,000 c.p.s. and then falls again somewhat more slowly.

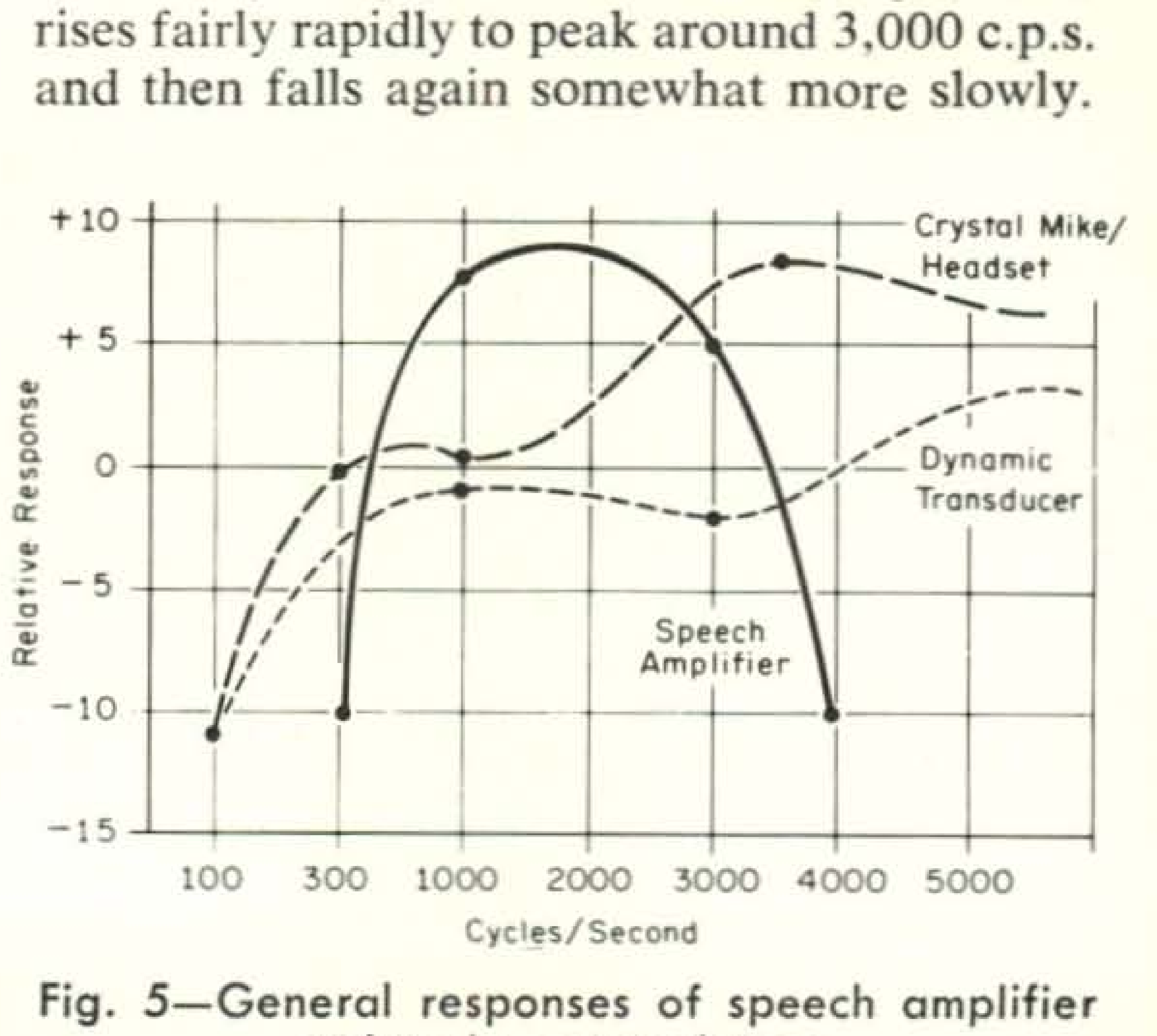

Fig. 5—General responses of speech amplifier and various transducers.

The high frequency sensitivity normally decreases with age. By age 30, the typical response will be down several db in the 1000 to 4000 cycles range; by age 50 as much as 15 db lower response will occur in the same frequency range and by age 60 the reduction in the same range typically falls 25 db. It is interesting to note that a woman's response peak is slightly higher than 3,000 c.p.s. but it suffers relatively little with age.

As uneven as the hearing response of a person is, still not all of the frequencies a person is capable of hearing need be received to produce understanding. Figures 2 and 3 show how understanding is affected by eliminating various portions of the voice frequency spectrum. The graphs are based on the understanding of words and not phrases. The "understand" curves would not fall as rapidly if phrases were used and the listener had a common knowledge of the language being spoken since it has been often demonstrated that only key words need be received for a phrase or sentence to have meaning.

Figure 2 shows, for instance, that all the frequencies above 3,000 cycles/second could be removed and understanding would be 80% of maximum. However, the power removal would only be less than 10%. Figure 3 shhows, for instance, that all frequencies below 500 c.p.s. could be removed and understanding remains about 90%. However, a sizable reduction in the power needed to convey understanding occurs; it drops to about 50%.

That understanding would remain high when the lower frequencies are removed is consistant with the hearing response shown in fig. 1; the ear is naturally more sensitive to the higher frequencies. That a significant power reduction would occur when the lower frequencies are removed is consistant with the power spectrum of the average male voice which is shown in fig. 4 and which shows a pronounced peak in the 500 to 600 cycle range.

It would seem that to transmit speech with minimum power and still retain understanding, one should eliminate as much of the low frequency response as possible; perhaps to 1,000 c.p.s., and let the high frequency response extend out as far as possible since it does not use any significant power. Two problems arise, however. The first is that a person's voice does not sound natural when frequencies of 500 to 1,000 cycles are eliminated. But the more restricting problem for

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most modulation systems is that the transmitted bandwidth increases in direct proportion to the highest voice frequency transmitted and it is generally desired to limit the highest frequency to 3,000 to 4,000 c.p.s. to keep the transmitted bandswidth down to 3 or 4 kc. If this high frequency cut off is established, the lower frequency cut-off must be made lower or the combined "understanding" figure produced by having both low and high frequency cut-offs will not be sufficient for effective communication. The usually aimed-for response of 300 to 3000 c.p.s. is, therefore, a compromise as far as power conservation, understanding, naturalness and bandwidth are concerned. If the latter two factors were not so important a response of 700 to 4000 c.p.s. would appear better. About 20% less power would be required to achieve the same value of understanding.

Once an audio signal is translated to an r.f. frequency not too much happens to it as far as audio response is concerned providing the frequency restrictive devices (Tuned circuits, crystal filters, mechanical filters, *etc.*) used in a transmitter or receiver are allowed to pass the desired r.f. bandwidth. Lack of dynamic range in either a transmttter or receiver produces intermodulation distortion products which can reduce intelligibility, but this is because of the spurious frequencies created. The same is true when an r.f. signal is processed through a limiter stage or r.f. clipper. In the latter cases, however, filters can be used to remove many of the spurious frequencies.

The audio stages in a transmitter before frequency translation and those in a receiver after demodulation affect the frequency response as does the microphone and loudspeaker. Some typical responses over the voice frequency range are given in fig. 5. The audio amplifier stages are assumed to have the coupling components chosen so the response is generally optimized for the 300 to 3000 cycle/second range. This would be typical for most commercial s.s.b. voice transmitters and communications receivers. The individual responses of microphones and loudspeakers vary, in practice, far more than the curves indicate. Individual designs and mountings may cause such devices to have multiple sharp peaks in the 100 to 5000 c.p.s. range. Some very expensive units will have a flatter response than those shown.

[*Continued on page 101*]

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THUNDER AND LIGHTNING

BY JIM ASHE*

THE brilliant flash and piercing, shattering bang of a nearby lightning strike gives us a special deep feeling about thunderstorms. We get an inner mental calibration that relates instantly to our basic survival instincts. The furious wind, rain, and spectacular visual and sound effects all indicate irresistible natural forces. We know the next lightning strike might come down where we stand. But while we may feel no precautions could be effective against those tremendous natural forces, the feeling isn't based on engineering facts. All that disturbance is just runaway atmosphere physics.

As a field of science, atmosphere physics dates back to 1746 or so. That was when Ben Franklin started his kite experiments, studying electricity in the atmosphere. That work still goes on and it has yielded many useful results. Now we have a clear idea what lightning is, even if we cannot guess exactly when and where it will strike. And with the understanding has come the power to protect ourselves and our property. A few simple precautions will almost eliminate the chance of lightning damage to houses, towers, or fragile electronic circuits. Let's start developing that understanding.

Atmosphere Physics

Atmosphere physics is a science concerned largely with electrical effects in our atmosphere. One of its surprising results is that our atmosphere has a constant electrical field amounting to some 100 to 140 volts per meter, directed downward as shown in fig. 1. This field is not easily detected, but other atmospheric effects are more observable. For instance, blizzards, some fogs, dust storms, volcanic eruptions, waterfalls, and nuclear explosions all generate atmospheric electricity, often visible as lightning.

But thunderstorms are the most noticeable source of atmospheric electricity, and they seem to provide it in the largest and most spectacular quantities. What is lightning? Now we know lightning is big electrical sparks in the atmosphere. But at one time it was believed lightning was the visible manifestation of a weapon—called a thunderbolt—thrown by a supernatural being. The thunderbolt was believed directed at some person or thing that had incurred divine displeasure, and people struck by lightning were not aided. Until the 1700's, nobody had direct evidence lightning might be something men might understand. If you have seen any horror movies you know their producers still like to show the most powerful scenes against a good background of thunder and flickering lightning.

In 1746, Ben Franklin set out to discover if lightning might be the same kind of electricity men were making with chemical and mechanical generators. He succeeded, in a series of carefully performed and accurately reported experiments. One of these experiments was to fly a kite into a thunderstorm

*POB 253, Cambridge, Mass. 02138.

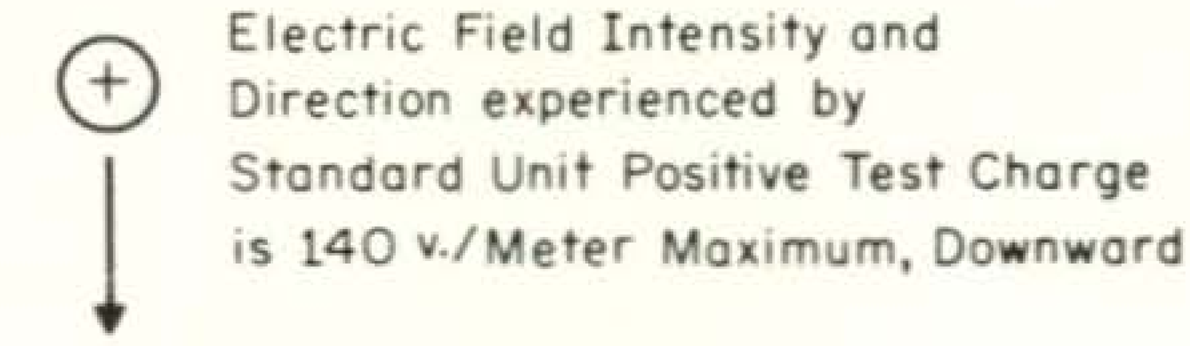

Fig. 1—Early workers in atmospheric physics were very surprised to discover the earth had an electric field with no apparent source.

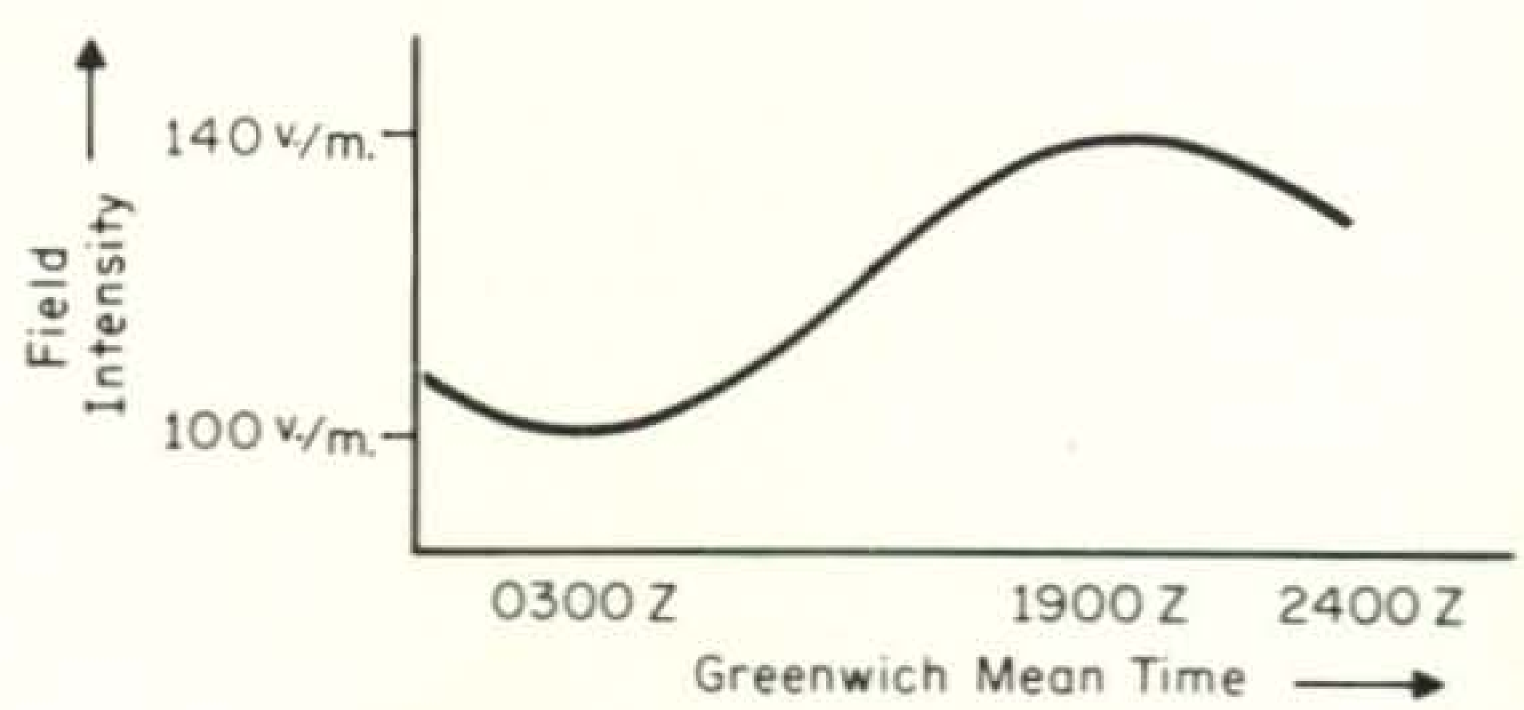

Fig. 2—Additional work showed the earth's field varied in strength in a regular cyclic manner with a 24-hour period.

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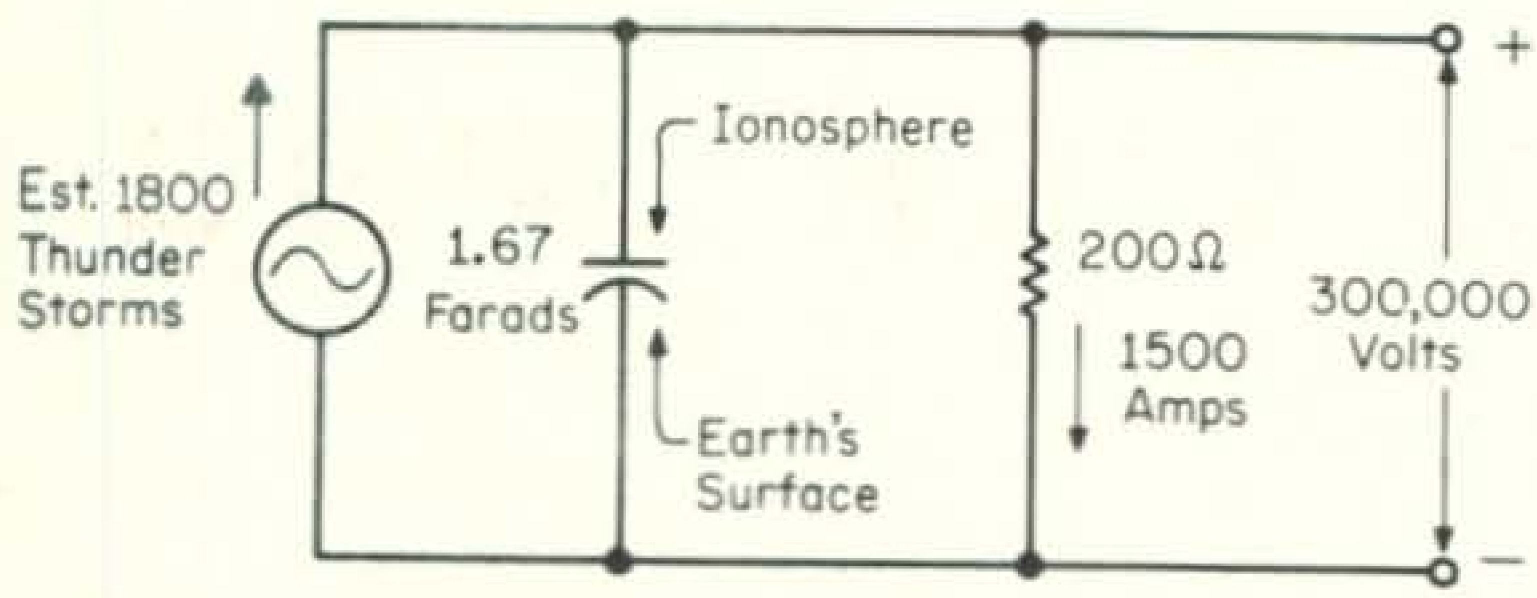

Fig. 3—Equivalent circuit of our Earth's atmosphere.

and see if he could draw electric sparks off the string. It turned out he could, and he was extremely fortunate to survive the experiment. His contemporary, G. Richmann, was killed in Russia trying to perform the same experiment. A similar technique is used today to induce lightning strikes to instrumented test points. Don't you try it.

A research ship off Florida fired 23 rockets one day toward a thunderstorm cloud 3000 feet overhead. The rockets, pulling up fine stainless steel wires, rose an average of 300 feet before strikes resulted. There were 17 strikes from those 23 firings, yielding much interesting test data, it is reported.

Ben Franklin survived to do many other good things, and his work marks the official beginning of atmosphere physics. In 1752, Lemonnier discovered that a "state of electricity" existed even in fair weather. And in 1775 Beccaria observed this electric field showed a daily variation as shown in fig. 2. But measurements were very difficult to make with the apparatus then available and it was not determined until 1883 that the atmosphere's electric field was directed downward. Finally, in 1923 some workers developed an apparent correlation between the field's daily variations and the number of thunderstorms believed to be in progress. And in 1950, two workers, Gish and Wait, were able to measure the current flowing from the tops of thunderstorms. It turned out to be about one ampere, flowing upwards. Summing up these results of 200 years of research effort, we have fig. 3 as an equivalent circuit of our earth's atmosphere electricity circulation.

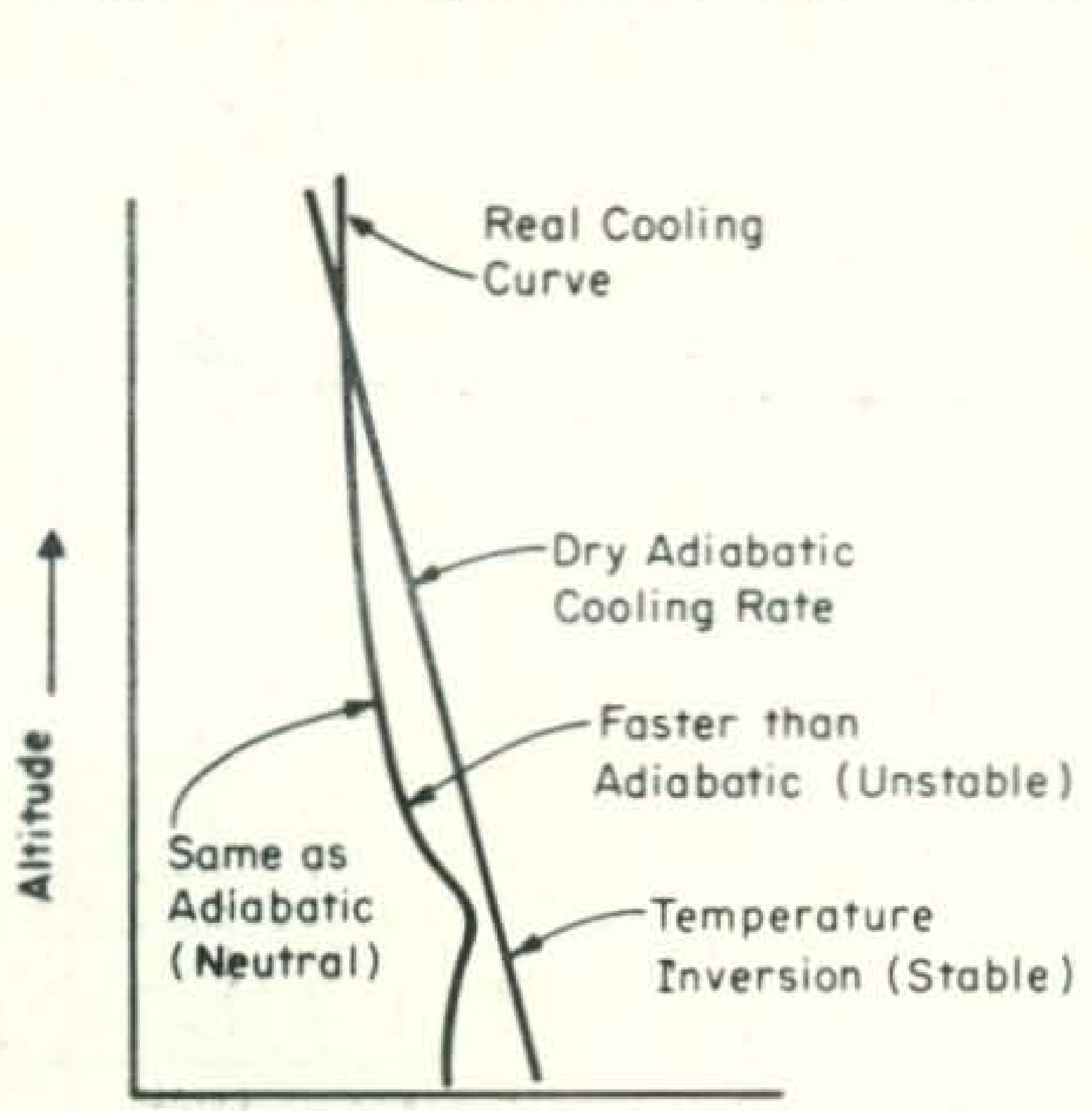

Fig. 4—Ideal cooling curve of atmosphere, compared with an experimental curve as determined by radioscope measurement.

We live on one plate of an immense electrical capacitor. The other plate is our ionosphere. If you find the world and times troubled and confusing, perhaps it will console you to know all this human ferment is taking place in a capacitor of about 1.67 farads, which is a pretty large capacitor. It should be; there are enough of us in it, and perhaps it is a vitally important capacitor. I think nobody knows yet, but I wonder if it isn't a controlling influence on our weather.

The voltage across the capacitor is about 300,000 volts, with a stored charge of roughly 500,000 coulombs. This amount of power is worth about $630 at 3¢ per KWH, and I recall one science-fiction story in which somebody worked out a way to collect and use this power. In the story the process runs away and disasters follow. It is quite a story, but it will not stand a close technical examination. Perhaps that is why I do not recall its title.

But our planetary capacitor is a very leaky capacitor. There is a continuous (conventional) current of around 1500 amperes flowing from the ionosphere back to the earth's surface. All the atmosphere, made slightly conductive by cosmic radiation, by the earth's natural radiation, and with a slight additional contribution from nuclear bombs, acts about like a 200 ohm resistor. Remembering there are a lot of square miles of surface, though, we can work out that the leakage is around 8 microamps per square mile, so our atmosphere isn't as good a conductor as our 200 ohm equivalent resistance might suggest.

How does all that electricity get up there? Fifteen hundred amperes should discharge 500,000 coulombs in less that a minute (namely about 33 seconds, since 1 coulomb = 1 ampere-second) if it is not being replaced somehow. If you have been thinking ahead you have the answer already. The capacitor is charged by our thunderstorms at a rate of about 1 ampere per thunderstorm, which is the significance of Gish & Wait's measure-

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ments made in 1950. In other words, there must be an average of 1500 thunderstorms in progress over the world at any one time. Meteorological estimates suggest about 1800 thunderstorms in progress, and these two figures, considering their indirect sources, are quite remarkably in agreement.

Now, about that daily variation in the earth's electrical field. Could this be because there are more storms at one time of day than another? This seems to be the case, with the peak occurring at the appropriate time for afternoon thunderstorm activity over Africa and the Amazon Valley.

Thunderstorms

To understand what makes a thunderstorm work, we have to know something about basic physics. Figure 4 shows a "dry adiabatic cooling curve." Simply, this tells us how air temperature naturally varies with altitude. If we pick a sample of air at, say, 1000 feet altitude and bring it down to ground level it will become about 5.5° *F* warmer. Or if we raise it to 2,000 feet altitude it will cool off by 5.5° *F*. This is why high mountains have snow on their tops.

Now, what would happen if our boxful of air at 1,000 feet were saturated with moisture, or in other words is at 100% humidity, and we raise it? Some of the moisture condenses out as fog, and the air cools off about 3 degrees per 1,000 feet, which is known as "wet adiabatic" cooling. Our relocated air will be warmer than its surroundings, if we raise it, and will want to rise some more. This slower than dry adiabatic cooling, on a huge mass-production scale, is what makes thunderstorms go.

The basic unit of a thunderstorm is a "thunderstorm cell," a single column of rising moist warm air, surrounded by cloud, wind, rain, and thunderstorm weather. We rarely observe single cells in the sky, because conditions appropriate for one are as good for many and we are likely to see a horizon or a sky full of them. If you know what to look for, though, you can occasionally spot indications that a particular part of a cell is over head.

A cross-section of a single cell is shown in fig. 5. A rising current of air cools gradually but remains warmer than the dry adiabatic curve as its moisture condenses out. The column is rising at velocities that may exceed 80 miles per hour in exceptional storms. At last it comes to an altitude where its temperature is well below freezing, and as it approaches the temperature of the surrounding air its relative buoyancy is lost and its momentum takes it only a little higher.

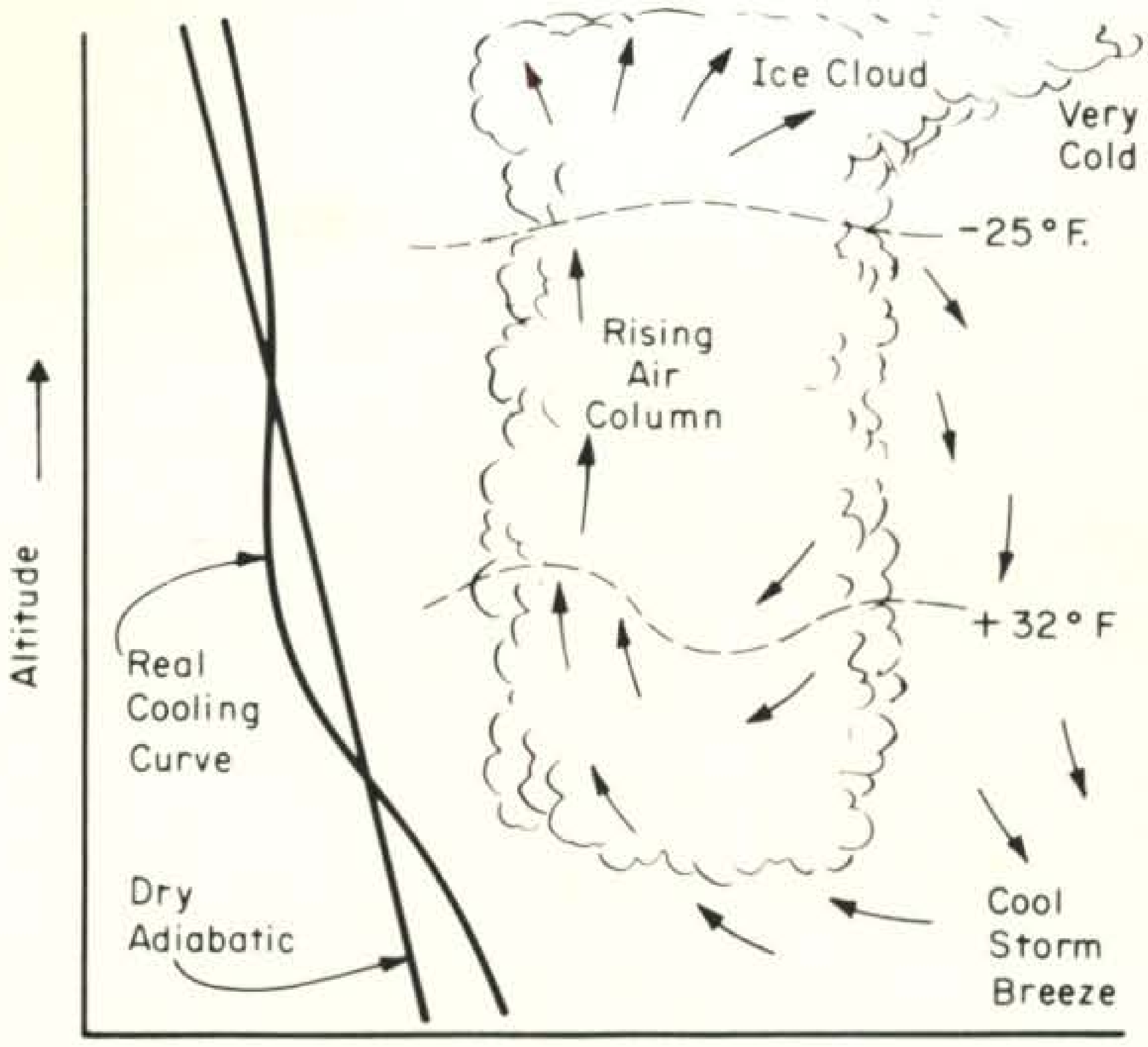

Fig. 5—Simplified structure of a thunderstorm cell. Rising air column is bouyed upward because it is warmer and lighter than surrounding air. At higher altitudes it continues rising because of momentum only.

Ice crystals are formed in the upper levels, and fall back into the cloud where they seed and invigorate the condensation process. They are responsible for the unusually large raindrops observed at the onset of the storm.

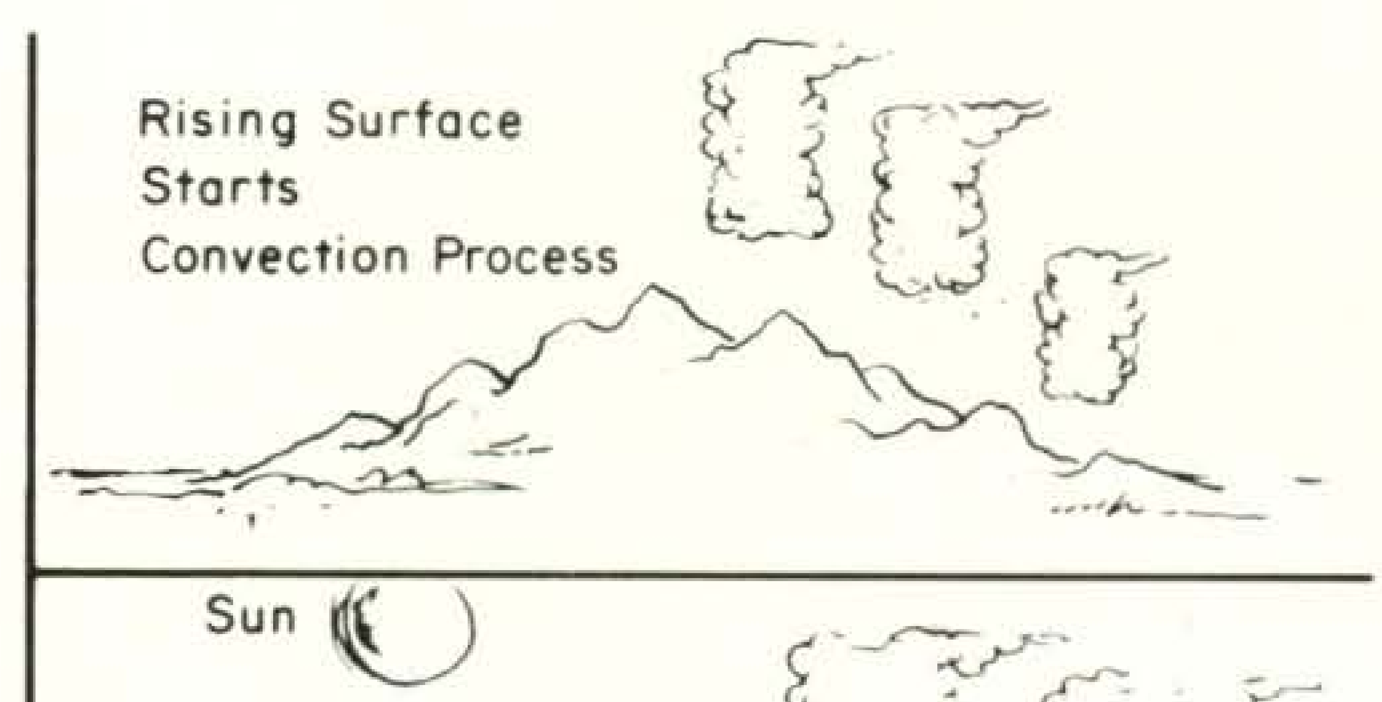

Fig. 6—Three basic ways in which thunderstorms are started naturally.

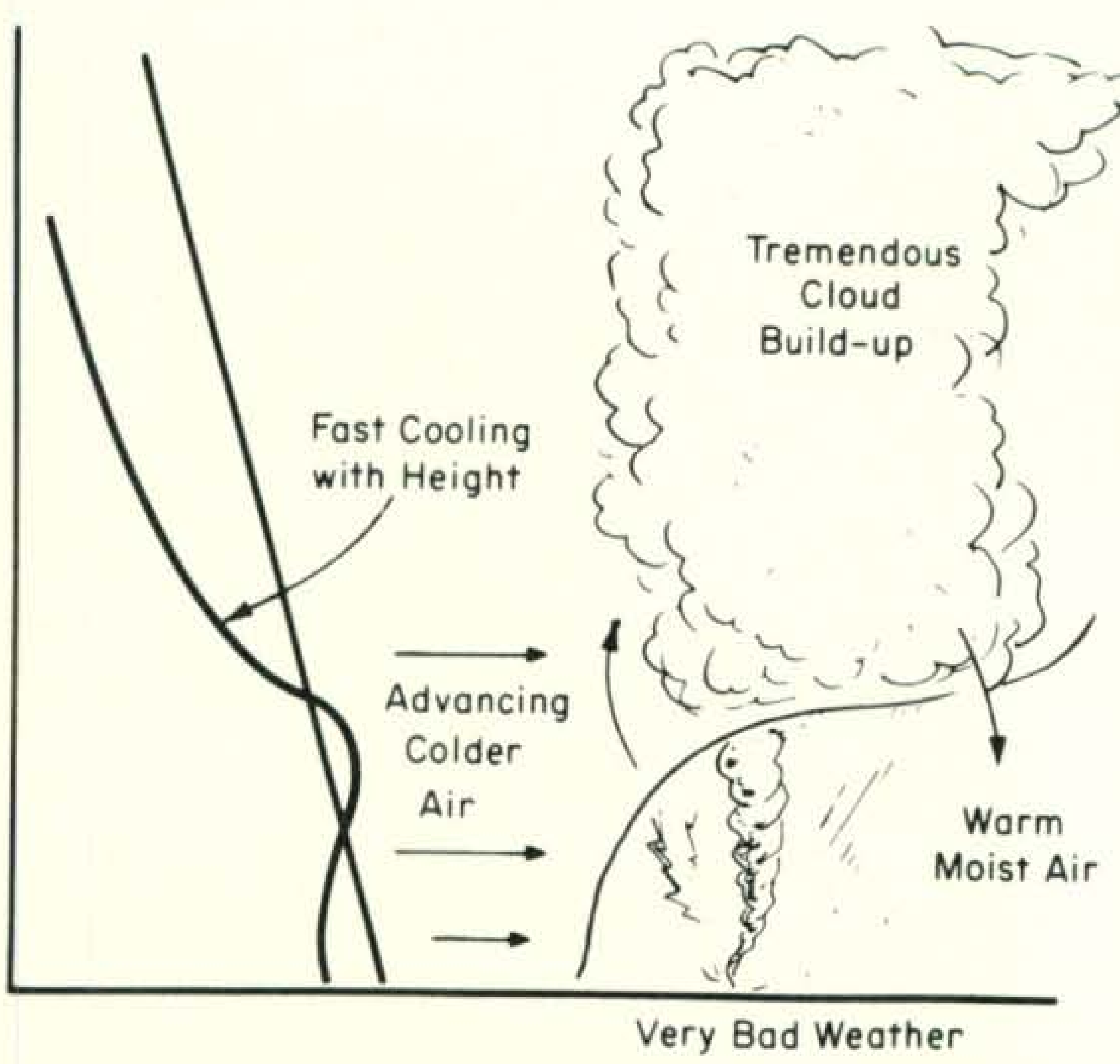

Fig. 7—An over-running cold front, which generates very bad weather.

If the top of the cloud does not extend into freezing levels and there is no ice crystal seeding, there is no storm. The cool draft observed just before the arrival of the storm is some of the high-altitude air falling back to earth, dried and cooled by its excursion to maybe thirty thousand feet. Thunderstorms make nice air conditioners, but I wouldn't want one in my house.

Many natural conditions, and a few man-made ones, can induce thunderstorms. I came across a report that huge thunderclouds formed downwind from the Saturn booster test site during static tests, as a result of the tremendous quantities of heat generated. This booster burns three tons of propellant per second in each of its five engines. The Apollo 8 moonshot takeoff only formed a few small cumulus clouds, since the Saturn was under way and did not release heat at one point to trigger any large cloud activity. And I have seen reports of storms induced in the tropics by burning grass fields at the correct time of day to trigger the convection process. But most storms occur without any assistance from men, and there is much research under way to find ways to control their development.

A storm occurs if there is enough hot, humid air available and some heat under it to start convection, and such conditions can occur in the Plains states as humid air seeps northward from the Gulf of Mexico over the hot plains. Again, the process may be started by warm, muggy air sliding up a mountain range, and the initial mechanical lift starts the convectional process. Meteorologists call these "orographic" storms. Finally, strong storms arise from cold fronts, and really bad ones from over-running cloud fronts. See fig. 6, illustrating the usual causes of thunderstorm formation, and fig. 7, showing an over-running cold front. These are the violent fronts that may be accompanied by tornadoes, which are also known to be very electrical atmospheric events often accompanied by violent, continuous electrical discharges.

Lightning

However impressive it may appear, lightning is only a big electric spark in the air. We no longer think it is a divine manifestation, to be averted by bell, Bible and holy candles. Now we use air terminals and think about ground system engineering, and appreciate the reduced insurance premiums offered to the owner of properly protected property.

Over the past years researchers studying lightning have solved some very difficult problems. Lightning strikes are not very predictable, and voltages and currents are very high. Some of the test gear used has been simple steel strips, which remember the peak magnetic field and so indicate the peak current of a strike; instrumented rockets; carefully protected oscilloscopes, and a wide range of photo recorders to determine what actually happens when there is a flash of lightning. The story is quite complex. We'll start at fig. 8.

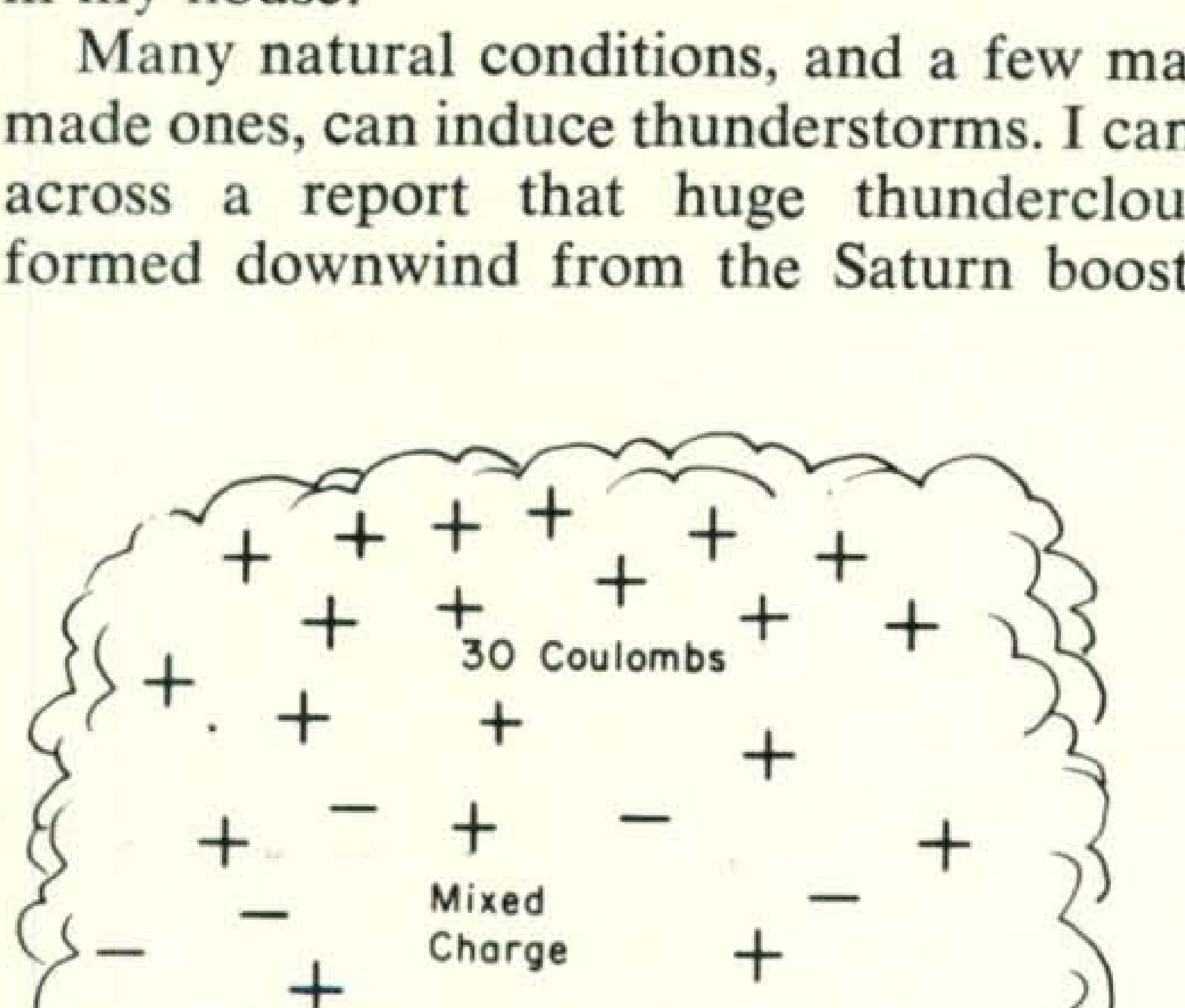

Fig. 8—Charge distribution in a thundercloud. Bound charge in earth is held by attraction, as described in basic physics books.

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Here is our thunderstorm cloud again. The rising air column carries ice particles and drops of water joining and breaking and splattering against each other. Electrical charges are generated and the positive charges carried upward in the cloud, while the negative ones are not. The rising air columns acts in a manner resembling the moving belt of a Van de Graaf generator.

Typically, our thunderstorm cell has about 1,000 coulombs of positive charge mixed with about 1,000 coulombs of negative charge distributed throughout its interior, and this averages out to electrically neutral. But about 30 coulombs of positive charge is accumulated in its upper volumes at about one hundred million volts with respect to ground, and at its bottom there is another 30 coulombs of negative charge, which is about one hundred million volts negative with respect to ground

Finally, in the surface under the cloud we have what the physicists call a "bound charge," which is held by the attraction of the charge overhead in the cloud. Since the cloud charge is negative, the bound earth charge is positive. As the cloud moves across the countryside at up to forty miles per hour, this bound charge races along under it, perhaps upsetting long-range telephone and other communications systems as it goes.

These potentials build up to a breaking point, and we see a flash of lightning. Many flashes occur between the two oppositely charged volumes in a single cloud, or between clouds, and are up to a mile or two long, although there are reports of flashes as long as 9 miles,

But the most interesting flashes, from our viewpoint, are the ones that strike the ground. The development of these flashes is pretty well worked out and best illustrated by imagining we are looking at pictures taken by a moving-film camera. The film, moving continously, acts as a fixed time base, and if a lightning flash were an instaneous event, we would see an image like that of fig. 9. We would get a single straight line, since all parts of the image would be illuminated simultaneously.

Instead, we get a more complex picture, similar to that of fig. 10. Up in the sky somewhere there is an initial breakdown, and it forms a lightning flash that may be only a few tens of feet long. The initial flash acts as an electrical connection between charged areas, and the developing field encourages the flash

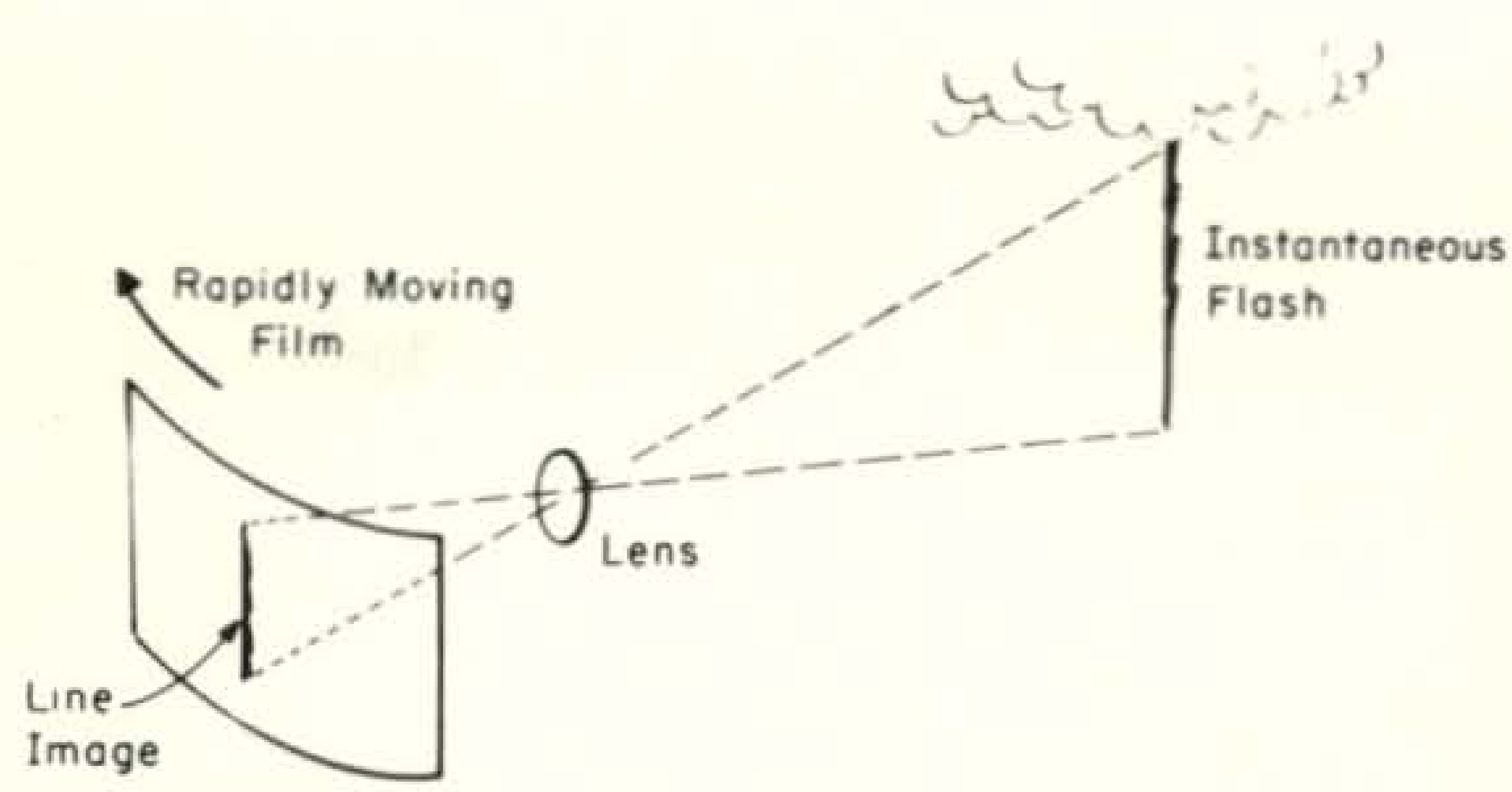

Fig. 9—A moving-film camera illustrating the image obtained if we are photographing an instantaneous flash.

to extend itself to a new high-potential region. Let's call these preliminary, exploring flashes "leaders."

Leaders typically develop downward, since that is the direction of strongest field. A leader advances a few tens of feet, and then there is a brief pause, and then the leader advances again. As the leader approaches the ground the field becomes very intense and another leader may develop, leaping from the ground up toward the sky. Since the processes that develop negative leaders are more effective than those that develop positive leaders, the two meet at an altitude of a few feet or tens of feet.

When the leaders meet the ionized channel is complete, and then the actual strike occurs. There is a brilliant flash, and then another flash as new leaders find additional charged areas, and there may be several flashes after that over a duration of one half second or so.

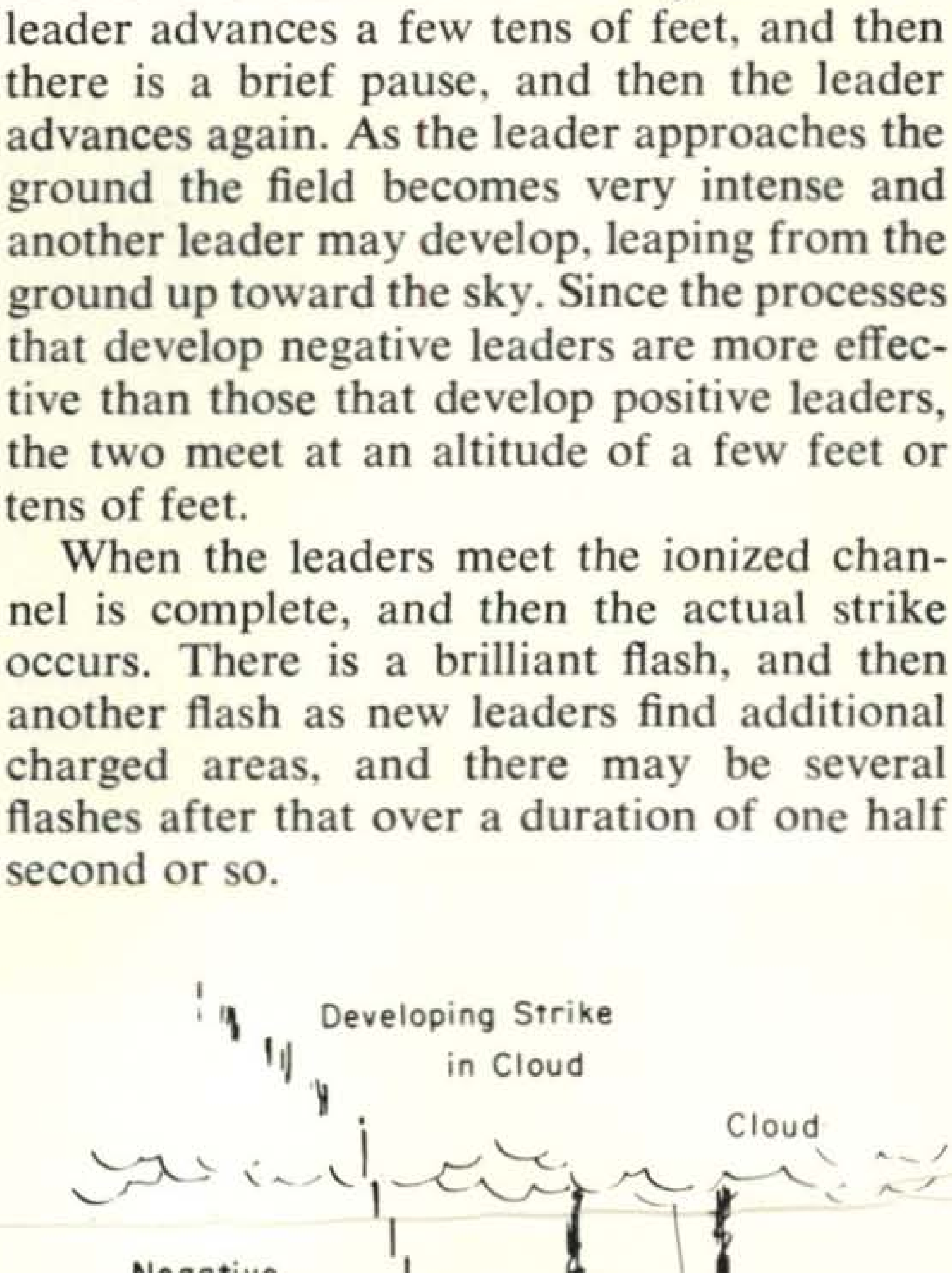

Fig. 10—The real image (very much simplified here) shows a lightning strike is a complex sequence of events. Thin diagonal line leading to second strike is a "dart leader," which moves very rapidly along the path of the preceding strike.

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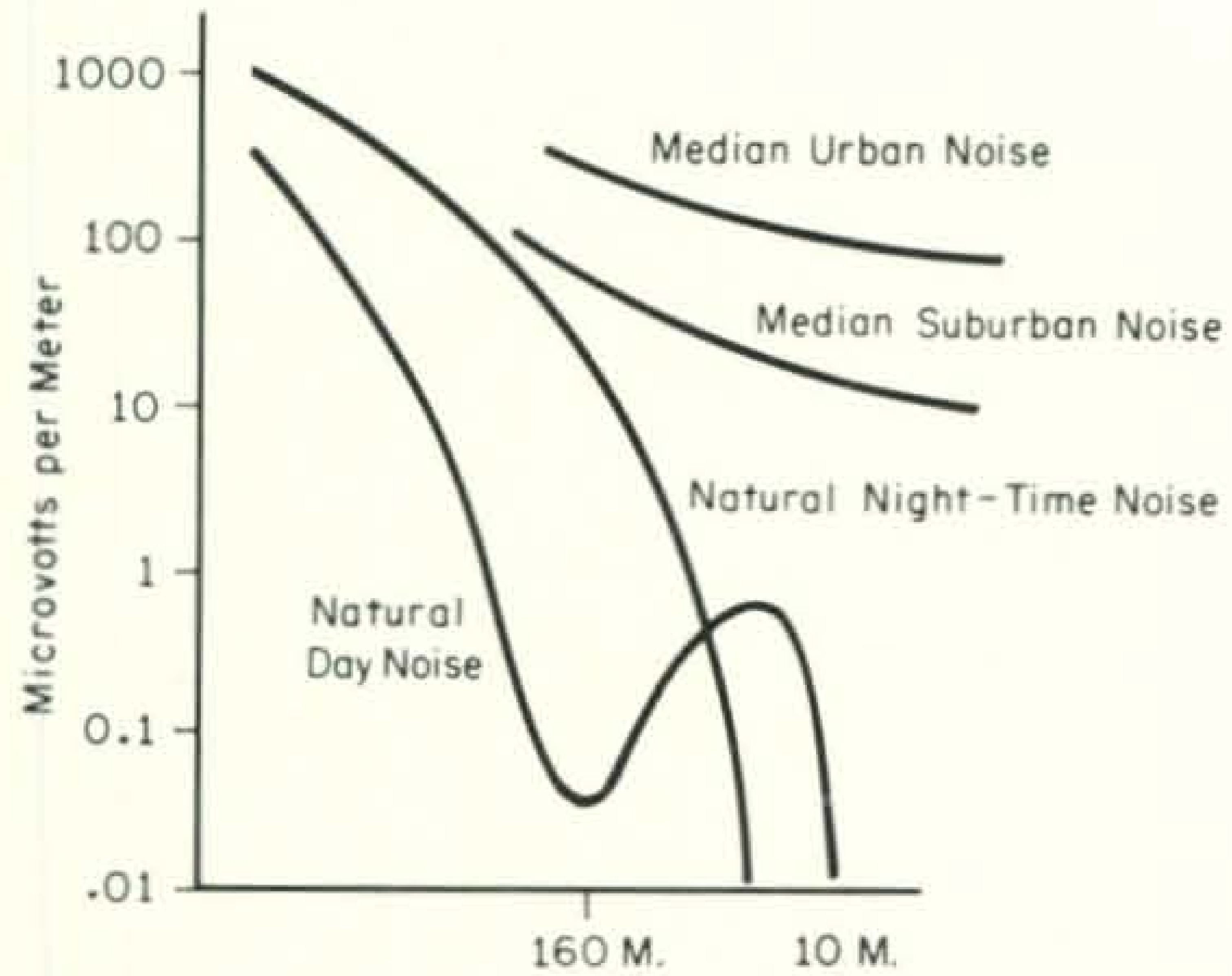

Fig. 11—Natural noise, due almost entirely to thunderstorms, shows a strong field strength dependency upon frequency and upon time of day.

Leader currents may be up to 1000 amperes, and strike currents are typically ten thousand to hundreds of thousands of amperes. Each strike ends when there is no longer enough charge available to maintain a current of 50 amperes or so, and the sequence ends when all available charges are used up. The thunderstorm cell typically replaces the lost charge in a few seconds, and the total energy released in a single strike is typically in the 350 KWH area.

Opinions and reports are in conflict, but it appears there really is something called "ball lightning." This is a bright reddish or bluish

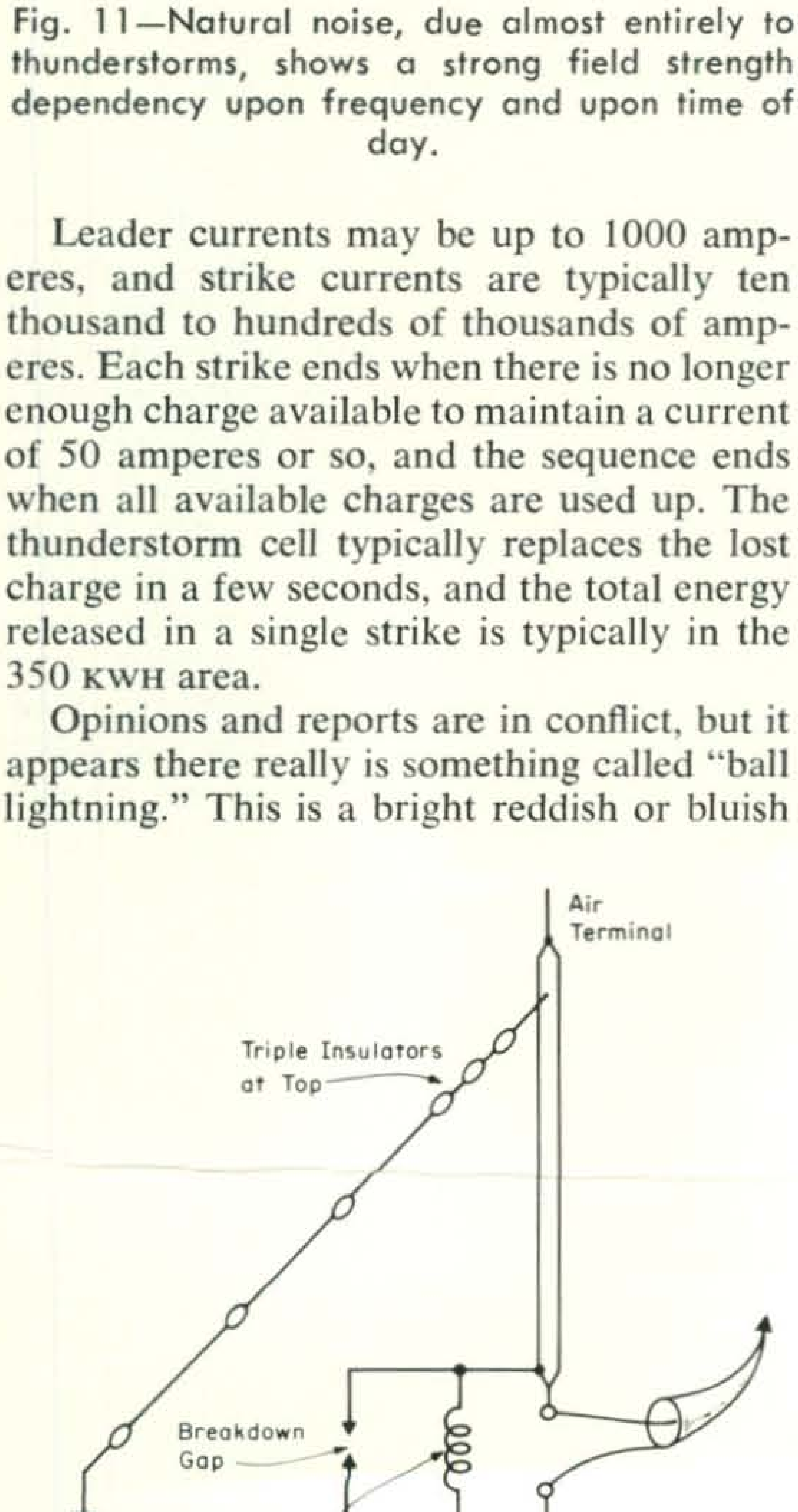

Fig. 12—Tower, with everything. Good tower safety design is not very complex and even a large installation can be completely protected for a few dollars additional cost.

ball whose diameter ranges from golf ball to basketball size. Laboratory attemps to produce ball lightning have met with moderate success, and current thinking about ball lightning has been strongly stimulated by some results of thermonuclear research.

There are two forms of lightning strike, "hot," and "cold." The literature I have seen on this is not very informative, but suggests the difference is that a "cold" strike is a leader only, perhaps followed by a single stroke, and "hot" lightning is the complete treatment of several strong, consecutive strokes.

In a nutshell, all lightning is bad news, even if it is miles away from you. If you are working on the lower bands you hear it as soon as you turn your rig. See fig. 11. This is a rough indication of the noise levels produced by lightning, and it is very interesting to note the daytime minimum in the 160 meter band.

Lightning Protection, Outdoors

What do you do if lightning strikes? If some of the popular literature I have read is any indication there is little to do and you might as well relax. Various stories relate such events as the exploding of a fifty foot trench two feet deep, and a good size hole through a fourteen inch concrete wall at the end of it. Other stories describing a sequence of events that might have lasted a tenth second are, I think, a bit unlikely.

But my research went a lot deeper than those reports. If lightning strikes it probably won't strike again right away (though it might strike again within a few years) and you can give your attention to the damage. If a man is struck by lightning he has a chance of complete recovery, provided you spend a minimum time looking at things and get on with the ordinary resuscitation measures prescribed for any electrical shock victim. If there is a fire you call the fire department and then try to put it out yourself, and *etc*.

There is much you can do to prevent lightning strikes. Lightning rods have been replaced by much smaller spikes, and we call these "air terminals." Look again at fig. 8. The air terminals dissipate the cloud's bound charge harmlessly into the air *before* the strike conditions develop. It has been observed that high structures simply do not get all the lightning traffic you would reasonably expect, and this is because they discharge both earth and cloud charges before they reach critical levels. Properly installed air terminals on your house may result in a re-

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duced insurance rate, too.

Here in fig. 12 is a single tower provided with about everything in the book. A single spike at the top serves as an air terminal, and this can be a six foot length of stainless steel rod. Any breaks in a direct route to ground are shunted by heavy duty r.f. chokes to provide a path for occasionally heavy currents passing up to the air terminal, and each choke has a breakdown gap across it to conduct a heavy lightning stroke. The feedline is similarly bypassed. If there are any bearings or rotating joints they are shunted with heavy braid straps. which avoids a free welding job one day. The guy wires are broken with the usual insulators, but there are three insulators near the tower. This encourages any strikes to the guys to pass downward away from the tower, rather than toward it, and each guy should have a good ground connection at its anchor.

Finally, a lightning arrestor system is provided at the point where the feedline enters the shack, as shown in fig. 13. When this system is worked out for your particular installation then sit back and think about it for a few minutes. Probably you can see any weak points the lightning can spot, and make corrections before trouble comes.

My reading about lightning has changed my perspective on tower work. There are stories of bolts from the blue, and after researching this article my new picture of our highly electrified atmosphere lends these reports some meaning. But I think it is more likely any such bolts emanated from a rather cloudy sky and the victims were adequately warned. Here is a word of advice. If there are any ominous looking clouds in sight, and particularly if you have heard thunder or even think you might hear it, I'd stay off that tower.

Lightning Protection, Indoors

If your solid-state receiver or converter develops a sick input transistor you might think the damage must have been done by a recent lightning discharge. Does that still have a reasonable sound? It should not, if you have read this far. Here are some more facts.

Amateurs occasionally report high voltages developing on their antennas during blizzards or dust storms. A passing thunderstorm type cloud may induce a strong earth charge and coronas without any lightning being evident. See fig. 8, once more. Strong winds may blow enough material around to induce rather high voltages and currents in a

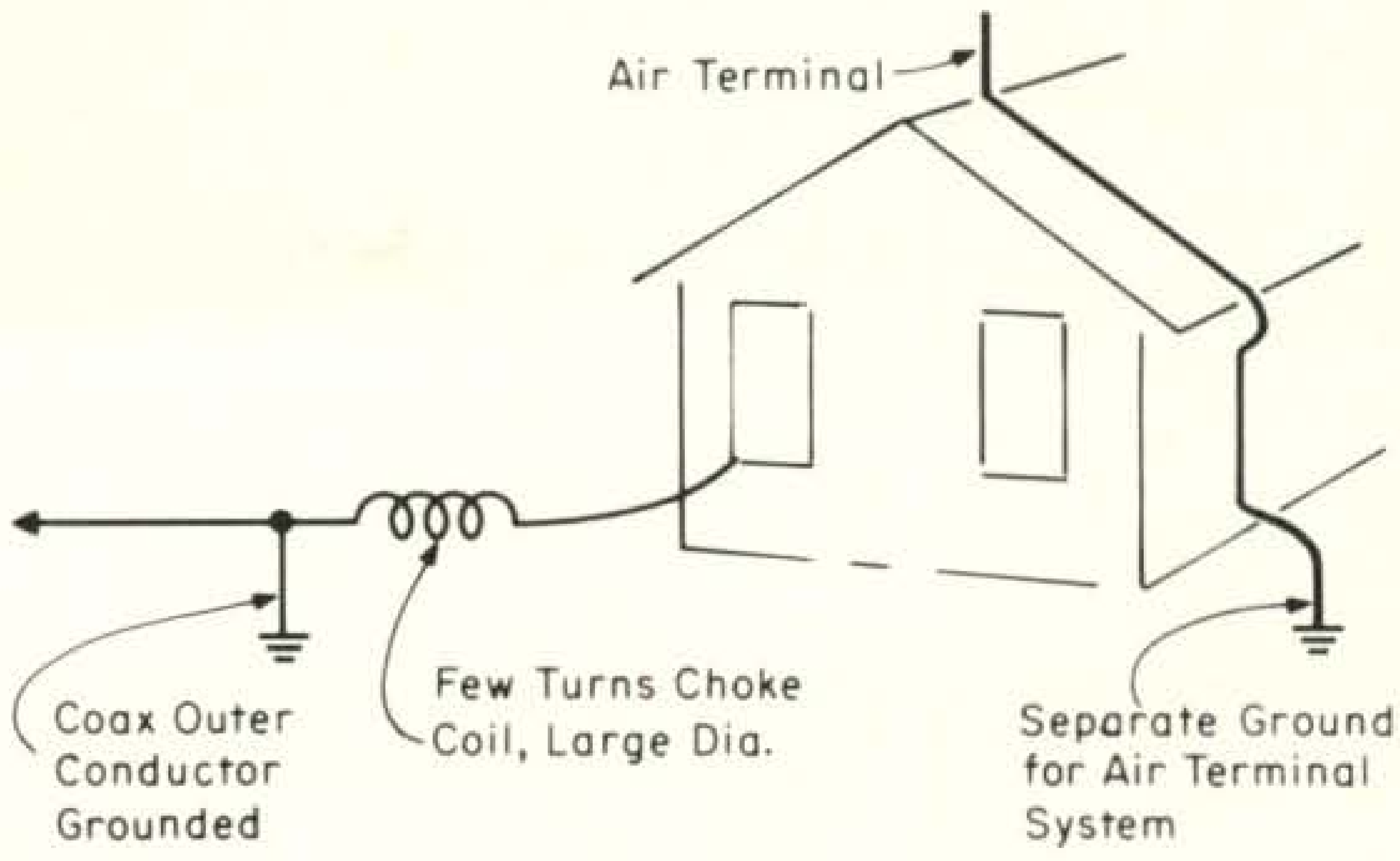

Fig. 13—A choke coil and additional grounding removes any chance a lightning strike could enter the shack. This is the same approach used in power line terminals and substations, and their large choke coils are clearly visible from outside the installation.

large antenna assembly. For instance, commercial practice is to ground both ends of a Beverage antenna because some atmospheric conditions will induce enough power into the antenna to burn up a fair-sized terminating resistor. See fig. 14. Our very electric atmosphere can harm fragile transistors easily.

No sophisticated design strategy can beat unplugging your gear when you aren't using it. A good BNC connector joint can be broken and remade many hundreds of times, if the male and female parts are properly assembled in the first place (BNC's seem very prone to trouble in this respect) and if the connector is handled gently. And BNC's are pretty good up to 10,000 mc. If you are on the air say 5% of all the hours per week and avoid operating when the weather looks dangerous, the opportunities for damage from atmospheric electricity are reduced by a factor that looks from here to be in the order of 1,000 to one. That's a pretty good return on a simple disconnecting operation.

The next strategy is to include something in your electronic circuit that blocks unwanted natural electricity. An appropriate

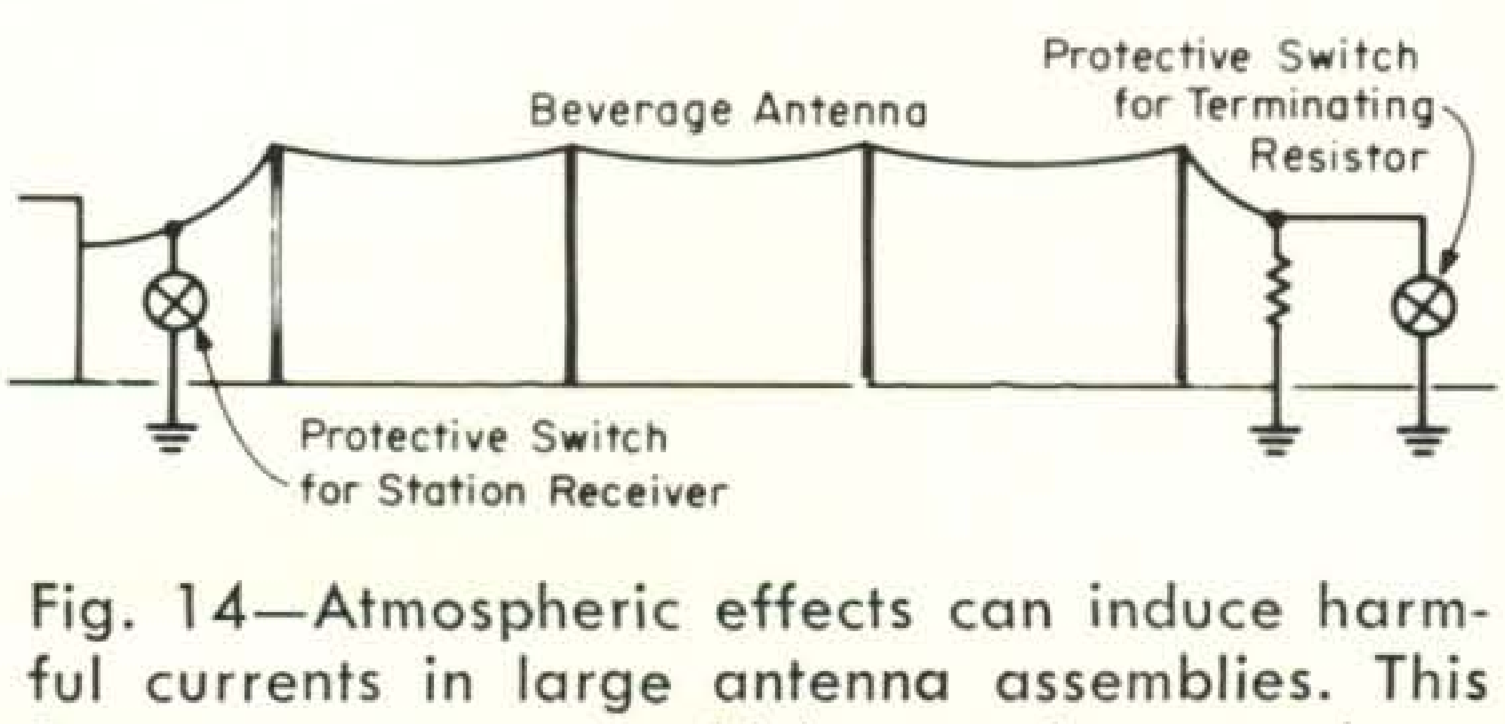

Fig. 14—Atmospheric effects can induce harmful currents in large antenna assemblies. This Beverage antenna, which may be very long, must be shorted to ground at both ends.

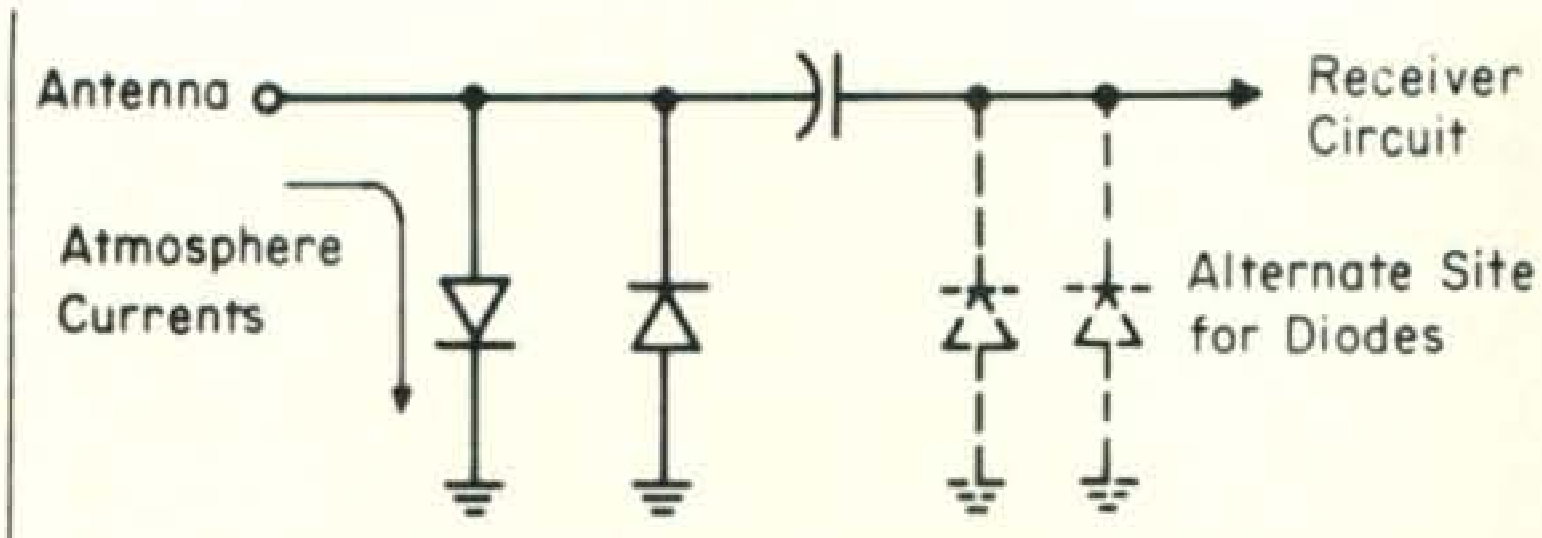

Fig. 15—Protective diodes may be used to reduce the voltages developed in electronic circuits. If overloaded, the diodes fail, become good shorts, and will have to be replaced.

diode and capacitor circuit appears in fig. 15. The capacitor is chosen to have the least capacitance adequate for transmission of the signal, and I suggest a ballpark figure of 2 ohms reactance in a 50 ohm circuit. That would be 0.02 microfarads at 80 meters, 680 mmf on 2 meters, and so on. The capacitor limits the charge applied to the transistor base circuit, and you can add a couple of germanium diodes for good measure. They act as limiters to conduct stray antenna currents to ground but should be easily replaceable. If your antenna is picking up electricity from the air and one of the diodes is in conduction it will short out your signal. Maybe you could put them on the other side of the capacitor.

A nicer arrangement is to provide a d.c. path for any natural electricity as shown in fig. 16. Here, we are using autotransformer matching circuit, or simply a shunt LC arrangement, which provides a d.c. short across the input. Stray currents are carried to ground, and you can add the blocking capacitor for good measure. These simple schemes can be adapted to any front end circuit with a minimum of difficulty if the tuning range is narrow, and will prevent loss of valuable solid state components.

Summary

Lightning is natural electricity in large quantities. It is predictable in an average way,

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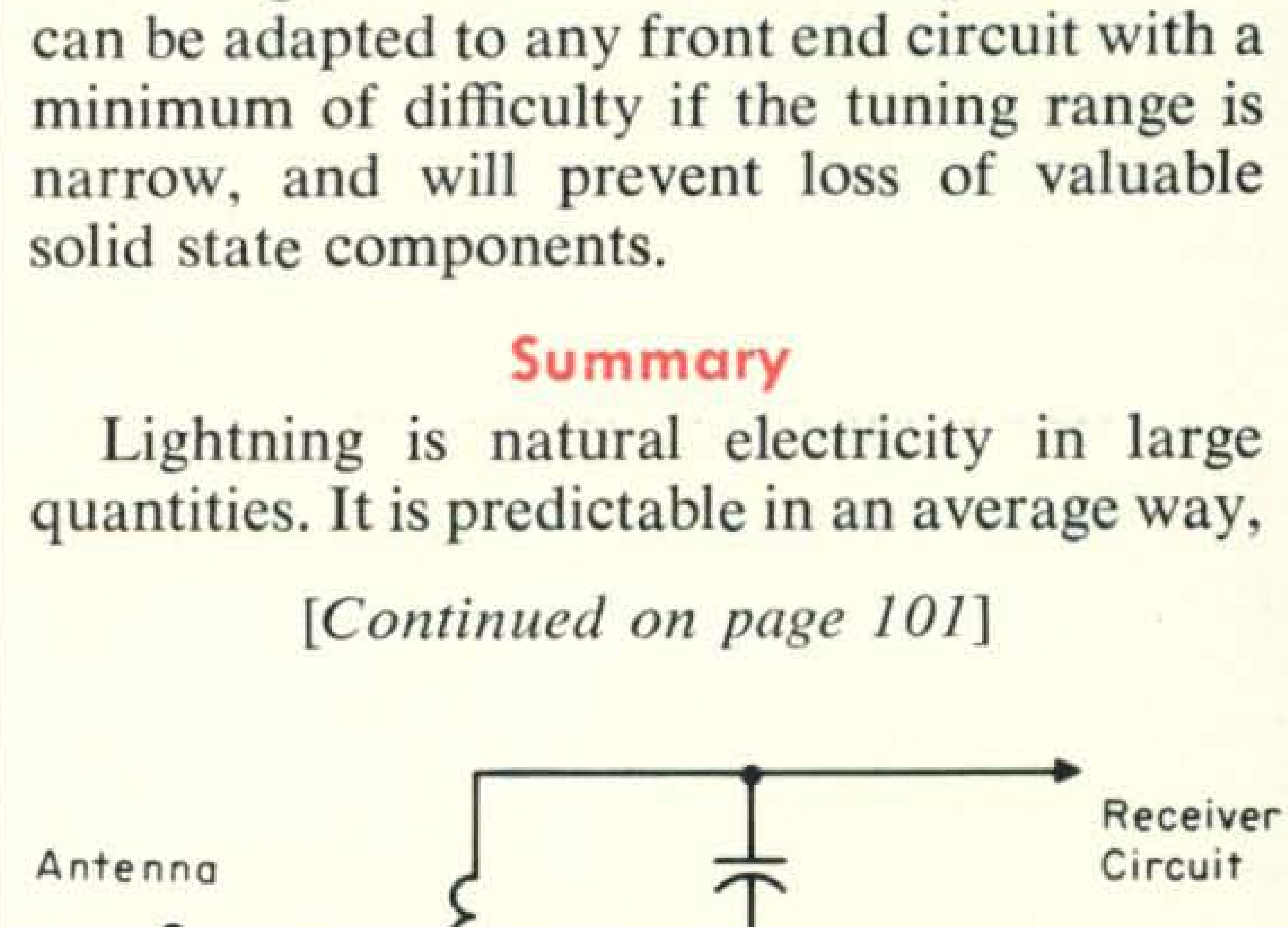

Fig. 16—A nicer way to keep atmospheric electricity out of your circuits. An LC resonant circuit is a short at d.c. but practically lossless at r.f.

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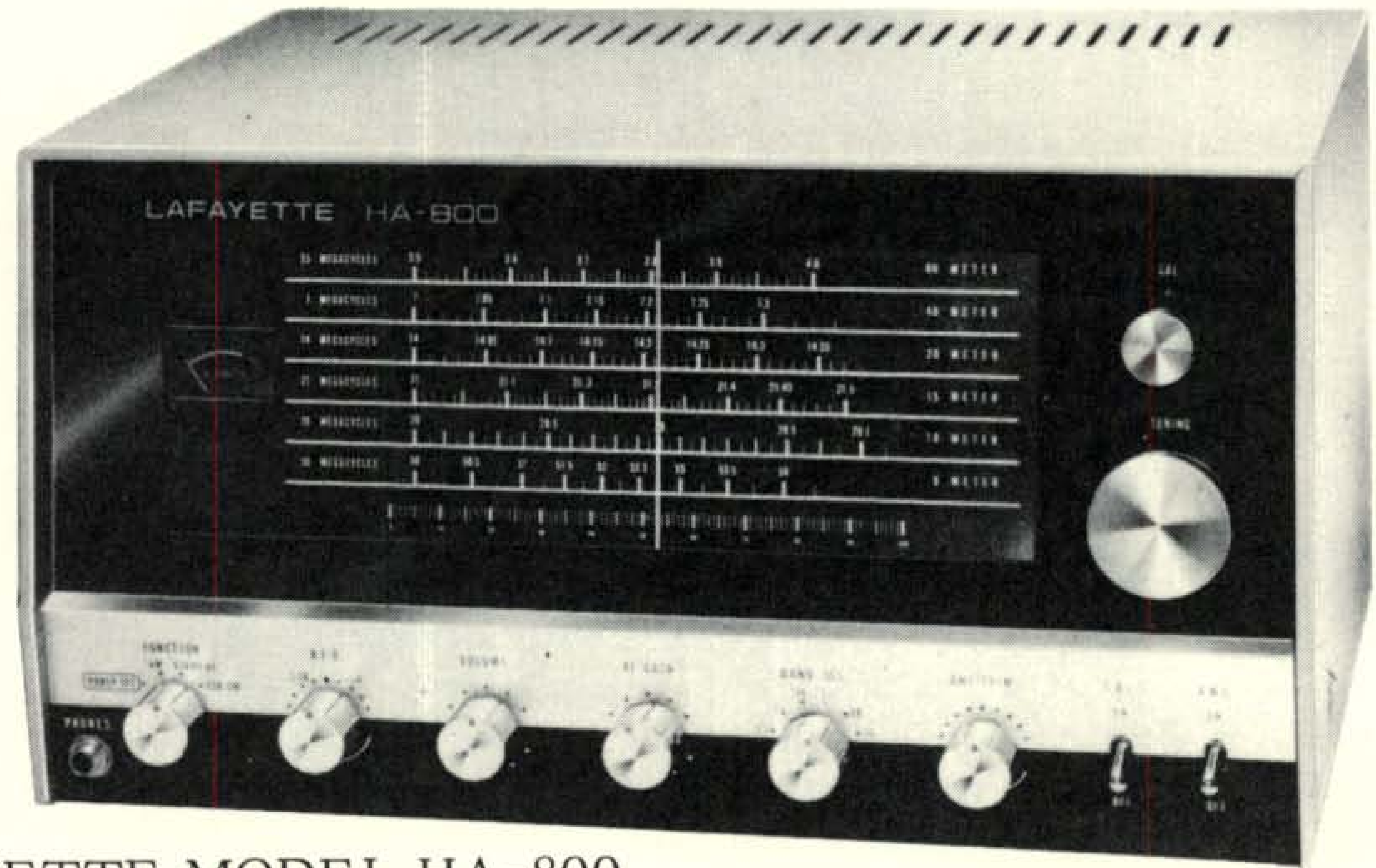

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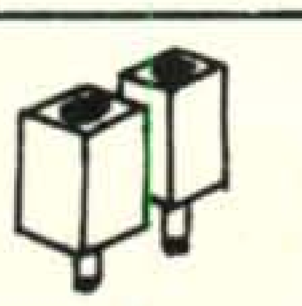

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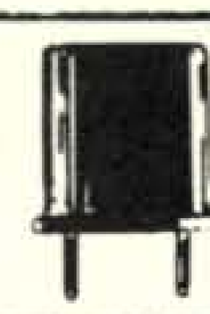

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Opinion;

A New Concept for the Amateur Extra Class License

BY JOHN A. ATTAWAY,* K4IIF

ALL active U.S. amateurs are aware of the changes in the Incentive Licensing system which were adopted by the Federal Communication's Commission in 1967 and implemented in 1968. For the first time in history it became necessary for a US amateur to hold the amateur Extra class license in order to gain full amateur privileges. This was a sharp departure from the philosophy in most other countries where amateur tests are generally much less difficult than the US General class examination.

Although two years have elapsed since these changes were announced, only a small percentage of US hams have bothered to qualify for the Extra class license. It would seem that like prohibition, the new licensing regulations were well intended but have proven to be bad law.

Let's take a few minutes to examine why. First of all, the name amateur Extra implies that a person holding this title is known to be doing an outstanding job in meeting the objectives of the amateur service. However, in practice this just isn't true, and the amateurs know it. A person can be a lousy ham according to the definition of FCC regulation 97.1, Basis and Purpose of the United States Amateur Service, and still be "Extra class" under the law. Consequently, the response of US amateurs has not been enthusiastic.

To clarify this position let's examine regulation 97.1, particularly its definition of the fundamental purpose of the Amateur Radio Service. It expresses this purpose in the following *five* principles. Note that there are five principles, not one. They are as follows:

"a.) Recognition and enhancement of the value of the amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications.

"b.) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.

"c.) Encouragement and improvement of the amateur radio service through rules which provide for advancing skills in both the communication and technical phases of the art.

"d.) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.

"e.) Continuation and extension of the amateur's unique ability to enhance international good will."

The obvious question is how well so these objectives correlate with the requirement of the amateur extra class license. Unfortunately, one must answer that the correlation is poor. Only point c.) is directly related to the requirements for the license class. Look at it point by point. Principle a.) is concerned with improvement in the ability to provide emergency communications. Obviously, no matter how dedicated and effective an amateur may be in providing emergency communications, the licensing regulations give him no recognition. Ironically, a lid who inadvertently interferes with emergency communication may have passed the 20 w.p.m. code test and thus be a superior Extra class ham.

With regard to point b.), contributing to the advancement of the art is becoming less critical in the modern amateur service because technology has outstripped the ability of most amateurs to make basic discoveries at the home workbench. While amateurs have certainly made contributions through Project OSCAR and the moonbounce experiments, major advances today are made in

[*Continued on page 94*]

*P.O. Box 205, Winter Haven, Fl. 33880

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CQ Reviews:
The Raytrack 6-Meter and 10-80-Meter 2 Kw Linear Amplifiers

BY WILFRED M. SCHERER,* W2AEF

FOR those desiring to go all out in a big way with high power on the 6-meter or any of the 10-80-meter amateur bands, the Raytrack linear amplifiers will provide such operation with input powers of 2000 watts p.e.p. on s.s.b. and a.m. or the maximum legal input of 1000 watts d.c. for c.w. and RTTY. Drive requirements are 100 watts for s.s.b., 50-70 watts for c.w. and RTTY and 30 watts carrier for a.m. which are easily obtainable from most of the popular exciters.

The Horizon VI L is strictly a 6-meter job, while the DX-2000-L is a bandswitched unit for 10-80-meter operation. These amplifiers are table-top models using an external power supply which may be placed on or below the operating desk.

Technical Details

Except for the frequency range, bandswitching and the tuned-circuit components, both models have the same basic circuitry and features.

Referring to the schematic for the 6-meter unit shown at fig. 1, the amplifier functions in a class-B grounded-grid setup using a pair of zero-bias 3-500Z triodes. Because of their excellent performance in this type service, these tubes have fast become popular for use in high-power linear amplifiers.

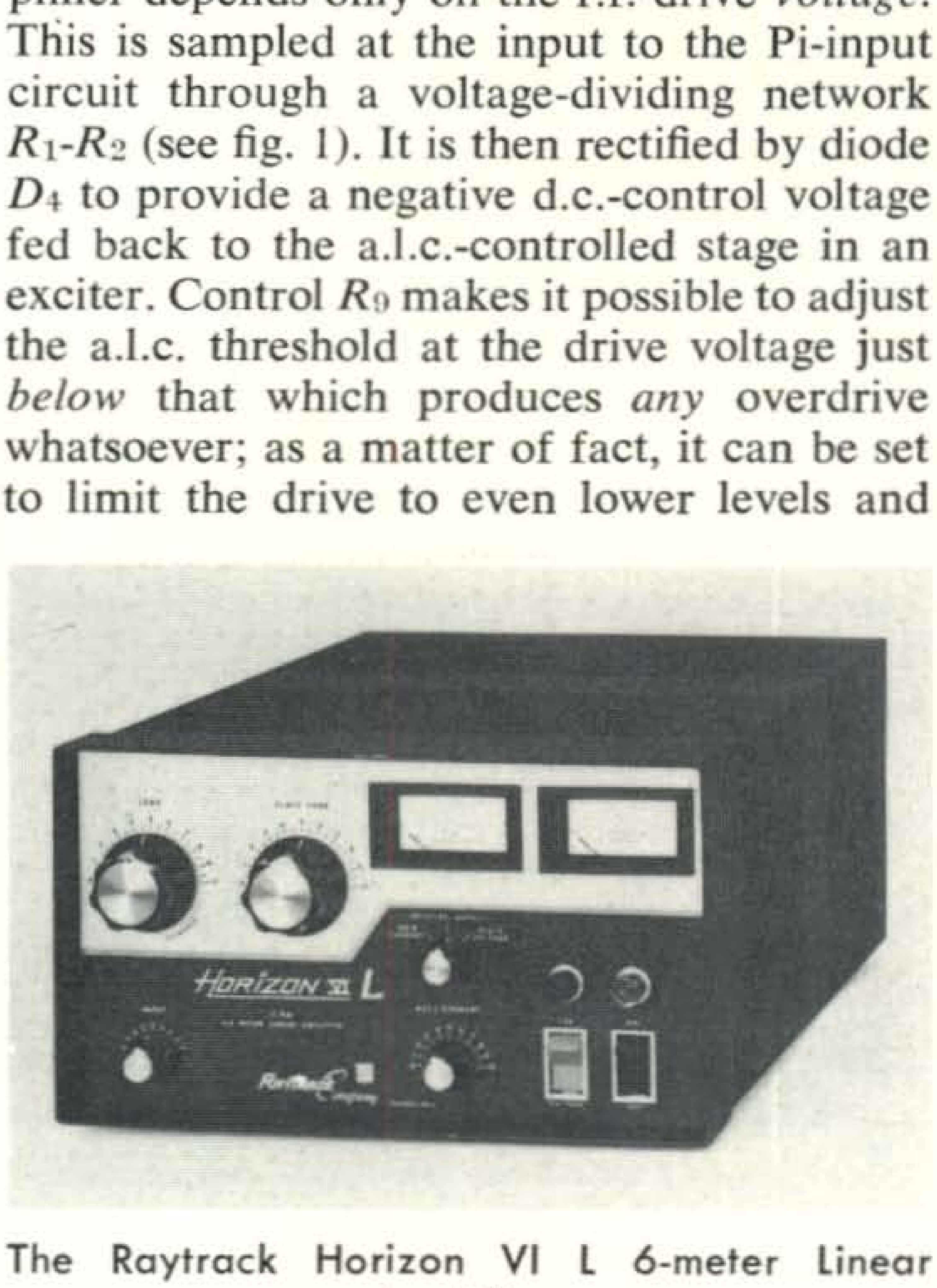
R.f. drive is applied to the tube cathodes (filaments) through a tunable Pi-network which has a nominal input impedance of 50 ohms. The tuned input presents a constant load to the exciter for good regulation to minimize distortion. It also makes the amplifier easier to drive and provides better efficiency than would a passive input.

The conventional use of bifilar-wound filament-lead chokes prevents the r.f. at the filaments from being bypassed to ground through the filament transformer.

A Pi-network also is used for the output circuit and it has an adjustable loading capacitor for matching to 50-ohm loads presenting an s.w.r. within 2:1.

Although the a.l.c. setup is unique, it is not a new idea, having been employed similarly in one or two cases before; yet it is one which we've often wondered why is not in more general use, particularly in exciters where the customary a.l.c. systems depend on some initial grid-current flow or overdrive before a.l.c. action takes place.

The arrangement used in the Raytrack amplifier depends only on the r.f.-drive *voltage*. This is sampled at the input to the Pi-input circuit through a voltage-dividing network R_1-R_2 (see fig. 1). It is then rectified by diode D_4 to provide a negative d.c.-control voltage fed back to the a.l.c.-controlled stage in an exciter. Control R_9 makes it possible to adjust the a.l.c. threshold at the drive voltage just *below* that which produces *any* overdrive whatsoever; as a matter of fact, it can be set to limit the drive to even lower levels and



The Raytrack Horizon VI L 6-meter Linear Amplifier.

*Technical Director, *CQ*.

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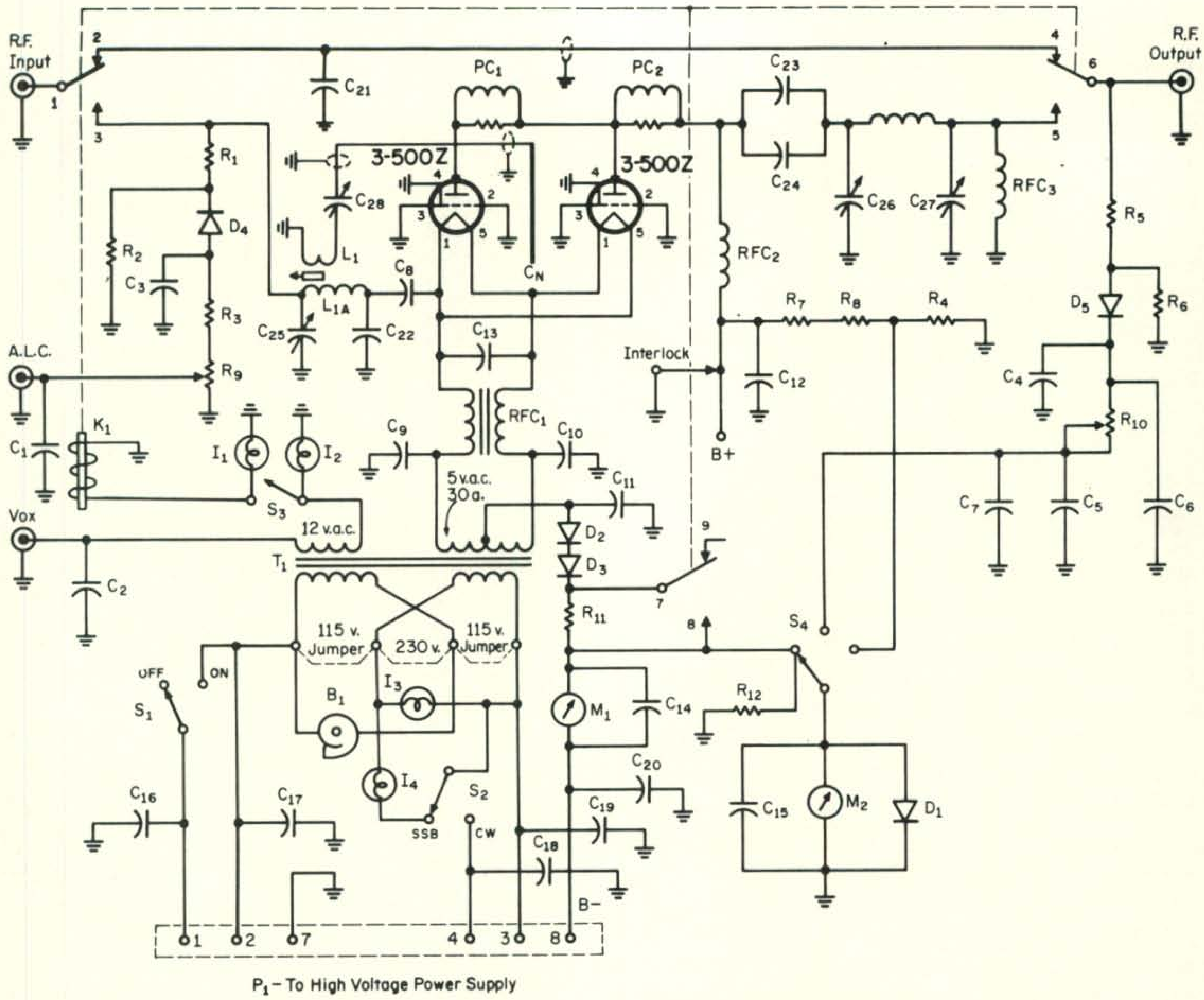

Fig. 1—Schematic diagram for the Raytrack 6-meter linear amplifier. When the exciter only is used, C_{21} (27 mmf) compensates for reactive effects in the transfer setup that might otherwise alter the s.w.r.

thus hold the peak power anywhere below the normal amount. It also functions under steady-state conditions and may thus be engaged for tuneup, c.w., a.m. or RTTY.

Power Supplies

Filament and relay powers are obtained from T_1 which has two primary windings that may be wired in parallel or in series for 115 or 230 v.a.c. operation respectively. A squirrel-cage blower is connected across one of the primaries and thus operates from 115 v.a.c.

The power transformer for the external h.v. power supply also has two primaries that can be wired for 115 or 230 v.a.c. operation. *Both* power supplies must be wired for the *same* a.c.-input voltage. Plate voltage from the secondary is obtained by a conventional type voltage doubler using 6 silicon-diode rectifiers in each leg and eight 200 mf, 450 v., electrolytic capacitors connected in series for a total of 25 mf filter capacitance to enhance the dynamic regulation.

A voltage-equalizing resistor of 100,000 ohms is installed across each capacitor. Although these resistors can act as a slow-discharge bleeder, a faster discharge and a safety measure are realized by a separate 100,000-ohm bleeder made up of a 50,000-ohm resistor connected across each section of the voltage doubler.

Three 2.7 ohm, 1/2-watt parallel-connected resistors are installed in series with the positive h.v. lead. In the event a short circuit on the h.v. line should fail to trip the primary circuit breakers of the transformer quickly enough, these resistors will burn out immediately and protect the power-supply components from damage.

Personnel protection is provided by a mechanical grounding switch that places a short circuit on the h.v. line in the amplifier whenever the amplifier case is removed. This quickly removes any residual charge from the filter capacitors and prevents any high

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voltage that might otherwise be present from appearing on the amplifier components.

For s.s.b. operation the full-load plate potential is approximately 2300 volts. For tuneup, c.w., RTTY and a.m., the plate potential is reduced by about 750 volts when a relay is actuated by a switch on the panel. The relay shifts the a.c. power source to a tap on the transformer primaries for reducing the secondary voltage.

Metering

Plate current is monitored by a 0-1 a. meter connected in series with the negative return for the high-voltage supply. Another meter can be switched to read the relative output power, plate voltage or grid current.

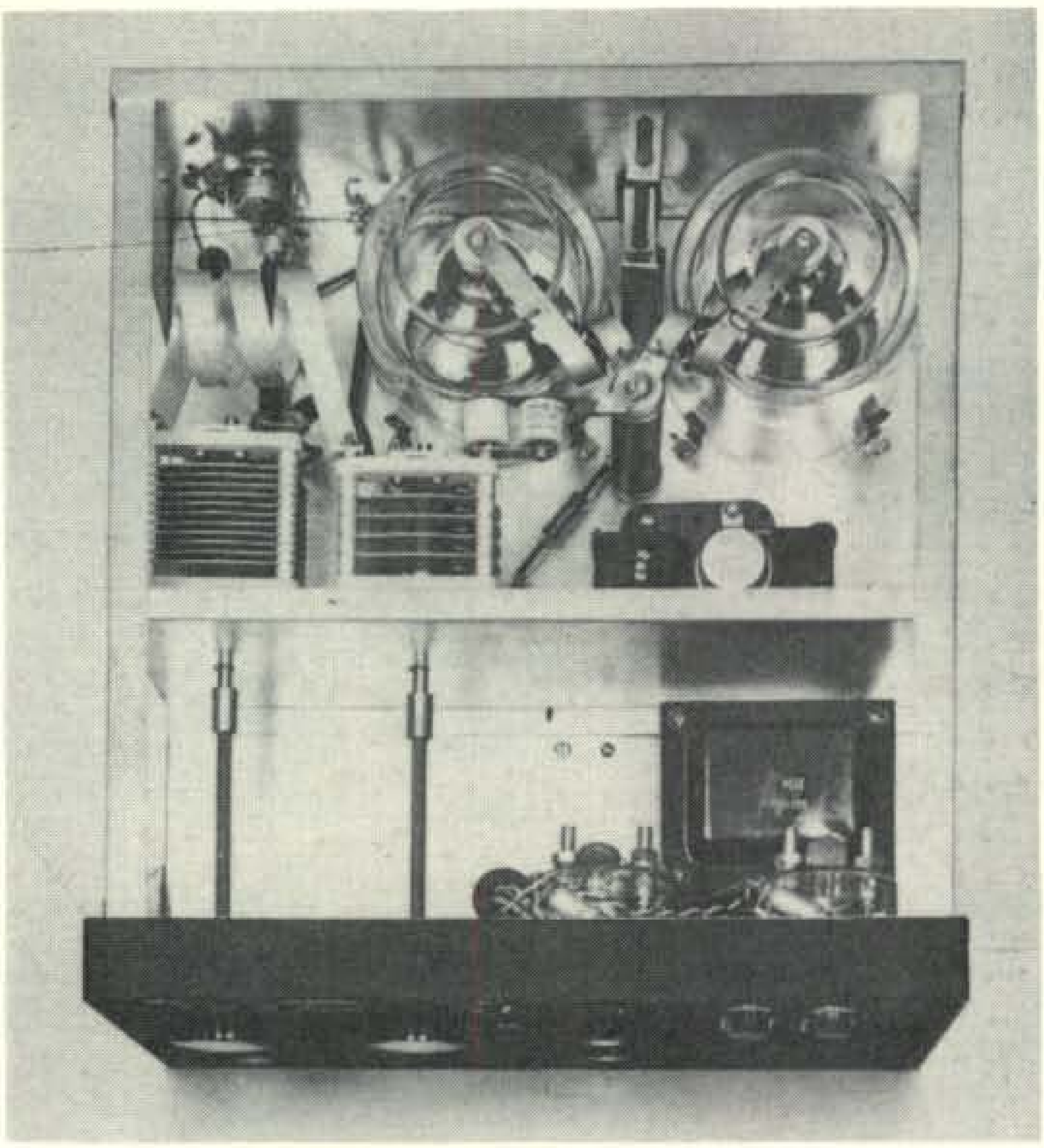
For relative-power readings, the r.f. output is sampled through the voltage-dividing network, R_5-R_6 and rectified by D_5 to cause a d.c. flow through the meter. Plate voltage is read when the meter is switched to a tap on a voltage divider, R_4, R_7, R_8 across the h.v. supply line. Unlike many grounded-grid type cathode-driven amplifiers, the tube grids here are connected directly to ground to maximize stability.[1] The grid current is read by the meter switched into the center-tap ground return from the filament transformer. Only grid current is indicated, because the negative side of the high voltage supply is not grounded, but goes directly to the transformer center tap, thus bypassing the grid-current meter.[2]

Diodes D_2-D_3 function as zener diodes to provide a few volts of bias that slightly reduces the idling plate current.

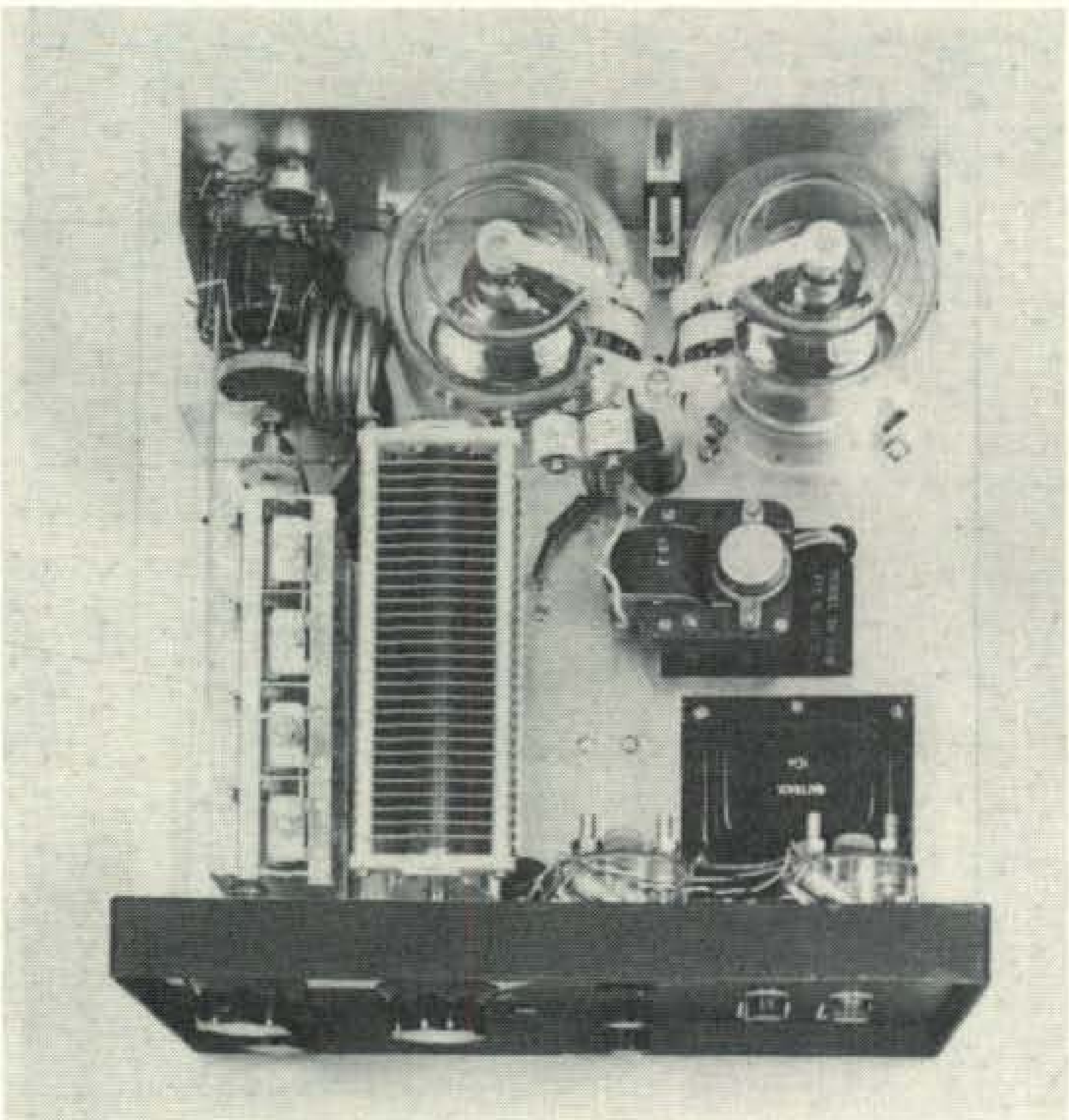
Control Circuits

Primary power is applied to T_1 with S_1. The blower then starts and the tube filaments light as does power-on lamp I_3. The h.v. supply also is activated through terminal 2 of P_1.

The exciter is normally connected directly to the antenna through the normally-closed contacts 1 & 2 and 4 & 6 on K_1. At this time, R_{11} in the filament center-tap return provides a high self bias that holds the tubes at cutoff, thus effectively keeping the tubes in a quie-



Top view of the Raytrack 6-meter linear amplifier. The plate-tank inductor is wound with 1/2" silver-plated strap. The parasitic-suppressor inductors at the tube caps are 3/8" strap. A neutralizing tab is located between the tube chimneys. A vertical insulated rod, at the rear, is coupled to the h.v.-grounding switch which is held closed by a spring. When the cabinet is installed it depresses the rod and opens the switch.



Top view of the Raytrack 10-80 meter linear amplifier. The toroid plate-tank inductor is at the upper left corner supported by the bandswitch. It is used on the 15-80 meter bands, while the airwound inductor, at the rear of the loading capacitor, is for 10-meters. A smaller size input circuit toroid is used for all bands and is installed below the chassis. The phono-motor type blower draws air from below chassis.

1Stability is enhanced in the 6-meter model by neutralizing with L_1, C_{28} and a tab between the two tube envelopes. Neutralization is not used in the low-band amplifier.

2A protective measure, however, is that a resistor, of a much higher value than the grid-meter circuit resistance, is used to ground the negative side of the h.v. line.

The Raytrack DX-2000L 10-80 meter linear amplifier.

scent state and eliminating hash in the receiver.

When it is desired to place the amplifier in operation, STANDBY switch S_3 is closed, connecting the high end of the relay-solenoid coil and the plate-meter lamp, I_1, to one end of the 12 v. winding on T_1. When the exciter is activatetd, K_1 also is then energized by the exciter's control relay where its normally-open auxiliary contacts now are closed and ground the other end of the 12-volt relay-supply winding. This also causes the plate-meter lamp, I_1, and the EXCITER-ON lamp, I_2, to light.

K_1 contacts 1 & 3 then transfer the exciter to the amplifier input and contacts 5 & 6 connect the antenna to the amplifier output. Relay contacts 7 & 8 close and short out R_{11}, thus removing the cutoff bias and allowing the tubes to function in class B when the r.f. drive is applied. Instantaneous operation between exciter alone or with the linear amplifier is had simply by operating the STANDBY switch. The plate meter lamp lights only when the amplifier is in an operating state.

S_2 is the S.S.B./C.W.-TUNE switch that drops the plate voltage for c.w. and tuneup as explained earlier. When it is set at the high-voltage position for s.s.b., lamp I_4 lights, indicating that operation is set up for maximum power with s.s.b.

Construction

The internal construction used in the amplifiers is shown and described at the accompanying photos. Externally, both units appear alike. The dimensions are 8″ × 13¼″ × 15⅝″ (H.W.D.). Weight is 30 lbs. The size of the H6AP power supply is 7⅞″ × 6⅜″ × 12¾″ and it weighs 42 lbs.

A word of caution might be noted at this point. The amplifier proper is removed by sliding it out of the front of the cabinet. The mechanical grounding switch is at the rear of the chassis and is held open by the top of the cabinet. Consequently, the switch is not activated, until the amplifier has been completetly withdrawn from the cabinet.

Operation and Performance

Tuneup is conducted in a conventional manner by first adjusting the exciter alone, then activating the amplifier and, with the specified drive applied, adjusting the amplifier controls (input-tune, plate-tune and loading) for maximum output at the plate current specified for the various modes of operation. Where the d.c. input is expected to be greater than the 1 kw legal restriction, a dummy load should be used.

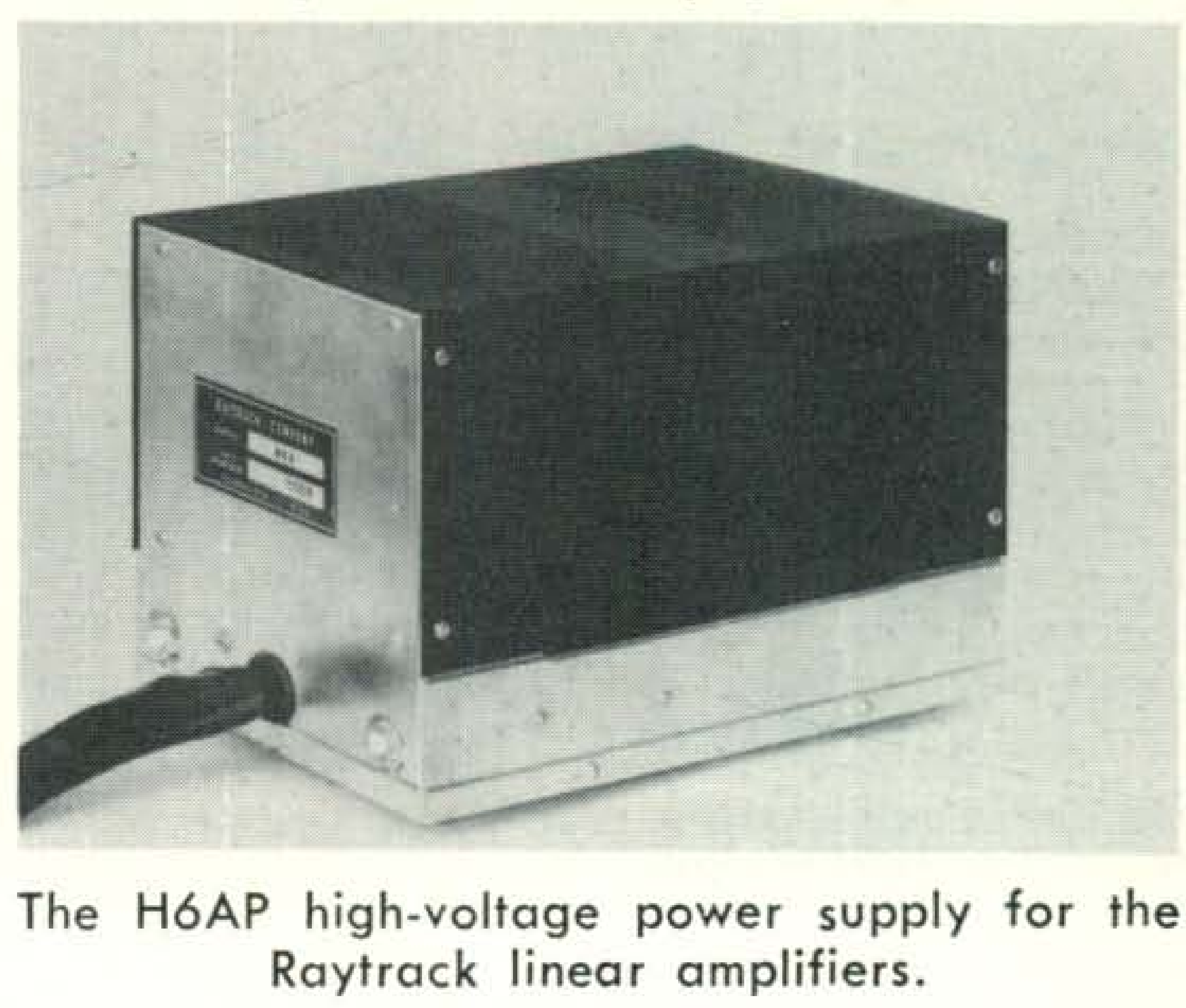
After proper tunup, the following results were obtained with the 6-meter amplifier:

With 100 watts of drive, the d.c. input for s.s.b. was 1955 watts with an output of 1150 watts. Grid current in this case amounted to about 300 ma which is above the 240 ma specified in the manual; however, the amplifier manufacturer has informed us that no tube deterioration has been experienced with s.s.b. operation after tuneup with even 400 ma grid current, as long as the amplifier is properly loaded and resonated.

Increasing the drive to 140 watts (or about 350 ma grid current) the amplifier could be pushed to 2300 watts input with 1450 watts output. In both of the above cases the p.e.p. was approximately 15% higher.

In either case, a trapezoid oscilloscope display using a two-tone test evidenced excellent linearity by its straight-sided pattern.

[*Continued on page 98*]



The H6AP high-voltage power supply for the Raytrack linear amplifiers.

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Australis-Oscar 5: January Launch Date Announced

BY GEORGE JACOBS,* W3ASK

THE green light is on! NASA has announced officially that the Australis-OSCAR 5 amateur radio satellite will be launched from the Western Test Range, California, at 1116 GMT on January 9 (plus or minus 10 minutes). No further delays are expected!

A definitive launch date was set by NASA after a four month ban on the use of Delta launch vehicles was lifted in late November. The ban was imposed after two Delta failures occurred during the summer.

Resumption of Delta launch operations was recommended by a NASA review board after exhaustive investigations pinpointed the difficulty and corrective action had been taken. On November 21 the British Skynet communication satellite was the first to be launched successfully after the ban was lifted. NASA announced that an INTELSAT III communication satellite was next in line with a Delta launch scheduled for mid-December. This will be followed by a TIROS-M weather satellite scheduled for launch on January 9. NASA has agreed to launch the Australis-OSCAR 5 satellite as a secondary payload on the TIROS-M mission.

Late Orbital Data

Here is some last minute orbital data and the times of south-north equatorial crossings for the first dozen orbits following launch.

LAUNCH SITE: Western Test Range, California
LAUNCH TIME: 1116 GMT (plus or minus ten minutes)
LAUNCH DATE: January 9, 1970
ALTITUDE: 900 statute miles

*11307 Clara St., Silver Spring, Md. 20902.

PERIOD: 114 minutes (sun synchronous)
INCLINATION: 102° (a polar orbit)
TIME OF NEAREST OVERHEAD PASSES: 3:15 P.M. south-north; 3:15 A.M. north-south (plus or minus local time)
NUMBER OF PASSES WITHIN RADIO RANGE: At equator-4; mid-USA-6 to 8; polar regions-all.
VHF CHANNEL: Continuous on 144.050 mc
HF CHANNEL: 29:450 mc from 0700 GMT on Friday to GMT Monday.

The following are ascending mode equatorial crossings (south to north direction) based on a launch time of 1116 GMT. Actual times may vary by plus or minus ten minutes.

Orbit No.	*Crossing* (Deg. W. Long.)	*Time* (GMT)
1	324	1222
2	353	1416
3	022	1610
4	051	1804
5	080	1958
6	109	2152
7	138	2346
8	167	0140
9	196	0334
10	225	0528
11	254	0722
12	283	0916

Successive passes will cross the equator 29° further west every 114 minutes.

Refer to the several articles appearing in *CQ* and *QST* during the past six months for additional information concerning the AOA-5 satellite. Be sure to check W1AW special bulletin for further launch and orbital information. ■

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DX

BY JOHN A. ATTAWAY,* K4IIF

FELICIDADES! Froliche Weinachten! Happy New Year! In any language it's the festival season, time to make merry, but also time to take stock of past events and look to the future.

From my personal viewpoint it's been a good year for writing this column. Busy, very busy, but a lot of fun, chiefly because of you. Writer's can only report the news, not make it, and since you've been busy with DX and DXpeditions there has been plenty to report and my job has been easy.

On some occasions we haven't been able to give your activities all the coverage they deserved. However, there's only so much space in the magazine and many phases of the hobby must be covered. A few misunderstandings have occurred when DXpedition info was sent only 4-6 weeks ahead of the issue immediately preceeding the event. Since the column goes in 8 weeks ahead it missed, and all we could do was wait for pictures. Some felt that we chose to ignore them so they sent no pictures. This kind of cycle we can do without. Be assured that we need your news and your pictures so please keep 'em coming.

New York QSL Checkpoint

As a convenience to the many DXers in the New York area, the Kings County Radio Club has been designated as an authorized *CQ* checkpoint. Applicants for WAZ and the SSB DX Awards may have their cards checked by either club president, W2MBU, or the Communication Manager, WB2NDI. The club's address is 1250 Ocean Ave., Brooklyn, N.Y. 11230.

De Extra

The Day/Month/Year Confusion: Here we are back on one of our favorite subjects, making a QSL card so that there is no question as to *when* the QSO took place. For many years the battle has been to convert everyone to the use of GMT (Greenwich Mean Time). Except for a few beginning DXers this has been accomplished, but another source of confusion still exists. Believe it or not this involves the *date* of the QSO.

For example, if the date were designated 12/2/69 all U.S. amateurs and QSL Managers would know at once that the contact occurred on Dec. 2, 1969. However, a large part of the time they would be dead wrong because many countries use the order day/month/year instead of month/day/year. In Europe 12/2/69 means Feb. 12, 1969.

Fortunately, some order is already developing out of this chaos. Many European stations now designate the month by a Roman numeral, so that Dec. 2, 1969 emerges as 2/XII/69, and *not* Feb. 12, 1969. De Extra heartily endorses this method and recommends it as a simple solution to this problem.

Also on the subject of QSLing problems, Gerd, DJ1QP/GC5AET, asks us to request that US stations send IRC's with their cards instead of US coins. He says that many US hams send a self-addressed envelope with a dime or a quarter. About all these coins are good for in another country is to make a charm bracelet. The banks won't take them until several dollars worth have accumulated, and even then they give a poor exchange rate. Always send IRC's or else stamps from the country in question. Stamps of almost any country may be obtained from Sax, W2SAW, who operates a foreign stamp service for DXers.

Canadian QSL managers have a similar problem with people who put US stamps on

S.S.B. DX Honor Roll

WA2RAU	319	SM5SB	305	F2MO	292	G3WW	269
W2TP	318	W2ZX	305	W2FXN	292	W9QLD	269
W9ILW	318	W4SSU	304	K1IXG	288	MP4BBW	267
W3NKM	316	W6YM	303	SM6CAS	286	W8BVF	266
VK2AHO	315	WØQZ	303	W2LV	286	G2PL	265
W2RGV	315	OK1ADM	302	W6EUF	286	WA6GLD	265
WA2IZS	315	W2BXA	302	K8RTW	286	G2BVN	264
W6EL	315	W4IC	302	W9EXY	284	W2FXE	264
TI2HP	314	G3AWZ	301	W3KT	281	W2MJ	261
K6LGF	314	G3DO	301	W1LLF	280	W6PTS	265
W8DE	314	G6TA	301	W6UOU	280	W6WNE	259
DL9OH	313	WA2EOQ	301	W3FWD	279	PJ2AA	258
W3QCW	313	W3DJZ	301	W4RLS	279	PAØEEM	256
I1AMU	312	G3HDA	300	K4OEI	279	CT1PK	254
W4OPM	312	E3ACD	300	DL3RK	278	W6BAF	254
K6YRA	311	K1SHN	300	DL1IN	276	K6CAZ	254
G3FKM	310	W9JT	300	K4HYL	276	HP1JC	252
KP4CL	310	5Z4ERR	298	W7DLR	276	PAØSNG	252
W4NJF	310	K2DX	297	PZ1AX	274	K4GXO	252
WA8AJI	310	W8BT	297	K9EAB	273	VE6TP	251
XE1AE	308	KØUKN	297	K9LUI	273	W8ILC	251
G8KS	307	K8IKB	296	W6RKP	272	W1AOL	251
ZS6LW	307	W8EVZ	293	G3NUG	270		
W5KUC	307	K8ONV	293	K9PPX	270		

*P.O. Box 205, Winter Haven, Fl. 33880

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their s.a.s.e. It should be obvious that you can't post a letter in Canada with US stamps anymore than you can post one in the US with Canadian stamps. Stop and think a minute guys and gals. The Canadians are certainly very good friends and neighbors, but Canada is still another country.

Rare & Special Prefixes for WPX

CW3–CW3BH was a special call used by CX3BH during the phone weekend of the *CQ* Worldwide DX Contest.

CWØ–CWØAA was a special call used by CX2CO during the phone weekend of the *CQ* Worldwide DX Contest.

EI –EIØRTS was operated from a scientific exhibition in Dublin Oct. 21-25, 1969.

I2-I9–The plant to institute a complete regional prefix system in Italy has apparently been abandoned, and only I1 and IØ prefixes will be issued.

ITØ–ITØETN reported on 14 and 21 mc s.s.b. QSL to P.O. 366, Catania, Sicily.

OG–This prefix was used by Finland's amateurs during the last Scandanavian contest. OG1VR was OH1VR, and OG3VV was OH3VV.

OI3–OI3SUF was a special Boy Scout station operated Oct. 18-19, 1969. QSL to OH3NY.

PZØ–PZØAA was very active from the Surinam Trade Fair.

UZ3–One of the new Russian prefixes.

VUØ–Used in the celebration of the Gandhi Centenial during October, 1969.
VUØBEL was quite active

WF2–WF2LIB was a special 2-day operation commemorating Columbus Day. QSL to WB2EJZ.

WF6–WF6NNW was the call of WA6AHF during National Newspaper Week in October.

3BA-3BZ–After the 3B to 3F block of calls was relinquished by Canada this series was assigned to Mauritius, formerly VQ8.

4J9–4J9DX was used by UA9AN during the *CQ* Worldwide DX Contest.

4M1–A special Venezuelan prefix.

9I5–All 9J2 stations were authorized to use this prefix during the 5th. Anniversary celebration of Zambia's independence.

160 Meter News

The big thing on 160 right now is the annual Trans-Atlantic and Trans-Pacific DX Tests which are at the half-way point. Remaining dates for the Atlantic caper are Jan. 11, Feb. 1, and Feb. 15, while the Pacific crew will be at it again on Jan. 10, Jan. 31, and Feb. 14.

If you wish to participate in the Atlantic tests on those dates, the time is 0500-0730 GMT. The frequencies vary according to location. Stations on the east coast of North America transmit 1800 and 1820 kc, while the west coast gang transmits from 1975 to 2000 kc. Most European stations will be between 1823 and 1830 kc, with some trying 1851-1861. Call CQ-DX-Test and listen in alternate 5 minute periods, with W/VE's leading off. The special "First Timers" test is omitted this year.

WPX HONOR ROLL

The WPX Honor Roll is based on confirmed current prefixes. Stations are listed with both net and gross prefix credits. The Honor Roll is based on the current *net* regardless of an operator's all-time gross prefix count.

MIXED		
W4OPM	Joe Hiller	900/1000
W8LY	Michael Bakos	727/755
G3DO	D.A.G. Edwards	703/755
K1SHN	Chuck Banta	685/702
I1SF	Serafino Franchi	657/657
W4IC	George Mack	626/657
WA6EPQ	Larry Brockman	622/656
W8KSR	Jon Hodgin	612/612
W8GMK	John Marhefka	611//611
WA6GLD	Jerry Hagen	601/626
DL1MD	Heribert Recht	557/557
SSB		
W4OPM	Joe Hiller	775/850
W4NJF	Gay Milius	758/772
WA5LOB	James Edwards	614/614
DL9OH	Karl Muller	611/611
G3DO	D.A.G. Edwards	603/625
K1SHN	Chuck Banta	586/601
I1AMU	Alfonso Porretta	562/599
HP1JC	Juan Chen	552/552
CW		
W4OPM	Joe Hiller	800/850
W8KPL	William Simpson	741/853
W8LY	Michael Bakos	729/757
VK3AHQ	Henry Denver	706/706
DL1QT	Helmut Baumert	700/700
G2GM	F.D. Cawley	606/666
W8GMK	John Marhefka	578/578
K1SHN	Chuck Banta	572/671
I1SF	Serafino Franchi	554/554
PHONE		
G3DO	D.A.G. Edwards	691/715
F2MO	Dort Michel	536/552
I1SF	Serafino Franchi	526/526

Completion of a WPX Honor Roll application is required for placement on the Honor Roll. Application blanks may be obtained by sending a self-addressed, stamped envelope to WPX Manager, 6563 Sapphire Drive, Jacksonville, Fl. 32208.

The WPX Program

S.S.B.

436........K7RDH	469........VK9WD
437........WAØMOJ	470........W2WNW
438........DL9XN	471........WA2BPL
465........K3JLK	472........ZS2DC
466........HI3AGS	473........W9FPM
467........KR6RL	474........VK3WW
468........PY2GE	475........K5EFW

C.W.

973........VK4MY	977........K4DSN
974........W9HE	978........W1BGD
975........OK2BEC	979........K2AAC
976........OK3KGQ	

Mixed

214........CT1LN	216........K4TSJ
215........PY3APH	217........PY7APS

Phone

180........JA1NDO	181........CT1UE

Endorsements

S.S.B.: W2HI–650, I1AMU–600, K2POA–600, YV4UA–500, WØGYM–450, PY2GE–350, W2LEJ–300, WA6TAX–300, K1-KNQ–250, K7RDH–250, – K9HDZ–250.

C.W.: W4OPM–900, WB2CDZ–550, K2-AAC–500, and W2GA–450.

Mixed: W4LRN–900, W4BQY–600, CT1LN –550, PY7APS–500, & PY3APH–450.

Phone: WA6TAX–400, CT1UE–350, & W1-PCD–350.

Europe: CT1LN, GM5AHS, & OK2BEC.

160 Meters: OK2BEC

80 Meters: OK2BEC

20 Meters: CT1LN & WB2FMK

15 Meters: CT1LN & WA5LOB

10 Meters: CT1LN & WA5LOB

VPX: Borje Jansson, SM4-3434

WPX rules and application blanks may be obtained by sending a self-addressed, stamped envelope to WPX Manager, 6563 Sapphire Drive, Jacksonville, Fl. 32208, or to DX Editor, P.O. Box 205, Winter Haven, Fl. 33880.

The S.S.B. DX Award Program

100 Countries	200 Countries
605........K1NBO	189........W4BA
606........VR1L	190........VK4MY
607........DL8EJ	191........PY7AOA
608........DJ5BV	192........PY3APH
	193........VE3HJ
	194........VE3QD

S.S.B. DX Award rules and application blanks may be obtained by sending a self-addressed, stamped envelope to Award's Manager, 3785 Susanna Drive, Cincinnati, Ohio 45239, or to DX Editor, P.O. Box 205, Winter Haven, Fl. 33880.

The Pacific test takes place on the above saturdays from 1330-1600 GMT. North American west coast uses 1975-2000, east coast 1800-1810. JA's will be at 1907.5-1912.5 kc, ZL's near 1876 kc, and VK's around 1803 kc. Special JA sunset tests will be held on the same dates, but 0730-1000 GMT or 11:30 P.M. to 2 A.M. Saturday W/VE time.

Further details may be obtained from Stew, W1BB.

Club of the Month

The Canadian D-X Association (CANAD-X): This very livewire club is now publishing an excellent bulletin, and from the number of new members reported each month would appear to be unchallenged as the fastest growing DX club in the world. The following information was provided by Ron Kreger, VE-3DLC, club president.

"The Canadian DX Association originally started in 1965 as the Ontario DX Association, a DX-minded group of amateurs who wished to meet together and exchange DX information. In March, 1968, when a check of the membership showed over 50% residing outside Ontario, the name was changed to the Canadian DX Association.

"The aims of CanaD-X are to provide services to Canadian amateurs interested in DXing. *Long Skip,* the club bulletin, is mailed twice monthly to all members. Membership in CanaD-X is available to Canadian amateurs only at a yearly rate of $6.00. However, interested U.S. amateurs may subscribe to *Long Skip* for $6.00/year although they cannot be club members. Included in the membership fee for VE-landers is the use of the CanaD-X Outgoing QSL Bureau which receives the members cards in bulk, sorts them, and forwards them to the appropriate bureaus.

"The 1969 Executive Committee consists of President, Ron Kreger, VE3DLC; Vice-president, Mort Wolfson, VE3ACD; 2nd. Vice-president, Bill Halliday, VE3UX; Secretary-Treasurer, Paul Edgley, VE3CKW; Recording Secretary, Bud Fockler, VE3NE; Public Relations, Jack Reed, VE3GMT; QSL Bureau Manager, Jim Montagnes, VE3BIF; and Bulletin Editor, Bill Jones, VE3HJ.

"CanaD-X welcomes all Canadian DXers to it's membership. For a free copy of *Long Skip* write to CanaD-X, P.O. Box 717, Stn. Q, Toronto 7, Ontario."

Islands-on-the-Air (IOTA) Awards

For those of you looking for a new twist, here it is. Geoff Watts now has 12 IOTA

See page 110 for New Reader Service

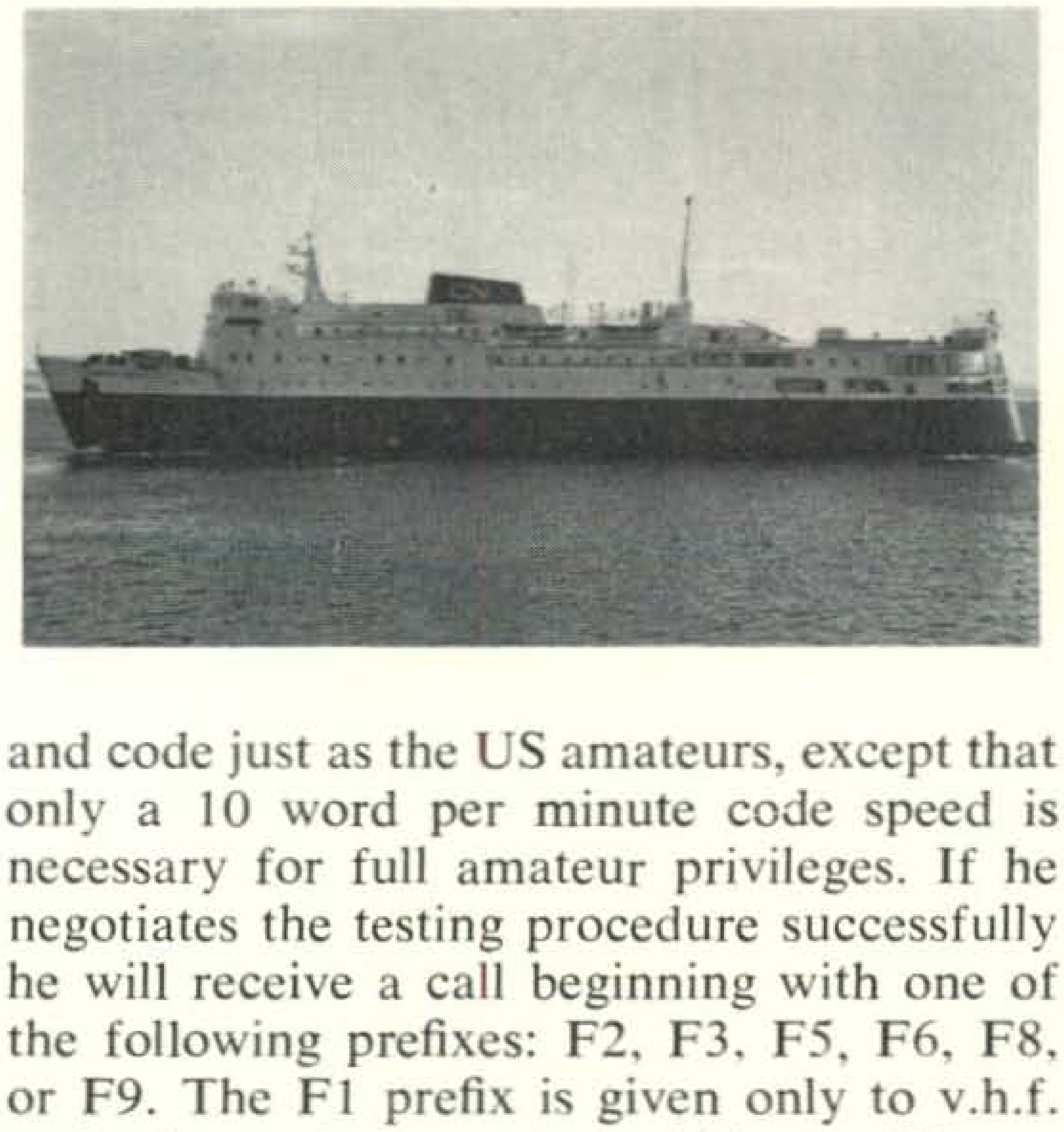
Awards, and in addition to the Silver Cup he awards to the world champion station in the yearly IOTA Contest, he is now awarding a cup to all who claim all 12 IOTA Awards.

IOTA-AF	IOTA African Award
IOTA-AN	IOTA Antarctica Award
IOTA-AS	IOTA Asia Award
IOTA-EU	IOTA Europe Award
IOTA-NA	IOTA North American Award
IOTA-OC	IOTA Oceania Award
IOTA-SA	IOTA South American Award
IOTA-CC-100	IOTA Century Club 100 Award
IOTA-WW	IOTA World Diploma
IOTA-AI	IOTA Artic Islands Award
IOTA-BI	IOTA British Isles Award
IOTA-WI	IOTA West Indies Award

Complete information and an 18 page Directory of Islands giving all the islands and island groups which count for IOTA, plus full details of the IOTA Contest, may be obtained by sending 6 IRCs to Geoff Watts, 'DX NEWS-SHEET', 62 Belmore Road, Norwich, NOR. 72-T, ENGLAND. Delivery will be via Air Mail.

For the past year Herb Rippe, W8DE, has been almost unchallenged as the champion stateside island hunter. Somebody jump in there and give Herb some competition.

Intermingled with modern shipboard radio gear is the ham rig of Mitch, VEØMD/VO1AW—one of the most active of the rare VEØ's. Mitch's operating time comes after a 12-hour shift in the radio room of the Motor Vessel *Ambrose Shea*. The "*Shea*" is a full ice-breaker ferry operating between North Sydney, N.S. and Argentia, Newfoundland. (*Photo via K4DSN*).



Amateur Radio in France

Information for this interesting article was contributed by OM, Claude, F9OE, Le Secretariat du Reseau des Emetteurs Francais (REF).

"First of all, the budding young French amateur must be at least 16 years old before he becomes eligible for a license. When he goes for the exam he is tested on both theory and code just as the US amateurs, except that only a 10 word per minute code speed is necessary for full amateur privileges. If he negotiates the testing procedure successfully he will receive a call beginning with one of the following prefixes: F2, F3, F5, F6, F8, or F9. The F1 prefix is given only to v.h.f. enthusiasts who operate on 144 mc, 435 mc, or higher, and no code test is required. F6 calls always have 3 letters and all F6K–calls are club stations. FØ calls are for visitors traveling in France and require no examination and no license fee, only a photo-copy of your license in your home country. FØ calls are valid for only 1 year.

French amateurs must pay a license application fee of $6.00 plus $6.50 charge to take the examination. Afterward there is an annual fee of $8.00 to renew the license. They may operate on all bands with a maximum power of 100 watts d.c.

"The national amateur radio society (REF) is quartered at 60 db de Bercy, Paris 12, and the address of it's QSL Bureau is Boite

A new member of the WPX ranks is George, 5A2TR, who (besides being very active on s.s.b.) has the often thankless job of being Lybia's QSL Bureau Manager. (*Photo via K4DSN*).

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The WAZ Program

S.S.B. WAZ

730........PY7AOA	736........K5QHS
731........CE6EW	737........JA4WI
732........W6ZBS	738........YS1O
733........VS6AL	739........XE1OOL
734........WAØCPX	740........W8CT
735........WA2FQG	

C.W.—Phone WAZ

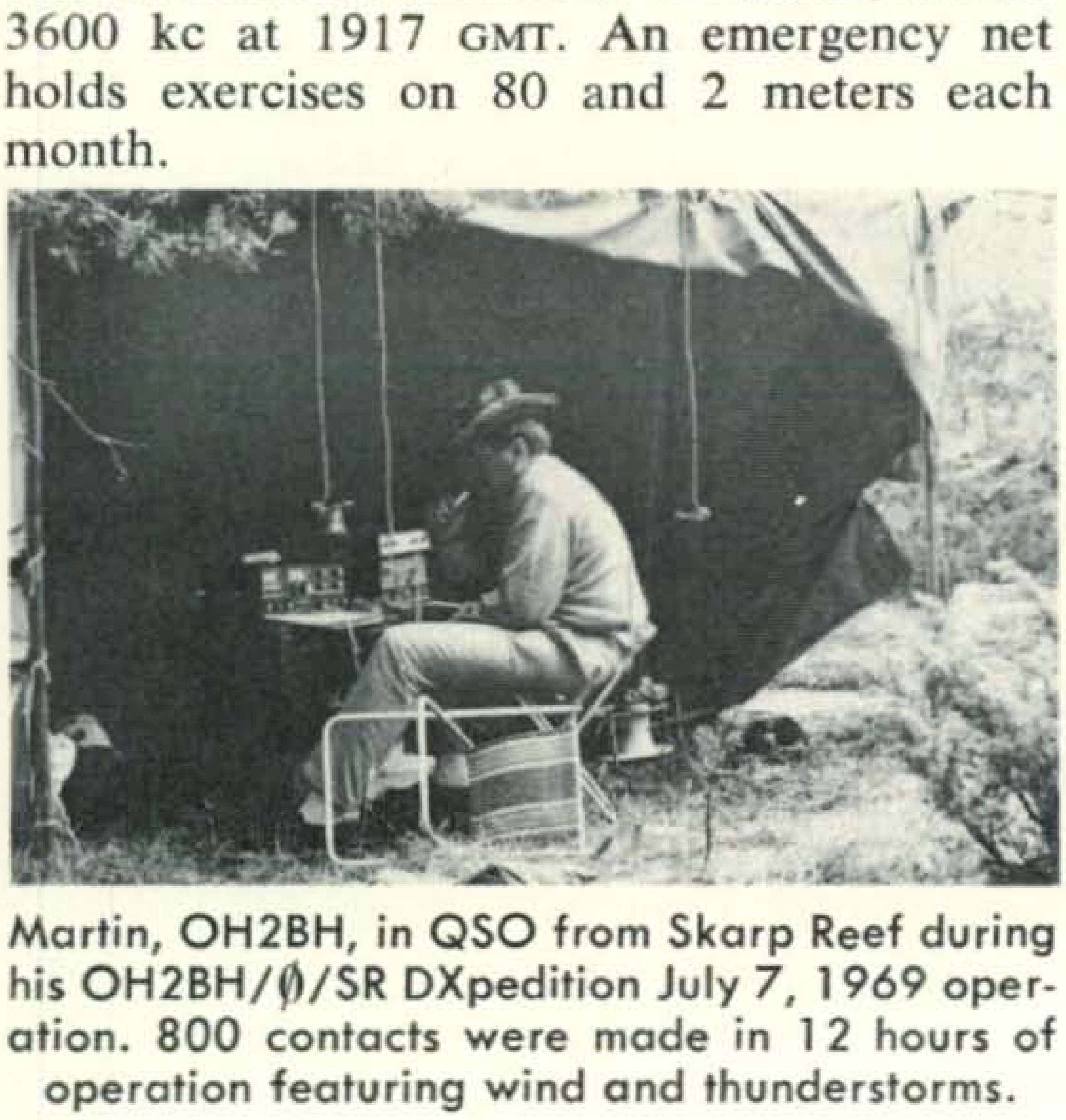
2781—–K9YXA	2793........WA3GNW
2782........PY4AP	2794........W1ECH
2783........W1JMT	2795........W2GRY
2784........G6YL	2796........W8GMK
2785........VE3XK	2797........W5TXN
2786........WA6UFW	2798........YS1O
2787........K4BBK	2799........XE1OOL
2788........OK1UK	2800........ZS6AIP
2789........W4JD	2801........W8CT
2790........PY7APS	2802........DJ8FF
2791........DJ6LN	2803........DL1CG
2792........W2DF	

Phone WAZ

427........YS1O	429........W8CT
428........XE1OOL	

WAZ rules and application blanks may be obtained by sending a self-addressed, stamped envelope to DX Editor, P.O. Box 205, Winter Haven, Fl. 33880.

Postal 70 (P.O. Box 70), Paris 12, France. REF operates a station, callsign F8REF, which broadcasts news of amateur events in the manner of W1AW in the US, except that F8REF always keeps the membership posted on DX news as routine local happenings. Scheduled broadcasts are on the first and third Thursdays of each month on 7052 kc at 1200 GMT, and the first and third Fridays of each month on 14150 kc at 1830 GMT, and on 3600 kc at 1917 GMT. An emergency net holds exercises on 80 and 2 meters each month.



Martin, OH2BH, in QSO from Skarp Reef during his OH2BH/Ø/SR DXpedition July 7, 1969 operation. 800 contacts were made in 12 hours of operation featuring wind and thunderstorms.

"REF issues several excellent DX awards. A general rules sheet may be obtained from the secretary by sending a self-addressed, stamped envelope or self-addressed envelope with IRC's. One IRC for surface mail and two for air mail to the states. These awards include the DUFC (Diplome de l'Union Francaise) which is based on contacts with the 59 DUF countries; the DDFM (Diplome des Departements Francais de la Metropole) for working different French departments; DPF (Diplome des Provinces Francais) for contacts with at least 16 different French provinces; DTA (Diplome des Terres Australes) for working 3 of the 4 French Austral countries which are the Crozet Islands, Kerguelen Islands, Adelie Land, and St. Paul—New Amsterdam; and the DTA award for making 1000 contacts exclusively on c.w.

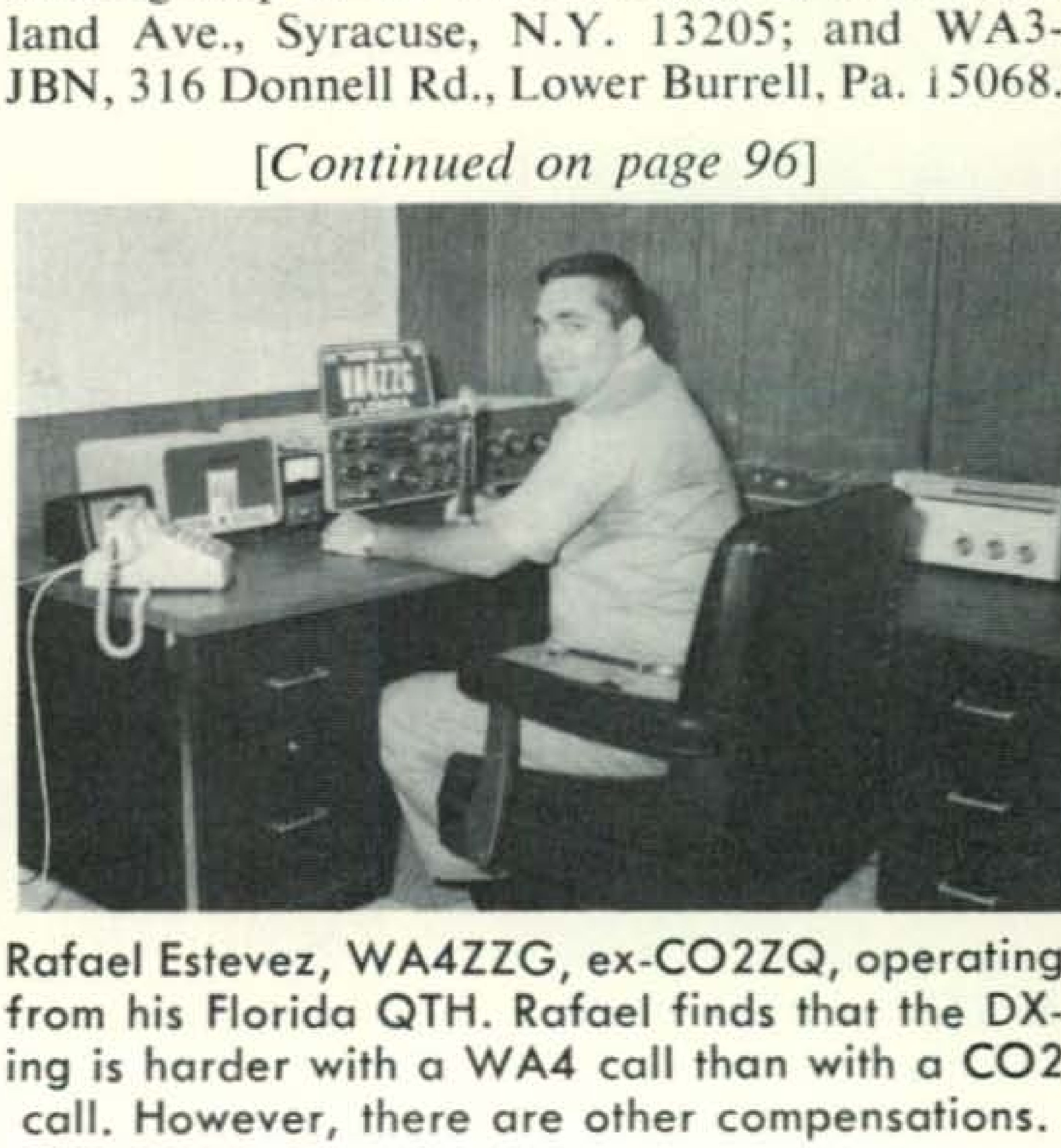
"The breakdown of sub-bands for French operators is as follows: 3.5-3.6 mc ffor c.w., 3.6-3.8 mc for c.w. and phone; 7.00-7.04 mc c.w. and 7.04-7.10 mc c.w. and phone; 14.0-14.1 mc c.w., and 14.1-14.35 mc c.w. and phone; 21.00-21.15 mc c.w., and 21.15-21.45 mc c.w. and phone; and 28.0-28.2 mc c.w., and 28.2-29.7 mc c.w. and phone. There are no 50 or 72 mc bands. RTTY is sanctioned and a temporary license may be obtained for television activity. France has a reciprocal licensing agreement with the US.

"REF has a present membership of 6800, of which 4900 are active amateurs."

QSL Information

The following stations have volunteered their services as QSL Managers for any DX station needing help in the U.S.: WN2JNV, 2424 Midland Ave., Syracuse, N.Y. 13205; and WA3-JBN, 316 Donnell Rd., Lower Burrell, Pa. 15068.

[*Continued on page 96*]



Rafael Estevez, WA4ZZG, ex-CO2ZQ, operating from his Florida QTH. Rafael finds that the DXing is harder with a WA4 call than with a CO2 call. However, there are other compensations.

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A MUST FOR EVERY DXER

DX AWARDS LOG

This fabulous book sells for $3.95 anywhere in the U.S. and is available for immediate delivery from the CQ Technical Library. However, with any subscription to CQ you can obtain a copy of the *DX Awards Log* for just $1.50 (a $2.45 savings). To obtain your DX Log at the discount price it must accompany a subscription order to CQ, but that order can be for renewals or extensions as well as for new subscriptions.

SUPPLY IS LIMITED—ACT NOW!
Without subscription, cost price is $3.95.

This new 150-page log book has been published for use by all DX'ers to keep an organized log of contacts and confirmations for the many DX awards now available.

Complete details are provided on the number and type of contacts needed for over 100 major awards made by amateur radio clubs throughout the world. In addition to specific award qualifications and costs, the method of confirmation and how and where to apply are also listed under each individual award.

Special individual logs are set up under each award providing space for a complete record of contacts and confirmations including log data required to be submitted with the award application.

The *DX Awards Log* required over two years preparation in order to contact radio clubs throughout the world for the latest data on awards currently being offered. It is the most complete and up-to-date source for such information. It will be invaluable to the "wallpaper collector" as well as any amateur of SWL making DX contacts.

Circulation Department, *CQ* Magazine
14 Vanderventer Ave., Port Washington, N.Y. 11050

Gentlemen:

Your offer is too good to miss. I have indicated my preference below. (Payment must accompany order.)

NAME...CALL...............................

ADDRESS...

CITY...STATE.......................ZIP.........................

I want the DX Awards Log with a *CQ* subscription for:

☐ 1 yr. at $7.50 ☐ 2 yrs. at $12.50 ☐ 3 yrs. at $16.50

☐ I just want the DX Awards Log at $3.95

☐ New Subscription ☐ Renewal ☐ Extension

THE awards PROGRAM

BY ED HOPPER,* W2GT

FLASH!
Sad to report the loss on 11-1-69
of #1 County Hunter
Cliff Corne, K9EAB.
See Foto CQ 10-65 & Story 11-65.

FLASH #2
Earl P. Shore, W7KOI
Has Qualified for #16
USA-CA-3079 All Counties Plaque
SEE W7KOI "STORY" MAR. '68 CQ.

THE January , "Story of The Month", *re:* Clarence Blalock, K4EO, after some data on awards issued. Earl Shobe, W7KOI qualified for an ALL 3079 County Plaque. Marv Hagan, WB2SJQ took time off from NET control to apply for his USA-CA-3000. Jerry Fischer, W2KXL got caught-up and sent for USA-CA-2500, 2000, 1500 and 1000. Steve Cope, K5KDG, in a round about way, applied for USA-CA-2500, 2000, 1500, 1000, and 500. John Brenner, WA2AMM eased-up on his printing and shipping of those County Hunter QSLs ($3 for 500 P.P. east of the Mississippi and $3.75 to west of the Mississippi) and obtained the following awards endorsed ALL 14 MC SSB: 2000, 1500, 1000, and 500. Ted Midlam, K7SQD/W7DSJ was issued a USA-CA-1500 award, endorsed ALL A-1, 1ST to Utah. Glad to hear from George Folk, K8QYG who won a USA-CA-1500 award. Joe Ripp, WA9SKB was issued USA-CA-1000 and 500 awards endorsed ALL 14 MC 2 × SSB MOBILE. Helmut Herrmann, DJ5WO acquired a USA-CA-500 award endorsed ALL A-1. John Herro, K9YRA also received a USA-CA-500 award.

*103 Whitman St., Rochelle Park, N.J. 07662.

Clarence V. Blalock, K4EO

Clarence V. Blalock, K4EO

Clarence was born 67 years ago. First licensed in 1932 but after being active for about a year, a second job as a trombone player with a band started to cut into sleeping time and really left no time for hamming. Thus the hobby got lost in the shuffle and was completely forgotten for a period of 32 years.

In 1958, Clarence had a bad fall on some ice and fractured a hip and has not been able to work since that time.

One day his son talked Clarance into going to a code practice session as the son wanted to get a novice license. After a few visits, the bug bit Clarence again and after brushing up on the code and theory, another license was obtained in 1962. Shortly after that he became a member of the Tarheel Emergency Net on 3923, and in 1964 became Secretary/Treasurer and has held that position for five years.

An interest in County Hunting was acquired about three years ago and USA-CA-500 award #626 was obtained July 7, 1967;

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N.Y. Counties Award

USA-CA HONOR ROLL

3000	**1500**	WA2AMM 178
WB2SJQ 29	K7SQD/ W7DSJ 113	K5KDG 179
2500	K8QYG 114	WA9SKB 180
W2KXL 57	W2KXL 115	**500**
K5KDG 58	WA2AMM 116	DJ5WO 749
2000	K5KDG 117	WA2AMM 750
W2KXL 81	**1000**	K9YRA 751
WA2AMM 82	W2KXL 177	K5KDG 752
K5KDG 83		WA9SKB 753

USA-CA-1000 award #147 was obtained February 5, 1969 and USA-CA-1500 award #108 was obtained September 2, 1969.

Clarence has eight children and eight grand-children. His youngest son, Harry, was killed in Viet Nam in April 1968, he was married and had one daughter. When Clarence lost his Wife, Beatrice, four months later–it just about seemed the end of everything. Fortunately, thanks to much help and understanding from friends in amateur radio, Clarence got back on the track and now, health permitting, K4EO is right in there pitching again.

He has recently been appointed Emergency Coordinator for Stanly county. With the help of members of the Yadkin Valley Amateur Radio Club, a 10 meter emergency net has been organized and working fine. Meetings are held on the 1st and 3rd Tuesdays on 28.9 at 0200 GMT.

Clarence would like to thank the *many* who have helped him, including W4YWX, W4LSP, WØYLN, W5DAU, K3YMK, K8-ODY and others too numerous to mention.

The equipment includes an HW-12; HW-100 with a 4-811A linear amplifier on 75 meters. All bands are worked 80 through 10 and antennas include dipoles on 80, 15 and 10; and a doublet on 40 and 20.

Cliff Corne, K9EAB

It is very sad to report the passing of Cliff (Butch) Corne, K9EAB, #1 County Hunter, on November 1, 1969. Although "Butch" had spent the last 20 years in an iron lung, the end came apparently from kidney stones and not due to any respiratory problems.

"Butch" had many hobbies, having exhausted in order: electric trains, model cars and planes, tropical fish, parakeets, amateur radio, and was in the midst of chasing Colt Commemoratives. He had already accumulated some 6000 dollars worth and had all his radio gear for sale to acquire more guns. About 2 years ago, when his voice weakened, he lost all interest in amateur radio, although he was an *excellent* c.w. operator.

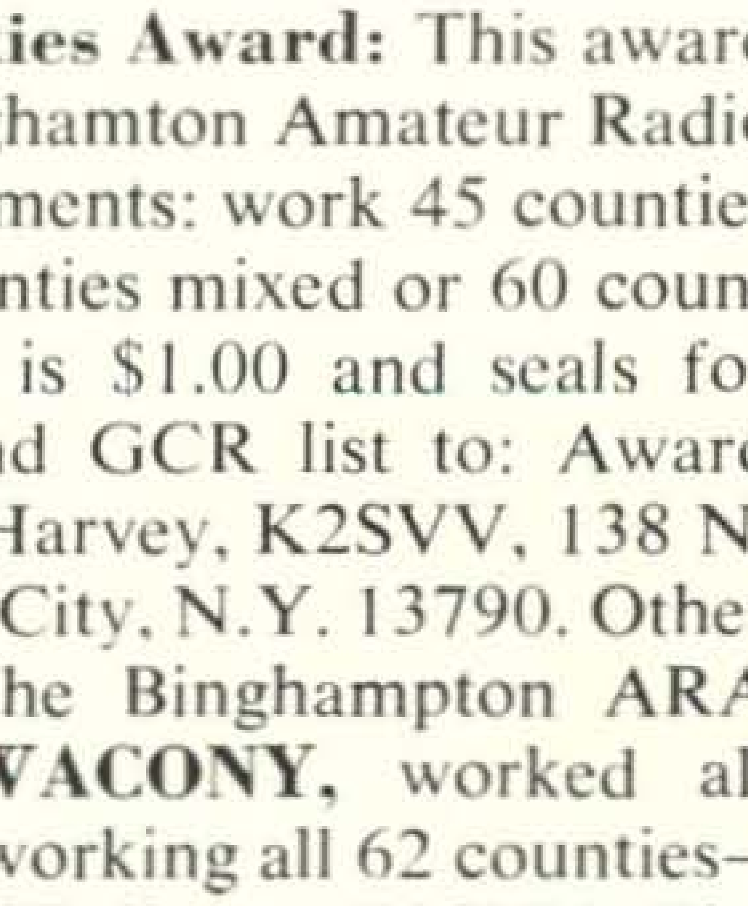
Cliff had been very active in promoting County Hunting begining around 1960, also enjoyed DXing, traffic handling, QSO parties, and contests of all kinds. He liked to collect awards and amassed more than 1,100 which included USA-CA-500 #1R; 1000 #6; 1500 #1; 2000 #1; 2500 #1; 3000 #1 and #1 ALL 3079 County Trophy.

From all associated with *CQ*, our deepest sympathy to Cliff, Sr., and Viv.

Awards

New York Counties Award: This award is issued by The Binghamton Amateur Radio Association. Requirements: work 45 counties v.h.f. only or 50 counties mixed or 60 counties. Cost of award is $1.00 and seals for s.a.s.e. and 25¢. Send GCR list to: Award Chairman, Maurice Harvey, K2SVV, 138 N. Baldwin St., Johnson City, N.Y. 13790. Other awards issued by The Binghampton ARA via K2SVV are: **WACONY,** worked all counties of N.Y. for working all 62 counties–cost is $.50, send GCR list to K2SVV. The **BARA Award** is issued for working five working members of the Binghamton Amateur Radio Association, or work the Club Station W2OW and 4 club members. The cost is $1.00, send GCR list to K2SVV.

Pacific DX Net Award: This achievement award is issued for working at least 25



Pacific DX Net Membership Award

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Pacific DX Net Achievement Award

official members of the Pacific DX Net in at least 10 countries since 3 January 1969 on 14 mc s.s.b. Send QSL-data, a signed statement and $1.00 (50¢ for members only) to permanent secretary, Ed DeYoung, KH6-GLU, P.O. Box 762, Kaunakakai, Molokai, Hawaii 96748. The Pacific DX Net was established 3rd January 1969 to promote DX activity and interest in the Oceania continental-area, to disseminate the latest DX News and to promote fellowship among Oceania DXers. The Net meets each Friday from 0600 GMT to 1000 GMT on 14265. Any Oceania, or ex-Oceania station is eligible for Full Net membership. Send QSL and 5-IRC's to Permanent Net Secretary. A numbered Net Certificate will be airmailed to you. Any non-Oceania station is eligible for Associate Net membership–same cost, Associate members will not be listed on the roll-call (Full members are) but Associate members do get preference on checking in for rare DX QSOs, etc.... The membership stands at this minute nearly 100, so space does not permit listing them.

Beaver Valley Radio Club Certificate: This award was described in *CQ* April 1969 and issued by the Beaver Vally Amateur Radio Club, Box 413, Fruitvale, B.C. Canada for QSOs with one club member and any nine VE stations (VE7s must contact 2 club members and any 8 VE7s). Send QSO data and 25¢ or 2-IRCs. As there has been a big demand for these awards, the one year (1969) rule has been dropped, thus there is *no* time limit.

Notes

Apparently I can not mention this too often – YES, I am the custodian for CQ USA-CA (United States of America Counties Award), and your first application MUST be made using a *USA-CA Record Book* which may be obtained direct from *CQ* for $1.25; to save time, send all other mail for this column to my home QTH. Oh yes, your Record Book, no matter how old, should be sent to W2GT *ONLY!* I am NOT enforcing the rule which requires QSLs from MOBILES to list a city/town.

Sorry that some readers have the wrong impression–*CQ* does NOT have any restrictions on what I put in the column, the only restrictions are it's length! So when I write to you that material has been cut, the ONLY reason is to cut the column to the proper (necessary) size. Thus I am often behind on AWARDS and other data, but I'll eventually catch up, I hope, Hi.

I had hoped to find room to give proper thanks to Gil, W5QPX and list all the fellows who have profited by his kindness and generosity. Gil has sent POD 26 directories to over 30 oversea stations and this does not include those who have received catalogues, manuals, magazines, callbooks, parts and other material. Another reader has offered several POD 26, so any oversea County Hunters in need, please let me know.

Gosh, I nearly forget to mention that County Hunters can obtain QSLs from Carmen, YS2CEN by sending QSL and s.a.s.e. to Roy, WA5OCG.

Another sad note, just received word that an old friend, John Kulik, W2ARB, became a silent key on October 31, 1969.

Wishing *YOU ALL* A WONDERFUL NEW YEAR and hope among your resolutions you will include one to be sure to send out those QSLs and to write and tell me, How was you month? 73, Ed., W2GT.

"We are using an outboard audio filter here..."

See page 110 for New Reader Service

Propagation

BY GEORGE JACOBS,* W3ASK

ALTHOUGH the sunspot cycle continues to decline slowly, excellent DX propagation conditions are forecast for both 10 and 15 meters during January. Both bands are expected to open to most areas of the world sometime during the daylight hours, often with exceptionally strong signal levels. Excellent short-skip openings are also forecast for 10 meters during the daylight hours between distances of approximately 1200 to 2300 miles. Similar short-skip conditions are expected on 15 meters from shortly after sunrise through the early evening hours, for distances between approximately 1000 and 2300 miles.

Excellent propagation conditions are forecast for 20 meters, for both DX and short-skip openings. DX openings are expected to peak shortly after sunrise and again during the late afternoon and early evening hours. For short-skip openings less than 1000 miles, conditions should be optimum from mid-morning through the late afternoon hours; for openings between 1000 and 2300 miles, optimum conditions are expected during the afternoon and early evening hours. Frequent DX and short-skip openings should also be possible on this band during the hours of darkness.

Good DX propagation conditions are forecast for 40 meters during January, with openings expected to many areas of the world from shortly after sundown, through the hours of darkness, and until shortly after sunrise, local time. During the daylight hours, optimum short-skip propagation conditions are expected for openings between 100 and 600 miles. During the late afternoon skip should lengthen, and by nightfall conditions should be optimum for short-skip openings between distances of approximately 800 and 2300 miles.

*11307 Clara Street, Silver Spring, Md. 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for Jan. 1, through Feb. 15, 1970

	Forecast Rating & Quality			
Days	(2)	(1)	(4)	(3)
Above Normal: Jan. 9, 11, 23, 28, 31. Feb. 6, 8, 12	B	B-C	A	A-B
Normal: Jan. 1, 3, 7-8, 10, 12-15, 18-19, 22, 24, 27, 29. Feb. 4-5, 7, 9-11, 13, 15	C	D	A-B	B
Below Normal: Jan. 2, 4, 6, 16-17, 20-21, 25-26, 30. Feb. 1, 3, 14	D	E	B-C	C-D
Disturbed: Jan. 5. Feb. 2	E	E	C-D	D-E

HOW TO USE THESE CHARTS

The following is an explanation of the symbols shown above, and instructions for the use of the *CQ* propagation predictions:

1—Enter Propagation Charts on following pages under appropriate band and distance or geographical area columns. Read predicted times of band openings at intersection of both columns.

2—Following each predicted time of band opening is a forecast rating which indicates the relative number of days the band is expected to open during each month of the forecast period. The higher the rating, the more frequent the opening, as follows: (4) band open more than 22 days each month; (3) between 14 and 22 days; (2) between 2 and 13 days; (1) less than 7 days.

On the "Short-Skip" Chart where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecat is made, and the second to the greater distance. Note the forecast rating for later use.

3—With the forecast rating noted above, start with the numbers in parenthese at the top of the "Last Minute Forecast" appearing above. Read down the table for a day-to-day forecast of propagation conditions in terms of Above Normal (WWV rating higher than 6); Normal (WWV rating 5-6); Below Normal (WWV rating 4); Disturbed (WWV rating less than 4). The letter symbols (A-E) describe reception conditions (signal quality, noise and fading levels) expected for each day of the month and have the following meaning: (A—excellent opening with strong, steady signals; B—good opening, moderately strong signals, little fading and noise; C—fair opening, signals fluctuating between moderately strong and weak; D—poor opening, signals generally weak and considerable fading and noise; E—poor opening, or none at all.

4—This month's Propagation Charts are based upon a transmitter power of 75 watts c.w.; 150 watts s.s.b., or 300 watts d.s.b., into a dipole antenna one quarter-wave above ground on 160, 80 and 40 meters and a half-wave above ground on 20, 15 and 10 meters. For each 10 db increase above these reference levels, reception quality shown in the "Last Minute Forecast" will improve by one level; for each 10 db loss reception will become poorer by one level.

5—Local Standard Time for these predictions is based on the 24-hour system.

6—These Propagation Charts are valid through March 15, 1970. These Charts are prepared from basic propagation, data published monthly by the Institute for Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

Fairly good 80 meter DX propagation conditions are forecast for January, with the band expected to open to many parts of the world during the hours of darkness. During the daylight hours, conditions are expected to be optimum for short-skip openings between approximately 50 and 250 miles. During the late afternoon and early evening hours skip is expected to lengthen, with conditions optimum for short-skip openings between dis-

See page 110 for New Reader Service

tances of 250-1500 miles. By nightfall, propagation should be optimum for openings up to and beyond 2300 miles.

Some fairly good 160 meter DX openings should be possible in January, during the hours of darkness and the sunrise period, especially when static levels are low. Frequent short-skip openings are also forecast during the hours of darkness, for distances up to 1300 miles. Less frequent openings should also be possible for distances up to 2300 miles.

All-in-all, January looks like a month of fairly good to excellent DX and short-skip propagation conditions on almost all of the h.f. amateur bands. Atmospheric noise levels (static) are expected to be at their lowest values of the year in the northern hemisphere, and signals should be exceptionally strong during most band openings.

Short-Skip Charts

This month's column contains a Short-Skip Propagation Chart for use in the continental United States for distances between 50 and 2300 miles. (The maximum distance possible, under normal conditions, for one-hop, short-skip propagation is 2300 miles). Special prediction charts centered on Hawaii and Alaska are also included. The Charts appearing this month are valid through March 15, 1970. See last month's column for detailed DX Propagation Charts for January. uary.

Sunspot Cycle

The Swiss Federal Solar Observatory at Zurich reports a monthly mean sunspot number of 90 for October, 1969. This results in a smoothed sunspot number of 104 centered on April, 1969, as the present cycle continues to decline at a relatively slow rate. This month's *CQ* propagation forecasts are based upon a predicted smoothed sunspot number of 95.

1969 Past—1970 Future

During 1969, solar activity remained at a relatively high level. The year began with a smoothed sunspot number of 109, and declined to a level in the mid-90's by December. At this level, propagation conditions continued to be excellent on the 10, 15 and 20 meter bands during the hours of daylight and on the 20 and 40 meter bands during the hours of darkness. It is now certain that 1969 will go down as a good year for DX propagation conditions.

The new year is expected to begin with a level of solar activity in the mid-90's, dropping to the mid-70's by the end of 1970. This represents a relatively high level for the first part of the year, dropping to a medium level by the end of the year. DX conditions during the first three or four months of the new year are expected to be much the same as they were for the corresponding period of 1969. By late spring, however, a slight decline should be noticeable on 10, 15 and 20 meters. These bands will probably open a little less frequently for DX than they did last summer. During the fall and winter months, this decrease is expected to become somewhat more noticeable. On the other hand, a slight improvement is expected in DX propagation conditions on the 40, 80 and 160 meter bands during the nighttime hours of the fall and winter months.

For a more comprehensive discussion of propagation changes that can be expected as the solar cycle continues to decline, see "A Seven Year Propagation Forecast For The Amateur DX Bands", by G. Jacobs and S. Leinwoll, appearing on page 52 of the November, 1969 issue of *CQ*.

Despite the decline in solar activity, 1970 is expected to be a good year for DX propagation conditions, although not as good as 1969 or 1968.

V.H.F. Ionospheric Openings

The *Quadrantids* meteor shower should occur on January 3. While it will last for only a day or two, it is expected to be one of the most intense showers that will occur during 1970, and could result in a number of meteor-scatter openings on the v.h.f. bands. The shower is expected to peak during the late afternoon and early evening hours of the 3rd, local time, with an average of 30 to 40 meteors entering the earth's atmosphere each hour.

What may be the last F-2 layer 6 meter openings of the present sunspot cycle may occur during January. An occasional trans-continental opening may be possible, as well as occasional openings between the mainland and Hawaii, and between the USA and Central and South America. The most likely time for F-2 layer 6 meter openings is from an hour or so before noon, through the early afternoon hours.

There is usually a seasonal decrease in the number of trans-equatorial type 6 meter

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openings during January, but some may occur between 8 and 11 P.M., local time.

Relatively little sporadic-E auroral activity is expected during January. Some v.h.f. openings due to these phenomena are likely to occur, however, when h.f. propagation conditions are below normal or disturbed. Check the "Last Minute Forecast" appearing at the beginning of this column for those days are expected to be disturbed or below normal during the month.

73, George, W3ASK

CQ Short-Skip Propagation Chart
January 15-March 15, 1970
Local Standard Time At Path Mid-Point
(24-Hour Time System)

Distance From Transmitter (Miles)

Band (Meters)	*50-250*	*250-750*	*750-1300*	*1300-2300*
10	*Nil*	*Nil*	07-08 (0-1) 08-09 (0-2) 09-10 (0-3) 10-12 (0-4) 12-15 (0-3) 15-17 (0-2) 17-18 (0-1)	07-08 (1) 08-09 (2-3) 09-10 (3-4) 10-12 (4) 12-15 (3-4) 15-16 (2-4) 16-17 (2-3) 17-18 (1-2) 18-19 (0-2) 19-20 (0-1)
15	*Nil*	07-08 (0-1) 08-15 (0-2) 15-17 (0-1)	06-07 (0-1) 07-08 (1-2) 08-11 (2-3) 8 (0-1) 11-15 (2-4) 15-16 (1-4) 16-17 (1-3) 17-18 (0-3) 18-19 (0-2) 19-21 (0-1)	06-07 (1) 07-08 (2) 08-09 (3) 07-0 09-11 (3-4) 11-16 (4) 16-18 (3-4) 18-19 (2-3) 19-20 (1-2) 20-21 (1) 21-22 (0-1)
20	09-11 (1-2) 11-14 (1-3) 14-15 (1-2) 15-17 (0-1)	07-09 (0-2) 09-11 (2-4) 11-14 (3-4) 14-15 (2-4) 15-17 (1-4) 17-19 (0-3) 19-20 (0-2) 20-07 (0-1)	07-08 (2) 08-09 (2-3) 09-17 (4) 17-19 (3-4) 19-20 (2-3) 20-22 (1-3) 22-00 (1-2) 00-06 (1) 06-07 (1-2)	06-07 (2) 07-08 (2-3) 08-09 (3-4) 09-10 (4) 10-14 (4-3) 14-19 (4) 19-21 (3-4) 21-22 (3) 22-00 (2) 00-03 (1-2) 03-06 (1)
40	07-08 (0-2) 08-09 (1-3) 09-10 (2-4) 10-17 (4) 17-18 (3-4) 18-20 (2-3) 20-22 (1-2) 22-07 (0-1)	07-08 (2) 08-09 (3) 09-11 (4-3) 11-15 (4-2) 15-18 (4) 18-20 (3-4) 20-22 (2-4) 22-02 (1-3) 02-07 (1-2)	07-08 (2) 08-11 (3-1) 11-15 (2-1) 15-17 (4-2) 17-18 (4-3) 18-22 (4) 22-02 (3-4) 02-05 (2-4) 05-07 (2-3)	07-08 (2-1) 08-15 (1-0) 15-17 (2-1) 17-18 (3) 18-04 (4) 04-05 (4-3) 05-07 (3-2)
80	07-08 (2-3) 08-10 (3-4) 10-15 (4-3) 15-21 (4) 21-00 (3-4) 00-04 (2-3) 04-07 (1-2)	07-08 (3) 08-09 (4-2) 09-10 (4-1) 10-15 (3-1) 15-16 (4-1) 16-18 (4-2) 18-00 (4) 00-04 (3-4) 04-07 (2-3)	07-08 (3-1) 08-09 (2-0) 09-16 (1-0) 16-18 (2-1) 18-20 (4-3) 20-04 (4) 04-06 (3) 06-07 (3-2)	07-08 (1-0) 08-16 (0) 16-18 (1-0) 18-20 (3-2) 20-03 (4) 03-04 (4-3) 04-05 (3) 05-06 (3-2) 06-07 (2-1)
160	09-17 (1-0) 17-19 (3-2) 19-05 (4) 05-07 (3) 07-09 (2-1)	17-18 (2-1) 18-19 (2) 19-21 (4-3) 21-05 (4) 05-06 (3) 06-07 (3-1) 07-09 (1-0)	17-18 (1-0) 18-19 (2-1) 19-21 (3-1) 21-03 (4-3) 03-05 (4) 05-06 (3-2) 06-07 (1)	18-19 (1-0) 19-21 (2-1) 21-03 (3) 03-05 (4-2) 05-06 (2) 06-07 (1-0)

ALASKA

Openings Given in GMT‡

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	19-20 (1) 20-22 (2) 22-23 (1)	16-17 (1) 17-22 (2) 22-00 (3) 00-01 (2) 01-02 (1)	11-15 (1) 15-17 (2) 17-22 (1) 22-00 (2) 00-02 (3) 02-03 (2) 03-04 (1)	04-13 (1) 07-12 (1)*
Central USA	19-21 (1) 21-00 (2) 00-01 (1)	17-18 (1) 18-20 (2) 20-23 (3) 23-00 (4) 00-01 (3) 01-02 (2) 02-04 (1)	11-16 (1) 16-18 (2) 18-23 (1) 23-01 (2) 01-04 (3) 04-05 (2) 05-06 (1)	05-14 (1) 08-13 (1)*
Western USA	19-20 (1) 20-21 (2) 21-23 (3) 23-01 (4) 01-02 (3) 02-03 (2) 03-04 (1)	17-18 (1) 18-19 (2) 19-23 (3) 23-02 (4) 02-03 (3) 03-04 (2) 04-05 (1)	11-17 (1) 17-18 (2) 18-20 (3) 20-01 (2) 01-02 (3) 02-04 (4) 04-05 (3) 05-06 (2) 06-07 (1)	04-05 (1) 05-12 (2) 12-15 (1) 15-16 (2) 16-17 (1) 05-12 (1)* 12-15 (2)* 15-17 (1)*

HAWAII

Openings Given In

Hawaiian Standard Time†

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	07-08 (1) 08-12 (2) 12-14 (3) 14-15 (2) 15-16 (1)	06-07 (1) 07-12 (2) 12-14 (3) 14-16 (4) 16-17 (2) 17-18 (1)	06-08 (2) 08-12 (1) 12-16 (2) 16-17 (3) 17-19 (4) 19-21 (3) 21-01 (2) 01-06 (1)	18-19 (1) 19-21 (2) 21-01 (3) 01-03 (2) 03-04 (1) 19-21 (1)* 21-01 (2)* 01-03 (1)*
Central USA	07-08 (1) 08-09 (2) 09-12 (3) 12-14 (4) 14-15 (2) 15-16 (1)	06-07 (1) 07-08 (2) 08-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	05-06 (1) 06-08 (3) 08-10 (2) 10-13 (1) 13-14 (2) 14-16 (3) 16-18 (4) 18-19 (3) 19-21 (2) 21-23 (1)	18-19 (1) 19-20 (2) 20-03 (3) 03-04 (2) 04-06 (1) 19-21 (1)* 21-03 (2)* 03-05 (1)*
Western USA	06-08 (1) 08-09 (2) 09-11 (3) 11-13 (4) 13-15 (3) 15-16 (2) 16-17 (1)	06-07 (1) 07-08 (2) 08-09 (3) 09-16 (4) 16-17 (3) 17-18 (2) 18-20 (1)	06-07 (2) 07-10 (4) 10-14 (3) 14-18 (4) 18-19 (3) 19-21 (2) 21-06 (1)	17-18 (1) 18-19 (2) 19-02 (4) 02-04 (3) 04-06 (2) 06-07 (1) 19-20 (1)* 20-22 (2)* 22-04 (3)* 04-05 (2)* 05-07 (1)*

*Indicates predicted 80 meter openings. Openings on 160 Meters are also likely to occur during those times when 80 Meter openings are shown with a forecast rating of (2) or higher.

‡To convert to Local Standard Time in Alaska, *subtract* 8 hours in the Pafific Standard Time oZne; 9 hours in the Yukon Zone; and 10 hours in the Alaskan Standard Time oZne, from the GMT times shown in the Chart. GMT is 5 hours *ahead* of EST; 6 hours *ahead* of CST; 7 hours *ahead* of MST; 8 hours *ahead* of PST. For example, when it is 18 GMT, it is 1 P.M. in Washington, D.C. and 10 A.M. in Los Angeles.

†Hawaiian Standard Time is 5 hours *behind* EST; 4 hours *behind* CST; 3 hours *behind* MST; 2 hours *behind* PST and 10 hours *behind* GMT or Z Time. For example, when it is noon in Honolulu, it is 17 or 5 P.M. EST in N.Y.C., and 14 or 2 P.M. in Seattle.

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Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

Jan. 3	Pacific Net Qso Party
Jan. 17-18	Louisiana QSO Party
Jan. 17-19	Connecticut QSO Party
Jan. 24-25	**CQ WW DX 160 C.W. Contest**
Jan. 24-26	Arkansas QSO Party
Jan. 30–Feb. 2	Old, Old Timers QSO Party
Jan. 31–Feb. 1	French C.W. Contest
Feb. 7-8	ARRL DX Phone Contest
Feb. 14-15	YL-OM Phone Contest
Feb. 14-15	QCWA QSO Party
Feb. 21-22	ARRL DX C.W. Contest
Feb. 28–Mar. 1	YL-OM C.W. Contest
Feb. 28–Mar. 1	Operation's Day
Feb. 28–Mar. 2	Vermont QSO Party
Feb. 28–Mar. 15	IARC Propagation CW/RTTY
Mar. 7-8	ARRL DX Phone Contest
Mar. 14-15	Virginia QSO Party
Mar. 21-22	ARRL DX C.W. Contest
Mar. 28–Apr. 19	IARC Propagation Phone
Apr. 4-5	Florida QSO Party
Apr. 11-12	**CQ WW WPX SSB Contest**
Apr. 18-19	Helvetia XXII Contest
Apr. 25-26	DARC WAE RTTY Contest

Pacific DX Net QSO Party

From:
0400 to 1000 GMT Saturday, January 3

An excellent opportunity to work some of these elusive Pacific islands.

Logs go to: KH6GLU, QSO Party Chairman, P.O. Box 762, Kaunakakai, Hawaii. Mail before Feb. 1 and include s.a.s.e. for copy of results.

*14 Sherwood Road, Stamford, Conn. 06905.

That's DJ9YI being congratulated by Mr. Platte, Director of Social Services in Wuppertal, with DJ8SW and K4IIF's approval.

Louisiana QSO Party

Starts: 1800 GMT Saturday, January 17
Ends: 2200 GMT Sunday, January 18

Logs go to: Lafayette A.R.C., att: Danny Griffith K5ARH, 123 Normandy Road, Lafayette, Louisiana 70501. Mailing deadline Feb. 28th, include s.a.s.e. for copy of results.

CQ WW DX 160 C.W. Contest

Starts: 0000 GMT Saturday, January 24
7 P.M. EST Friday, January 23
Ends: 1500 GMT Sunday, January 25
10 A.M. EST Sunday, January 25

Don't forget to keep the "DX Window" open for the DX boys. You will never be able to hear them if the W/K and VE's operate in the 1825-1830 portion of the band. Working DX on frequency just does not work out. Call them up at the low frequency end of the band, 1800-1805, that's where they will be looking for you.

We also implore the phone boys to please keep this spot clear for the contest week-end.

Log sheets and United States Operating Regulations for 160 may be obtained from *CQ* or W2EQS upon request. A large s.a.s.e. must accompany your request.

This year your logs go to: Contest Chairman, Charles M. O'Brien, W2EQS, 48 Prospect Ave., Westwood, N.J. 07675. Mailing deadline is February 28th.

Arkansas QSO Party

Starts: 2200 GMT Saturday, January 24
Ends: 0400 GMT Monday, January 26

Logs go to: North Arkansas A.R.S., Att: J. K. Fancher, Jr. W5WEE, 407 Skyline Terrace, Harrison, Arkansas 72601. Deadline Feb. 5th.

Complete rules for the precetding 4 events will be found in last month's CALENDER.

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Connecticut QSO Party

Starts: 2300 GMT Saturday, January 17
Ends: 0400 GMT Monday, January 19

This is the 7th annual QSO party sponsored by the Candlewood Amateur Radio Association.

Exchange: QSO nr., RS/RST and QTH. County for Conn. stations, ARRL section or country for all others.

Scoring: One point per QSO. Conn. stations multiply total by ARRL sections and countries worked. Out-of-state stations will use Conn. counties for their multiplier, (max. of 8). The same station may be worked on each band and mode for QSO points.

Awards: Certificates to the top scorer in each ARRL section and country. (min. of 6 QSOs). And the two highest scorers in each Conn. county. Novice awards will also be made.

Frequencies: 3540, 3925, 7040, 7275, 14040, 14300, 21050, 21300, 28040, 28880. Novices, 3740, 7175, 21125.

Mailing deadline is Feb. 20th and logs go to: Connecticut QSO Party, c/o Tom O'Hara, W1DDJ, 7 West Wooster St., Danbury, Conn. 06810. Include s.a.s.e. for results.

French DX Contest

C.W.–Jan. 31-Feb. 1
Phone–Feb. 28-Mar. 1
Starts: 1400 GMT Saturday
Ends: 2200 GMT Sunday

Only 24 hours out of the 32 hour contest period is permitted for scoring. The 8 hours of non-operation may be taken in 1, 2 or 3 periods anytime during the contest, and be clearly indicated on the log.

Exchange: Usual 5 or 6 figures, RS/RST plus a 3 figure QSO number starting with 001.

Points: 3 for each QSO with a French or DUF country station.

Multiplier: 1 for each REF department and DUF country worked on each band. (F stations will identify their dept. by 2 figures after their call.)

Scoring: Multiply total QSO points by the sum total of the multiplier from each band.

There will be HB, LX and ON stations on in their own activity during this period. Contacts with these stations and also 9Q, 9U and 9X, will also count for QSO and multiplier points in this contest.

[*Continued on page 92*]

Claimed Scores
1969 CQ WW DX Phone Contest

Single Operator All Band	
LAØAD	2,512,695
VK6RU	1,774,808
KH6IJ	1,711,708
W6RR	1,500,000
W4ZCY	1,302,400
4Z4HF	1,110,793
YS1XEE	849,420
K1KNQ	783,288
WB6UDC	610,000
WA6EPQ	510,000
W6DGH	484,000
28 mc	
OZ3SK	448,500
K6NA	263,271
K4KJN	206,080
K4II	187,648
W4LBP	173,972
W5EU	136,904
SM4CMG	113,288
K2BK	131,157
WB6AQF	111,628
DL9VS	96,000
21 mc	
OD5FA	261,595
JA1JXU	214,303
W4NQM	186,450
K4SKI	133,596
DL4JW	130,368
K4SXD	105,108
VE6AGV	91,512
PY1CHP	79,560
14 mc	
KP4CL	459,420
VP9BY	290,760
VE6GN	224,128
TG9UZ	220,010
WA3GUL	180,082
TF2WLN	160,484
JA1OCA	103,912
OH2CP	101,296
7 mc	
CT1GD	5,265
JA1IST	1,342
3.5 mc	
VE7BDJ	13,653
OE1WO/CHO	12,322
WA8VMQ	1,080
Multi-Operator Single Trans.	
W9LKJ	1,459,860
W5RER	1,432,368
K9CUY	677,115
W3WPG	589,034
WA3FXJ	393,894
K6ILG	369,820
W6NJU	233,000
Multi-Operator Multi-Trans.	
W6VSS	4,700,000
K6UYC	2,260,000
K4CG	2,022,720
W6ISA	2,008,157
WB6HGU	1,700,000
K8UDJ	1,621,820
K4BVD	1,192,032
W6UUI	1,103,000

The DLØWR crew, Ed, DJ9YI, Werner, DJ8SW and Klaus, DJ4AX, proudly displaying the John Knight, W6YY, Trophy they won in the Multi-operator, Single Transmitter division of the CQ 1968 WW DX Phone Contest. That's our own DX Editor, John Attaway, K4IIF, at the operating position. John was in Germany last September, and had made the presentation at a civic ceremony at the City Hall in Wuppertal.

Q AND A

BY WILFRED M. SCHERER,* W2AEF

THIS month's Q & A Column will again start off with more on TXI, since it is becoming a growing concern among radio amateurs.

Of particularly happy interest is the cooperative aid and recognition toward the situation by at least two manufacturers of solid-state appliances in contrast to the poor performance of a manufacturer as previously reported.

Here are the reports on these cases, the first of which is from George Goldstone, W8-AP, 1010 Burnham Road, Bloomfield Hills, Mich. 48013.

"The rig at W8AP runs 2 kw p.e.p. and did a good job of swamping my neighbor's Rittenhouse solid-state radio/intercom unit, some 250 yards away. Like almost all such intercoms, they are turned on all the time; there is no line switch!

"I wrote to Emerson-Rittenhouse Co., Inc., Honeoye Falls, N.Y. 14472, and was supplied with the service manual for the intercom, plus what they call there "standard R.F.I. kit." This consisted of several 0.1 mf ceramic disc capacitors (low voltage, of course) to bypass the input terminals from the remote speaker/pick-ups to ground. On this model, there were 4 input terminals, and more than one remote speaker had been paralleled across the inputs. Every one of these remote speakers acts as an antenna!

"An additional part of the kit was a tiny transformer which is inserted between the input selector switch and the input to the audio board. This was very simple to install, following the clear instructions in the service manual.

"When the job was completed—with the friendly cooperation of my neighbor (whose son is now studying for a novice ticket)—the r.f.i. or TXI was completely eliminated.

"A second bit of TXI in the neighborhood developed a few weeks ago when another neighbor bought a Scott "Stereo Compact" Model 2503. I wrote to H. H. Scott, Inc., 111 Powder Mill Road, Maynard, Mass. 01754, and received their Technical Bulletin #37. While I have not yet had time to install the bypassing suggested, I think it will clear up once the suggested steps are taken. The general procedure should apply to other equipment, so I am enclosing a copy of this bulletin. I hope this will be of help."

The Scott Bulletin #37 outlines procedures for determining the points at which the interference is introduced. This is followed up with suggested preventitive measures to be incorporated in each case. For the most part these involve remedies as heretofore reported in Q & A Columns, such as bypassing speaker leads, bypassing or filtetring a.c. power-line inputs, bypassing a.f.-input circuits, relocating or shielding of speaker leads. In respect to the latter 18-gauge two-conductor shielded cable (Belden #3428) is recommended.

The Scott people's recognition of TXI or r.f.i. (r.f. interference) problems is indicated by the preface to their bulletin which reads, "In certain areas and under certain circumstances it is possible that r.f. interference can be so intense that it "overpowers" the elaborate anti r.f. circuitry provided in Scott amplifiers and tuners. This interference is generally present when the units are in use near a radio transmitter, either commercial or ham broadcast."

The second report is one received personally from Tom McCann, K2CM, of Morris Plains, N.J. He too, received aid and excellent cooperation from H. H. Scott, Inc., through Mr. J. Rich and from Scott's local service representative, Boho Labs. Fortunately, the owner of the TXI- affected gear, two doors away also, was most cooperative; as a matter of fact, he himself did the major part of the modification work required for successful solutions to the TXI which had been experienced.

The equipment involved was a Bogen-Presto record player, a Sony tape recorder and a Scott solid-state f.m. tuner and hi-fi stereo system. K2CM's transmitter is a Collins KWS-1 operating with 1 kw p.e.p. input on 15, 20, 40 and 75 meters.

Having just moved into a large garden-apartment complex, Tom deemed it best to install his antenna as far away from the building as possible and oriented for the least

*Technical Director, *CQ*.

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radiation in this direction which fortunately left suitable directivity to the communications areas of interest.

The antenna is a multi-dipole setup using one coax feedline buried in the ground on the run to the building 175 feet away. Use of a vertical radiator had been attempted on 40 meters, but it was discarded inasmuch as it proved to be real disastrous as far as TXI was concerned.

Except with 20-meter operation, the TXI was pretty well cleaned up by bypassing the stereo-speaker leads at the hi-fi amplifier terminals and by installing a good ground system. In this respect, the speaker ground connections at these terminals had been carried through a wiring harness to a point within the equipment where other grounds from additional leads had been made. R.f. was then induced into the harness wiring before it could reach the ground point. Adequate grounding was therefore not obtained, until it was made directly to the chassis at the phono jacks used for the external leads.

Some slight TXI was still observed during 20-meter operation and eventually more seriously cropped up with 2-meter operation into a "Big Wheel" antenna 75 feet from the building.

This was cured by additional shielding of external-input leads and grounding between the accessories plus their filtering at the amplifier chassis connectors. Double shielding was used for these leads by employing a second shield slipped over each existing cable with this shield connected *only* to the chassis ground in the main equipment. An alternate method, by the way, would be use of two-conductor shielded cable with the shield connected only to the amplifier-chassis ground. This keeps *all* the a.f.-signal paths off of the shield and allows it to function strictly as an effective shield for the signal leads.

The input filtering consisted of a 1K resistor in series with the hot lead from each chassis connector and with the amplifier-side of each resistor bypassed directly to the chassis with 100 mmf. Fortunately, the input transistors were f.e.t.'s with a high input impedance, thus making this type of filtering effective. Low-impedance bipolar transistors might have required an r.f. choke in place of the resistor plus a larger bypass. Closer attention was further made to grounding, ending up with as near a one-point grounding setup as possible.

The third report is from Robert Avigor, 4X4CJ, P.O. Box 3159, Tel-Aviv, Israel. Besides relating some TXI experiences and successful solutions, it indicates that TXI has also become an international problem.

"I was quite intrigued by your Q & A for August 1969 with respect to what you so aptly describe as TXI. Having "suffered" from this malady, perhaps the following solutions found here would be of interest to your readers.

"The first case was my interfering with a Sony Stereo Tape Recorder at a distance of some 150 feet. I was coming through whether on a mere recording session or a playback. The solution was found that as the tape deck had no common ground with the recorder itself, this had to be installed–a mere piece of wire between the two units–and my trouble was over.

"The second case was more severe. The r.f. was coming through the a.c. line into my neighbors apartment where he has in use an a.c.-operated transistor radio and an a.c.-operated Sony transistorized mono tape recorder. It was further noted that although an Emerson TV set was operating in my apartment, it was not affected at all.

"There were two solutions. The first was to install a small r.f. choke on the a.c. line of both the transistor radio and the tape recorder. The current drain being very low with such units, the r.f. chokes were quite safe. This cut down the interference by 90%. However, since my neighbor stopped saying hello to me, I did one thing better, by installing an isolation transformer (220 v. 220 v.a.c.) of 1 kw. This stopped *all* the interference and everyone is happy.

"The rig here is a Drake TX-4 and R-4A plus a 14AVQ vertical antenna atop a 105-foot tower, all being well grounded–including the tower itself. So, there you have it."

To this we might add that difficulties with r.f. on a.c. power circuits are more apt to occur where the building wiring (at the involved locations) is unshielded, such as may be the case with "Romex" now widely used for house wiring.

In regard to our original discussion on TXI (August 1969 Q & A Column) an irate reader attempted to take us apart particularly by asserting we were "witch hunting". It is quite evident from the TXI problems reported here and elsewhere in the past few months, that the situation is a fact. The sooner this is recognized and the necessary steps taken to eliminate it, the better off we'll all be.

Furthermore, besides making other ridiculous assertions, this reader was under the misaprehension that we claimed TXI could cause the affected solid-state appliances to produce harmonics that might interfere with other equipment. While this could take place, as will be shown subsequently, our point was that harmonics caused in TXI-affected equipment could raise havoc with the equipment itself, such as might be the case with a TV set.

As for such TXI-created harmonics affecting other external equipment, this is not as apt to happen as a general rule; nevertheless, the following taken from the Drake TR-6 manual clearly indicates such possibilities: (the particular discussion is related to TVI which for the case in point also involves TXI):

"This interference is also caused by the fundamental output of the ham transmitter. If this signal is allowed to appear across any non-linear device. it will generate harmonics or intermodulation products, as the case may be. These products are reradiated to a TV receiver and thus are a potential cause of TVI.

Such non-linear devices can include: rusty drainpipes, defective telephone wiring or rusty antenna installations, *transistor radios (including car radios),* TV sets connected to any antenna, crystal sets, field strength meters employing diodes, and a variety of other sources.

A TV receiver employing *semiconductors* in its front end *can* cause this kind of interference even (and especially) with the set turned off. Cases are known where discarded TV receivers stored in basements a block away with rabbit ears extended caused TVI in an entire neighborhood." (Emphasis is ours).

Since TVI has been involved in the above discussion, we might as well continue with the following:

TVI-Proof Transmitters

Many inquiries have been received concerning TVI problems with manufactured amateur transmitters. Some of these also are in quest of a "TVI-proof" rig. Well, there ain't no such animal" in the true sense.

Just how TVI-proof a *given* transmitter may be is largely dependent on the TV signal-strength area (strong or weak), the relative locations of the transmitting gear (including its antenna system) and the TV setup.

The main causes of TVI are:

1–Transmitter harmonics that fall within a TV channel.

2–Harmonics generated in nearby nonlinear elements as a result of corroded rubbing or loose joints in such things as plumbing, metal gutters and leaders, wire fencing, guy wires, TV-receiving antenna systems, etc.

3–Front-end overload of the TV set by the fundamental signal of the transmitter.

4–Transmitter frequency that falls near the i.f. passband of the TV set, such as experienced on 21 mc with the older TV sets.

Transmitter harmonics may be radiated directly from the equipment chassis, cabinet, power or accessory leads or through the antenna system.

The better modern-day manufactured gear has measures for minimizing the possibility of direct radiation from the equipment itself. Such measures include shielding, filtering of external leads, etc. In addition, particular circuitry and types of operation are employed that are less prone to introduce or accentuate harmonics.

Transfer of harmonics to the antenna system usually is reduced by the use of a Pi-network at the p.a. output. The harmonic attenuation attained by such equipment may be in the order of 40-50 db. Where operation is conducted in moderate or weak TV-signal areas, this degree of attenuation most likely will be inadequate for preventing TVI due to harmonics fed to the antenna system. Under such conditions, the addition of a good low-pass filter, installed at the transmitter output, will provide an extra 40-70 db of harmonic attenuation that in most cases will be sufficient; as a matter of fact, such a filter almost always is a must for eliminating TVI on Channel 2 when 28 mc amateur operation is conducted.

In some cases a transmitter may be found which includes a special built-in low-pass filter, while in the case of some high-power linear amplifiers the inclusion of an *L*- network may be found which may provide 10-15 db more attenuation. The use of a well-designed antenna-matching coupler also will provide added harmonic attenuation of 15-20 db.

Of course, if the TVI is due to direct harmonic radiation from the transmitter unit itself, a filter in the transmission line will not necessarily solve the problem. Such a condition may be determined by feeding the

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transmitter output through coax to a *shielded* dummy load. Any TVI then experienced is due to direct radiation from the unit.

If, when the transmitter output is now fed to the antenna system, any previously existing TVI becomes worse, it is obvious that a filter at the output is required.

A possible exception to the above condition might be TVI cause #2 mentioned earlier. This will not be discussed at this time, since it is a situation external to the transmitting equipment. Likewise, the cures for causes 3 and 4 will not be covered, inasmuch as these essentially are deficiencies related to the TV set alone, requiring corrective measures thereat. Our primary concern at this time is in respect to the effectiveness, under certain conditions, of measures incorporated in manufactured gear toward "TVI-proofing" the equipment.

From an operating standpoint, a precautionary measure would be to avoid pushing the rig too hard. The harmonic output rises at a faster rate than does the fundamental output power. Therefore, keep the drive down, or in the case of s.s.b., maintain the mic level below the point where the a.l.c. starts to work.

Intermittent Low Level with NCX-3

QUESTION: I have an NCX-3 which has been working perfectly, but now after the transceiver is on for a few minutes, stations come in very strongly, then suddenly the receiver mutes and cuts the audio way down, but I can still hear the signals weakly. I thought at first that something was activating the relay, but when I watched it, the relay did not move when the trouble occurred. I tried another muting diode with negative results.

If this muting happens before the transmitter is activated, I cannot load up the transmitter. I usually have to first turn the set on and off several times. I can't seem to lay my fingers on the trouble. Can you give me any hints as to where to look?

ANSWER: The fault causing the above troubles evidently is common to both the receiver and transmitter sections of the set. Make sure the antenna connector is okay. This also goes for the antenna system or other gadgets in the transmission line. Make sure all relay contacts are clean. To clean, use a relay-burnishing tool or slide a good grade of bond paper through and between the contacts while holding them closed. Do *not* use a file.

It is doubtful if the trouble is located in the muting system; but just in case it is, check the receiver and transmitting muting-line voltages at pin 7, V_{14A} and pin 7 of V_{15} as per manual page 23.

Check tubes and socket connections (including tube-pin contacts thereat—wiggle tubes in sockets). Do this particularly at the 1st i.f., the carrier oscillator or v.f.o. and the driver circuits, since these stages are used both on receive and transmit. Look for defective screen by-passes here, defective coupling capacitor or voltage-dropping resistor.

Check *exciter-tune* capacitors for dirty or loose ground wipers. Clean if needed. Try to localize the trouble by noting if the problem exists on *all* bands, or on just one and by checking and recording voltages on each stage both before and after the trouble shows up.

An acknowledgement from this reader reported that by following one of the above suggestions, the difficulty was traced to a defective resistor at the carrier-oscillator socket. Thanks OM!

Damp Chaser

QUESTION: I urgently need one of these devices called a "Damp Chaser" which I believe was a low-wattage long insulated resistor for 110 v.a.c. to put below a chassis in electronic equipment for keeping the gear warm during non-operating periods. I have poured over all the current catalogues but have been unable to find this item listed anywheres. Can you help?

ANSWER: We do recall the Damp Chaser, but have not been able to locate a source. Suggest you use a similar one as employed in the Hallicrafters SX-115. It is a 2000-ohm 8-watt job called a Candohm, and should be obtainable from Hallicrafters under part number 024-101258.

An alternative is to use a 5-watt 3-4K ceramic-insulated resistor (Sprague Koolohm-5 NIT) as described in the July 1964 *CQ* under the title "Maintaining VHF Converter Performance."

Still another expedient would be to use a 6-watt 110 v. lamp bulb which is small enough to install under a chassis.

Squeal with NCX-5

QUESTION: When transmitting with my NCX-5 transceiver, a squeal occurs when the mic gain is advanced very far. How can this bet cured?

ANSWER: The cause of the squeal under the

[*Continued on page 99*]

SURPLUS sidelights

BY GORDON ELIOT WHITE

OLD surplus never dies, at least the classic items, like the World War II Command Sets, the BC-221 frequency meter, the SCR-522 pioneer v.h.f. set, and the handful of other sets that have given amateurs and s.w.ls so much service for the last 25 years. The Command receivers, designed *thirty-five years ago*, are, like the Hindu god Vishnu, emerging reborn again, in some new test equipment developed by Extranuclear Laboratories Inc., in Pittsburgh.

The precisely-designed tuning capacitors from the 1.5-3 and 3.0-6.0 megacycle Command Receivers, are the heart of a high-stability precision oscillator that Extranuclear Labs are turning out. Of course there is no current source for *new* Command Set parts. Aircraft Radio Corporation, in Boonton, N.J., junked its tooling ten years ago, after making the A.R.C.-12 series of Command units which served during the Korean War, so Extranuclear has turned to the surplus market, and to amateurs, to obtain these units.

*5716 N. King's Highway, Alexandria, Virginia 22303.

Fig. 1—The TDMS receiver.

Anyone who has even a few of the capacitors from the 1,500 kc to 3.0 or 3.0-6.0 mc receivers, and wants to turn a few dollars, should contact Edward O'Malley, production Manager, Extranuclear Laboratories Inc., box 11512, Pittsburgh, Pennsylvania, 15238, and describe the number and condition of the capacitors he can furnish. The part number, which should be stamped on the frame of the capacitor in red ink, is #4601. Other part numbers are not useful.

The 4601 units were used in the RAT, RAV, ARA, SCR-274-N and AN/ARC-5 series' by both the Army and the Navy. The fully-meshed capacitance of each section of the three-part gang is 159.64 microfarads, plus or minus 0.3 mmf. There are 8 rotor plates per section. The condition of the dial drive gears is not important, but the 33:1 main drive must be intact.

Amateurs have long put these beautifully-built capacitors to new uses, and they formed the heart of several commercial units including some postwar SSB aircraft equipment, and other designs far removed from the miniature "channel" receivers that Fred Drake and Paul Farnham conjured up in Boonton so long ago when the Army's disaster with the Air Mail in 1933 showed just how poor military radios were. I fell in love with the classic Command Set design when I first opened one up and looked at the neat under-

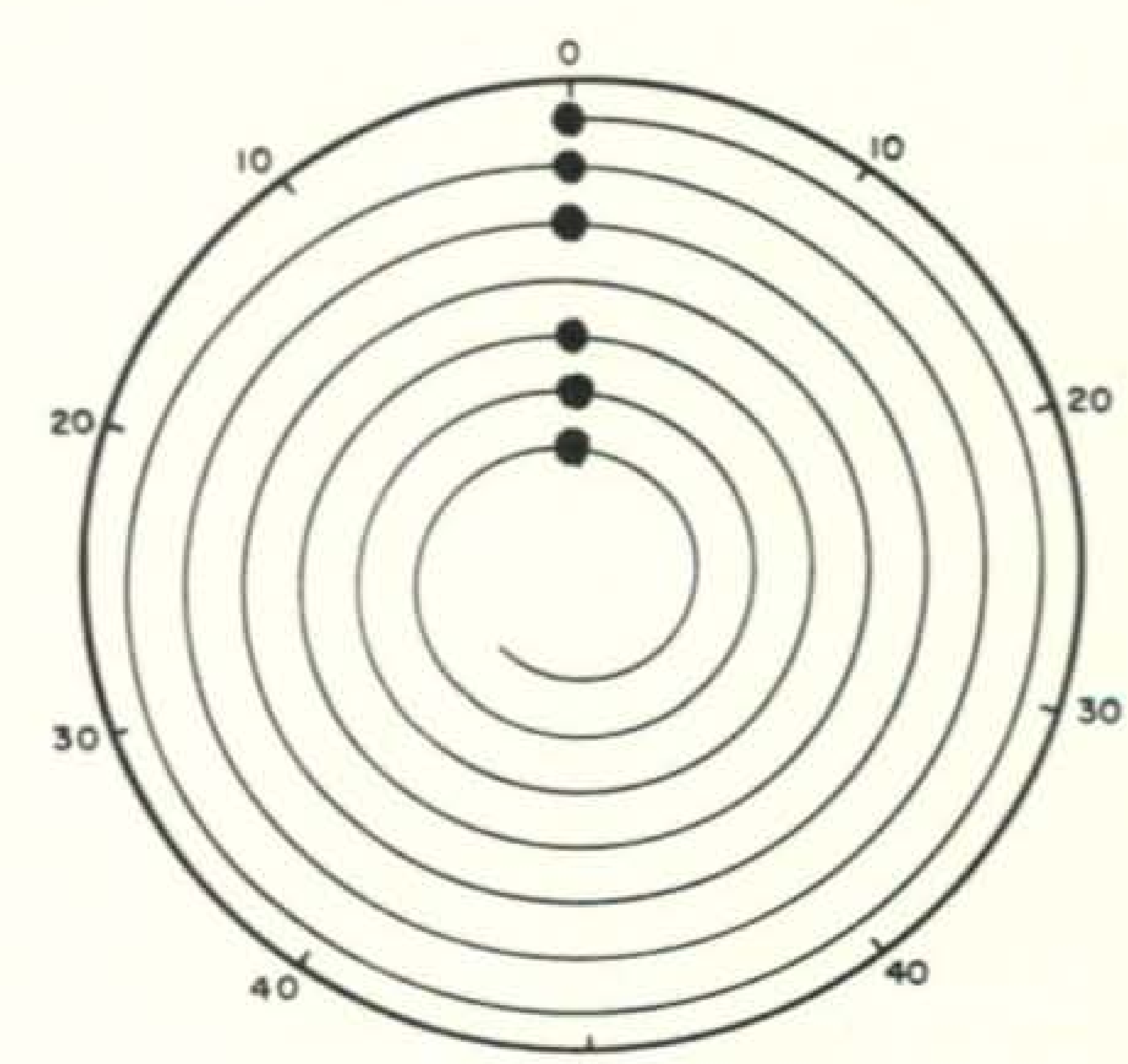

Fig. 2—The spiral receiver trace when a perfect "D" character is being set.

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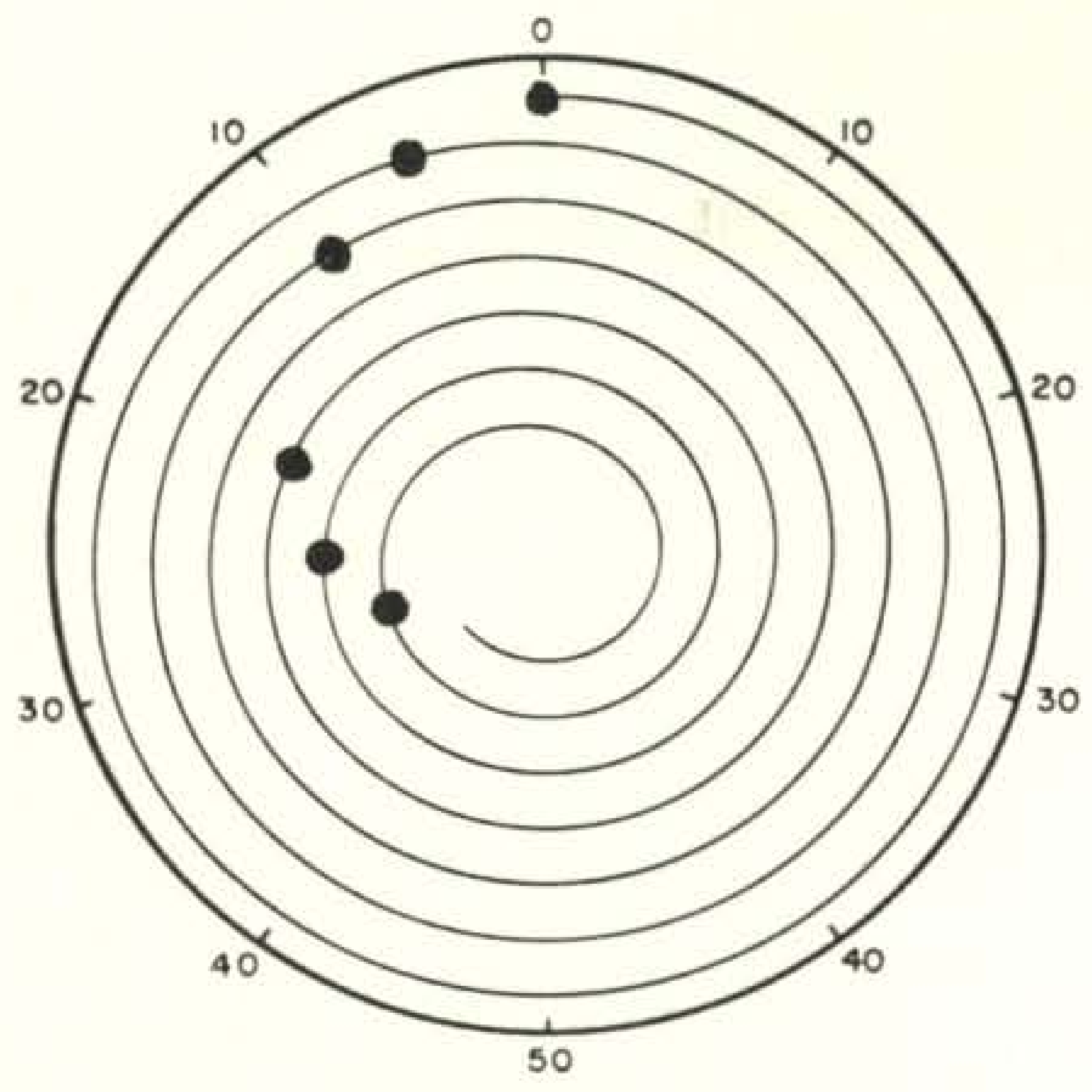

Fig. 3—Transmission where the speed is too fast.

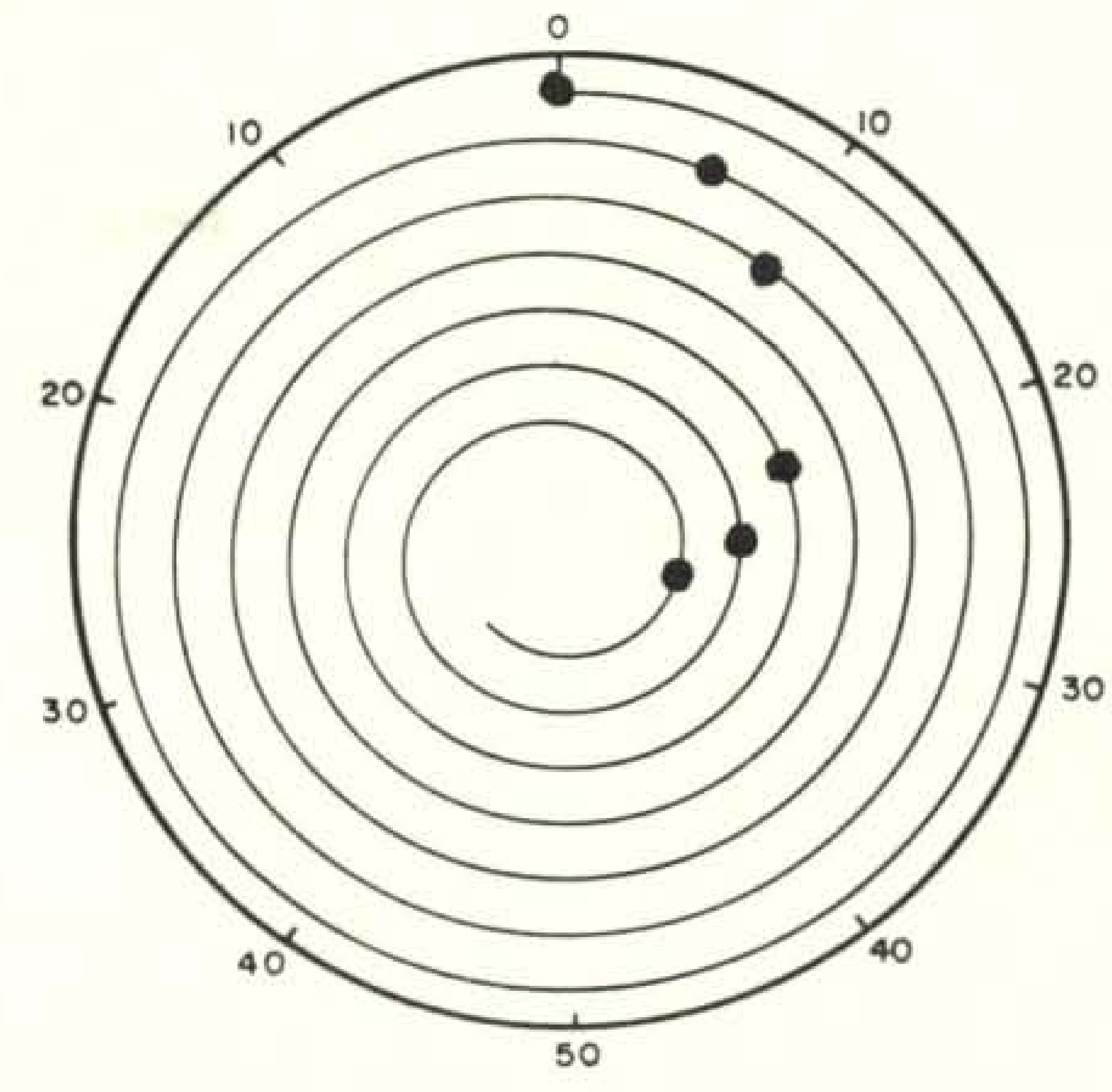

Fig. 4—Transmission where the speed is too slow.

chassis layout, so unlike most of the military, or Heaven knows, the civilian production electronic gear I have seen.

The Command Sets themselves were copied by Western Electric, for the Army, in 1941, when little A.R.C. declined to tool up for massive production. Later Stromberg-Carlson and Colonial Radio built the sets, and, finally, the Lewyt Company built a chinese copy in 1947, using surplus A.R.C. parts, but the finely-crafted A.R.C. production were always the best. The Lewyt sets were undoubtedly the worst.

I heard coincidentally last fall, that an amateur, K5ILG, Wade Williams, of El Paso, had turned up a missing link in the tangled history of the Command Sets. At a point in 1940 when the Navy was wondering if it really wanted to buy the A.R.C. design, it held off after contracting for the RAV sets, and cast around for a "better" design. The tenative result was the RBD, which I could not track down in the contract documents. It turns out that the RBD was a slightly larger RAX, a set which many surplus hounds will recall. Built by General Electric, it was larger, heavier, less reliable, but more sensitive than the Command design at frequencies above 20 mc largely because it had an additional stage of r.f. amplification.

The RAX went into RBY patrol planes, along with a lot of command sets, but the RBD was apparently abandoned as general-use aircraft radio gear after the initial contract. Readers of my earlier Command Set historical articles will recall that the Army, too, tried to do better than the SCR-274-N. Their SCR-240 (Westinghouse) ended up as a footlocker-sized beast, far too heavy for any but the largest bombers. The chief of the Army Air Corps at the time, General Oscar Westover, ruled that if the SCR-240 was too heavy, we'll let the fliers use the SCR-183. It was lighter...also it was a 1925 tuned r.f.

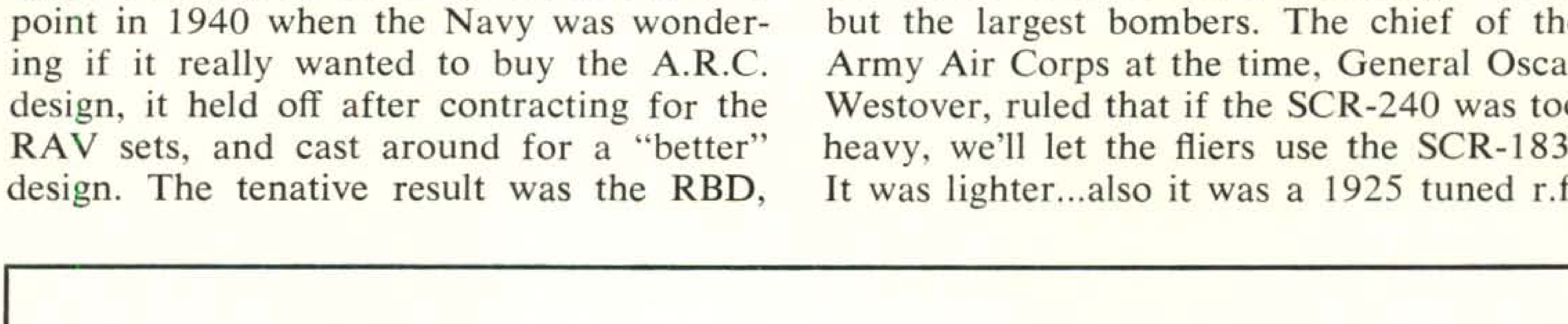

Fig. 5—The receiver series control diagram.

design, roughly comparable to using the SCR-522 in a Phantom jet.

Bendix Radio designed the last futile Command Set before the A.R.C. set was finally recognized as the best design, but if any of the few Bendix SCR-274-A or -B sets still exist, they have eluded me.

If any *CQ* readers know where RBD,

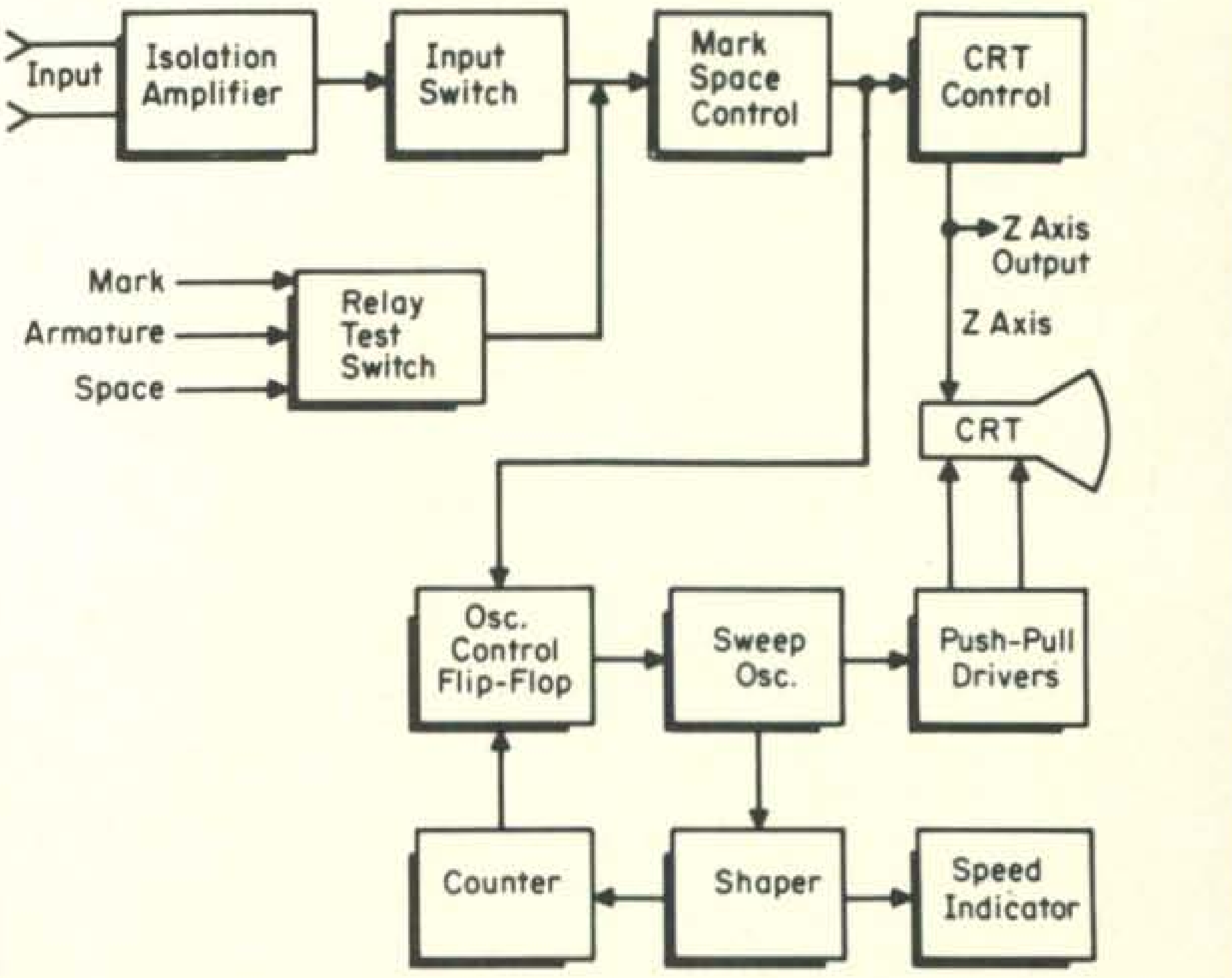

Fig. 6—A block diagram of the receiver.

SCR-240, SCR-274-A, or RAV sets may be found, I would be very interested in that information. I have collected units of almost all of the Command Sets, but the 9-13.5 mc RAV receiver, and the non-A.R.C. sets are still missing from my little Command Set museum.

———

The TDMS Distortion Set

On a totally different surplus subject, I want to mention the TDMS telecommunications distortion set, made in the U.S. by Radiation Inc., of Melbourne, Florida. Radiation, which has built a lot of interesting equipment for C.I.A., N.S.A., the State Department, and other agencies. Apparently Radiation did a redesign of the British TDMS gear about 10 years ago. The Company has been very helpful in giving me information on this equipment, and I in turn will pass along what may be of use to *CQ* readers.

The TDMS is a set of distortion meters that put out TTY signals which may be varied from zero to 50 percent distortion, read the amount of distortion which a TTY transmitter produces, and otherwise provide facilities for fully checking Teletype equipment, demodulators, etc. Though the chief display uses a peculiar circular presentation on the 'scope, the square-wave presentation which is so pretty, may be obtained on auxiliary equipment.

Fig. 1 is a photo of the TDMS receiver. It is similar in application to the Stelma DAC-V, though it antedates the Stelma unit.

The TDMS will operate at Baud rates from 20 to 160, covering all the slower speeds at

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Back issues of *CQ* are available from our Circulation Department. Issues in the current year sell for face value (.75) and all others in stock are one dollar each, postpaid. If the issue is no longer in stock, photo copies of specific articles are available at one dollar each. Preferably, the entire issue will be sent.

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which teleprinter sets operate. It does not reach to the data-spted equipment of 1,200 baud, and higher, that is coming into commercial use, but it is very useful for Amateur work in the 60-100 word per minute range.

The TDMS consists of three units, the receiver, pictured above, which is used to monitor the signal, the transmitter, and the Tel-A-Scan 'scope, used for a square-wave presentation.

The receiver allows display of the circular display without interrupting an operating circuit. It will accept stop-start or synchronous signals, Fig. 2 shows the spiral receiver trace when a perfect "D" character is being sent. Various forms of distortion are shown by displacement of the character element dots from a vertical line. Dealing with speed, fig. 3 shows transmission which is too fast, and fig. 4 shows a slower than standard transmitter. Bias and other distortion may be shown by other dot displacements.

The transmitter section puts out a variety of teleprinter pulses, and allows manipulation of distortion in various ways to test lines, radio circuits, etc. The Tel-A-Scan, as mentioned above, displays a square-wave image of the signal.

Usually the units are contained in a three-section, 19 inch rack, with the power supply mounted at the rear. Alternatively, the power unit may be provided as a portable unit, on a 'scope cart.

The TDMS is of course highly complex gear. In looking for it, surplus, one should check to see that all relays, including the message-generating coder, are in place, as parts are unobtainable.

Fig. 6 is a block diagram of the receiver unit. Complex though it is, it is highly useful to the RTTY man, and these sets are to be found, though they are not common, in surplus stores. I rate this as a "find" which may be easily overlooked, in fact the first one I found had been canabalized by a novice who thought the 'scope could be converted for use as a modulation monitor. ■

Contest Calendar [*from page 92*]

Awards: Certificates to the top scorers in each country. Contest contacts may also be applied for the many French awards, DUF, DPF, DDFM and DTA.

Logs go to: REF, Contest Committee, Boulevard de Bercy 60, 75 – Paris – 12, France.

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Old, Old Timers QSO Party

Starts: 2200 GMT Friday, January 30
Ends: 2200 GMT Monday, February 2

This year's Party is sponsored by the Washington, D.C. Chapter. The affair is for OOTC members only, and only contacts between members will count.

There is no time limit this year, and the same station may be contacted once on each band and mode for QSO and multiplier credit.

Exchange: QSO nr., state, province or country, name and OOTC number.

Scoring: 1 point per QSO between stations in the US and Canada, 3 points if its with a DX station. For DX stations, 1 point with stations in own country, 5 points for all other contacts.

A multiplier of 1 for each state, province and country worked. Alaska and Hawaii count as DX, and D.C. as a state.

Final score, total QSO points multiplied by the sum of the multipliers from all bands.

Frequencies: C.W.–3560, 7060, 14060, 21060, 28060. Phone—3860, 7260, 14260, 21360, 28,660. (DX stations operating outside the US phone band should indicate the frequency where they will be listening.)

Awards: Certificates to the highest scorers in each state, province and country. A minimum of 25 contacts must be logged for the state and province award. There is a Trophy for the "Top Banana" in the contest.

This year logs go to E. B. Redington, W4ZM, 3912 N. Upland St., Arlington, Va. 22207.

The OOTC publication *Spark-Gap Times* will carry the results.

Editor's Notes

Conditions for the Phone Contest were again excellent, some thought they even surpassed last year's ideal conditions. And the activity was terrific so new scoring records can be expected. Looks like George Jacobs has scored another hit and Freddie Caposella will have to up-date the all time records.

The list of claimed scores is only a cross-section of some of higher and most interesting early scores.

Let's hope the c.w. week-end does not let us down, a report in next month's column.

73 for now, Frank, W1WY

New Concept [*from page 64*]

well-equipped laboratories. The ability to pass the Extra class exam doesn't qualify a man to compete with the scientists of General Electric, Bell Telephone, RCA, etc.

The only one of the five principles directly related to the Extra class license requirements is c.). The new tests measure advancing skills in the technical phases of the art, and to some extent in the communication phases. However, since c.w. is not as widely used in commercial and military communications as it was 10-20 years ago, the value of a higher code speed is doubtful. Progression through the Novice, Technician, General, and Advanced classes would seem to meet this need adequately.

Point d.), expansion of the reservoir of trained people, is not directly, or even indirectly, related to the requirements of the amateur Extra class license.

The last principle, point e.), continuation and extension of the amateur's unique ability to enhance international good will, involves an extremely important area. However, the extra class requirements take no notice of the value of amateurs who make hundreds of

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SAVE $25

Purchase an FDFM-2S or FDFM-2 for the REGULAR PRICE, with no trade-in and you may take a $25 credit toward the purchase of any OTHER merchandise.

The VARITRONICS FDFM-2S is a compact, ruggedly-constructed, 12vdc, 6-channel 2 Meter FM Transceiver that is ideal for portable, mobile or base station use. It is a natural for Local Coverage or 2 Meter FM Repeater systems. The All Solid State circuitry utilizes 33 transistors and 9 diodes. Transmitter RF input is 10 watts (5 out). Current drain in transmit is 1.5 amps; in receive - 225 MA. Receiver is double-conversion, with sensitivity better than .5uV @ 20 db S/N. Meter indicates signal strength during receive, and relative RF out during transmit. In the "BATT" position, the meter indicates battery level. The FDFM-2S comes complete with a high-impedance microphone, built-in speaker, mobile mounting bracket, mike clip, power cables and 3 crystals. (Channel one receives 146.94 - transmits 146.34; Channel 2 is simplex on 146.94.) All you do is hook the transceiver up to a good antenna and a 12-15 v.d.c. power source. 6½" wide x 3" high x 7½" deep. 4¼ pounds $310.00

The VARITRONICS MODEL FDFM-2 is the same as the above described FDFM-2S, but is lower power (5 watts in - 2½ watts out), and is furnished with a removable telescoping whip antenna for portable use $250.00

BP-1 Battery Pack for FDFM-2 that snaps on the rear of the cabinet for an ideal Portable unit. Uses eight 1½ volt "D" cells . . . . $ 12.95

FM-20M 12vdc Mobile Amplifier for FDFM-2 boosts RF power to 20 watts input (10 watts out), and conveniently snaps on to the rear of unit. Solid State. 6½"w x 3"h x 3"d. One pound $150.00

FM-20BM is an amplifier and AC power supply combination for the FDFM-2 for base station use. This unit is completely Solid State and boosts the RF power to 20 watts input (10 watts out). It is in the same size & style of cabinet as the FDFM-2. 6½"w x 3"h x 7½" deep. 6¾ lbs. $235.00

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contacts each year with their counterparts in other countries. In today's world, the value of this activity in increasing understanding between peoples of different lands should not be ignored. However, the lad who tunes up right on top of an important DX QSO may be the superior amateur under the law because he passed the Extra class exam.

Having considered the dilemma, is their a solution? Definitely yes! The requirements of the amateur Extra class license can and should be modified to recognize truly outstanding performance in meeting the five fundamental purposes of the amateur service, not just one of them. It is not proposed that the present amateur extra's be "defrocked." The route they followed is directly related to one of the five purposes. However, there should be other routes as well, based on the other fundamental purposes. For example, an Advanced class amateur who distinguishes himself in providing emergency communications, and in the organization and operation of bona fide emergency nets, should be considered an "Extra class" amateur. An amateur who makes a valid contribution to the advancement of the radio art should be considered an "Extra class" amateur. An amateur who distinguishes himself in DX activities designed to enhance international good will should certainly be an "Extra class" amateur.

Some may feel that it would be impossible for the FCC to rule on such diverse criteria. However, we would disagree. It should be a reasonably simple matter to devise a system for evaluating these criteria which would actually simplify the work of the FCC examiners. If an amateur renders outstanding service in an emergency situation his performance could be attested by letters and documents provided by civic and governmental leaders, as well as ARRL officials and other amateurs. A ham who renders outstanding service in DX work could supply letters, QSL cards, and other documents as evidence of his performance. Publications in scientific journals, or even one of the monthly amateur journals, could provide evidence of a technical contribution.

It is our belief that the amateur and citizen's division of the FCC could devise a very straightforward way for handling these cases, and that it would go a long way to encourage truly superior performance on the part of US amateurs. What do you think? ■

DX [*from page 74*]

A2CAF–Via W4NJF, 1416 Rutland Drive, Virginia Beach, Va. 23454.
A2CAH–To G3XYP.
A2CAQ–A.R. Edwards, P.O. Box 45, Freetown, Botswana.
C31BY–c/o G3OKQ.
CP1GF–To W6AFI, 44 Toylon Terrace, Danville, Calif. 94526.
CW3BH–Via CX3BH.
CWØAA–To CX2CO.
DL4VA–MATCOMEUR (LSMO) Vandegrift, APO New York 09052.
DLØRC–c/o DJ2TK.
DU1BEN–Box 370, Manila, Philippine Islands.
EL9C–Via P.O. Box 8101, Spokane, Wa. 92203.
EP QSL Bureau–To Capt. Richard Harris, WA5VKJ, Signal Branch Box 1000, APO New York, N.Y. 09205.
F5SF (ex-FF4AL, TU2AL, & EL3A)–R. Lold, B.P. 22, 66-Argeles-Sur-Mer, France.
FB8XX–c/o F2MO.
GC5AET–Via DJ1QP, Falkstr. 1, 59 Siegen, Germany.
HBØXFY–North & South American stations to WA9HYS, all others to DL8RH.
K7DCC/VKØ–c/o K2BPP, Mountainside Road, Mendham, N.J. 07945.
KA1C–Via WA8NZH.
KA2CM (June, 1961-May, 1965)–To DL4QP, Box 388, 1946 Comm SQ, APO New York 09611.
KC6JC–c/o W2RDD.
KG4DS–Via VE3BYN.
KH6GQW–European stations QSL to DL7FT.
KH6NR–Kure DXpedition, 530 Peltier Ave., Honolulu, Hawaii 96818.
KR6BD–NOT via K6JAJ.
KV4EY–To W3HNK.
KX6BS–c/o K7LMF.
M1I–Via I1GAD.
OD5BA–To W2CTN.
OH2BH/Ø/SR–c/o P.O. Box 40015, Helsinki 40, Finland.
OX5BL–FEC Box 425, APO, New York,09023.
OX5BO (January-September, 1967)–Via DL4-QP.
PY7AWD–To PY7PO.
SV1CH–North American stations QSL to WA3-KSQ, 2202 Hyde Lane, Bowie, Md. 20715.
SKØTM–Tekniska Museet, S-115 27, Stockholm, Sweden.
TA1AM–K4EPI, 750 Lily Flagg Rd.,, Huntsville, Ala. 35802.
TA1HY–P.O. Box 23, Bakirkoy, Istanbul, Turkey.
TA2BK–c/o DJ2PJ.
TA2CD–Via DJ7CD.
TAØA–P.O. Box 699, Karakoy, Istanbul, Turkey.
TF2WLW–To K3EST.
TG9JH & TG9PG–c/o U.S. Military Group (A.F. Sec) APO, New York 09891.

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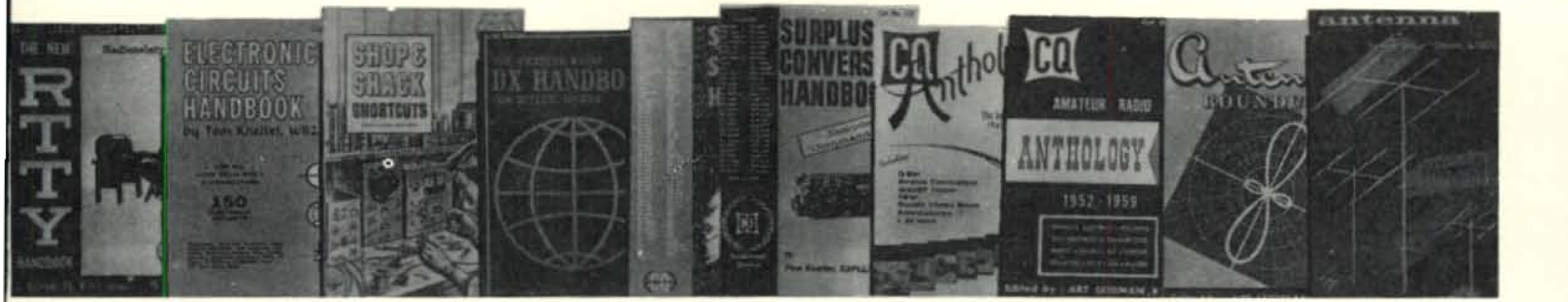

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Surplus Conversion Handbook

Compiled by Tom Kneitel, WB2AAI, this contains 192 pages of conversion articles, covering almost every piece of surplus gear worth the effort to convert to ham use. $3.00

Surplus Schematics

Ken Grayson has loaded this book with schematics for currently popular pieces of conversion gear, making it invaluable to amateurs as a guide to surplus gear. $2.50

Antenna Roundup I

Edited by Art Seidman, a 160 page mass of antenna information directed at answering a multitude of questions surrounding the mysterious antenna. $4.00

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Ten big theory articles backed up by 82 detailed and illustrated construction projects from UHF to microwave, long wires to 17 element beams and Sterba Curtain arrays. $4.00

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73, John, K4IIF

CQ Reviews: Raytrack [*from page 68*]

No flattopping was present at the maximum-power peak levels, even without a.l.c. A spectrum analysis showed the 3rd-order distortion products to be 31 db below peak output, but this was a limitation imposed by the exciter used which was no better in this respect. (Raytrack's rating for the amplifier is 34 db down).

With the maximum-legal input of 1000 watts for c.w. and RTTY, the output was 575 watts. Drive requirements were 50 watts with

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just under 200 ma grid current.

Operation for a.m. with a carrier input effectively equivalent to 500 watts, the carrier output was 300 watts with 1200 watts peak output at 100-percent modulation. Only 30 watts of carrier drive was required, which is about the maximum allowable for proper a.m. operation. Amplifier operation with some of the popular lower-power a.m. transceivers, or those using a controlled-carrier system, will provide a power gain of approximately 10×.

If there is no control to reduce an a.m.-exciter carrier output to within the 30-watt drive limitation and if a.l.c. from the amplifier is applied to the exciter, adjusting the a.l.c. threshold control (on the amplifier), will make it possible to reduce the exciter drive as needed. In other cases, detuning the amplifier input-tube may suffice.

10 to 80-Meter Amplifier

The DX-2000-L 10-80 meter amplifier, which is bandswitched, employs toroid inductors at both the input and output circuits. In this amplifier the input network is fixed-tuned. Use of the toroids saves space and provides higher-*Q* circuits, and also allows higher efficiency. They aid stability and are less prone to introduce TVI through stray radiation. No special neutralizing setup is required in this amplifier.

The performance was essentially like that experienced with the 6-meter model. Operating within 2 kw d.c. input, the power output ranged from 1250 watts on 3.5 mc to 1100 watts on 28 mc with 100 watts drive and 1500-1200 watts with 130 watts drive. Operating within the 1 kw legal limit, output on c.w. with 70 watts drive ranged from 700 to 525 watts and 350-300 watts carrier on a.m. with 30 watts drive.

The Raytrack Horizon-VI-L 6-meter Linear Amplifier is priced at $595. The DX-2000-L 10-80 Meter Linear Amplifier is priced at $649. The H6AP power supply, which is used for either amplifier, is included with either amplifier. These are products of Raytrack Company, 3498 East Fulton Street, Columbus, Ohio 43227. *—W2AEF*

Q & A [*from page 87*]

above conditions probably is due to r.f. feedback due to a high s.w.r. or inadequate grounding of the equipment. This cause might be indicated if the squeal disappears with operation on another band. This also may be checked using a dummy load. If the problem disappears, r.f. feedback must be the culprit when the antenna is connected.

Besides correcting this source of the trouble, another solution may be changing the length of the mic cable.

Other effective measures would be to insert a 1 mh r.f. choke in the mic lead at the mic jack or to install an r-c filter at the input lead to the tube socket for the mic amplifier. To do this, connect a 10K 1/2-watt resistor between C_{23}-R_{11} and pin 2 of V_{8A} and bypass pin 2 of V_{8A} directly to pin 7 with 100-500 mmf disc or mica capacitor. Similar treatment may be needed between the arm of the mic gain, R_3, and pin 2 of V_{6A}, the second mic amplifier.

NASA Publications

There are two NASA publications available for those interested in views taken from spacecraft.

"Exploring Space With A Camera" (Cat. No. NAS 1.21:168, price $4.25 per copy) is a 9″ × 12″ 214-page album of unprecedented photographs taken during the first ten years of the space age and includes those taken of the earth and its features, the moon and Mars. About one-quarter of these are in thrilling color. Also included is an appendix with descriptions of the characteristics and color photographs of a number of the more sophisticated U.S. spacecraft up to the Apollo.

"Earth Photographs From Gemini VI Through XII" (Cat. No. NAS 1.21:171, price $8.00 per copy) has 327 pages and features full-color photographs of the Earth's surface taken on seven Gemini flights in 1965 and 1966. The photos are arranged as if taken on a single flight around the world, starting with the Florida Peninsula, followed by the Canary Islands, deserts, shores and mountains of Africa, very high-altitude views of the Arabian peninsula, India and Australia, glimpses of the equatorial seas and islands, the peaks, jungles and rivers of South America and Mexico, finally ending up with the U.S. Gulf Coast and back to Cape Kennedy.

Captions point out the geological, oceanographic, meteorological, and industrial uses for such photography.

From what we've seen of these publications, their context besides being historical, is most thrilling, educational and outstandingly portrays the earth's beauty.

These books may be obtained from: Superintendent of Documents, Government Print-

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ing Office, Washington, D.C. 20402. Specify catalogue number and make remittance as per above.

Oscar V Telemetry

In the event that Oscar V has finally been launched and is still working, for those who may have difficulty in determining the frequency of the telemetry tones (by means of an oscilloscope or beating against a known a.f. signal) in the short time allotted for a direct readout in each case, we suggest that the signals be recorded and later played back for making the measurements at leisure.

73, Bill, W2AEF

Letters [*from page 8*]

Propagation Special

Editor, *CQ:*

I've just finished your special propagation issue, and would like to offer my congratulations. An outstanding job!

Rapheal Soifer, K2QBW
Hartsdale, N.Y.

Editor, *CQ:*

This is just a note to congratulate you and *CQ* on the fine series on the ionosphere and its vagaries.

The whole thing was well written, well edited

Keith Henney, K1AC
Snowville, N.H.

Lightning [*from page 62*]

and there is nothing supernatural about it. If you understand something about its origins you realize there are a variety of lesser electrical conditions in the air, as well as lightning, and sound planning is simply a matter of taking these various possibilities into account and applying reasonable remedies. The appropriate safety measures are not complicated, are likely to improve the life of gear connected to the antenna, and will minimize the chance of damage if a strike does occur. You may even get reduced insurance rates. ■

Effective Speech Trans. [*from page 53*]

Conclusion

If the operators and equipment used on both ends of a QSO remained constant, it might be possible to fairly well optimize the frequency response throughout for maximum results. Of course, this is not normally the case. It should be clear, however, that peaks in audio response caused either in the transmitter or receiver circuitry which give emphasis to frequencies where adequate hearing

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sensitivity already exists, are undersirable because they will first saturate the system. If a transmitter does not seem to produce the same audio "punch" as another of similiar power and with (or without) similar speech compression, a bit of checking of the audio responses throughout the system and correction, as necessary, by standard audio shaping circuits may yield a worthwhile improvement. ■

Neutralization [*from page 49*]

$$= \frac{30 \times 10}{30 - 10}$$

$$= \frac{300}{20}$$

$$= 15\ mmf$$

Thus Cn of fig. 9 would consist of a 3-30 mmf trimmer and a 15 mmf series fixed capacitor.

Neutralization Procedures

The following steps should be taken to neutralize an amplifier stage properly:

1. Turn off all power to the equipment.

2. Disconnect positive plate and screen voltages from the stage being neutralized and all following stages.

3. Attach the null indicator to the output of the stage. There are many types of null indicators. Either a neon bulb, a flashlight bulb and a loop of wire, or an r.f. probe will do nicely.

4. Turn on power to the equipment.

5. Tune driver plate circuit to resonance.

6. Tunė plate tank circuit to maximum indication.

7. Adjust neutralizing capacitor until the null indicator shows minimum.

8. Retune amplifier plate tank to maximum indication.

9. Readjust neutralizing capacitor for minimum indication.

10. Repeat steps 8 and 9 until you get no indication of r.f. voltage. The stage is now neutralized.

When the amplifier is properly neutralized, maximum grid current coincides with minimum plate current. Another indication of a properly neutralized amplifier is that maximum r.f. output will be obtained at the plate current dip (minimum plate current). ■

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EMBOSSED OR PLAIN QSL's carls. Samples free with cut catalog. 25¢ Ace Printing, 6801 Clark Ave., Cleveland, Ohio 44102.

RTTY gear for sale. List issued monthly. 88 or 44 Mhy torroids, uncased, five for $2.50 postpaid. Elliott Buchanan and Associates, Inc., 1067 Mandana Blvd., Oakland, Calif. 94610.

HALLICRAFTERS SR-150, PS-150 AC power, HT-45 amplifier with AC power, extra 3-400Z. All mint condition. $585.00. W9FRK/3, Washington, D.C. Tel. 301-656-5976.

FOR SALE: Hammarlund HQ-140X receiver, good condx, $99. Local deal only. WA2HGJ, 304B South Tenth Ave., Highland Park, N.J. (201) 572-2980.

SALE: NCX-3/NCX-A $210; HW-16/xtals $90; HG-10B $45. Write for details. M. Dammeyer, 507 4th ABSQ, CMR Box 5089; APO Seattle 98728.

NOVICE CRYSTALS: 40-15M $1.33, 80M $1.83. Free flyer. Nat Stinnette Electronics, Umatilla, Fla. 32784.

SWAN 350C with 110/220 volt 60 cycle power supply and 12 volt DC power supply. Used 1 week. $400.00. W7ZFY, W. N. Rohrer, Quarters 12-N-6, Governers Island, New York, N.Y. 10004. Phone 212-825-1690.

FOR SALE: Hammarlund HQ-170 AC good condx. $200. J. G. Swaney, NSGA Box 253, Ft. Meade, Md. 20755.

WORLD RADIO used gear has trial-guarantee-terms! KWM2 — $695.00; G50 — $159.95; SR150 — $299.95; HW32—$89.95; DuoBander 84—$119.95; EICO 753—$129.95; TR3 — $369.95; NCX3 — $169.95; NC200 — $249.95; SB33—$199.95; SB34—$299.95. Free "bluebook" list for more. Write WORLD RADIO, Bob 919, Council Bluffs, Iowa 51501.

WANTED: The following antique radios: Colin B Kennedy Model 110, 220 and 2 stage amplifier; Pilot AC Super Wasp Shortwave receiver with plug in coils; Atwater Kent Breadboard and Horn Speaker. Wallace I. Glavich, 1208 Gross Street, Eureka, California.

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FOR SALE: Collins 75A4, 2 filters mint, $350.00; Hallicrafters HT-32A also mint condx., $235.00. W3HQO, 1405 New Rodgers Road, Bristol Gardens Apts., Apt. M-12, Bristol, Pa. 19007.

WANTED: Johnson 6N2 Thunderbolt Linear; Heath HA-14 Linear, HP-14 DC supply, HP-24 AC supply. Robert Dixon, 311 East Kelso Road, Columbus, Ohio 43202.

SELL: ARC-4 with 12-24V Dy-motor never altered $30. DX40 pwr. xfmr. new $10. Coil-cond. & dial for BC221, good VFO $15. J. Crowl, Box 74, Ingram, Texas 78025.

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W-10-U AWARD. Work Ten University Club Radio Stations. QSL's and $1/00 to Georgia Southern College Radio Club Secretary, W4DQD.

SELL: DX-6OA $60; HG-10 $25; Dowkey antenna relay $10; all three $85. W4RNL, 245 Morning View Drive, Athens, Georgia 30601.

WANTED: Hallicrafters HA-10 LF/MF tuner for SX-117. Walt Chatham, WA4WFN, 4117 Conrad Road, Alexandria, Va. 22312.

FOR SALE: Collins 75A4, 2 filters, mint condx., $375.00. Hallicrafters HT-32A mint, $240.00. W3HQO, Apt. M-12, 1405 New Rodgers Rd., Bristol, Pa. 19007.

DICK, W3WIY, Wishes you and yours, Seasons Greetings, and Best of Everything in 1970.

HEATH IG-102 Sig. Gen. New $30. Conar 68D Color dot gen. New $80. Want LM W/PS and orig. book. Wm. L. Petterson, 5930 Denver Street, N.E. St. Petersburg, Fla. 33703.

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SWAP: New TX-62 2 mo. old for a Comm. III 2 meters, must be mint. J. Gysan, 53 Lothrop Street, Beverly, Mass.

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FOR SALE OR SWAP: NHF-152A in good condition for $35.00 or will swap on Swan VOK or DC Power Supply. R. Dorough, W5DPN, 117 Pecan Street, Terrell, Texas 75160.

FOR SALE: Drake DC-4 & Hustler antenna—$100 or best offer. Charles Melancon, P.O. Box 20273, Baton Rouge, La. 70803.

FOR SALE: Hallicrafters HT-32, Mint condition; looks like new and performs like new. $215.00; B. Nastoff, 320 W. 56th Place, Gary, Indiana 46410.

FOR SALE OR TRADE: Johnson Mess. II 10 meter transceiver excellent condition. $100.00 or HW-22 or HW-32 or what have you. W. K. Meadows, 223 So. David Ave., Jackson, Ohio 45640.

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WANTED: Clegg Zeus Xmtr. Interceptor rec. mint condx. WB2-YDI, A. Colucci, 284 Trouville Rd., Copiague, N.Y. 11726. MY 1-4254.

CQ MAGAZINE, October 1945, urgently wanted. Covers not necessary. A. Herridge, G3IDG, 96 George Street, Basingstoke, Hants, England.

HR-10 W/SPKR and Calib. $49. Sky Champion, $29. Signal Gen. 8 to 330 MC, $75. Globe Linear, $29. Send stamp for list. A. J. Savicky, 105 Nursery Lane, Lancaster, Pa. 17603.

SELL: HT32B with HT41 Amp $450. Or HT32B and SX117 Rcvr $480. All 3 units $625. In use now. W. Rabe, W9AOL, 233 N. Taylor, Oak Park, Ill. 60302.

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FOR SALE: Heathkit HP-13 w/manual; tested but never used; w/plugs & cables. $50. Owen, K5VXJ, 632 Cimarron Ave., Raton, N. Mex.

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144 MH Transceiver SCR-522 with power supply. See surplus Sidelight, CQ Oct. 1969/$15.00 FOB. Paul Rich, Box 4, Morton, Ill.

WANTED: Antique radio tubes prior to 1919, QST's 1916-21 inclusive. W9LGH, 610 Monroe Ave., River Forest, Ill. 60305.

FOR SALE: HT-37, $175.00, Ameco 6 & 2 meter converter. Central Electronics, 10A, 458 VFO and Sideband Slicer. Make me an offer. K2HDLL, 7 Johnson Ave., Plattsburgh, N.Y.

ROCHESTER, N.Y. is again Hamfest, VHF meet and flea market headquarters for largest event in Northeast, May 16, 1970. Write WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

SELL: A. C. Instructograph with 15 tapes $40. WANTED: SB 610, H010, Coax relay. Tom Dornback, K9MKX, 19W167, 21st Place, Lombard, Illinois 60148.

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ALUMAFOAM COAX: 10¢ per foot PPD. Samples 25¢. Ken Morey, 803 West Sixth, Pittsburgh, Kan. 66762.

MINT CONDX Nat'l NCX200 xcvr W/AC 200 p.s., man'ls, orig. ctns. $250. W2EHB, 32 Bryant, Blackwood, N.J. 08012.

WANTED: Prop-pitch motor in good condx. State price and shipping info. M. E. Knowles, K1HVV, 9 Brown Street, N. Billerica, Mass. 01862.

MAGAZINES CQ: QST: 73: Ham Radio: FM issues available at 5¢ each, plus postage. Send list of desired issues with S.A.S.E. for quick response on which ones are on hand to Lerc Arc, 2814 Empire Ave., Burbank, Calif. 91504.

HEATH HW-32 and HP23 power supply $100.00. Mint condition. Telephone number Area—309-346-4644.

WANTED: Diversity receivers for AM Short-Wave Broadcast Reception 49-13 meter bands. M. V. Palmer, 4108 N.W. Fruit Valley Road, Vancouver, Wn. 98660.

FOR SALE: Ameco model R5 solid state receiver mint cond. 6 thru all bands—AM-CW-SSB—$80.00. H. L. Synder, 2185 Sampson Street, Pittsburgh, Pa. 15235.

FOR SALE: Johnson Thunderbolt KW linear amplifier. Mint condition, in original carton, with instruction manual. $200. Local sale preferred. Mel Cohen, K2EWJ, 12 Huntington Bay Rd., Huntington, N.Y. 11743.

See page 110 for New Reader Service

FOR SALE: SBE34 with xtal calibrator and mike, like new $300. SB300 receiver, excellent $225. Dick Manahan, 8300 Ingersol Rd., Alexandria, Va. 22309.

FOR SALE: Teletype model 26 with table, sync motor $55. FOB Santa Rosa. W6DOU, 3154 Stoney Point Road, Santa Rosa, Calif. 95401.

WANTED: Knight-Kit model KG-635 or Heathkit model 10-18 or 10-12 oscilloscope. Aso want good portable tube tester. Glenn Anderson, 1100 New Jersey Ave., Pine Beach, N.J. 08741.

SALE: NCX-200 80-10 xcvr with NCXA speaker—PS console. Have to go to college! Excellent condx—no scratches. $300 complete. Thomas Nail, WA2BCK, 96 Fairhaven Dr., Buffalo, N.Y. 14225.

SELL: QST 1922 thru 1944—1923 missing. Good condition. Best offer. K4HT, Box 446, Fairhope, Al. 36532.

ATTENTION: Heath HW-16, spkr, manual, xtals for sale, $100 in perfect condx, wkrd 47 states, 35 countries. Want quad ant info, ant type. J. Byrn, 125 Buckwood Dr., Richmnd, Ky. 40475.

POSTAL EMPLOYEES—Active and retired. National net opens Tue. thru Sat. 0330Z 3597 kHz. For info contact W8QCU.

SELL: Brand new Galaxy GT-550 transceiver, AC supply, SC 550 speaker, 25KC. calibrator. Factory sealed carton. $475.00. WA9HRN, Craig Pitcher, 580 Crooked Lane, Barrington, Ill. 60010.

SELL: Collins S Line 75S3-B; 32S-3; 312B-4 Station control; 516F-2 pwr supply. High serial, mint condx. Original cartons $1,095. J. B. Robison, 2411 Metz, Houston, Texas 77034.

FOR SALE: Eldico SSB-100 MIL General coverage SB Xmtr. Needs minor repair $125.00. K5ENL, Ed Biock, Grandview, Texas 76050.

WANTED: DX schedules on 80 meter CW. Write W2KF, 309 Cherry Hill Blvd., Cherry Hill, N.J. 08034.

SELL: Drake R4-A $275 Globe Scout $25. Richard Harker, WA7DOK, 2711 Kincaid, Eugene, Ore. 97405.

HEATH SB-200, 300, 400 Halli SX-71 rcvr, new 4-1000 A tube, Swan 240 xcvr with 12v. mobile p.s., Mosely beam and rotator. Estate sale. Wyman, 4453 Via Pinzon, Palos Vordes Est., Calif. 90472.

SELL: ART-13 transmitter with maintenance manual, plugs, spare 813, 811's. You pay shipping. K9KRW, Box 436, Highland Park, Illinois.

VALIANT II, F.W., New tubes, 3B28's, like new—$175.00. WA5DZP, 314 E. Main, Ada, Okla.

SELL: HQ105TR Transmit 10M or CB, receive .55-30 MC with amateur bandspread. $100 FOB. Sag. Loomis, 4328 State, Saginaw, Mich. 48603.

FOR SALE: Drake 2-NT. Excellent condition. First $90 takes it. Write or call. Ed Benson, 216-16 85th Ave., Hollis Hills, N.Y. 11427.

AN/PRC-25 (-77), AM-4306/GRC, AN/ARC 131, AN/VRC-12 wanted in good condx. Will arrange pick-up. SM0AAK, Box 12, Bromma 1, Sweden.

SELL: Cliff Dweller 40-80, unused, assembled, 100 feet PWR cable—$75.00. Mark-20 M KW Dipole, new condx—$16.00. K2HNB, PY 6-9595; 57 Meeting Lane, Hicksville, N.Y. 11801.

12 Volt DC to 115 volt AC power pack HE 50-10 meter transceiver DX 100 Transmitter, Heath 2 meter (Tower), 500 watt RCA. Mod. Xfmer. 813 Tubes-and more. E. Smih, 2 Geoffery Ave., Syosset, N.R. 11791.

WANTED: Manual for Model 15 or 19 teletype TM 11-2215, TM11-2216. For Sale: 250th Eimac tube $10. Heard S. Lowery, 915 Madison Street, Manchester, Tenn. 37355.

WANTED: Reasonably priced Triband Beam. L. Julien, K9DEY, 711 S. Euclid Ave., Villa Park, Ill. 60181.

COLLINS S LINE FOR SALE: 75S3B, 32S3, Pwr supply and station control, high Ser number, Ex condx. WA0GUN, 231 So. Jasmine Street, Denver, Colo. 80222.

RTTY FSK, SSB, AM, CW, FM, all in this like-new HX-500. Also for salem BC-221, Mosley CM-1. W7DI, 6633 E. Palo Verde Lane, Scottsdale, Az. 85253.

R. F. DISTORTION INDICATOR P & H Model D1-1 with two-tone oscillator. Like new. $75.00. Glen Richie, 643 Diamond Rd., Salem, Virginia 24153.

HAM TRANSISTORS REWOUND, using hi temperature wire and insulation. Jess Price, W4CLJ, 411 Gunby Ave., Orlando, Fla. 32801.

FOR SALE: GC1-A Heath Mohican Receiver with A.C. & Battery power supplies & manual. $80.00. P.P. WA2NND, S. M. Burkhard, 367 West Broadway Ave., Watertown, N.Y. 13601.

WANTED: "J" Coil (50-100kc) for HRO-7. Send price. Sarroug Turner, WJWQM. P.O. Box 806, Rosenberg, Texas 77471.

FOR SALE: General coverage receiver SP600 JX $175.00. S. Elmer, 3479 Kersdale Rd., Cleveland, Ohio 44124.

TRADE: Sprague Telohmike TO-4 Cap, analyzer, WANT: DX-60 or HW-16. M. V. Sulfridge, WN4NPK, 2133 Norvell Dr., Knoxville, Tenn. 37916.

JOHNSON MATCHBOX 250-23-3 SWR bridge $75; Vibroplex vibro-keyer $12; M&M electronic keyer EK-1 $25; Dow Key DK60-2C DPDT auxiliary contacts $12. Will ship. WB2CKU, 7 Bowen Place, Stony Brook, N.Y. 11790.

FOR SALE: ARC/5-T28 surplus xmtr 100 to 156 M-Z. Un-modified. Complete with tubes and plug. $35.00. Joe V. Wright, W5AQN, Box 1316, Rockport, Texas. 78382.

FOR SALE: GE Spacer 2 meter transceiver in good condition, $50.00 FOB or will swap for Swan DC Power supply. R. Dorough, W5DPN, 117 Pecan Street, Terrell, Texas 75160.

SELL: Gasoline driven AC generator 3 to 4 KVA $150 Buy 75 A42.1kc filter old radios. John Smith, 1924 Dolphin Blvd., St. Petersburg, Florida 33707.

WANTED: Last issue of QST to complete my personal collection, May 1916. Any reasonable price paid. K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

LINEAR AMP 800 watts PEP. Mfg. by P&H Co. LC 400 C w/tubes. Excellent cond. Send check $75 will ship prepaid. W0ZB, 12331 Conway Rd., Creve Coeur, Mo. 63141.

PLEASE sell or lend me construction/operating manual for Viking I. W. W. Hiehle, 4322 O'Kane Ct., Fort George Meade, MD 20755.

WANTED: Kodak 7" f3.5 projection lens (Ektanon for slide projector). W2FZE, 1269 Chestnut St., Roselle, N.J. 07203.

ART-13 Xmitter, like new, use xtal mike & adaptor for xtal control. $50. W3FGE, 8-E Southway, Greenbelt, Md. 20770.

SALE OR TRADE: Sylvania V-400 CCTV camera, like new w/4 lens & turret $195. Wm. Sakal, W2KJF, 62 Bacon Hill Rd., Pleasantville, N.Y. 10570.

FOR SALE: Hy-Gain 6 mtr, 6 element beam—$19.95; AR-22 rotor—75' wire—$19.95. Good condx. Geffner, 48 Park Ave., E. Merrick, N.Y.

WANT (LA area) Stereo deck: 3 motors—3 or more heads. Lifters, 10½" capacity. 2 speeds 7½ ips down. Meters, counter & easy edit. W6YAT, 2309 Vista Gordo Dr., Los Angeles, Calif. 90026.

CANADIANS: Complete amateur equipment service. Lic'd technician, fully equipped, kits wired. Bob Fransen, VE6TW, Box 197, Sherwood Park, Alta.

SELL: Wireless & electrical cyclopedia. Catalog #18. Electro Importing Co., 233 Fulton St., N.Y.C. 2nd Edition 1917. Ray Howe, 1412 Bush St., Red Wing, Minn. 55066.

SWAN 350 (late) new finals $235. or best offer, 117xc supply $65., both $285. Excellent condx. R. H. Odom, Jr., 1410 Converse Ave., Fayetteville, N.C. 28303.

WANTED: Two pilot super—WASP Dials and Escutcheons, Also QST for October 1954. W8FX, 27209 W. Six Mile Road, Detroit, Mich. 48240.

HISTORICAL COLLECTION Needs old QSL's, correspondence, etc. from 1XM, 1MX and W1MX. M.I.T. Radio Society, W1MX, Box 558, 3 Ames Street, Cambridge, Mass. 02139.

BRAND NEW oil filled condensers: 2-20MFD/3000VDC $15.00 each: 5-50MFD/1000VDC $6.00 each all items plus postage. Bill Hayward, 3408 Monterey, St. Joseph, Missouri 64507.

SELL OR TRADE: New Swan 350C won at Hamfest—do not use—$315.00. Johnson Navigator—excellent—$70.00. Ranger—$60.00. Stamp for list. Want—75A2. J. R. Shank, 21 Terrace Lane, Elizabethtown, Pa. 17022.

1 MC. Freq. counter—Berkeley 6-place digital readout. Shipped PREPAID in U.S. $225. or best offer. Jim Cooper, W2BVE, POB 73, Paramus, N.J. 07652.

FOR THE HAM HI-FI BUFF...Complete Bound volumes AUDIO Engineering/Audio May 1947-December 1965 19 volumes $200.00. FOB my QTH. Edgar Newman, 217 New York Avenue, Massapequa Park, N.Y. 11762.

FOR SALE: Ranger II good 7 yr. old. bought new—1 owner. $100.00. Chas. Hettinger, 1753 E. Grand Escondado, Calif. 92025.

FOR SALE: DX 60 75 W X/TTER in gud condition. Also a Mosley Vertical for 10-15-20 and 40 meters both $65.00 dollars. Local deal preferred. Call or write WB2NDS, 16 Fane Court, Brooklyn, N.Y. 11229.

WANTED: Ham transmitting and receiving accessories for cash. W8IIT, 281 Jenny Lane, Dayon, Ohio 45459.

HALL. HT-40 Xmtr like new not a kit. $50.00. A. E. Wilson, East Brewster, Mass.

NEW TUNAVERTER 1450X, 144-148 Mhz. ARC Model R-19, 118-148 Mhz, mint. R. Selleck, 23311 Iris Ave., Torrance, Calif. 90505.

VHF, Hallicrafters HA-2, HA-6 transverters with power supply. Mint condition, $250. K2YRU, 88 Montclair Dr., Rochester, N.Y. 14617.

FOR SALE: Hammarlund HQ 129 X. in really fine condition with matching speaker. New Tubes—entire set. $75. Write Box 201, Elmont, N.Y.

FOR SALE: Cabinet Racks with doors. 22" x 22" x 76", over 6 ft. of 19" panel space. Good condition. No shipping. $30.00 each W4JSC, Box 15013, Tampa, Fla. 33614.

WILL TRADE SR-46 exc. condition with 4 crystals mike & filter for either a Valliant 1 or Apache TX1 in working condition. Write WA8UQX, Harpers Ferry, W. Va.

CLEGG ZEUS fine condition $275, Clegg Thor 6 with AC P/S $140, LA-6 Het Freq. Meter 100-500 Mc .01% good $75, Gen Radio Output power Meter type 1840-A very good $65. P. Reid, 1500 N. Atlantic Ave., Cocoa Beach, Fla. 32931.

FOR SALE: 12 Large Clear plastic lead-Acid storage battery cells, 24 volts, 480 ampere-hours like new. Gould ET-9 only $250.00. Howard S. Long, Box 11155, Denver, Colo. 80211.

TELETYPE MODEL 31-KSR portable. Very tiny, weighs under 20 pounds. Like new, extra nice. $495. K1VTM, Box 103, Sherborn, Mass. 01770.

FOR SALE: DX-100 xmitter $50.00 needs minor repair (No grid current). 40 ft. Tilt tower, wonder post $50.00. R. Salaar, 914 So. Indiana, Mercedes, Tex. 78570.

SELL: Jennings UCS300 Vac variables w/turn Head—$30; Hewlett-Packard AC-4 indicating plug-in Decades $5; Digital counters—$40, H/P 560A Digital printers. $100 G. R. Trammell, 1507 White Oak Ct., Martinsville, Va. 24112.

RTTY INFORMATION for the Amateur interested in RTTY. F. DeMotte, P.O. Box 6047, Daytona Beach, Florida 32022.

ATTN: Coin collector Hams. Need U.S. Type coins. Send S.A.S.E. for info. C. N. Zornes, W9TAL, 15309 Oak Street, Oak Forest, Ill. 60452.

SELL: SSB RIG homebrew, 100 watts complete with power supply, Collins Pto, scope, R. Mendelson, W2OKO, 27 Somerset Pl., Murray Hill, N.J.

FOR SALE: 75S-3 Collins receiver, good condition, almost mint. Also 323-S transmitter in very good condition, almost mint. Power supply, cabling for both to go along with sale. Interested party should contact seller at 242 Kingsland Ave., Brooklyn 11222. Will sell for $900.00.

SELL: Mint DX-60B, HR-10B, SWR Mtr, 16 xtals, key, many extras, guaranteed. $160. WA1JFG, 120 Oak Tree Dr., N. Kingstown, R.I. 02852.

SELL: Challanger: Ranger I: HW-120X; HQ-129X: Eico 720: FBXA: SW3: Knight T50: LM18: Fred Brown, 157 Walsh Street, Medford, Mass. 02155.

SELL: 51J-3/R-388. Rough, but works, extra PTO included $180. Collins SM-2 micro phone $16, F455Y2-1 Mech filter (S Line). R. H. Odom, 1410 Converse, Fayetteville, N.C. 28303.

GONSET 6M 500W Linear $165; 2M 225W $95; Hallicrafters S-37 2M AM/FM Receiver $75; Drake 2BQ, $25; 2AC $9; New Bird #43; trade list SASE. W4API, Box 4095, Arlington, Virginia 22204.

VIKING RANGER—75 Watt VFO, Lafayette Communic. Rcvr, Gotham 10 mtr. 4el. beam—$115. WA2WYH, Brooklyn, N.Y. Tel: 648-2078.

NEW: P&H PS. 1000B 1000V 1 A mobile supply $105. 813's 10.00 new RCA 829B's 9.00 ea. BC453B new 15. new 459A 10.00 FOB W9KAJ, Rt 4, Box 599, Delavan, Wi. 53115.

WANTED: Good used Quad or beam similiar to TA-33 Jr. Also GT-550 VOX ES cal. WA0YYR, Dale Dermott, 103 W. 4th Street, Lamar, Mo. 64759.

FOR SALE: Heath HW32A, HP-23-HP-13 xtal calib. Microphone—HS-24 spkr. Hustler 20 mtr ant. $190.00. Bill Jaclow, K1QMV., 783 Center Street, Ludlow, Ma. 01056.

WANTED FOR RESTORING PURPOSES, 2 Crosley 3" dials, 1 Federal No. 2, 2 inch dial 1/4" shaft, 3 Gube tube socket for 01A tubes 2 Gube audio transformers for CR9, DeForest Unit Panels, tandem variable condenser for Kennedy 220 receiver. G. Angle, K0TAM, Clear Lake, S. Dak. 57226.

SELL: Knight R-100A rcvr. plus S-meter, $80. Knight T-150A xmtr, $80. Both vy gud condx. New Eico 730 mod., $60. SAVE, complete rig. $200. WA9PQM, 1101 W. Ridge Rd., Hobart, Indiana 46342.

ESTATE SALE: Three complete Collins setups, owned by late Dr. Sam Cosnov, include 75A4, KWS-1, 30L1, KWM2, etc. with all accessories plus new tower and beam. Equipment now stored at W6AG and priced right for fast sale. SASE for complete list with prices asked. 213-764-4401.

SELL: SB-34 with SBE mike and xtal calib. $260. Valiant I F.W. excellent cond. W6DJZ, 3748 Floresta Way, Los Angeles, Calif. 90043.

PERFECT CONDITION HT37 $150.00 W2TXV, Kelly, 8 Promenade, Glen Head, N.Y. 11545.

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MODEL V-7A Vacuum tube voltmeter—AQ audio oscillator—Model OM-1 Oscilloscope—all in mint condition. Best offer. J. Lundy, WA5BMM, Box 26, Deming, New Mexico 88030.

FOR SALE: KWM-2, 30L-1, 516F-2, A.C. supply. All for $1,150.00. All in mint condition. John Sypek, 28 Mercedes Street, Chicopee Falls, Mass.

EICO 753 Xcvr with 751 and 717 keyer. WAS, WAC, DXCC 120 with this rig. Best offers gets it. WA5JWU, 1836 S. Woodhaven, Baton Rouge, La.

SELL: Collins-32S1—$370; R4A—$275, MS4—$20, AC4 Drake $70, 75S3-222. 1 filter $380. BTI-LK2000 $500 with 4-1000, HW-32 $75. F. L. Baker, W8QJR, Box 546, McComb Ohio 45858.

NC98 & speaker $50 trade HT37 & NC270 for transceiver—equal value. K. C. Connell, K5DZP, 3020 San Antonio, Tex. 76901.

WANTED: Ham M and Prop Pitch rotators. Sell: Wagner Plate Xfmers 3600-0-3600 volts at 1 amp $25; 1½ AMP $35; All 110/220 Primaries. W0AIH, Paul Bittner, 814 4th Street S, Virginia, Minn. 55792.

FOR SALE: Drake 2-C and 2-CQ with accessories. $200. Drake 2-NT with crystals: $100. 6 months old, excellent condition, must sell. WN2IZS, Howard Robin, 39-04 Allwood Place, Fair Lawn, N.J. 07410.

LAMPKIN 105-B frequency Meter covers all Ham, C.B., and commercial Channels up to 500 M.C. Like new $150. W. J. Davis, 4434 Josejie Ave., Lakewood, Calif. 90713.

FOR SALE: The Fabulous Polycom 62 B w/ac & dc mike and manual. Ex. cond. Will ship, u pay. Also cush craft 6/2 zip beam new $10.00. R. N. Coan, W3CPU, 1513 Farlow Ave., Crofton, Md. 21113.

FOR SALE: Very good DX-100 $50.00. WA3EIP, Dennis Quinn, 88 Woodrow Court, Sharon, Pa. 16146.

TG34 Code Mach. W/Tapes; TCS14 rcvr & xmtr; GRC Batt Rcvr; Heath T3 Sig Tracer; I177B Tube tester; WA4HPY, 1208 E. Wright Rd., Greenville, NC. 27834.

NATIONAL RADIO INSTITUTE Communications Course transmitter with p/s and manuals. Never used. $55 prepaid. W. L. Patterson, 5930 Denver St. NE, St. Petersburg, Fla. 33703.

FOR SALE: Pwr. xmr. 950 V. at 500 Mil—6.3 v at 2A 5V at 6A. 6" x 7" sealed unit. $10.00 plus shipping. V. A. Petry, 3010 w. 1st Street, Springfield, Ohio 45504.

TRADE: Pair Fanon FCB-5A w/t's many tubes (TV and oldies) pwr. xfmers, Admiral stereo w/spkrs—needs work. Want Swr meter, GDM w/man., nov. xtals, D. Watson, Star Rt., Northport, Ala. 35476.

WANTED: SB601. Cash or trade. W3MSN, 5400 Boulder Dr., Oxon Hill, Md. 20021.

WANTED: B & W Model 850A inductor assembly. State condition and terms. A. C. Emerald, 8956 Swallow Ave., Fountain Valley, Calif. 92708.

NCX-5 MK II, NCX-A, XCU-27 $435; CSB-101 $160; HT-32A $225; 75S-3 Don Burns, 4410 Reading Rd., Dayton, Ohio 45420.

WANTED: BC 639 receiver tunes 100-156 mc with power supply good condx. Vernon Mansfield, Cumberland Center, Me. 04021.

CE 20A, mint cond. with BC 458 VFO and manual $90.00 or trade for Linear. D. L. Eanes, Ona, West Virginia. 25545.

HEATH SB-301, SB-401, SB-630, SB-600 for sale. Sell complete package. $560.00 or separately. Mint condx. W6JEI, 2225 Gehringer Dr., Concord, Calif. 94520.

WILL SWAP: Heath Apache transmitter in mint condition for Heath HW 12 transceiver. Also wanted, dial for grandfather rack-type HRO receiver. John Merritt, WA4SKS, 5103 Hewitt Dr., Fayetteville, N.C.

FOR SALE: 6 M FM set, GE, converted, with xtals, and manuals. $45 FOB. Loomis, 4328 State Road, Saginaw, Mich. 48603.

WANTED: Lakeshore Bandhopper VFO. State price and condition. W9TQR, Felix S. Anderson, 5357 N. Bowmanville Ave., Chicago, Ill. 60625.

HAM TRANSFORMERS REWOUND, Using Hi temperature wire and insulation. Jess Price, W4CLJ, 411 Gunby Ave., Orlando, Fla. 32801.

FOR SALE: CE 200V serial No. E-1342. Recent factory overhaul. Original owner, manual and carton. No modification. $350.00. Dr. F. P. Potylicki, W8EMZ, 2223 Chestnut Rd., Seven Hills, Ohio 44131.

SEND YOUR discarded call books & handbooks for handicapped hams' club to distribute to its members. A. Herridge, G3IDG, 96 George Street, Basingstoke, Hants, England.

CANADIANS: Complete equipment service, fully equipped, gov't lic'd technician, kits serv'd. Bob Fransen, VE6TW, Box 197, Sherwood Park, Alta.

WILL PAY $30 plus shipping for working model 15 rtty printer. Send info to K0WTS, J. Schrimsher, 7004 N.W. Hwy. 9, K.C., Mo. 64152.

RTTY: CV-89 Teletype converter, good condition. $175 (will include manual). M-14 T.D. $25, M14 typing reperf—$35. Jim Cooper, 834 Palmer Ave., Maywood, N.J. 17607.

WANTED: To buy, borrow: Schematic or manual for precision apparatus Co. ocscilloscope, model ES-500A. Marty Feeney, K1OYB, 38 Howard Street, Portland, Maine.

TUBE & transistor tester Eico Model 666—like new—$25. W8RHZ, 9718 Liberty Rd., Twinsburg, Oh. 44087.

FM GEAR: GE yase FI-33 $200, P-33BAM portable $125., both on .34-.94/.94-.94. R. Zach, 33 Pike Place, RFD-4, Mahopac, N.Y. 10541.

COLLINS 310-B-3 nominal 20 watt exciter/transmitter partially converted but still operable, w/instruction book & conversion instructions—$50 FOB. W2RPZ, E. Newman, 217 New York Ave., Massapequa Pk., N.Y. 11762.

FOR SALE: New matched diodes for 20A $3.50 pp. Tel-Trol 12V negative trans. vibrator $5. pp. W3MSN, 5400 Boulder Dr., Oxon Hill, Md. 20021.

CANADIAN receiver, National NC303 w/speaker & 2 meter converter—$350. Transmitter Heath SB400—$350. HW30 famous Heath lunch box tour w/tuning meter, mike & one crystal—$50. Parts for Tri-band 2 element quad, 8 fiberglass arms, 2 spiders & boom—$30. C. W. Dean, RR 1 River Rd., Niagara-on-the-Lake, Ont., Canada.

WANTED: DR-30 with P/S, mint, will pay going price. Also need TMC-GSB-1. W. G. Martin, Box 1304, Hq 5 Air Force APO San Fran. 96525.

SELL: 10 years QST 1951 to 1960—$20; 3 el 20 mtr beam—$30. M. A. George, 35 Ridgeway Ave., Pittsfield, Mass. 01201.

LINEAR CHASIS 1 kw. with 810 tubes $15. W3KG, 4 Knox Rve., Monessen, Pa. 15062.

SELL: GL872GE receifiers tubes—used, look and work like new. Guaranteed. Harper Richards, East Street, Argyle, N.Y. 12809.

FOR SALE: Gontham 15 meter beam $10.00. W0DZC, Thompson, Iowa.

WANTED TO BUY KWS-1 & 75A4 cash deal & must be in hundred mile radius, also used 40 meter beam. J. Gordon, WBHBQ, Box G, Moundsville, W.V. 26041.

KITS BUILT and repaired: All work done by experienced builders w/amateurs and commercial phone licenses. Write for details. C.C.C. Ind. Labs., 7235 Hunters Branch Dr., Atlanta, Ga. 30328.

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BUILDERS: Send for list of Hi power final and power supply parts—Save! W6RW, Mace, 8600 Skyline Dr., L.A. 90046.

FOR SALE: Excellent HX20 SSB transmitter & H.B. supply $110; SX96-$80.00, together $175.00. W8DWJ, 500 Norway Ave., Cincinnati, Ohio 45229.

RTTY INFORMATION for the Amateur interested in RTTY. F. DeMotte, P.O. Box 6047, Daytona Beach, Florida 32022.

TRADE: Comco table rack 450FG. Exciter 100 w amp. rec. remote control unit. For 2m transceiver. J. W. Waples, Rt. 3, Box 612, Deland, Fla. 32720.

WANTED: Manual for General Electronic Dist. Co. of N.Y. Model 200 Signal generator. A. M. Gus Goings, WA4CPL, P.O. Box 1195, Tauares, Fla. 32778.

SELL: Knight TR-108, 2-meter am transceiver, 12vdc/115vac; Knight T-150A, 80-6 meters, cw/am, vfo; Globe Scout 65B, 160-10 meters, cw/am. Ray Crawford, W4VRO, 7120 Kingsbury Circle, Tampa, Fla. 33610.

COLLINS T.C.S. Rec—½500 kc to 12 mc.w/ac supply —$45. U pay shipping. Want Match box. K4VCP, 2537, Cannady Rd., N.E., Roanoke, Va. 24012.

TRANSOCEANIC Zenith portable, model H500, ac-dc, battery, 7 bands, bc-31 mc, manual, extra tubes, exc. condx. Best offer. W2ASI 15 Kensington Oval, Isle of Sans Souci, Davenport Neck, New Rochelle, N.Y. 10805.

SELL OR TRADE: Gonset 6 meter Comm 11B perfect, DX 35, Scout 65A, Old Hallicrafters recvr made early thirties, miscel xtals all freqs. Want Johnson Match box 275W. W8IOR, 5163 Brown Rd., RFD 1, Lake Odessa, Mi. 48849.

SELL: Squires-Sanders SS-1R rcvr w/SS-1S noise silencer & manuals. Vy gd Cond. $385. K8AGO, 15030 Bradner Rd., Plymouth, Mi. 48170.

FOR SALE: Complete model 19 Teletype w/typing reperf, W2JAV TU w/local loop. pick up only. WA8CKT, 662 W. Lincoln St., Caro, Mi. 48723.

WANTED: Manual for Hammarland HQ100, also want 4x5 or 5x7 view camera, w/ or w/o lens. Wm. Terp, 1616 Jay Lane, Green Bay, Wisc. 54304.

WANTED: Instruction manual, new roll-chart and updating info for Hickok Model 600 tube tester. J. Wilson, WA8CKB, 10755 Thornview Dr., Sharonville, Ohio. 45241.

SELL: VFO 80 mtrs described in Dec. 67 CQ—$15. Linear 750W described in Mar/Apr 64 CQ to HVY to ship $75. & 40 mtr mobile cw—$20. W6BLZ, 528 Colima St., La Jolla, Calif. 92037.

FOR SALE: Lafayette HA350—$50. pp. Albert Hale, Rt. 2, Boise, Idaho 83702.

WANTED: RME single sideband selector model 5301. Paul Henry, W8BPK, RD1, Box 247, Toronto, Ohio 43964.

SELL: Johnson Vik Challanger xmitter—$50. Lafayette HE-30 receiver—$45. HE-56 6m converter, Utica 650A 6m xceiver—$125. R. Krakauer, 199 S. Allen St., Albany, N.Y. 12208.

WANTED: Heath Tower, state price, must be in good condition. Robert Tate, 363-10th Avenue, San Francisco, Calif. 94118.

CLEANING SHACK—List for SASE. DX-100, R-388, ESSCO TU, Kw Amps, Scope, RTTY's, Exp. gear. J. Brink, POB 3734, Fayetteville, N.C. 28305.

WANTED: Tektronix scope 502, 310, 530 or 540 series any condx. Have Elmac AF68. 80-6 VFO AM/CW mint etc. sell or trade. K2LCS, 163 Ledgewood Cir., Rochester, N.Y. 14615.

FOR SALE: Johnson Viking Valiant, CE-20A Both real nice. WA0KLC, 315 East 20 Grand Island, Nebr. 68801.

HALLICRAFTERS SR46A & HA26, in factory carton. $125 plus shipping. WA5WGO, 4911 Western Street, New Orleans, La. 70122.

LETS TRADE: Will trade one new 4-1000A tube for either the Heathkits HQ 10 Spectrum Monitor Scope or the RM-23 Pre-Selector. Contact Everett C. Collin, WA3DVO, 2029 East Lanvale Street, Baltimore, Maryland 21213.

CANADIANS: Complete amateur equipment service, Lic'd technician, fully equipped, kits wired. Bob Fransen, VE6TW, Box 197, Sherwood Park, Alta.

SALE: Collins 351-D2 Mobile Mt., PM2, portable pwr suppy & CC2 & Cables $125. Brother Malseed, Calvert Hall College, Towson, Md. 21204.

TRADE OR SELL: One Berkley Electronic counter model 5510 with manual. 304th tubes 304TL tubes want good clean receiver such as a Drake 2B. Bob Wagner, Box 582, Fairview, New Mexico 87532.

ROCK-HOUNDS: Would you be interested in an informal daily or weekly air get-together? Contact K4iv by card or SSB on 14,245. Robert W. Field, RR#2, Owensboro, Ky. 42301.

FOR SALE: KWM2, 516F2, 312B5, 30L1. R390A, SW240, ACPS, TCU Console, $225. Movie camera, B&H 200EE, Case, $150. 312A1 spkr/cont (75A4), $35. J. W. Craig, W1FBG, 29 Sherborne Ave., Portmouth, New Hampshire 03801.

FOR SALE: 6 meter Black-Widow transceiver. 110 volt. $100 00. or make offer. Will trade of 2 meter transceiver, or ? W6GOU, Beverly Hills, Cal. 90212.

NOVICE: Heath DX60 $55. Tower $25. Calif. only. Contact W6RLN, K. C. Jones, 6172 Gumm Dr., Huntington Beach, Calif.

SWAP for TA-33 JR Mosley Beam, 3 X 4-65A, 2 x 829B, Trafo 1250-0-1250 0.3A 4X4MN. P.O.B. 7219, Haifa, Israel.

FOR SALE: A1 shape Hallicrafters SX146 with .5kc filter, $170.00. Knight T60, $32.00. Both $189.00. R. Harrison, 475 S.W. 150 Ave., Beaverton, Oregon 97005.

NEED Texas or Gregg County? Fer sked on 15 meter CW. Write WN5YDB, Mark Waldman, 308 Horseshoe, Kilgore, Texas 75662.

WANTED HW12, HW16. Damaged or not working ok if price reasonable. WA4BXZ, 3005 Cliffside Rd., Kingsport, Tenn. 37664.

FOR SALE: Complete mobile station. Swan 140 w/ manual, 350 watt p.s., Hustler ant, bumper mt and ptt mike. $140 takes all. WA6FXV, 10259 Ainsworth Dr., Cupertino, Calif. 95014.

SELL: Drake R4-A perfect $275, Globe Scout Xmiter $25. R. Harker, WA7DOK, 2711 Kincaid, Eugene, Ore. 97405.

FOR SALE: Hammarlund HQ170, excellent condition. Best offer. L. G. Mumm, 7267 W. Cody Circle, Milw., Wis. 53223.

SELL mint condx DX60B, HR-10B, key, 11 xtals, extras. Ship for $150. WA1JFG, Jay, 120 Oak Tree Dr., N. Kingstown, R.I. 02852.

WANTED: Novice crystals. At reasonable price. Ed Yee, 1894 31st Ave., S.F., Calif. 94122.

WANTED: IRE/IEEE Professional Group Transactions. Advise issues available. W4YHD, 6800 Hampshire Road, McLean, Virginia 22101.

WANTED: Manual for General Electronic Dist. Co. New York Model 200 Signal Generator. A. M. 'Gus' Goings, WA4CPL, P.O. Box 1195, Tavares, Fla. 32778.

OLD OLD TIMERS CLUB welcomes any amateur to join if you have been licensed for forty years. Send your QSL card for application to Chas. W. Boegel, Jr., W0CVU, 1500 Center Point Road, N.E., Cedar Rapids, Iowa 52402.

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See page 110 for New Reader Service

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Advertiser's Index

See page 110 for New Reader Service

The Best Deal in our History

(NCX-500, 5 bands, 500 watts for less than $250.)

Since we opened our door, we have never had a more attractive ham offer!

We offer to hams, worldwide, the famous National NCX-500 transceiver *new* at the thrifty price of $249.95. With the companion AC-500 Power Supply the total price is only $299.95: less than the price of America's most popular kit. Here are the salient features of this deal:

PRICE SCHEDULE

1. NCX-500 with AC-500 (no speaker, no cabinet) $299.95
2. NCX-500 with NCX-A Supply (speaker and cabinet included) $319.95
3. NCX-500 with Linear Systems' Power Supply 400-12—$359.95
4. NCX-500 without supply—$249.95
5. XC-28 plug-in solid state crystal calibrator (available after February 15, 1970) $19.95

A. Only fresh, factory cartoned material offered.
B. A full 6 months warranty provided.
C. No trades considered at these prices.
D. Prices quoted are FOB Harvard, Mass.
E. Bank America Card, Master Charge, or American Express charge accepted. Financing available through GECC subject to their acceptance of your credit.
F. Special overseas prices available to sterling customers. Write. Remember this set works on 230 volts, 50 cycles equally well.
G. Offer limited to first come, first served.

SPECIFICATIONS:

Frequency Coverage: 3500-4000 kHz, 7000-7300 kHz, 14000-14500 kHz, 21000-21500 kHz, 28500-29100 kHz (2 additional crystals available at $7 each to provide expanded coverage of entire 10 meter band).

Power Input: 500 watts PEP on sideband, 360 watts on CW, 125 watts on AM, D rated 20% for mobile operation.

Emission: SSB upper on 10, 15 and 20 meters; lower on 40 and 80 meters.

Output Impedance: 40-60 ohms minimum pi network.

Receiver Offset Tune: By means of a varactor controlled oscillator you obtain plus or minus 3 kHz.

SSB Generation: Crystal lattice filter 6-50 db shape factor 2.2-1, gate 2.8 kHz on 6 db, center frequency 5.202 mHz; uses stable solid state ring modulator.

Dial Calibration: 5 kHz on all bands.

Tuning Ratio: Excellent mechanical resolution with 45-1 rate.

Electrical Stability: Nominally 1500 cycles in first 30 minutes thereafter plus or minus 400 cycles for room ambient.

Suppression: Carrier minus db, rejected sideband minus 40 db, third order products minus 30 db at full output.

Sensitivity: .5 microvolt for 10 db s/n in ss mode.

Audio Output: Better than 2 watts into 3.2 ohms.

Metering: PA cathode current on transmitter. S units on receive.

Special Features: Includes side tone monitoring plus built-in code practice oscillator for Novices; incrementation toning, provision for crystal calibrator.

Dimensions: 6$\frac{3}{16}$" high x 13$\frac{3}{8}$" wide x 11" deep. Weighs but 15 lbs.

Accessories Available: AC-500 supply, 21 lbs.; NCX-A deluxe supply, 25 lbs.; 400-12 mobile DC supply, 13 lbs.; AC supply operates on either 117 or 234 VAC 50-60 cycles; suitable for export. Mobile bracket furnished at no extra charge.

Shipments: Prefer via United Parcel Service, Railway Express or Parcel Post. Specify and include provisions for same otherwise charges will go COD.

The National NCX-500 with its AC-500 currently sells at $425 and $99 respectively. Thus, this deal is both timely and thrifty. If you have waited because you could not afford a modern rig, here's your *buy* now; even while the rest of the world came up on price. If you are a beginner or even if you have a big rig and need a second one for a spare, the NCX-500 should be your cup of tea; and it's splendid for mobile too. Study the specifications, read the magazine reviews, but send in your order while our stock lasts.

HERBERT W. GORDON COMPANY.

America's largest exclusive ham store

Woodchuck Hill Road
Harvard, Massachusetts 01451
(617) 456-3548

See page 110 for New Reader Service

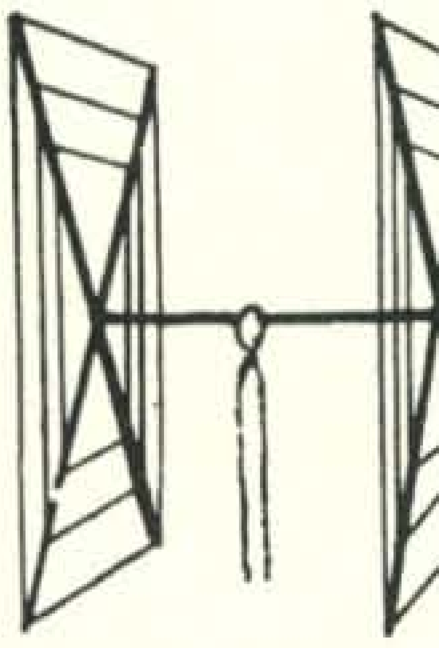
AHA! YOU THOUGHT GOTHAM

made run-of-the-mill ordinary antennas. No, no, no. Our materials are the best, and our design superior. WA1JFG won the New England Round-Up championship with our 3-element 15meter beam by a margin of 5,982 points!

QUADS

Worked 42 countries in two weeks with my Gotham Quad and only 75 watts... W3

CUBICAL QUAD ANTENNAS — these two element beams have a full wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators) — absolutely no bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount: uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a fool-proof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you!



10/15/20 CUBICAL QUAD SPECIFICATIONS

Antenna Designation: 10/15/20 Quad
Number of Elements: Two. A full wavelength driven element and reflector for each band.
Freq. Covered: 14-14.4 Mc. 21-21.45 Mc. 28-29.7 Mc.
Shipping Weight: 28 lbs. Net Weight: 25 lbs.
Dimensions: About 16′ square.
Power Rating: 5 KW.
Operation Mode: All
SWR: 1.05:1 at resonance
Gain: 8.1 db. over isotropic
F/B Ratio: A minimum of 17 db. F/B
Boom: 10′ long x 1¼″ O.D.: 18 gauge steel; double plated; gold color
Beam Mount: Square aluminum alloy plate incorporating four steel U-bolt assemblies. Will easily support 100 lbs. Universal polarization.

Radiating Elements: Steel wire, tempered and plated, .064″ diameter.

X Frameworks: Each framework consists of two 12′ sections of 1″ OD aluminum 'hi-strength' (Revere) tubing, with telescoping ⅞″ tubing and short section of dowel. Plated hose clamps tighten down on telescoping sections.

Radiator Terminals: Cinch-Jones two-terminal fittings

Feedline (not furnished); 52 ohm coaxial cable

Now check these startling prices—note that they are *much lower* than even the bamboo-type:

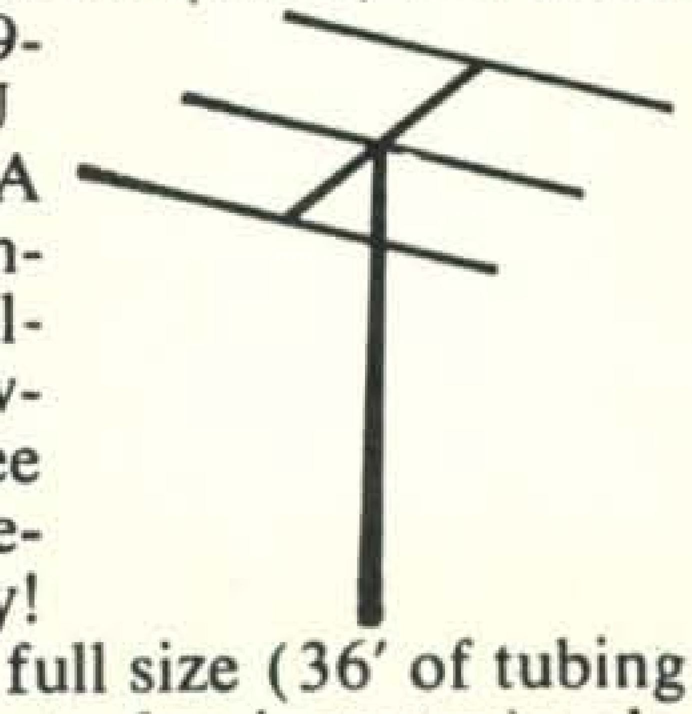
10-15-20 CUBICAL QUAD	$35.00
10-15 CUBICAL QUAD	30.00
15-20 CUBICAL QUAD	32.00
TWENTY METER CUBICAL QUAD	25.00
FIFTEEN METER CUBICAL QUAD	24.00
TEN METER CUBICAL QUAD	23.00

(all use single coax feedline)

GOTHAM
1805 Purdy, Dept. CQ,
Miami Beach, Fla. 33139

BEAMS

The first morning I put up my 3 element Gotham beam (20 ft) I worked YO4CT, ON5LW, SP9-ADQ, and 4U1ITU THAT ANTENNA WORKS! WN4DYN Compare the performance, value, and price of the following beams and you will see that this offer is unprecedented in radio history!



Each beam is brand new; full size (36′ of tubing for *each* 20 meter element, for instance); absolutely complete including a boom and all hardware; uses a single 52 or 72 ohm coaxial feedline; the SWR is 1:1; easily handles 5 KW; ⅞″ and 1″ alumnium alloy tubing is employed for maximum strength and low wind loading; all beams are adjustable to any frequency in the band.

2 EL 20	$19	4 EL 10	$18
3 EL 20	25	7 EL 10	32*
4 EL 20	32*	4 EL 6	18
2 EL 15	15	8 EL 6	28*
3 EL 15	19	12 EL 2	25*
4 EL 15	25*	*20′ boom	
5 EL 15	28*		

ALL-BAND VERTICALS

"All band vertical!" asked one skeptic. "Twenty meters is murder these days. Let's see you make a contact on twenty meter phone with low power!" So K4KXR switched to twenty, using a V80 antenna and 35 watts AM. Here is a small portion of the stations he worked: VE3FAZ, T12FGS, W5KYJ, W1WOZ, W2-ODH, WA3DJT, WB2FCB, W2YHH, VE3-FOB, WA8CZE, K1SYB, K2RDJ, K1MVV, K8HGY, K3UTL, W8QJC, WA2LVE, YS1-MAM, WA8ATS, K2PGS, W2QJP, W4JWJ, K2PSK, WA8CGA, WB2KWY, W2IWJ, VE3-KT. Moral: It's the antenna that counts! *FLASH!* Switched to 15 c.w. and worked KZ5-IKN, KZ5OWN, HC1LC, PY5ASN, FG7XT, XE2I, KP4AQL, SM5BGK, G2AOB, YV5-CLK, OZ4H, and over a thousand other stations!

V40 vertical for 40, 20, 15, 10, 6 meters	$14.95
V80 vertical for 80, 75, 40, 20, 15, 10, 6 meters	$16.95
V160 vertical for 160, 80, 75, 40, 20, 15, 10, 6 meters	$18.95

HOW TO ORDER: Send money order. We ship immediately by REA Express charges collect. Gotham ham and CB antennas are available for pick-up in: Rockford, Ill.; Orange, Calif.; Cleveland, Ohio; Daytona Beach, Fla.; Calgary, Canada; Hannibal, Mo.; Indianapolis, Ind.; South Bend, Ind.; Oklahoma City, Okla.; Leavenworth, Kansas; Dallas, Texas; Brockton, Mass.; Ellwood City, Penna.; and in the Benelux Countries and Australia. Write for name and address of franchised distributor. Other cities open.

See page 110 for New Reader Service

New RCA WV-500B VoltOhmyst®
only $88.00*