RADIO

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THE WORLDWIDE TECHNICAL AUTHORITY • OF AMATEUR • SHORT WAVE AND EXPERIMENTAL RADIO •

F. STRENGTH METER

This Month:

Dx Contest News -- L. A. Flood Notes
"Bi-Square" Directive Antenna Array
Constructional Data on Oscilloscopes
Inexpensive Receiver Construction

10 M

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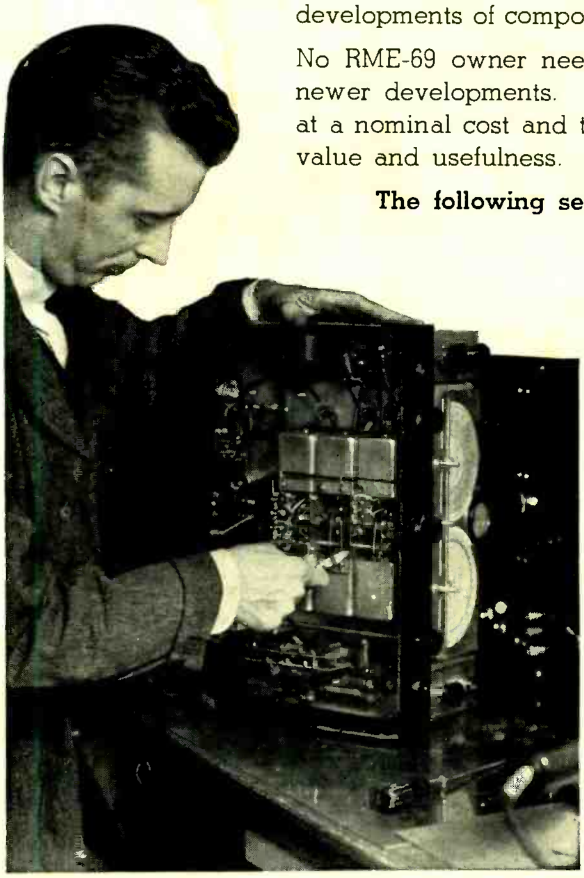

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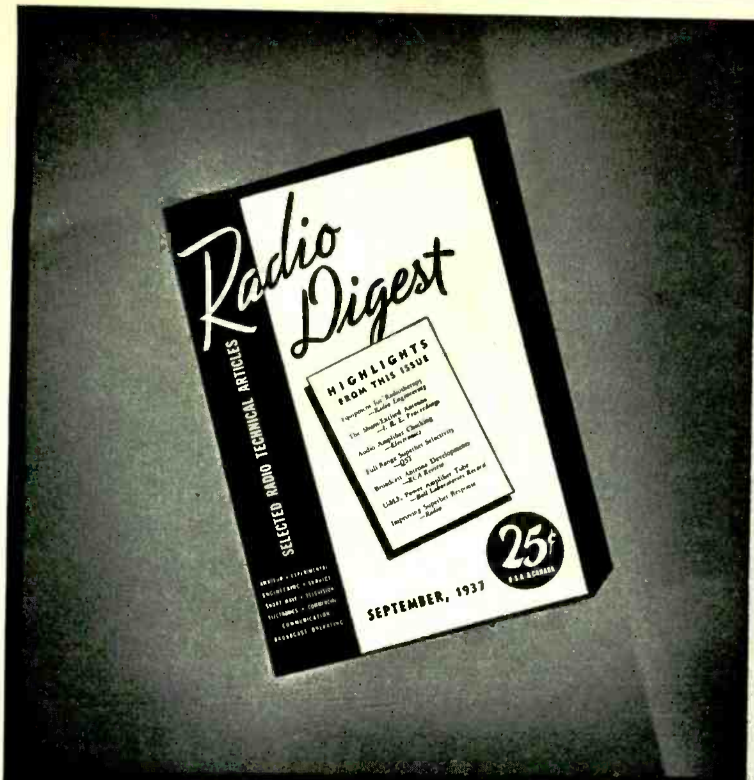

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April • 1938 Number 228

RADIO

In this issue "Radio" presents:

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MISCELLANEOUS FEATURES

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The . . .

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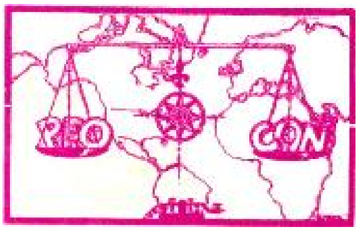


Hugo, Oklahoma

Sirs:

Well, here's that man again and I have a lot more to say this time—and it is not about who to QSL, or fone men vs. c.w. men, or all that space-taking rot. It's about the proposition the fellow is up against who is working up on the 30 Mc. end of the ten-meter band.

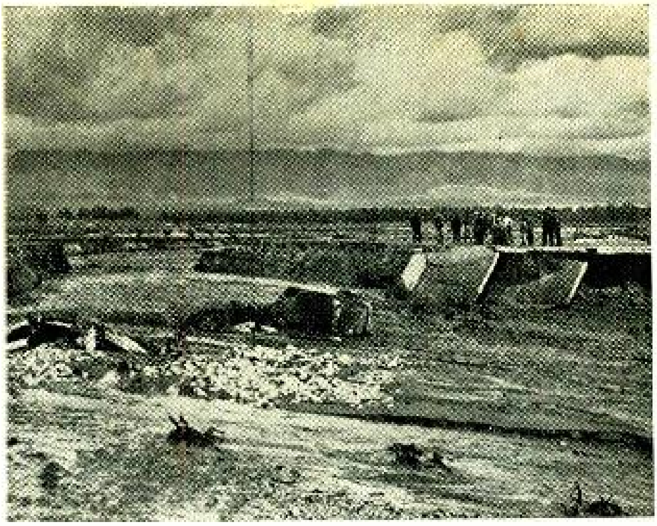
Only today with our regular weekly Sunday rag chew, the old rock that keeps our frequency up on 29,672 kc. decided that it wanted a rest and for no reason at all it just quit oscillating. As we could do nothing to make it start, we put in a spare, moved up to 28,500 and yelled a nice CQ with the aid of the 8JK rotary beam, and raised a station about our frequency. His first words were, "You are a new fellow; aren't you? I don't remember ever hearing you before!!!"

Boy, was my face red? I had been on the air every day for the past three months. I have had plenty of high frequency QSO's in that time and a small, yes, very small, number of dx contacts. (Yep, I called 'em by the score but word is so slow getting around in this old world that I guess they haven't heard that the band is now open clear to the 30 Mc. end way, I didn't raise them.)

Tonight on 28,500, with all of my five nice dx QSO's, every fellow said that he had never heard me before. When asked if he ever listened on the extreme high end, he replied that that was a waste of time—that no one ever operated there. Only one fellow is wise and that is VK2GU. Wonder why the other boys don't wake up?

I am going to stay on this low frequency until I get another rock in here to put me back way up high. Then the dx can either listen up there for me or else; don't suppose, though, that they give a durn to work me, so's I'll feel

[*Continued on Page 91*]



This is not a washed-out bridge; it is what was left of the highway seen approaching from the right. "Run off" from the hills in the background did much damage similar to this for miles around.

AMATEURS AND THE L. A. FLOOD

"SAN FRANCISCO, March 3—A message received from the Los Angeles bureau of the Associated Press via amateur radio today said . . ."

"RIVERSIDE, March 3 (via amateur radio)—Two more bodies were . . ."

"LOS ANGELES, March 3 (via amateur radio and bulletins broadcast over Los Angeles radio stations) — Regular transportation and communications facilities were . . ."

Date lines similar to the above appeared in newspapers throughout the United States when Southern California recently experienced its worst flood in decades; regular wire communication facilities were disrupted, highways and tracks were washed out, planes could not use landing fields, and Los Angeles was virtually isolated for several days except for radio. Over 11 inches of rain fell in 5 days, more precipitation than is received all season in dry years. More rain than this fell back in the mountains, converting the dry Los Angeles river bed (the brunt of jokes by easterners visiting California) into a mad, swirling torrent. While the disaster was bad enough, with over 150 dead and damage in excess of fifty million dollars, the situation appeared darker than it actually was to outsiders because of the several days of isolation. One of the many services amateurs were able to render was the sending of messages to anxious relatives and friends of Los Angelenos informing them that the "John Jones" listed as missing in radio reports sent over broadcast stations and picked up and printed in eastern papers was not their John Jones but someone else. Thus was much unnecessary anxiety and unwarranted sorrow alleviated.

The emergency gear of W6DEP was hustled into the back of the car and rushed to a vantage point where reports on how the flood control at Long Beach was withstanding the raging flood waters could be relayed to city and state officials. The transmitter on right utilizes a plate modulated 807 on all bands from 5 to 160 meters, is powered by a gas engine driven a.c. generator.

Not only did Los Angeles find itself at the mercy of angry flood waters, but five neighboring counties were in as bad or worse a fix. The fact that Los Angeles and most of the surrounding towns were not completely without power for more than a few minutes at a time enabled not only the radio division of the Los Angeles flood control and amateurs but also local police, state, Red Cross, army, county, and air-

"The show must go on" in Hollywood even when the liquid sunshine is three feet deep. This N.B.C. announcer, shown here interviewing an enthusiastic youngster who "saw the whole flood", had to use a raft to prevent the broadcasting equipment from getting wet.

ways' radio stations to operate at full capacity, without being hindered by the necessity for resorting to emergency power. Los Angeles is supplied by two different power companies, and only once or twice were both services "out" at the same time all over the city. Though somewhat jittery, power service to at least part of the city was functioning most of the time. Had power failed completely, the amateurs would have been in a position to render a still greater service than they did, because collectively they possess more battery and gasoline-powered equipment than do the other radio services. As things were, equipment of the latter type did yeoman service in providing communication to outlying resorts and localities where power wires were down.

The national networks, the railroads, the newspapers, the bus lines, the telephone company, the telegraph companies, all availed themselves of the services of amateur radio, and all were high in their praise of amateurs. Even the picture-by-wire agencies used amateur radio, after obtaining special permission from the F.C.C., to transmit their pictures via this method until their lines were restored.

The Paramount Studios in Hollywood had occasion to contact an executive at Balboa Beach, boating resort 50 miles south of Los Angeles. Anxious studio heads tried unsuccessfully to get word to him. Finally a line from the south was cleared, and W6KW in San Diego acted as intermediary for the studio, relaying north to Balboa via wire. The studio reported that they had thus been saved many thousands of dollars.

When their own lines went out, the rail companies were at a loss as to just where their trains were. Two brand new streamliners were completely "lost". They were known to be somewhere between Los Angeles and Salt Lake. Whether they were marooned between washed-out bridges, returning to Salt Lake, or just what their fate was could only be guessed. Naturally there was considerable concern as to the location and welfare of the various trains. A chain consisting of W6MRT, W6GXM, W6KDI (Cedar City, Utah), W6DSV, W6BMC, and W6GQC (Salt Lake) along the two routes east enabled rail officials to track down their lost trains.

San Diego amateurs kept their city in touch with the outside world while wire lines were out. The city missed the worst of the storm but regular communication facilities were disrupted. W6LIP, W6EAN, W6BKY and other amateurs in and near Los Angeles put in long hours handling Associated Press and other important traffic for San Diego, the amateurs in the latter city doing a noble job of keeping their city posted and in touch with things while wires were down.

A power failure resulted at the KNX transmitter and at the C.B.S. studios in Hollywood. Battery power was substituted at the studios with no interruption of program service. However, such was not the case at the transmitter, where the power demand was in the neighborhood of 250 KVA. Through heroic efforts of the power company, service was restored within a few hours. But the downpour continued un-

Several amateurs who tried to reach isolated communities with emergency-powered radio gear were swept from the roadway by swift flowing waters which rapidly cut channels of their own. Upon returning after the water subsided, some found their autos in the condition of the one shown here. Other autos were not found at all.

This battery-powered Collins 50-watt shortwave transmitter was the only link between the KNX-C.B.S. studio in Hollywood and the KNX transmitter 12 miles away in the San Fernando valley when torrential rains made the "loops" (wire lines) inoperative.

abated. Telephone service became affected by the torrential rains. By midnight of March 2nd, a check-up of the program and talking circuits to the transmitter showed them to be in a precarious condition. A Collins fifty-watt shortwave transmitter was put into service. This radio circuit was completely tested and made ready by sign-on time next day. The little Collins (KAAC, 1646 kc.) put out a very respectable signal to the transmitter 12 miles away when lines were completely severed.

The shortwave transmitter was coupled to an emergency Marconi antenna. Several electric fans were directed upon the dynamotor and transmitter as an added precaution due to the close quarters in which the equipment was operated. However, fans were unnecessary, inasmuch as both transmitter and generator ran surprisingly cool with no external coolers.

Another interesting situation was presented at the KNX transmitter, the point of reception of KAAC. A more undesirable receiving location could hardly be found. With the receiver only a few feet from the 50 kw. transmitter, plenty of extraneous noise from blowers, pumps, etc., was anticipated. But aside from considerable "hash" from the high-voltage mercury vapor rectifiers, the received output of KAAC was rebroadcast with remarkably good quality. This emergency studio-to-transmitter link carried the entire program schedule of KNX for all of the broadcast day of March 3rd and until four p.m. of the 4th. It is thought that the noise silencer in the RME receiver used proved a contributing factor toward getting through the transmitter noises and other adverse reception conditions.

What with many of the big "shows" originating in Hollywood, the National Broadcasting Company found itself somewhat embarrassed by lack of wire facilities. Thursday night, when the water was at its height, N.B.C. was faced with the problem of getting the Vallee show, the Crosby show, and the Taylor-Morgan show on the net. Failure would cost it well over a hundred thousand dollars. The trans-pacific receiving equipment of R.C.A. at Point Reyes (San Francisco) was swung over to KFI and the programs fed east from San Francisco. This all required pre-arrangement, and how was it done? By amateur radio. For a day and a half all traffic of the National Broadcasting Company for San Francisco and New York was handled by amateurs.

So pleased was N.B.C. with the way things clicked without a hitch that it is organizing an amateur radio emergency net.

The mobile 100-watt field transmitter of KFI was dispatched to Venice, the beach resort town that once used canals for streets. The streets had as much water in them as the canals ever did, and while there was little loss of life, more water was about generally than in the towns that actually suffered the most damage. The town was not completely evacuated, and a boat with a small u.h.f. "beer mug" transmit-

W6KW's rig in San Diego was on the air continuously from 9 p.m. March 2d until 12:30 a.m. March 4th handling Associated Press, public utility, and personal distress messages. W6KW is at the mill, W6CNB at the mike.

ter was sent out with an announcer to interview residents who refused to leave their homes. The interviews were to be relayed via the 100 watter in the truck to KFI and hence over the network. The power had not failed in spite of the high water, and in houses where people remained, radios were playing full volume. The problem was to find a house where the radio was not tuned to KFI, because when such houses were approached trouble from feedback was encountered. Finally a lady stubbornly perching on the kitchen table was startled to have a gentleman in a rowboat greet her with, "Lady, would you mind turning off your radio so I can ask you some questions?"

The water had accumulated at various places to a depth of several feet, and it was necessary to obtain boats and supplies from the Red Cross in Los Angeles. As no communication was available, a portable 160-meter phone station was set up by W6JFM and W6LVL at Sunset Pier, where on the arrival of another portable transmitter operated by W6HBD and W6CQK they moved to the chamber of commerce building. From there they effected contact with W6VR, temporarily located in the Beverly Hills police station.

The portable set up by W6HBD was put off the air by power failure; so it was moved across the street and installed in a booth at a small cafe, where power from another utility was available. The two stations worked together in dispatching boats for the Venice life guards, who evacuated refugees from the flooded residential districts. After midnight the W6LVL gear was moved back to Los Angeles and was installed in the Red Cross headquarters where it was used to dispatch Red Cross traffic the rest of the night and the next day.

One of the most serious situations existed in the North Hollywood-Van Nuys-Canoga Park district in the San Fernando Valley, north of the Santa Monica mountains ("Hollywood Hills") from Los Angeles. The Big Tujunga wash comes right through the center of North Hollywood's residential district, where many studio employees have their homes. So terrific was the force of the water that on some turns it undercut buildings for a distance of several hundred feet, tumbling them into the stream to be broken up and carried out to sea 35 miles away.

Virtually the whole district was under water and without communication, which was urgently needed because of the havoc wrought by the torrent. Many were homeless. An undetermined number were known to be taking shelter in the North Hollywood school house. How many was unknown. Whether they were hungry, needed blankets, was unknown. Except for short periods when faltering power came on only to be disrupted again, this area was without gas, lights, or water from Tuesday night until Saturday morning.

To solve the communication problem, W6PAK and W6LRO set out with mobile 5-meter rigs for the top of Cahuenga pass to act as relay stations for marooned San Fernando valley u.h.f. mobile amateurs unable to get their signals over the hills into Los Angeles. Practically marooned himself because of further flooding and damage to the road, W6PAK was unwilling to relax his vigilance because of the importance of the circuit he was maintaining. As a result he operated from his car 50 hours continuously without relief.

Upon hearing of the plight of the people sheltered in the North Hollywood high school and learning of the lack of pertinent information regarding their welfare, W6OZV drove as far towards the school as he could persuade his car to go, hiked four miles through water that was up to his armpits at times, discovered over 300 homeless people taking refuge in the schoolhouse. Taking down a list of things needed and other information, he then hiked four miles back to his car where he drove to the top of the hills, put his 5-meter rig on the air and reported to Los Angeles his findings and list of items urgently needed by the refugees.

Further to the west in the San Fernando valley the community of Canoga Park was saved from complete isolation by the work of W6JWY in that town.

The several portable mobile outfits in the valley could not be utilized to their fullest extent because nearly all roads were impassable, thus preventing moving of the transmitters to where they could be of greater service. However, the fact that they were not reliant upon the city mains for power enabled them to be of inestimable value during the time that phone and a.c. lines were down.

Perhaps the most serious emergency existed in Orange county. The Santa Ana river, normally dry except during rain storms, overflowed its banks, washed out levees and sent a four foot wall of water surging through the city of Anaheim, destroying homes and property, and taking about twenty-five of the thirty lives that were lost in Orange county. All communities in that area were isolated from one another, and it remained for amateurs in that area to establish communication and to assist in rescue and emergency work. This was accomplished by the efforts of Naval Communication Reserve personnel under the direction of Lieutenant (jg) C. W. Jones, N6BYZ, who organized a network of amateurs that worked day and night for several days. The net maintained communication from each of the communities affected to the police radio station in Santa Ana, which in turn directed rescue work to these communities. Lieut. Jones organized this network on Wednesday afternoon, the day before the river overflowed. The network consisted of the control station, W6PHN, located in the city hall at Anaheim; N6CVO, Riverside; W6CNK, Santa Ana; W6BXI, Garden Grove; W6KNK, Ft. MacArthur, and W6FM, San Diego.

N6BXI at Garden Grove was manned and emergency power equipment capable of supplying power for the transmitter and two receivers was installed and tested. W6CNK in Santa Ana was placed in operation by amateurs under the supervision of Norol Evans, W6LYM. Contact was established between N6BXI and W6CNK, N6BXI using the auxiliary power supply. At about three a.m. Thursday morning, March 3rd, contact was established with N6CIW using the naval reserve call CB11C in Imperial valley, which was also using portable power, the utility system having failed. Official

Houses a few hundred feet from a "wash" were likely to find themselves situated on a river bank after flood waters ignored old channels, undermined houses as has occurred here to the left side of the dwelling. Many expensive homes were undercut in this manner, toppled into raging torrents to be broken up and carried to the sea.

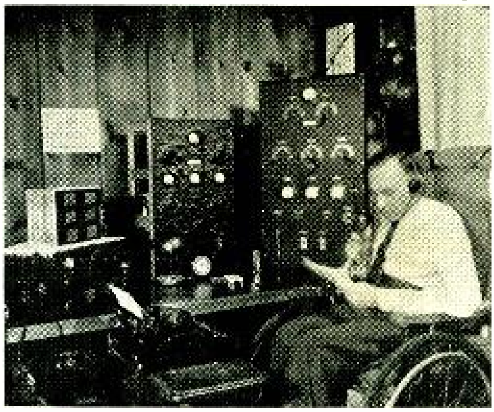
traffic was handled at this time. Shortly after, contact was established with N6KTE in Santa Barbara.

By 5 a.m. all cities in Orange county were isolated. Hardest hit was Anaheim, directly in the path of the overflowing Santa Ana river. In the upper reaches of the Santa Ana river, San Bernardino and Riverside were without communication, and parts of that area were without power. Despite dire warnings, Ensign Ray Hancock, W6ALK, made his way from Long Beach to Santa Ana, where he took command of naval reserve activities there.

A contact was made with W6KNK at Fort MacArthur in San Pedro, which furnished a much needed outlet for Los Angeles traffic, and communication was further established with Los Angeles through W6CHX in the National Guard Armory, and through whom all National Guard traffic was handled. Amateurs who gave so freely of their time and facilities in this network included W6BXI, W6BYZ, W6VT, W6CVO, W6CMT, W6HQX, W6LYM and W6CNK. The network functioned smoothly all the time it was in operation, and only official traffic of urgent character was handled.

Long Beach did not fully realize the seriousness of things until the Los Angeles river, which runs through one edge of Long Beach into the ocean, began to rise at an alarming rate, fed by all the washes and mountain streams up above. The flood control, as the river is called when it hits Long Beach (artificial embankments and "controlled" channels make it such) would not be able to withstand the terrific onslaught of water later than 11 p.m., the army and city engineers observed, if the water kept on rising at the same rate. Reports from "up above" indicated that more and more water could be expected. True, the project had been constructed as a flood control, but nobody had ever dreamed that it would be called upon to handle such a volume of angry water. A bridge across the control where it empties into the Pacific collapsed carrying over a dozen daring spectators into the stormy sea and to their deaths. Only one bridge in the area remained intact, and it did not seem to be standing the driving torrent too well. If it went out, an expanse of residential section would be isolated; if the control gave way, the district would have been inundated.

W6DEP, one member of the Long Beach emergency preparedness council, piled his portable-emergency gear into his car along with a gas engine driven generator and persuaded officials to let him cross the creaking bridge to the west side, where he could be of the most service should things give way. There, close to the water's edge, he gave a continuous report on the height of the water and conditions as observed from that side. This data was relayed to the Long Beach city council and engineers via W6RO. A circuit to Sacramento via W6AM and KABY, the state police radio net control station, enabled the National Guard in Long Beach to inform the capitol as to the impending danger. A schedule was kept at 15 minute intervals, in readiness for the emergency. Just as the zero hour approached, the river broke out at a point above Long Beach, flooding that area but relieving the pressure on the Long Beach sector. The fact that the control held did not lessen the gratitude of the city and National Guard officials and engineers; they appreciated the fact that had things gone bad they would not have been without communication in the distressed area. They were loud in their praise of the communications division of their emergency disaster committee.



"Barney" Boyd, W6LYY, handled press and hundreds of flood messages while San Diego was without communication for 27 hours. San Diego missed the full fury of the storm but was without wire communication when lines into Los Angeles went out.

Victorville, small community in the flat of the Mojave desert some distance from Los Angeles, became isolated and a serious emergency existed when the Mojave river went on a rampage. Only communication was via W6MRT, local amateur, and via KIIY, station of the department of water and power. A circuit consisting of W6DSB at Independence, W6MRT, and KIIY kept the Los Angeles light and power company supplied with in-

[*Continued on Page 94*]

DX

HERB. BECKER, W6QD

Readers are invited to send monthly contributions for publication in these columns direct to Mr. Becker, 1117 West 45th Street, Los Angeles, Calif.

Dx Contest News

At the last minute the following Contest scores and news were frantically accumulated and your dx editor rushed frantically to the printer only to find the magazine on the press. I promptly grabbed a monkey-wrench and threw it at the press . . . and of course that's what you call "throwing a monkey-wrench into the machinery". Anyway, it got results and now my fine tired-out dx owls . . . read on for a few of the scores.

Before going farther, however, let me say that we will not guarantee the accuracy of the scores listed, nor will we deny that some of them might later be cut down because of errors or even disqualified . . . on account of off-frequency operation or other naughtiness.

W3EVT	150,500	W9GRV	42,000
W6GRL	140,600	W7AMX	41,800
W9ARL	135,000	W9FS	41,000
W6CXW	118,000	W6DOB	39,500
W2BHW	104,000	W8NV	35,900
W6JBO	99,200	W6LYM	35,000
W6HX	94,600	W9PLM	35,000
W4AH	90,000	W8QDU	32,000
W8BTI	82,000	W3GAU	30,000
W1TS	80,000	W9IML	30,400
W4AJX	80,000	W9TH	29,000
W6CUH	71,000	W7DXZ	29,100
W6GRX	63,000	W6BAM	25,600
W6QD	62,000	W2IRV	25,200
W9LOJ	60,000	W5KC	25,000
W6GCX	54,400	W1AVK	24,500
W9NNZ	51,100	W6DRE	20,000
W9UQT	52,900	W5VV	19,000
W6AM	51,600	W6VB	18,000
W1ZB	51,600	W6LCF	16,700
W1FTR	47,000	W2CYS	15,600
W9PST	46,600	W5BB	10,000
W6EPZ	42,400		

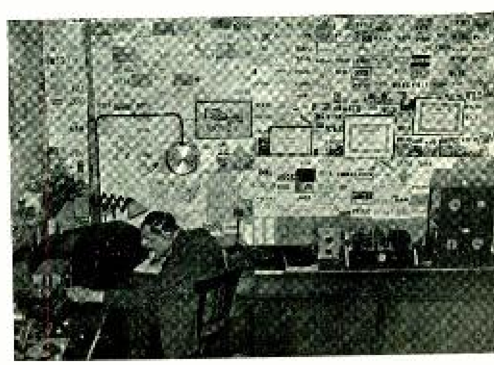
Just a flash of the foreign scores: K6CGK 149,000; OK1BC 100,000; LU7AZ 99,470; F8TQ 85,000; LU9BV 49,400; LU9AX 30,800; LU3DH 11,088; OZ2M 9000; ES5C 2550; ZL1BR 25,000; PA0AZ 59,000; PA0LF 38,000; PA0PN 16,000; PA0XM 16,000; VS6AG 6320; PA0FX 1677; K4KD 131,895 . . . Two days before the contest closed G6NF had over 80,000.

A few of the highlights from the different boys . . . W3EVT had 324 contacts, used 8 antennas and ran a kw. into a pair of 100TH tubes. W6GRL had 293 QSO's, used all of his antennas; 5 vee beams, a rhombic and a couple of "Q"'s. Doc said he had plenty of tough luck as a truck-derrick went down the street and raked down one of his transmission line [illegible]ou see, that only left him 9 or 10 antennas to us[illegible] He was also complaining of an R9 power leak. None of us believes that because we've been there and listened. His QRA is so quiet that you can almost hear the guy on the other end turn on his filaments. Anyway, Doc wants to know he had tough luck and that's why he only got 140,000. As a matter of fact I think he was wise in sleeping through his alarm clock one a.m. . . . when he didn't get up 'till 9. Gee, it makes me yawn to think about it.

W6CXW had a heck of time getting ready for the contest. He didn't start to get ready until a week before the brawl . . . and it was then we had that week of "extreme dampness." Henry kept waiting for a day for it to stop raining so he could raise his antenna. Finally Friday, the day of the contest, arrived and it was still coming down so Henry swims from pole to pole and makes the necessary changes. Our hat is off to CXW for really geting in there and pitchin'. He got himself three new countries which makes 135 now. There is just one thing that bothered Henry— he spent three days calling VP6LN . . . and when he finally did hook him the VP said he was the loudest sig he had heard all day. CXW changed his transmitter from last year, though still using two 250THs . . . and a new NC101X helped too. Then there is this fellow W6JBO with his 99,000 who deserves a hand. His family had just moved into their new home a month previous to the contest and JBO had not been on the air until just *one* day before the contest opened up. He had no chance to check the new location for transmitting, to find its peculiarities. All of his antennas were put up a week before and they consisted of "Q" types. The only difficulty he ran into was that he blinked the lights in the entire neighborhood, and the power company received about 30 complaints in this regard. Hi. Dick's new rig consists of a couple of 250TH's running about a kw. input. Receiver is an NC101X.

K6CGK is at it again on five bands . . . 149,600 points with 941 QSO's and a multiplier of 53. He was surely going to town and was hopping from one band to another so fast that you'd swear you'd been into that new XXX variety. He is surely a hound for punishment because now he is right in the middle of the phone contest. Whew!!! While I think of it I want to mention W3EVT again . . . He deserves plenty of credit for his showing; he is 18 years old and if I remember correctly he scored about 77,000 last year. More power to him.

Ah! A W9 to the rescue . . . W9ARL sits there with 135,000 from 290 contacts and a multiplier of 157. Yessir, it looks like the W9's went out and did it and good ol' Johnny Marshall kept up his



Receiving position at PA0GN. The main transmitter is in another corner of the room.

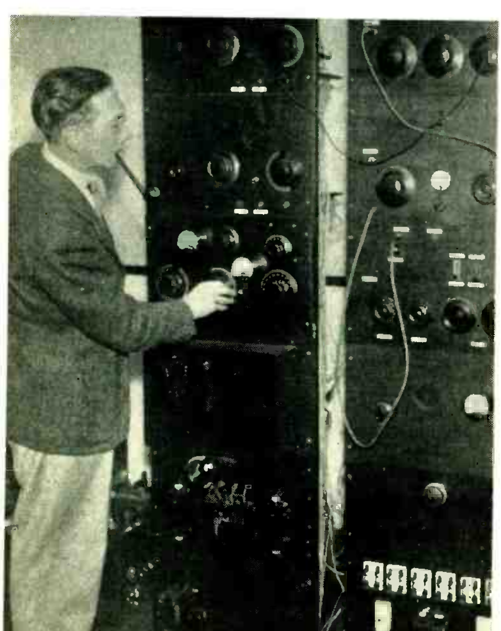
vitality for the nine-day marathon. Johnny was heard knocking the Europeans for a loop on both 40 and 80, which is really something . . . at least from the viewpoint of the W6's. In the 4th district it looks like W4AH with 90,000 and W4AJX with 80,000 leading the way.

In the 7th district W7AMX looms up with close to 42,000. However there may be someone in the bushes hiding. W2BHW is the highest heard from in his district but any minute now someone may spring loose . . . you can't tell. The 1st district of course would go to Roddy with probably over 100,000 but he won't talk; so I guess W1TS will pop up with more than 80,000. W1ZB is sure he has 51,600 however.

Getting back into the 6th district . . . W6HX did some mighty fine work using 4 bands. Like W6JBO he is located in a thickly settled neighborhood, making it impossible to put up long and fancy beam antennas. His antenna setup consisted of an 8JK beam, a 40-meter "Q" and a 20-meter "Q". The 8JK and 20 Q were used on 10, too. Transmitter push-pull Eimac 250TH's and the receiver an HRO.

W9AKJ had just moved and was operating portable during the contest. He went on 28 Mc. only and worked 35 countries, 14 of them being new ones. He had been laying for Asia for years and then hooked two J's without much trouble. W9UQT was in there going strong and did himself proud. Worked 21 countries on 40 and that sounds like something for a W9 in Illinois. W9UQT uses a pair of HF300's in the final and the receiver is an NC101X.

Now for a laugh at the expense of W2FSN . . . will quote his leter: "Score for W2FSN was 6222 points. Wonder if you can send a good kick in the pants by return mail. I got all set for the contest with a beam for VK figuring we could fill the log with VK's. After losing lots of sleep and running up a score of 40,000 . . . I read the rules and found an allowance of only three QSO's per country. WOW. Did [illegible] score drop? Well, next year I'll read 'em before going into it."



G6OT, the call of H. A. M. Clark, is well-known throughout the world.

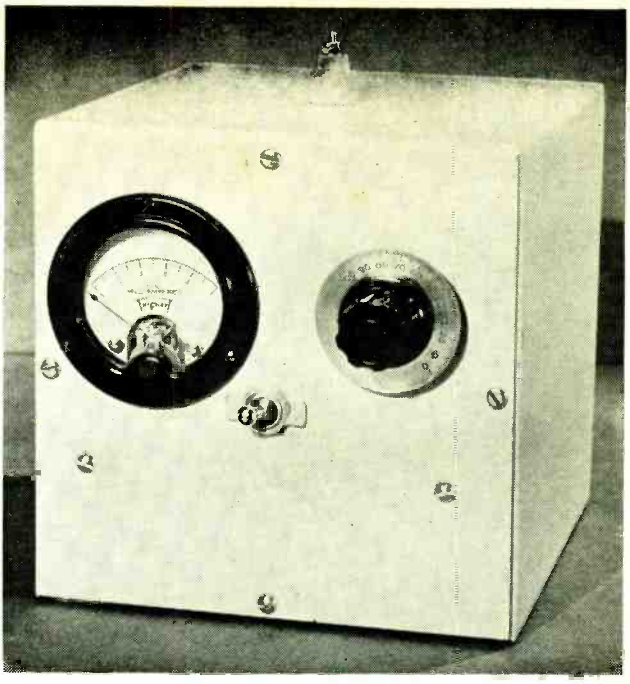
OK1BC was one of the most consistent. He used four bands and scored 100,000 points, 900 QSO's. On 7 Mc. he used a vee beam, and on 14 Mc. a 4-section flat-top beam, while on 28 Mc. a 2-section flat-top did the trick. OK1BC uses a 35T with about 100 watts, and the receiver is an FBXA rebuilt like an HRO. LU7AZ was working them fast and furious, and his signal was one of the most consistent on the 10,- 20- or 40-meter bands. He had 950 contacts, which means plenty of numbers dished out. F8TQ did a good job in gathering his 85,000 and he said that the 28 Mc. sigs would often stay in until 2100 G.m.t. VK4JU didn't know his score but said something about having 1492 contacts. With a couple of days yet to go G6NF had over 80,000 so I guess he might do it for good old G. G6WY, G6QX, G6QS, were some of the most consistent. G2ZQ was too busy getting ready to be married to do much in the contest. Don't forget gang, April 2nd is his farewell . . . to dx. John feels as happy as though he had added zone 41.

PA0AZ with his 59,000 looks good for the Netherlands and his signal was also very consistent. Don't know what ON4AU rolled up but it must have been pretty good. OZ9Q punched through a good signal at all times but did not give reports in proportion to the way he was coming in. K7PQ kept up a dizzy pace and there was another guy who I'll bet couldn't keep track of which band he was on . . . he changed so often. Then, too, this fellow Mayer, K4KD was all over the place, as was K5AN. The pet peeve of the W6 gang was their inability to raise CN8AV without spending a day or two chasing him.

W6CUH galloped all over three bands with his EC, chasing everybody including CN8AV. Charlie got 71,000 and considering the fact that he has a job to "contend with," we think that score is swell. Had he been able to lay off work and choose his time on the air he would have given everyone a run for his money. Charlie had tough luck the first part of the contest on 28 Mc. due to his antenna running the wrong way for Europe. When passing by his "shack" one night I noticed the backyard lit up like a movie premier. I stopped and wondered, "What is Charlie doing, giving a garden party, or what?" My curiosity was satisfied when I discovered him hard at work putting together a 10-meter antenna, under these improvised lights, so that he would be ready for 10 the next morning. Well, the antenna did the trick and from that point on he got out on 10 meters.

How many of you remember NY1AB of the 1934 DX Contest . . . I'll never forget him punching off the QSO's at two a minute. He had the highest score in the world for that brawl. Well, this same guy, George Vandekamp is now W6GCX and he ran up 54,400 points during this last one. It is noticeable to see the change in the contests from one year to another. This year there was a definite scarcity of PK stations . . . and those that were contacted didn't seem to know there was such a thing as a contest. One PK said ARRL didn't send him a number so he wasn't in it. However, after much persuasion a few of us did wrangle a number out of a PK or two. Those of you who got UX3FI will be glad to know he is in Siberia. At least that is what he said and the funny part of it was with that "powerleak" note on 7 Mc. he tried to spring his fone on a couple of the boys. Hi. The XU's were a little better about giving a number although they caused many headaches. What would a DX contest be without VS6AG, John Alvares . . . He was the guy who saved the day for a VS6. John made 6320 points

[*Continued on Page 94*]



An Inexpensive FIELD-STRENGTH METER

By RAY L. DAWLEY,* W6DHG

A good field-strength meter is almost a necessity around the shack of the ham who is interested in antenna experimentation. He is always interested in comparing the patterns of radiation and the relative field strengths of the various arrays as he tries them. Such a meter is almost a necessity when tuning an array of the close-spacing type, either rotatable or fixed, to determine maximum gain in the forward direction and greatest attenuation in the backward direction.

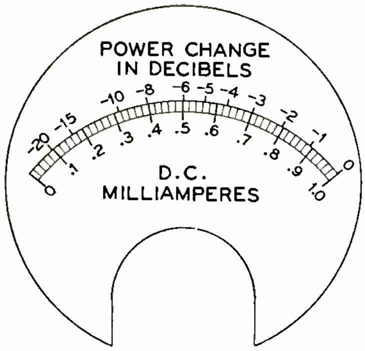
Another use of the f.s. meter is in comparing the outputs of the transmitter, when working into the same antenna, as various parameters are changed within it. The adjustments of a grid-modulated or a class-B linear transmitter are difficult to make if some means of determining the comparative output of the rig under different operating conditions is not available.

Design

Now, as to the construction and design of the meter itself. First, the meter must obviously be portable. This means that it must be battery powered. And, if the batteries are to remain in service for a reasonable period of time, both the filament and plate power requirements of the meter should be small. But, the second requirement of the meter is that it should have reasonable sensitivity. Sensitivity is necessary so that measurements can be made some distance from the antenna to eliminate the possible effects of standing wave conditions between the antenna and the f.s. meter.

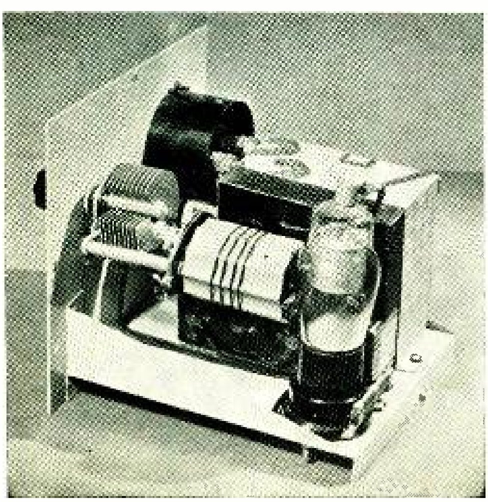
Of course these two requirements are at opposition to each other. It is easy to design a sensitive meter, but considerably different to design one that is both sensitive and meagre in its power requirements. Then, tying up with both of these former requirements, the meter must be very stable, both with respect to ease of taking measurements and with respect to its holding calibration over a period of time. This requirement of stability immediately rules any regenerative circuit out of the picture. Regeneration would add to sensitivity, but stability would greatly suffer and accurate calibration would be impossible.

*Technical Editor, RADIO.

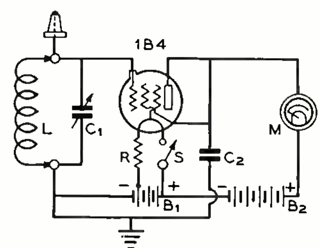


This scale may be cut out and used with the 2-inch meter illustrated in the photograph. A press proof on heavy paper will be sent on receipt of a stamped, self-addressed envelope if you do not wish to mutilate this page.

In the past, the majority of amateur-built field-strength meters have consisted of a diode rectifier connected to a milliammeter. This type of meter fills the bill on every count except the one of required sensitivity. Of course a diode gives no power gain. And the diode actually takes power from the incoming signal to actuate the indicating meter. A diode f.s. meter is satisfactory for the taking of measurements in the immediate vicinity of a comparatively high-powered station, but measurements at any distance at all must be made with the aid of a large receiving antenna. When all these things are taken into consideration it might seem that it would be difficult to find a circuit arrangement answering to all these requirements. But it so happens that it is not; the common biased or power detector circuit is almost ideally suited to the job. Only one low-drain tube is required; the circuit is sensitive; only a very small amount of power is required to produce a comparatively large plate current change; the arrangement is perfectly stable and none of the energy picked up in the antenna is actually taken to actuate the indicating meter.



A meter of this type, though designed to operate on 2½ meters, was described in connection with the development of the push-button controlled beam as described in the June, 1937, issue of RADIO. The meter to be described herein is simply an adaptation of that



C_1—140-µµfd. midget variable
C_2—.002-µfd. mica
R—15-ohm resistor
S—On-off switch, s.p.s.t. toggle
M—0-1 d.c. milliammeter (2" size to use chart given)
B_1—4½-volt C battery. Filament leads connected to + and —3, ground connected to —4½
B_2—22½-volt C battery
L—Coils—see text

circuit to the needs of the amateur desiring to experiment with antenna radiation patterns on the bands from 56 Mc. down in frequency through 1.7 Mc.

The Circuit

A 1B4 tube, triode connected, is used as the detector the same as in the original meter. Two small batteries are required for the plate, filament and bias supplies. The plate voltage is 22½ volts, the bias about 2½ volts and the filament voltage, the rated value of 2 volts. Under normal use, the batteries shown with the unit should give a useful life of 6 months to one year, depending upon how close to calibration the meter must be held. As the batteries become aged, the calibration will change.

The one tuned circuit in the meter is designed so as to be able to cover any two consecutive amateur bands. A single 140-µµfd. condenser is used across the plug-in coil, and since

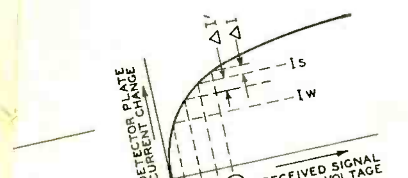
[*Continued on Page 91*]

What Happens in a

SUPER-REGENERATIVE RECEIVER

Continuing last month's discussion, adapted from an article[1] appearing in January, 1938, I.R.E. Proceedings, the author dispels some of the atmosphere of mystery which, in the minds of many persons, seems to surround the super-regenerative circuit.

By FREDERICK W. FRINK*



(Left) Effect of varying the quench frequency. (...). Effect of a strong carrier wave on the reception of a weak signal.

Part II.

Effect of Quench Frequency on Sensitivity

Experience shows that in a given design of a separately-quenched superregenerative receiver there is a particular quench frequency which gives maximum sensitivity. When a receiver with a rectangular-wave quench voltage is receiving an unmodulated carrier wave, the detector plate current change produced by the signal is proportional to the *difference* between the periods of full u.h.f. oscillation in the detector tube both with and without the incoming signal. This is true because the detector plate current depends on both the amplitude and the duration of the ultra-high-frequency voltage. The increment in u.h.f. oscillation period caused by the received signal also represents the increment in the total quantity of electricity passing through the detector plate during each quench cycle. Increasing the number of quench cycles per second increases the change in the average detector plate current produced by the signal, because the above-mentioned increment in the quantity of electricity flowing during *each quench cycle* remains the same while the quench frequency is increased, *provided* there is sufficient time for the ultra-high-frequency voltage to build up to the saturation value during each quench cycle.

Thus, the change in the average detector plate current produced by the signal is directly proportional to the quench frequency, until the quench frequency becomes so high that the ultra-high-frequency voltage does not have time to build up to the saturation value. After this condition is reached, a further increase in quench frequency causes a falling off in the sensitivity.

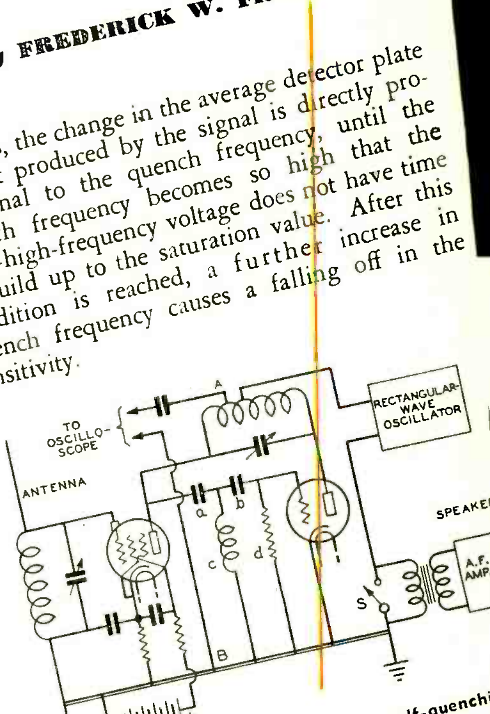


Figure 11. Circuits for studying the self-quenching super-regenerative detector.

When a sine-wave voltage is used, the frequency has a similar effect on the se... but the effect is complicated by the ... the grid voltage, or the plate voltage undergo continual variation, due to ... cation of the quench voltage. The ... of the ultra-high-frequency voltage ... after the class-C condition is reach...

[1] "The Basic Principles of Superregen... tion," F. W. Frink, *Proc.* of I.R.E., Ja...

*17 Leighton Ave., Yonkers, New Y...

...iven period ...y) increases ... is increased. ... by the u.h.f. ...ncreasing the ... of ultra-high-... causes an in-...t, thus causing ... voltage across ...ariations in the ...tion cause varia-... current. By a ...will not be given ...he detector plate ...he received signal ...spect to the signal

...uenching frequency ...ave is received was ...easing the resistance ...e quench frequency ... range, and could be ... Whenever a carrier ...sily observed increase ... took place.

...sults shown in figures ...asily be explained. The ... up at a rate dependent ... received signal voltage. ...ompanied by an increase ...ude of the negative bias ...y the grid-current flow ... resistor. The increase in ... decrease in the amplifica-... tube, until an equilibrium ...ached, in which the output

[...ued on Page 68]

...es of Superregenerative Recep-... *Proceedings* I.R.E., January, 1938.

... the receiver ... For taking os-... rectangular-wave ... voltage was ob-... oscillator oper-...uency considerably lower than ...ng frequency of the detector. ...btaining the plate voltage in ... to make it possible to obtain ... of the u.h.f. wave trains with-...f synchronizing the oscilloon how early in the quench cycle this occurs. In figure 9(a), the broken line indicates the maximum amplitude to which the ultra-high-frequency voltage can rise at various times during the positive half of the quench-voltage cycle. Curves S and T represent the building up of the ultra-high-frequency voltage without a signal and with a signal, respectively. The area increment, represented by the shaded area between the two curves, represents the effect of the signal.

Figure 9(b) represents the results ... quench frequency is doubled. The ... the two curves has been decrea... quench voltage has already ... erably by the time the ... class-C condition, ... num amplitude ... f the quench ... e decrea...

tact noises, which pro... starts the ultra-hig... the absence of a ... are very irre... effect at ... period... spo...

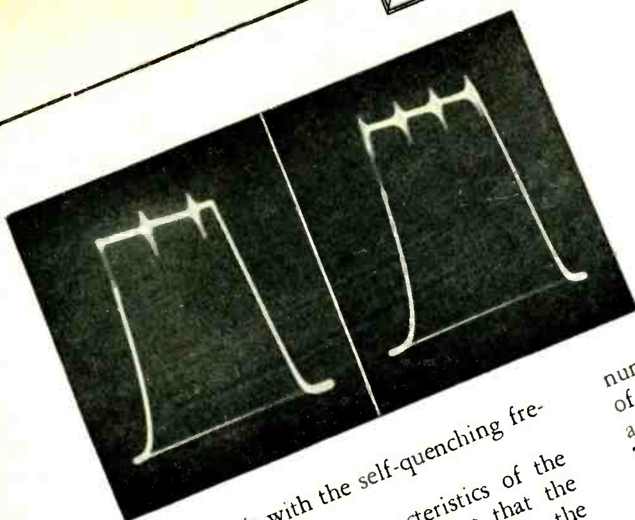


Figure 12. (a) Voltage between A and B of figure 11 with weak received signal. (b) With strong signal.

scope sweep circuit with the self-quenching frequency of the detector.

One of the important characteristics of the self-quenching detector is the fact that the quench frequency varies greatly with the strength of the incoming signal, and it would be difficult to observe this variation if the oscilloscope sweep circuit were synchronized with the quench frequency. Applying the plate voltage intermittently by means of a rectangular-wave oscillator makes it necessary for the detector to start operating again under the same conditions each time the plate voltage is applied, and the only requirement necessary for obtaining a stationary image on the oscilloscope screen is that the sweep circuit be synchronized with the rectangular-wave voltage. The rectangular-wave generator was operated within the audio-frequency range, so that its frequency would be enough lower than the quench frequency to show more than one wave train of the u.h.f. oscillations.

Switch S in figure 11 was opened for tuning the receiver, and then closed for taking the oscillograms, so that the rectangular-wave voltage would not be distorted by the audio-frequency transformer. Choke coil c, not ordinarily present in such circuits, was used for preventing the rectangular-wave voltage from being applied between grid and cathode of the detector. Constants in the grid circuit were: a = 50 micromicrofarads, b = 50 micromicrofarads, c = 2.5 millihenrys, d = 4 megohms.

Figure 12(a), obtained with the oscilloscope connected between points A and B in figure 11, shows the operation during a single cycle of the rectangular-wave voltage, while a weak carrier wave was being received. Figure 12(b) shows the effect of greatly increasing the strength of the carrier wave. Evidently, the u.h.f. oscillations occur in a series of wave trains which are equally spaced with respect to time, and the number of these wave trains in a g... of time (i.e., the quench frequen... as the strength of the carrier wave... The maximum amplitude reached... oscillations is not increased by ... strength of the carrier wave.

The increase in the number ... frequency wave trains per secon... crease in the average grid curre... an increase in the average bia... the grid leak. In this way, ... carrier amplitude due to modul... tions in the detector plate ... mathematical analysis,[3] which ... here, it can be shown that ... current change produced by ... varies logarithmically with r... amplitude.

The fact that the self-q... increases when a carrier w... also verified by merely inc... of the grid leak until th... came within the audible ... heard in the loudspeaker... wave was received, an e... in the quench frequency...

The reasons for the r... 12(a) and 12(b) can ... u.h.f. oscillations build... on the amplitude of th... This building up is ac... in the absolute magni... voltage produced ... through the grid-leak... bias voltage causes a... tion provided by the... condition is finally r...

[Conti...

[3] "The Basic Princip... tion," F. W. Frink, ...

What Happens in a

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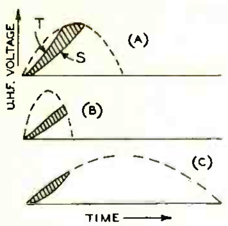


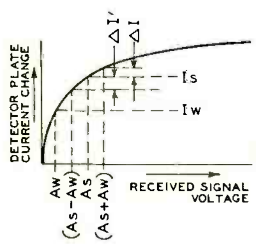


Figure 9. (Left) Effect of varying the quench frequency. Figure 10. Effect of a strong carrier wave on the reception of a weak signal.

Part II.

Effect of Quench Frequency on Sensitivity

Experience shows that in a given design of a separately-quenched superregenerative receiver there is a particular quench frequency which gives maximum sensitivity. When a receiver with a rectangular-wave quench voltage is receiving an unmodulated carrier wave, the detector plate current change produced by the signal is proportional to the *difference* between the periods of full u.h.f. oscillation in the detector tube both with and without the incoming signal. This is true because the detector plate current depends on both the amplitude and the duration of the ultra-high-frequency voltage. The increment in u.h.f. oscillation period caused by the received signal also represents the increment in the total quantity of electricity passing through the detector plate during each quench cycle. Increasing the number of quench cycles per second increases the change in the average detector plate current produced by the signal, because the above-mentioned increment in the quantity of electricity flowing during *each quench cycle* remains the same while the quench frequency is increased, *provided* there is sufficient time for the ultra-high-frequency voltage to build up to the saturation value during each quench cycle.

By FREDERICK W. FRINK*

Thus, the change in the average detector plate current produced by the signal is directly proportional to the quench frequency, until the quench frequency becomes so high that the ultra-high-frequency voltage does not have time to build up to the saturation value. After this condition is reached, a further increase in quench frequency causes a falling off in the sensitivity.

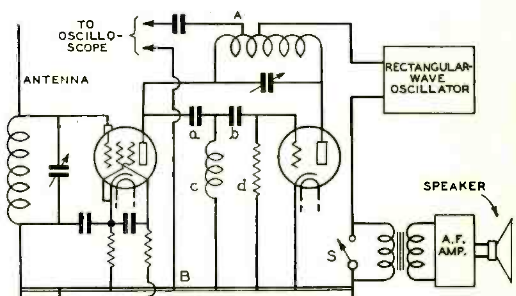


Figure 11. Circuits for studying the self-quenching of a super-regenerative detector.

When a sine-wave voltage is used, the quench frequency has a similar effect on the sensitivity, but the effect is complicated by the fact that the grid voltage, or the plate voltage, or both, undergo continual variation, due to the application of the quench voltage. The amplitude of the ultra-high-frequency voltage immediately after the class-C condition is reached depends

[1] "The Basic Principles of Superregenerative Reception," F. W. Frink, *Proc.* of I.R.E., January, 1938.

*17 Leighton Ave., Yonkers, New York.

on how early in the quench cycle this occurs. In figure 9(a), the broken line indicates the maximum amplitude to which the ultra-high-frequency voltage can rise at various times during the positive half of the quench-voltage cycle. Curves S and T represent the building up of the ultra-high-frequency voltage without a signal and with a signal, respectively. The area increment, represented by the shaded area between the two curves, represents the effect of the signal.

Figure 9(b) represents the results when the quench frequency is doubled. The area between the two curves has been decreased, because the quench voltage has already fallen off considerably by the time the oscillations reach the class-C condition, and this prevents the maximum amplitude from being as great as before. If the quench frequency is increased indefinitely, the decrease in this area ultimately becomes great enough to cause a decrease in the average detector plate current change produced by the received signal, in spite of the increase in the number of quench cycles per second.

Figure 9(c) represents the results for a lower quench frequency, and shows that the shaded area is decreased in this case also, in comparison with figure 9(a). Futhermore, at the frequency corresponding to figure 9(c) there is also a loss of sensitivity due to the smaller number of ultra-high-frequency wave trains per second; in other words, to the lower quench frequency.

Optimum Quench Frequency

The optimum quench frequency depends on the rate at which the ultra-high frequency voltage builds up, which in turn depends on the amount of regeneration used.

Of course, there are other considerations besides sensitivity which affect the choice of the quench frequency. Ordinarily, the quench frequency should be well above the audio-frequency range, not only to make it inaudible, but also to facilitate by-passing, and to prevent the quench voltage from entering the audio-frequency amplifier and overloading it. On the other hand, if the quench frequency is too high, interference may be caused by harmonics within the tuning range of the receiver.

Chorocteristic Noise of Receiver

When no signals are being received, the superregenerative circuit ordinarily produces a continuous noise, known as the "characteristic noise." This is evidently caused by circuit noises, such as thermal agitation, shot effect, and contact noises, which provide the impetus that starts the ultra-high-frequency oscillations in the absence of a signal. Since the circuit noises are very irregular, they do not have the same effect at the beginnings of all of the build-up periods, and for this reason the detector responds as though a very irregularly modulated carrier wave were being received. When a strong carrier wave is received, this noise disappears almost entirely. A weak signal, also, can be rendered inaudible by the reception of a strong carrier wave on a frequency different from that of the weak signal.

This effect can readily be explained by referring to the sensitivity characteristic represented in figure 10. If a carrier wave having amplitude A_w is received, the detector plate current change produced thereby is I_w. If this carrier wave is removed and a stronger carrier wave, having amplitude A_s, is substituted, the detector plate current change is I_s. Now, if both carrier waves are received simultaneously and they do not have the same frequency, we cannot find the combined effect by merely adding the two amplitudes A_w and A_s, because the phase relations between the two voltages undergo a continuous change.

When the two voltages are in phase, the resultant amplitude is (A_s+A_w), and the detector plate current is greater by an amount ΔI than it would be if only the stronger signal were present. When the two voltages are 180 degrees out of phase, the resultant amplitude is (A_s-A_w), and the detector plate current is decreased by an amount $\Delta I'$ below I_s. The detector plate current varies between the values $(I_s+\Delta I)$ and $(I_s-\Delta I')$ at a frequency equal to the difference between the signal frequencies, and if this beat frequency is above the audible range no audible effect is produced. Since ΔI is approximately equal to $\Delta I'$, the average detector plate current remains at practically the same value as though the stronger signal were present alone. Since the weaker signal does not add appreciably to the variation in the detector plate current, except at the superaudible beat frequency, it is impossible for any audio-frequency modulation present on the weaker signal to produce any appreciable audio-frequency current in the detector plate circuit.

The effect is somewhat similar to that which occurs in a linear detector when used without superregeneration. In such a detector it is possible for a strong carrier wave to change the operating conditions in such a manner that a weaker signal, even though modulated, is unable to produce any audio-frequency current, provided the frequency difference between the two signals is above the audible range.[2]

Because of the curvature of the logarithmic characteristic shown in figure 10, $\Delta I'$ is not exactly equal to ΔI, and for this reason the suppression of the weaker signal is not complete. However, the curvature also tends to reduce the sensitivity to the weaker signal, because of the decrease in the slope of the curve with increasing amplitude. It is probable that the suppression of the weaker signal is due partly to the decrease in this slope with increasing amplitude, and partly to the varying phase difference between the two signals as explained above.

After considering the effect of a strong carrier wave upon the reception of a weak signal, it is easy to see how the characteristic noise can be suppressed in a similar manner. When no signal is being received, the ultra-high-frequency components of the circuit noises always cause ultra-high-frequency oscillations to be started at the beginning of each build-up period, and the phase of these oscillations makes no difference in the resulting detector plate current. However, when a strong carrier wave is being received, the question of phase relations becomes important. At the beginnings of the build-up periods, the oscillations produced by the noise voltages are sometimes aiding and sometimes opposing the oscillations produced by the received signal voltage, depending on the phase relations. As a result, the effect of the noise voltages tends to average out over a period of time long enough for producing an audio-frequency voltage.

Adjustment of Quench Voltoge

By slowly reducing the amplitude of the quench voltage it is possible to obtain a rather critical adjustment in which the characteristic noise is much reduced, even when no signal is being received, but the receiver is still sensitive to received signals. In such a case the reduction in the characteristic noise is caused by incomplete quenching of the ultra-high-frequency oscillations. At the beginning of each build-up period there is enough residual u.h.f. voltage to suppress the noise in the same manner as it would be suppressed by a received carrier wave. A received signal stronger than the residual u.h.f. voltage can still be received, but there is a considerable tendency toward amplitude distortion, probably because of the fact that during that portion of the audio-frequency modulation cycle in which the signal voltage drops to minimum the above-mentioned residual voltage has a tendency to take control of the receiver.

As might be expected, the residual voltage can produce audible beat notes with a weak incoming signal. This is due to the fact that the phase relationship between the two u.h.f. voltages at the beginnings of successive build-up periods varies at a rate corresponding to an audio frequency. Since the varying phase relationship *at the beginnings of the build-up periods* is the only thing which determines the beat frequency, it is possible to obtain the same beat frequency at several settings of the detector tuning condenser, corresponding to several frequencies of oscillation, each of which differs from the signal frequency by an amount equal to the audible frequency plus some multiple of the quench frequency. In other words, one u.h.f. voltage may slip ahead of the other by *more than one cycle*, from one build-up period to the next, producing practically the same effect as though it had slipped ahead by only a fraction of a cycle.

The fact that the beat notes are not caused by harmonics from the quench oscillator is shown by the fact that increasing the amplitude of the quench voltage, thus increasing the quenching effect, causes the beat notes to disappear.

Self-Quenching Super-regenerotive Detectors

To avoid the necessity of providing a separate vacuum tube oscillator for generating the quench voltage, superregenerative detectors are sometimes made self-quenching, by increasing the grid-leak resistance until the bias voltage produced is great enough to cause intermittent blocking of the u.h.f. oscillations without the assistance of an externally applied quench voltage. In such a case the detector plate voltage is direct only, and no fixed grid bias is used.

To study this type of operation, the receiver shown in figure 11 was used. For taking oscillograms, the detector plate voltage was obtained from a rectangular-wave oscillator operating at a frequency considerably lower than the self-quenching frequency of the detector. The object of obtaining the plate voltage in this manner was to make it possible to obtain a stationary image of the u.h.f. wave trains without the necessity of synchronizing the oscillo-

[2] F. E. Terman, "Radio Engineering," First Edition, Chap. VIII, Page 319, McGraw-Hill Book Co.

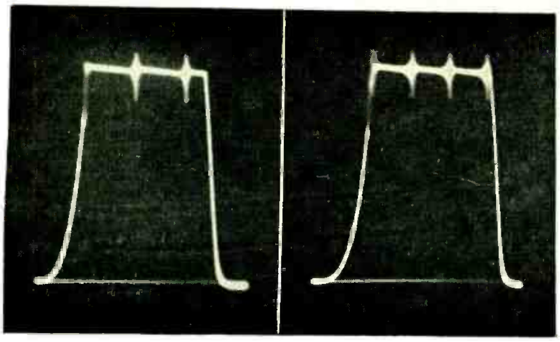


Figure 12. (a) Voltage between A and B of figure 11 with weak received signal. (b) With strong signal.

scope sweep circuit with the self-quenching frequency of the detector.

One of the important characteristics of the self-quenching detector is the fact that the quench frequency varies greatly with the strength of the incoming signal, and it would be difficult to observe this variation if the oscilloscope sweep circuit were synchronized with the quench frequency. Applying the plate voltage intermittently by means of a rectangular-wave oscillator makes it necessary for the detector to start operating again under the same conditions each time the plate voltage is applied, and the only requirement necessary for obtaining a stationary image on the oscilloscope screen is that the sweep circuit be synchronized with the rectangular-wave voltage. The rectangular-wave generator was operated within the audio-frequency range, so that its frequency would be enough lower than the quench frequency to show more than one wave train of the u.h.f. oscillations.

Switch S in figure 11 was opened for tuning the receiver, and then closed for taking the oscillograms, so that the rectangular-wave voltage would not be distorted by the audio-frequency transformer. Choke coil c, not ordinarily present in such circuits, was used for preventing the rectangular-wave voltage from being applied between grid and cathode of the detector. Constants in the grid circuit were: a = 50 micromicrofarads, b = 50 micromicrofarads, c = 2.5 millihenrys, d = 4 megohms.

Figure 12(a), obtained with the oscilloscope connected between points A and B in figure 11, shows the operation during a single cycle of the rectangular-wave voltage, while a weak carrier wave was being received. Figure 12(b) shows the effect of greatly increasing the strength of the carrier wave. Evidently, the u.h.f. oscillations occur in a series of wave trains which are equally spaced with respect to time, and the number of these wave trains in a given period of time (i.e., the quench frequency) increases as the strength of the carrier wave is increased. The maximum amplitude reached by the u.h.f. oscillations is not increased by increasing the strength of the carrier wave.

The increase in the number of ultra-high-frequency wave trains per second causes an increase in the average grid current, thus causing an increase in the average bias voltage across the grid leak. In this way, variations in the carrier amplitude due to modulation cause variations in the detector plate current. By a mathematical analysis,[3] which will not be given here, it can be shown that the detector plate current change produced by the received signal varies logarithmically with respect to the signal amplitude.

The fact that the self-quenching frequency increases when a carrier wave is received was also verified by merely increasing the resistance of the grid leak until the quench frequency came within the audible range, and could be heard in the loudspeaker. Whenever a carrier wave was received, an easily observed increase in the quench frequency took place.

The reasons for the results shown in figures 12(a) and 12(b) can easily be explained. The u.h.f. oscillations build up at a rate dependent on the amplitude of the received signal voltage. This building up is accompanied by an increase in the absolute magnitude of the negative bias voltage produced by the grid-current flow through the grid-leak resistor. The increase in bias voltage causes a decrease in the amplification provided by the tube, until an equilibrium condition is finally reached, in which the output

[*Continued on Page 68*]

[3]"The Basic Principles of Superregenerative Reception," F. W. Frink, *Proceedings* I.R.E., January, 1938.

A BEAM *without Insulators*

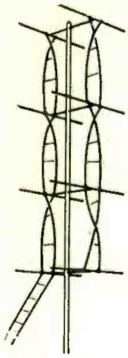


FIGURE 1
PERSPECTIVE VIEW
4 ANTENNAS 4 REFLECTORS

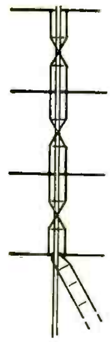
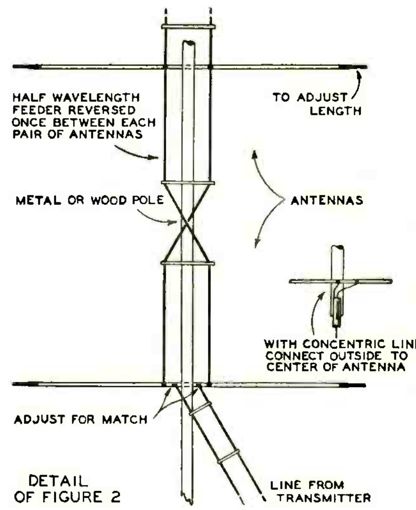


FIGURE 2
FRONT VIEW
WITH OR WITHOUT
REFLECTORS

Through the courtesy of Mr. H. H. Beverage, Chief Research Engineer of R.C.A. Communications, Inc., we have received a description of the 8-element beams used on the New York-Philadelphia relay system on about 100 megacycles. The method of construction is such that many amateurs interested in 28 Mc. and higher frequency bands may wish to duplicate it.

The arrangement used by R.C.A. consists of at least four horizontal half-wavelength antennas stacked vertically, and as many reflectors—which may be omitted in amateur installations if desired. A vertical pole is used as a support. It can be metal or wood. At the top, and at each half-wavelength below it, horizontal pipes ½-wavelength long are mounted so as to extend out ¼-wave on each side. At the ends of these pipes, the center of the half-wavelength antennas and reflectors are mounted. See figures 1 and 2. A plumber can build the whole job. The vertical distance between doublets is a full ½-wave in space. The length of the antennas will be an electrical half-wave, or somewhere around 94% of a half-wave in space, while the reflectors are about 2% longer. The antennas are connected by ½-wavelength lines, reversed between each antenna so that all will radiate in phase. These lines are simply jumped across the center of each antenna. All impedances are thus reflected to the center of each antenna, and a transmission line can be jumped across the proper amount of antenna at the center of the bottom dipole so as to match the line impedance and eliminate standing waves on the line. A two-wire line or a concentric line will do, the latter being better if used for receiving—as it probably will. The reflectors are similarly connected with transposed feeders, but there is no connection to the antennas or to the line running to the transmitter, the reflecting system being parasitically excited.

It is not advisable to put any meters in the line near the antenna when adjusting it. A galvanometer and loop of wire can be slid along the transmission line to check for standing waves, or an extra quarter-wavelength of line can be cut in at the transmitter to see if the line current at that end remains constant with a longer line.



DETAIL
OF FIGURE 2

It may be difficult to eliminate the standing waves unless the antenna lengths are correct. By making the dipoles a little short, they can be tuned by sliding extensions in each end, or threading them in. We suggest keeping all antennas the same length, and the same for the reflectors. The reflectors can be adjusted first with a field-strength meter placed in front or

[*Continued on Page 70*]

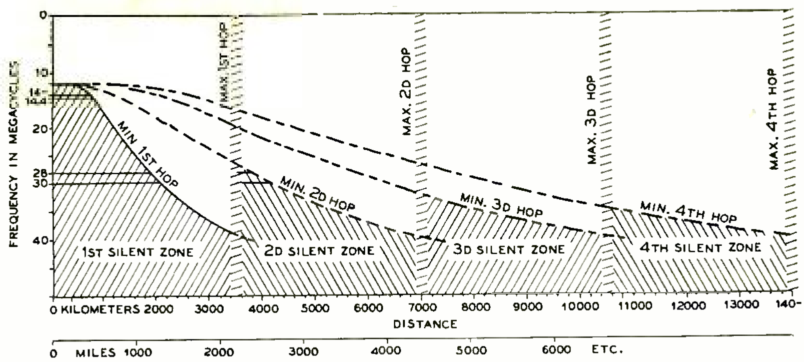


FIGURE 1. SHOWING SKIP DISTANCE AT NOON, DECEMBER 15, 1937

Determination of SKIP DISTANCE

By E. H. CONKLIN*

It is often brought to our attention that amateurs generally do not have a clear conception of *skip distance,* and, therefore, are unfamiliar with the relationship between conditions occurring on two different bands. This knowledge is particularly important on 28 megacycles and the higher frequency bands where more than one *silent zone* may appear, and where distant signals are not always heard. A knowledge of the subject is a great help to those who wish to use the highest frequency bands when they are open for dx and to get the enormous thrill of having a fine contact on an almost empty ten-meter band, or of working a thousand miles on "five."

Let us use as an illustration the skip distances broadcast each Wednesday afternoon by the National Bureau of Standards.[1] The first item in the broadcast of December 15, 1937, gave the vertical-signal critical frequencies and the virtual heights for the most important layers, as in Table I.

Table I.

	Critical Frequency	Virtual Height
E layer, ordinary ray	3320 kc.	120 km.
F_2 layer, extraordinary ray	12,200 kc.	230 km.

The third item gave the maximum usable frequencies calculated from the Table I data for varying distances. This is shown in Table II, to which we have added the distances in miles, for convenience.

Table II.

Distance kilometers	Distance miles	Maximum usable frequency in kilocycles
400	250	12,500
700	440	14,700
1000	625	18,100
1300	800	21,600
1600	1000	25,000
2000	1250	29,200
2500	1550	33,500
3500	2180	39,500

This data, conversely, indicates the minimum distance—the skip distance—that can be heard at various frequencies. Out to this distance is the *first silent zone.* This data has been charted in figure 1 in the line giving the minimum first-hop distances. Minimum second, third and fourth hop distances have also been plotted because they are of interest. The vertical columns of cross-hatching at 3500 km. (2180 miles) and multiples thereof, give the outer limits of distance for each hop, assuming that signals below a vertical angle of 3½ degrees are absorbed by the ground near the transmitter. Longer hops might be possible under better transmission conditions; there is some information indicating that 3 degree and even 2½ degree radiation is possible.[2]

The first silent zone for all frequencies has been darkened by cross-hatching. It is simple enough to understand that at these frequencies

*Associate Editor, RADIO.

[1]"New Ionosphere Broadcasts," RADIO, Oct., 1937.

[2]"The Effect of Average Ground on Antenna Radiation," RADIO, March, 1938.

and distances no signals are heard because the ionosphere will not turn down the necessary high angle radiation. What happens here is illustrated in figure 2. For this illustration a frequency has been assumed at which the E layer causes no complete reflection, and at which the critical frequency of the F_2 layer is such as not to reflect high angle rays.

When the zone of silence extends less than half way to the maximum distance for a single hop, a two-hop signal will be heard at and beyond 2180 miles, so there will be no additional distant silent zones. For example, let us study a 25-megacycle signal in figure 1. It will not be heard until the distance is 1000 miles from the transmitter, after which a single-hop signal will be heard from 1000 to 2000 miles. From that point to 2180 miles, both a one- and two-hop signal will be received; if these are changing in amplitude or phase, fading will take place. Just beyond 2180 miles and up to 3000 miles only the two-hop signal will be heard. From there to 4000 miles, two- and three-hop signals will come through, while from there to 4360 miles a four-hop ray will also be received. At greater distances, the situation progressively becomes more complicated, and accounts for the "watery" effect on 7-Mc. Australian signals often observed in eastern U. S. A.

At a lower frequency such as 14 Mc., signals received 1800 miles away will contain rays which have hopped four and less times; the signal will be the result of all these parts. If all are in phase, the signal will be loud; if two of the four balance out the other two, the signal will be zero until this equilibrium is disturbed at which time it will "fade up" again. It can be assumed that two paths will produce the most serious fading, inasmuch as it is less likely that signals arriving via a greater number of paths will completely cancel.

At 30 megacycles, the first silent zone is noticeably longer than at 28 Mc. This can account for different conditions on the two ends of the band, at a critical distance. Beyond 2180 miles, a short *second silent zone* extends out to 2340 and 2590 miles for each end of the band. Inasmuch as the third hop can be heard at a distance less than the maximum for two hops, there are no further silent zones. A third zone would be observed, however, on 35 megacycles.

The highest possible frequency to be returned to the earth on this day appears to be about 40 Mc. This would be heard at a very narrow band of distances.

We have assumed that the layer is the same for thousands of miles from Washington, D. C., but this is not strictly true. Long distance transmission may encounter somewhat different conditions, even to the extent of being reflected by the E layer over part of the distance. When the E layer takes over the job of bending down the signals, such as when five-meter signals are heard 500 to 1200 miles away on a summer evening due to sporadic E reflections, the low layer height makes even the maximum hop shorter over that part of the path covered by the sporadic E layer.

A diagram similar to figure 1 can be drawn for the E layer when it controls high frequency

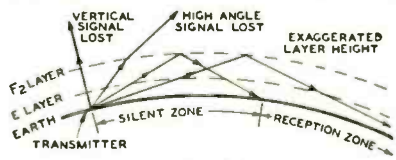


FIGURE 2.

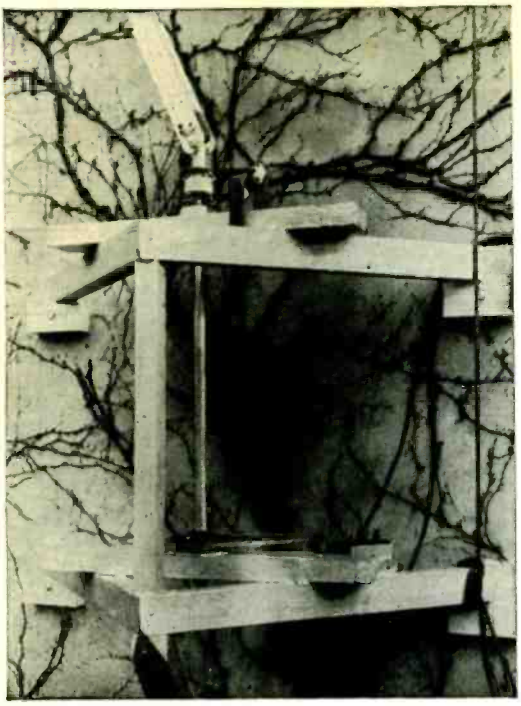
SHOWING LOST HIGH ANGLE RAYS AND ILLUSTRATING WHY THERE IS A SILENT ZONE AT HIGH FREQUENCIES

transmission. Because its height is much lower (see Table I), all the hops are much shorter. The maximum one-hop distance is then about 1200 miles, and the maximum two-hop transmission of 2400 miles is rare due to the usually localized nature of the sporadic E layer.

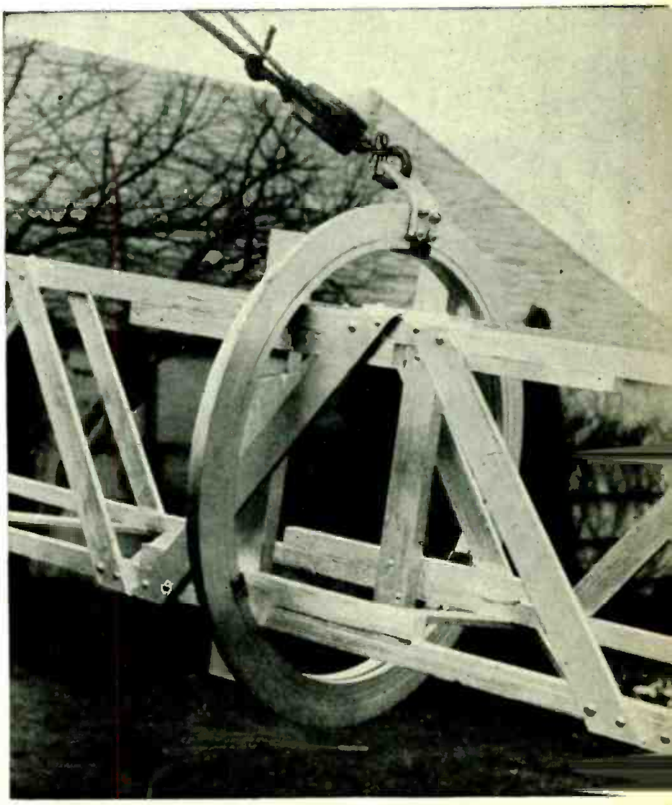
It should be clear, therefore, that there is a definite relationship between the skip distance on our several high frequency bands. If the F_2 layer height is equal to that of December 15 on a winter day and there is no silent zone at all on 14 Mc., then the ten-meter band should be open beyond about 950 miles. The five-meter band should be good at 2150 to 2200 miles and multiples of that distance if the favorable layer condition extends far enough. During the current winter, 28-Mc. signals as close as 700 miles have been heard on what appears to have been F_2 layer transmission, and 56-Mc. signals have crossed oceans. Likewise, during summer when 28-Mc. signals are heard as close as about 300 miles via a sporadic E layer reflection, 56-Mc. signals should be heard at about 1200 miles, if the layer extends to both points of reflection—i.e., at 150 and 600 miles from the receiver. If ten-meter signals from a nearer point are heard, the five-meter band will probably be open to distances even closer than 1200 miles.

● The whole affair is so light that one person can let it down or pull it up in half a minute . . . the mast itself is all wood, 32 feet long, and weighs just 30 pounds . . . at the bottom the four side members are brought together between steel plates. See page 28 for details.

A Rotatable Mast for Beam Antennas



Close-up of the lower part of the rotating assembly . . . the mast has been lowered about 30 degrees, so as to show the action of the hinge joint between the mast itself and the lower part of the assembly.



The upper bearing which not only holds the mast up and permits it to rotate but also provides a point of attachment for the rope that raises it . . . all adjustments are made from the ground, after letting the mast down by means of a rope and pulley.

A ROTATABLE MAST

• For Beam Antennas

By W. van B. ROBERTS,* W3CHO

The accompanying photographs and sketches show the construction of the rotatable mast which was forecast in the writer's article in RADIO for January, 1938. The present article does not deal with any particular kind of beam antennas, but describes an arrangement for rotating any moderate-sized beam. This arrangement has features of value to the experimenter who wishes to adjust or change his beam frequently. In the first place, all adjustments are made from the ground, after letting the mast down by means of a rope and pulley. The whole affair is so light that one person can let it down or pull it up in half a minute. It is not necessary to disconnect anything to do this. The driving and direction indicating mechanisms and the slip rings are accessibly located on the bottom section which is not affected by the lowering of the mast.

The Upper Bearing

The most difficult element of the entire design is the upper bearing which not only holds the mast up and permits it to rotate but also provides a point of attachment for the rope that raises it. This bearing is shown in a close-up view in one of the pictures, while in another it is seen pulled up and held in place (by a weight on the hoisting rope) in the angle between a couple of two-by-fours fastened to the chimney. It is simply a large ball bearing, turned out of steel rings at a cost of $18.00. A cross section is shown in figure 1. It is felt that there is room for much improvement in the design of this bearing, both in the matter of reducing its cost and its weight. Its cost has been given above and its weight is 23 pounds. Many different schemes were considered, but something of this sort was the only one that came to mind that would permit of the masts being raised and lowered without ever climbing up on the chimney or building any complicated structure on the chimney.

*Patent Department, R.C.A., New York City.

The Rotating Assembly

One of the photos is a close-up of the lower part of the rotating assembly. The supporting structure for it is fastened to the side of the house with lag screws. In this view, the mast has been lowered about 30 degrees, so as to show the action of the hinge joint between the mast itself and the lower part of the assembly. This hinge is simply a cross bolt at the lower end of the mast, which rests (with a snug fit, to avoid lost motion) in a slot in the top end of a vertical one-inch steel shaft. A smaller bolt is inserted across the slot above the hinge bolt to make sure that the hinge bolt cannot jump out of the slot when the mast is lowered below the horizontal position. By simply removing this small bolt the mast is readily lifted off the lower assembly and carried indoors for painting, storage, etc.

Slip Rings for the Feeders

Just below the hinge joint are seen the slip rings, each mounted on three tiny stand-off insulators which, in turn, are screwed to a wood disk fastened on the shaft by a set screw. To act as brushes, flat strips of braided conductor encircle the rings, and have their ends fastened to stand-offs, one end of each strip having a small coil spring inserted to keep a uniform tension. The transmission line coming down the mast (not yet installed when the photo was taken) terminates on stand-offs just above the hinge. Short jumpers of flexible, insulated conductor are used to connect these stand-offs to the slip rings so as to permit lowering the mast without disconnecting the jumpers. The line from the transmitter is connected to the stand-offs to which the brushes are tied.

Immediately below the slip rings the steel shaft passes through a plain bearing inserted in a two-by-four cross piece. This bearing takes no vertical load and practically no horizontal force when the mast is up, but must resist a horizontal force of 100 pounds or so when the mast is lowered. The bottom six inches of the str . shaft is turned down to a ¾-inch diameter, and on this part are located the drive pulley, and, just below it and out of sight, the ball bearing that takes the weight of the whole assembly. Under the cross arm that supports the ball bearing is a collar which is probably not really necessary, but which was put on to prevent any chance of the shaft popping up when the mast is lowered below the horizontal.

Reversible Rotation

The driving motor was arranged to turn the mast in either direction by opening up the motor and bringing the leads from the motor winding and starting winding out separately to a four-point three-position switch (Yaxley 3243 J) located in the shack and connected as in figure 2. This gives an "off" position in the middle, with rotation one way to the right and the other way to the left. A double-pole double-throw switch together with any sort of line switch would, of course, do. The motor is an Emerson 1/40 horse power, which contains a gear box reducing its speed to about 7 r.p.m. This geared-down motor cost $12.50 complete.

The direction indicator in use at present is the same old potentiometer that was described in the article referred to, but since it is now at the bottom end of the steel shaft, where it can be sheltered from rain and oiled to prevent rusting, no difficulty of the sort mentioned in the previous article is expected.

The mast itself is all wood, 32 feet long, and weighs just 30 pounds. The side members are pieces called "plaster grouts" and measure about ¾ by ⅞. The lacings are white pine lattice material. The joints are all glued with Casco and screwed. At the bottom the four side members are brought together between steel plates that project a couple of inches and carry the cross bolt that rests in the slot at the top of the shaft. Everything exposed is covered with aluminum paint. In addition to this, housings have been added over all the parts susceptible to rust except the ball bearing up by the chimney. There it is hoped that some sort of skirt may be arranged to cover the crack on the inner vertical surface of this bearing, through which water can be blown into the ball race and freeze. Meantime, care is taken to leave the mast always so oriented when not in use that it can be lowered to melt the ice from the bearing should it become frozen solid.

In the article referred to, W3AIR was credited with much assistance in making the heavy mast shown therein, (incidentally, his assist-

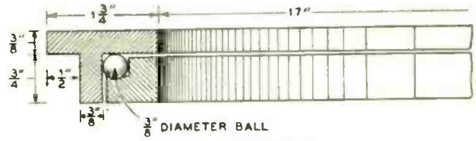


FIGURE 1

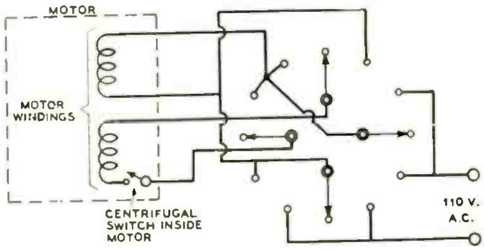


FIGURE 2

ance continued in the present arrangement) so it seemed appropriate to offer him the old mast after it was replaced by the new one. This offer was duly made in his shack one day, and just while he was considering whether or not he could use it, a sudden terrific gust of wind came along and his own 60-foot affair collapsed and, carrying a half dozen antenna systems with it, crashed in many pieces on a roof only a couple of feet over our heads. It sounded for a moment as if it were raining Mack trucks. Needless to say, that settled the question of whether or not he could use the old mast!

●

New Stations Planned

The FCC has created a new class of station, the *educational broadcast station*, which will be non-commercial in character and subject to the rules and regulations governing other high frequency broadcast stations. This answers the ancient cry of educational agencies that they be given a place in the radio sun.

These stations will be licensed to organized non-profit educational agencies for the advancement of their educational work and for the transmission of educational and entertainment programs to the general public. No sponsored or commercial programs may be transmitted, and all commercial announcements must be cut from programs rebroadcast by these stations from regular broadcast stations.

Educational stations will operate on twenty-five single channels (frequencies) spaced 40 kc. apart from 41,020 to 41,980 kilocycles.

—R. P. T.

Directing Stuff at Things

In which the author tells how to make a gear for rotating an antenna, the cost of which will only be about $2.50 and a visit to the junk yard.

By JULES HERBUVEAUX,* W9SGM

The reason for my being a ham comes from a colossal inferiority complex. A defense mechanism in fact. I have always looked at radio engineers as a cat looks at a herring. My earliest contacts, dating back to 1921, always resulted in my being left behind the eight ball.

The glamour of their position, the hint of far off places, that man-of-the-world attitude, their lone-eagle, devil-may-care nonchalance, and the way they could toss off long strings of technical terms completely hypnotized me.

My innate inferiority complex made me strike out for a ham license to find out whether or not these engineers were talking about me in their mysterious patois.

Let's skip the months of preparation and finally the passing of the license examination. From the moment of my momentous decision to investigate the higher things of life and incidentally find out how the other half lived, I had another incentive. F. S. Mabry, one of Westinghouse's crack engineers, bet me a 30-watt transmitter that I wouldn't make the grade. I did and he did.

Came the delivery of my rig. With fear and trepidation I threw a party. I invited a bunch of engineers from our company. They all came. I was at last in the magic circle. They were actually anxious to see my new rig. I have since wondered at their anxiety, however, as I think there was some mention, by me of course, that there were some pitch bottles among the other tubes.

What a night. They all showed up with their side-cutters. "Hmmmm," they said, "Tri-tet and a pair of 865's in parallel." ". . . in parallel,"—— a burst of indignation arose from all. The side-cutters were whipped out. . . .

The next day I made a deal with W9WS and we finally got it running again.

A rule and a discovery were made that eventful night. The rule was and is: All visitors are frisked at the door for side-cutters and these weapons are checked until departure. The discovery was: No engineer agrees with any other. The reason there are so many dyspeptics among them, is, that they rarely agree with themselves. I have often wondered at the quite general acceptance of Ohm's Law.

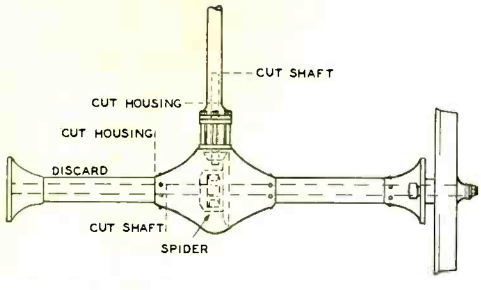
Since that eventful night there has been much re-building. I now have a 600-watt rig and nobody in the world but myself knows the circuit. It works—works perfectly, and I have gone to higher things, antennas in fact.

The February issue of RADIO was thoroughly ingested and resulted in a rotating nightmare. In my dream, it seems, I was sauntering along a country road, through a woods, when I decided to do a bit of whistling. I warmed up by whistling a CQ. Came a bedlam of answers and they all seemed to come from above. I looked up and to my amazement the woods was really a forest of tall poles. On top of each pole was a shack with a horizontal wind-mill. From the windows of each shack were hams answering my CQ with razzberries and, mark you well, the ether adornments were all whirling at top speed.

Awakening with a start I decided that there were just two possible courses to follow, i.e.: get out floor plans of rotary gear boxes or find a convenient and cheap source of gear trains.

Gears suggested automobiles, they suggested junk-yards and when I arrived at one, they suggested differentials. Upon investigation I found that as with horses, there are more rear ends of automobiles than there are automobiles.

*c/o N.B.C., Merchandise Mart, Chicago, Ill.



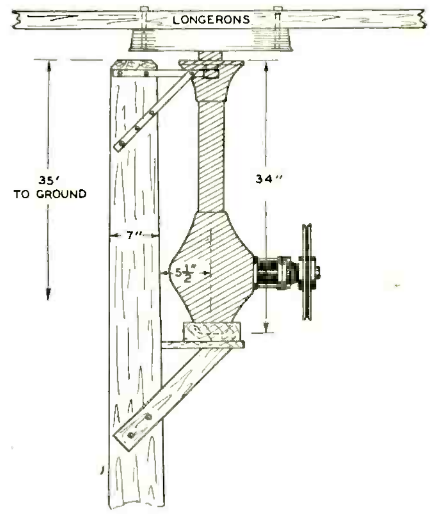
A model-T rear axle was chosen with the drive shaft integral. (Price, $3.00.) This was at least $2.00 too much but I forgot to wear my other suit to the yard. Clean this assembly a bit and take it apart. All the tools you will need are some end wrenches and a hack-saw. Don't be afraid of the weight; you will throw half of this mess away.

First take off the propeller-shaft housing which is bolted through a collar to the differential housing. Knock out the pin which holds the universal joint and slide the shaft out of the housing. If the wheels are still on the axle, take them off and remove the differential-housing bolts. Do this over a large grease pan as there will be plenty of oil spilled. Slide both housings off and lay washers, roller bearings, et al, in order, so you won't forget where they came from and in which order they might go back. Now saw the axle and propeller shaft housing as per the accompanying figure. Next you can cut the propeller shaft, allowing enough room for the type of pulley you intend to use.

The next operation will most likely be accomplished at a machine shop. Clamp the axle assembly in a vise with the ring gear at the bottom. Clip the safety wire and take off the three nuts holding the spider. This spider consists of a triple shaft with three free running gears. Don't try to drill it as this stuff is plenty hard. This spider must be jammed in some way to prevent its free turning. It can either be jammed by having one of the spider gears welded or, if you can get an extra spider gear, you can drop it between two of the others and it will jam things nicely. The man at the machine shop had one and gave it to me. While at the shop, have them cut the axle opposite the large gear $4\frac{1}{2}''$ from its bevel gear. Now re-assemble the whole thing. Slide your rope pulley on the propeller shaft and set it so that there will be very little end play in the shaft. Put a wheel on the remaining axle and you are all set. This entire assembly weighs 75 lbs. It seems heavy but here are its advantages.

It includes a turn-table. The sturdy, roller-bearing construction will allow any size antenna you can make, to be suspended. It is completely housed and weatherproof. It will never wear out and has a positive $3\frac{3}{4}$-to-1 gear ratio at the propeller shaft. The wind resistance is very low and the down thrust center is $5\frac{1}{4}''$ from the antenna pole. I am using mine on a telegraph pole 35 feet off the ground. The entire cost of this gear should be about $2.50.

I am going to take full advantage of the strength of this unit as I am hanging a bird-



bath at each end and by using hollow tubes as radiators will be able to sprinkle the lawn.

I wonder if I am getting like those guys I talked about in the beginning.

●

Ten Years Ago

. . . in March

Ten-meter band opened officially by the Federal Radio Commission.

The Wilkins' Expedition, then at Fairbanks, Alaska, in first QSO with U. S. hams.

Amateur crystals priced at ten dollars and up.

The word TRANSCEIVER still new enough to be set off with quotation marks.

. . . in April

First two-way ten-meter transcontinental QSO.

"S. S. Morrissey" sailed from Seattle to Alaskan and Asiatic waters, with Ed Manley, signing VOQ, as operator, and fully equipped for communication with hams.

Television by means of the scanning disc announced by General Electric.

THE WHY OF HARMONICS

In the minds of the majority of radio amateurs (and in those of a goodly number of radio professionals as well), the reason for the generation of harmonics by a non-linear impedance such as a vacuum tube is a bit indistinct. The fact that the distorted wave shape that is emitted from this tube can be resolved into a certain percentage of fundamental, plus additional percentages of second, third, and higher order sine-wave harmonic components, is also unclear to most of them.

Any distorted waveform may be resolved into its exact composition of fundamental and integral harmonic frequencies by a method of graphical analysis commonly known as the Fourier analysis. In this article Mr. Stafford discusses the reasons for the generation of harmonics and the method whereby the various sine-wave harmonic components as found by a Fourier analysis can be superimposed upon the fundamental to produce the original distorted wave shape.

By **C. B. STAFFORD*** **W9KWP**

The radio amateur holds a peculiar position in the technical world. He is frequently able to accomplish feats through his persistence which have stumped college-trained engineers. But the ham does this in spite of his lack of technical training—not because of it. He is usually anxious to know what goes on inside of his circuit or vacuum tube but hasn't the time to investigate. Many of the phenomena can be explained advantageously through rough graphical analysis, without going into the mathematical treatment necessary for a complete demonstration. With this in mind, let us proceed to the situation of harmonic distortion.

Harmonics may be both useful and harmful. They may cut down the frequency deviation by permitting crystal control of a higher frequency stage, and they may get you a pink ticket from Grand Island with the same transmitter. They can cause an audio amplifier or modulator to sound like a cat fight in an ash-can, or by proper control, they may be used to make a telephone mike sound almost intelligible. As a result, it is of vital importance to the designing engineer to know something of the use, causes for, and treatment of harmonics. We amateurs have rule of thumb methods for the approximate solution of most of our harmonic troubles, but it should be of interest to see just why harmonics are almost always found in our rigs.

A Typical Curve

Figure 1 shows a characteristic curve for the circuit indicated. Although a rectifier is usually the least objectionable source of harmonics for most of us, the lazy-S type of curve is typical of vacuum tube performance curves and will serve our purposes well. This type of curve is most familiar to us in the grid-voltage vs. plate-current curve. It is indeed a rare instance when a voltage or current is a linear function of another voltage or current in a vacuum tube circuit. This is just another way of saying that few vacuum tubes are without cut-off or saturation points. Because the curve chosen is similar to many others, the graphical analysis presented here will apply to other inter-element relationships and different circuits.

Examination of the curve shows that when a certain negative voltage, $E = k$, is applied, that no current flows through the circuit. Also, when the voltage applied is $E = q$, the current practically ceases to increase with further increases in applied voltage. Apply to this tube a volt-

*241 South Grant St., W. LaFayette, Indiana.

age which varies as a sine wave. This curve is denoted by (*e*). It can be seen that soon after the starting time of this wave of applied voltage, it reaches a negative value of *k*. At this point no current flows in the circuit. The applied voltage decreases past *k* to a maximum negative value and then returns to *k*. At this point, current again begins to flow in the circuit. As *e* increases, *I* also increases rapidly until *e* and *I* simultaneously reach a maximum value. From there they decrease to the starting point. The ordinates of the current wave are obtained by extending the abscissas of the applied voltage until they intersect the characteristic curve for any desired value of *t* (time). This current curve, *I*, is far from the same shape as the applied voltage. This is essentially what happens when an amplifier distorts, a doubler functions as such, or a rectifier changes a.c. to d.c. These effects are due to the non-linear characteristic of the tube.

Analysis Into Sine-Waves

In electrical theory, most calculations are greatly simplified if one has only a pure sine wave with which to deal. As an example of this, a sine wave is the only wave which, when applied to the primary of a transformer, will exactly reproduce itself in the secondary. Other

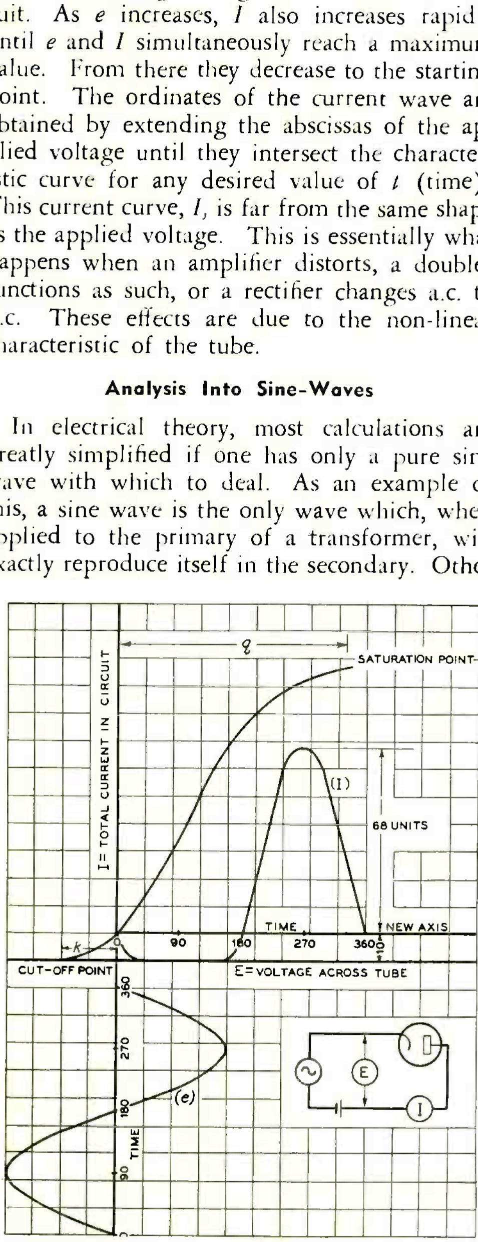


Figure 1 shows the characteristic curve for the circuit indicated in the lower right hand side of the drawing.

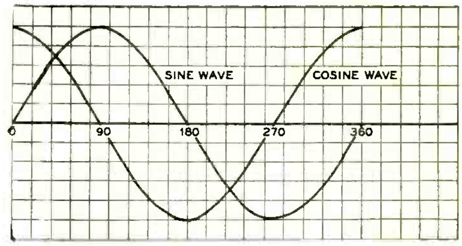


Figure 2 depicts the relationship between a sine wave and a cosine wave of the same frequency and amplitude referred to the same set of axes.

waves will come out of the secondary somewhat distorted. Of more importance to us at the moment is the fact that if we can show that the current wave produced in this rectifier circuit may be made up of a fundamental and a number of harmonics, we have proven that a non-linear device of this sort inherently develops frequencies other than the ones impressed.

It is possible to analyze this wave (by Fourier's series[1]) and determine just what waves are necessary to duplicate the original. But this is too involved a process for a discussion of this type. Suppose that we draw a sine wave such that its maximum value is —39 units. It is readily seen (figure 3) that this is approximately the same shape as the current wave, *I*, but that it is displaced from the horizontal axis through the current obtainable with zero applied voltage by a value of 16 units. For some work, this sine wave would be close enough to use in place of the actual current wave. By adding other sinusoidal waves to this one, however, we may eventually build up a wave which is identical, for all practical purposes, to the one being considered.

Addition of Second-Harmonic Wave

Let us now add to the first sine wave a cosine wave whose maximum amplitude is —14.5 units. This wave we shall assume has double the frequency of the first one, and is therefore a second harmonic. A cosine wave is merely a sinusoidal wave which reaches its maximum value 90 electrical degrees before a corresponding sine wave would. Figure 2 shows the relationship between a sine wave and a cosine wave of the same frequency and amplitude referred to the same set of axes. At any instant, or at any point on the curve corresponding to some time indicated along the horizontal axis

[1]"Radio Engineering Handbook," Keith Henney.

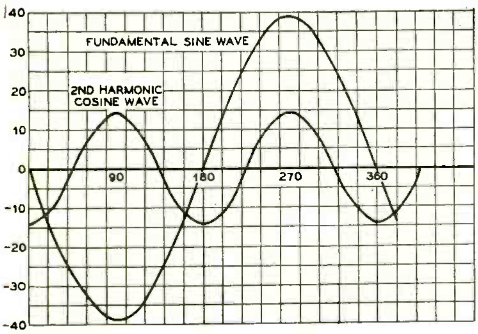


Figure 3.

in figure 3, the resulting voltage will be the algebraic sum of the voltages of the fundamental sine wave and the second harmonic cosine wave. This new resulting voltage wave will be found by adding the vertical distances to the component waves (keeping the sign — plus upward and minus downward) for as many points as are necessary to plot the curve. This has been done in figure 4, and the resulting wave is shown as a solid line. This wave is much more like the current wave than just a single sine wave, but it is yet far from perfect.

The wave as it now stands is composed of a fundamental sine wave and a second harmonic cosine wave. Referring to figure 4 we make the following analysis. The portions *ab* and *de* agree well with the rectified wave, *I*. The segment *bcd* should be a straight line. The segments *fg* and *hj* should also be more nearly straight.

Third Harmonic Added

Let us add a third harmonic sine wave to the wave as it now is. The third harmonic should have an amplitude of 1.01 units. This is indicated in figure 4 as "Third Harmonic." Adding the ordinates of this wave to those of the wave composed of the fundamental and second harmonic gives us the wave shown by the dotted line. *b* has been shifted upward and to the left to a new position, *b'*. This decreases the steepness of *ab'* to conform better to the rectified wave. *c* has been lowered to position *c'* and line segment *b'c'd'* is much more nearly straight than was line *bcd*. *fg* and *hj* have also been straightened. If a fifth harmonic sine wave of maximum amplitude = 0.05 units is added to the fundamental, second, and third harmonics, the corners at *b'* and *d'* will be further sharpened, and the curve closely approximates the rectified wave. But this would not change the graph enough to justify its inclusion. It can be shown mathematically that there would have to be a very large number of waves to produce a theoretical curve which was identical to the rectified wave. But for most work, the wave here composed would be satisfactory.

Percentage Wave Composition

Let us now see how closely we have approximated the rectified wave. First translate our horizontal axis to the position labeled "New Axis." The ordinates of the curve from this axis will be +16 units greater than from the previous axis. Using this axis, the maximum positive value of the curve is 70 units. This is 2 units more than the maximum value of the

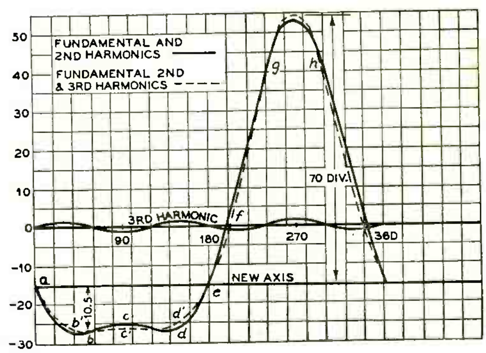


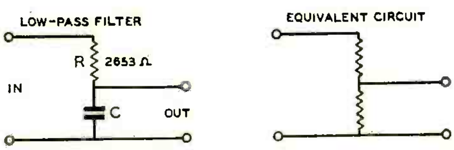
Figure 4.

rectified wave. The maximum negative values are 10.5 and 10.0 units respectively. Both curves are very nearly equal to zero at $t = 0$, 180, and 360. From the above it is obvious that the sine wave impressed on the half-wave rectifier has produced an output wave containing a fundamental, a 37% second harmonic, a 40% d.c. component, a 2½% third harmonic, and a number of other weaker harmonics. Any non-linear device can be expected to respond similarly.

In radio engineering practice, one rarely is confronted with a problem which involves a single sine wave. Distorted waves are much more common. But due to the fact that any distorted wave may be broken down into a group of sinusoidal wave components, it is easily possible to handle problems which would otherwise be extremely difficult. As an example of this, let us consider a simple low-pass filter. This is a filter which will pass a larger percentage of the low frequencies than of the highs.

Practical Application

Suppose that we impress a *voltage* wave, like the *current* wave which we obtained from the output of the rectifier, on the input terminals of the circuit shown in figure 5. This is easily conceivable if we consider that the current flowing through our rectifier might also have passed through a series resistance. The voltage drop across this resistance would then be that used in



MFD.	FREQUENCY - CPS		
	60	120	180
1	2653	1327	884
10	265.3	132.7	88.4

REACTANCE OF C, IN OHMS, FOR VARIOUS FREQUENCIES AND CAPACITIES

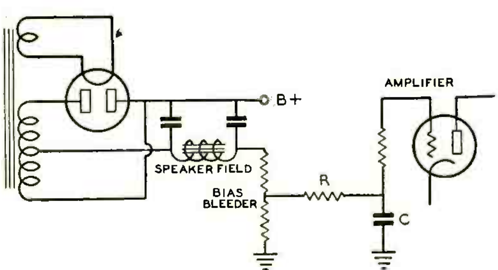


Figure 5 (above). Figure 6 (below).

this example. Letting each division or unit on our previous graph represent one volt, our impressed voltage may be expressed as a 26 v.d.c., 39 volt 60 cycle, 14 volt 120 cycle, and 1 volt 180 cycle source. When $C = 0$, the output voltage will be the same as the input voltage at no-load (for instance, as a grid bias supply). When $C = 1$, the d.c. component will remain unchanged. Since the reactance of a 1 μfd. condenser ("effective resistance") at 60 cycles is 2653 ohms, the 60-cycle voltage will cause current to flow in the filter. As $R = 2653$ ohms, the output voltage will be $39/2 = 19.5$ volts at 60 cycles.

The impedance of the condenser at 120 cycles is half of what it is at 60 cycles, therefore the 120-cycle output will be $14/3 = 4.76$ volts. And the impedance at 180 cycles is only 1/3 of the 60-cycle impedance and the 180-cycle output will thus be $1/4 = 0.25$ volts. These voltages were obtained on the assumption that the leakage and other losses in the condenser were negligible. This is a reasonable assumption as a good paper and oil dielectric condenser should have an insulation resistance of at least 1000 megohms for a 1 μfd. condenser.

Let us now assume that $C = 10$ μfd. The impedance of a 10 μfd. condenser is only 1/10 that of a 1 μfd. condenser at any frequency. The d.c. output would remain the same. The 60-cycle output would be $39/11 = 3.5$ volts. The 120-cycle output would be $14/21 = 0.6$ and the 180-cycle output would have practically vanished. Apparently the changes in capacity do not affect the d.c. component. This may be considered as a sine wave of zero frequency. It can now readily be seen why this device is called a low-pass filter. The zero frequency wave in this special case was not affected and the maximum frequency wave was eliminated.

Figure 6 shows a circuit which is commonly used to provide extra filtering for the bias supplies on final amplifiers in commercial broadcast receivers. Many hams also use this device, a simple low-pass filter, for similar purposes. The value of R is usually as high as is consistent with the maximum allowable voltage drop in it. This same circuit is frequently used in tone controls.

One can briefly summarize by saying that it is normal to expect any non-linear device to generate harmonics. By means of Fourier's series, or by cut and try methods, one can determine what harmonics are present, and can then treat the circuit in an appropriate manner.

●

W9UAQ 56 Mc. Beacon

Last fall, two Chicago amateurs became interested in an attempt to obtain data about "five-meter" dx by putting an automatically keyed transmitter on the air continuously. A *Streamliner* transmitter was built,[1] with the constructional assistance of Vic. Ruebhausen (W9QDA, ex-W2HXD), and placed in operation at the home of Al Cox in Oak Park, Illinois, under the call W9UAQ.

While the recommended circuit for the

[*Continued on Page 72*]

[1]Humes, "Five-Ten-Twenty, Crystal Controlled," RADIO, page 19, November, 1937.

The "BI-SQUARE" *Directable Array*

Here is a new array, with reversible directivity, that requires but one pole, will cover the compass with low-angle, horizontally-polarized radiation. Reports from foreign stations worked to date on the experimental model have averaged R8.8.

By W. W. SMITH,* W6BCX

The amateur confined to an apartment top or a small city lot is at a marked disadvantage when it comes to erecting antennas that will lay down a strong signal at distant points. Even at 10 and 20 meters it is difficult to string up arrays for various points of the compass without more ground space than is available to the average city amateur. And if the arrays are not placed just right or separated sufficiently, there will be coupling from one array to another, resulting in poor discrimination and directivity. As a result the city amateur oftentimes turns to a rotatable affair, one which takes up but little ground space and can be aimed in the desired direction.

With no intention of belittling rotary arrays, it is the intent of this article to describe an electrically-directable 10-meter array that seems to justify the attention of amateurs restricted to rather cramped quarters. By actual test the performance compares favorably with that of the "Lazy-H" array (two-co-linear elements stacked a half-wave above two more), the latter having proved to be about the most effective 10-meter array one can put up excepting the long wire arrays such as the diamond. The first 10-meter phone w.a.c. was made on a pair of "Lazy-H" arrays. If one of the elements of the array to be described is carefully analyzed, the similarity of the radiating portion to the radiators of the "Lazy-H" is apparent.

Fundamentally the system consists of two broadside radiators in the form of two squares oriented as illustrated in figure 1-A, placed at *right angles* to each other instead of as shown. Hence the name "Bi-Square Beam." A relay is used to connect the feed line to one or the other of the two radiators. Actually the two broadside radiators are supported at right angles to each other from a single 40-foot pole, as illustrated at "B". The radiators and stubs themselves do a good part of the guying. The guy wire extensions must be anchored some distance from the pole, but even neighbors who object to poles and "hot" radiators and feeders in their yards seldom voice objection to an inconspicuous and harmless guy wire.

Characteristics of the Array

The radiators are bi-directional broadside. In other words, one of the square elements is directional at right angles to the plane of the wires forming that radiator. While not too directional horizontally, the nulls (off the ends) are quite noticeable, and the vertical directivity is such as to concentrate most of the radiation at the low, useful angles. Thus, while the horizontal directivity shows a "nose" broad enough that two radiating elements at right angles will effectively cover the compass, the vertical directivity is such that very little power is wasted in "moon shooting".

Horizontally Polarized

The horizontal polarization of the array results in a minimum of noise and maximum signal pickup when receiving, and high ground reflection efficiency when transmitting.

High Radiation Resistance

While theoretically the radiation resistance of an antenna is unimportant from the standpoint of efficiency so long as the radiation resistance is a sizable percentage of the total resistance, the high voltages encountered when

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*Editor, RADIO.

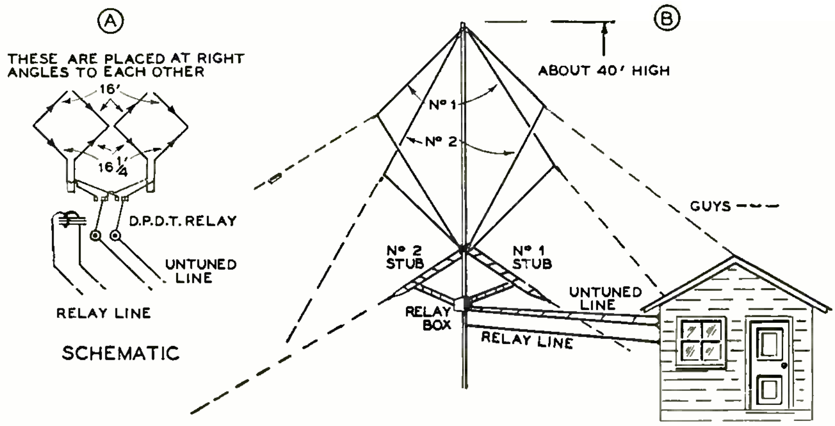


Figure 1. At "A" is shown the schematic diagram of the "Bi-Square" Beam antenna. The radiators are square, a half-wavelength on a side, directional broadside, and in practice oriented at right angles to each other as at "B". The array produces low-angle radiation, horizontally polarized. The dimensions shown are for 10-meter operation.

the radiation resistance is low complicate the insulation problem. The insulator losses in a location near salt water may become surprisingly high after a time. And unless a very good grade of ceramic is used, ordinary fog or rain will reduce the effectiveness of the insulators and increase the losses. This does not become particularly serious until the radiation resistance is less than 10 ohms, but is an item nevertheless.

The chief advantage of a high radiation resistance is that the array is not so critical as to frequency. This means that the array is less critical of adjustment, and allows the array to be used with equal effectiveness on all frequencies within an amateur band, both when transmitting and receiving.

The "bi-square" beam has a high radiation resistance, higher than that of the average doublet. This means that ordinary inexpensive receiving insulators may be tolerated for suspending the radiators. It also means that it is easy to tune up and get going, and that it may be used with excellent results on both 28 and 30 Mc. when cut approximately to 29 Mc. On receiving, one part of the band will not be "hotter" than another, because an antenna with a high radiation resistance has a broad resonance peak.

While the two radiating elements are not only close together but actually share the same space as it were, there is no coupling between them if they are symmetrical and identical. In other words, they must be exactly at right angles. While a small amount of coupling will not noticeably affect the power gain when transmitting, it will reduce the discrimination, high discrimination being desirable from a QRM standpoint both when receiving and transmitting. A check for the existence of mutual coupling due to unsymmetrical construction is described later.

Construction and Adjustment

The supporting pole need not be of large cross section, as there is little strain or pull upon it. A 40-foot pole constructed of "two by two" should be satisfactory unless surrounding buildings or trees are such as to indicate more height would be desirable. Because neither the current nor the voltage reaches a very high value, the dielectric loss in the wood pole is negligible; the pole is not in a strong field.

The radiator elements are laid out as in figure 1-A, insulators being placed where indicated at "B". The top legs of each radiator should be made exactly 16 feet long, and the bottom legs 16 feet 3 inches long for operation over the 28-30 Mc. band. The insulators for the bottom four legs attach 23 feet down from the top of the pole, or from the point where the top legs attach to the pole if not the top.

For proper operation of the array it is important that the legs of each radiator form a near-perfect square. If the legs are cut and attached exactly as described, this condition should be met.

A small, weatherproof box should be attached about 6 or 8 feet below the point where the bottom 4 legs attach to the pole. The best point at which to attach the box will depend upon the angle at which the two matching stubs leave the pole. The position of the box should be such that the lines from the stubs to the box will leave the stubs at approximately a right angle. The "relay house" can be temporarily attached to the pole and then later moved if necessary to provide a right angle between the lines and the stubs to which they attach.

Small, ceramic feed-through insulators of the type used in transmitter construction may be used for bringing the three pairs of feed wires into the relay box. The voltage on the line is not high enough to require elaborate insulation.

The relay may be of most any type commonly used by amateurs so long as the insulation is reasonably good and it is of the d.p.d.t. type. However, a relay designed for r.f. use is preferable. The control wires may be twisted bell wire or telephone wire; the latter is advisable if the relay requires more than a few volts. The relay should be so connected that when no current is flowing through the relay, the transmission line from the transmitter connects to the *most used* radiator. In most locations one of the radiators will be used considerably more than the other.

The Transmission Line

Though the transmission line may use anything from 2-inch to 6-inch spacing, 4-inch spacing seems advisable. The line may consist of either no. 12 or no. 14 enamelled or bare wire, spaced by 4-inch ceramic spreaders of the less expensive type. The radiation from such a line is less than from a line with 6-inch spacing (1/8 of the spacing of a 10-meter "flat-top beam"), yet not so close that slight variations in spacing will have a noticeable effect on the surge impedance.

About 35 feet more line than is actually required to reach the relay box from the transmitter should be constructed. The surplus can be used to form the matching stubs and to connect the stubs to the relay.

A ten-foot length of the line is cut and attached to one of the radiator elements. A pair of two-inch leads are soldered to a small 6.3-volt dial lamp, clips being fastened to the ends of the wires. This combined shorting bar and resonance indicator is then slid up and down the stub to find points "X-X". The resonance point is not extremely sharp, making the adjustment easy. As a starting point, the jumper-indicator is attached about 8 or 9 feet from the point where the stub attaches to the radiator.

The stub is excited during this process by inductive coupling to the transmission line going to the transmitter, which should preferably be tuned to about 29 Mc. A three- to five-turn coil of insulated wire is taped or otherwise fastened to the jumper-indicator as indicated in figure 2-A, and connected to the transmission line.

The transmission line should be *inductively* coupled to the final amplifier very loosely by means of a few turns of heavily insulated wire, and about 50 watts input applied to the transmitter. These precautions will prevent your being burned by r.f. voltage or electrocuted by plate voltage while handling the stub and transmission line during the adjustment procedure.

After finding points "X-X" (maximum brilliancy), the stub should be arranged as in figure 2-B, the junction being soldered. As there is no r.f. voltage at the bottom of the stub, no insulator need be used in the guy wire extension of the stub. However, it is good practice to insert one or two in order to break up the guy, thus avoiding the possibility of shock excitation and re-radiation. In breaking up the guy wires, care should be taken to avoid any lengths of wire between 13 and 19 feet.

The next step is to find the correct point of attachment for the feed line, points "Y-Y". The line from the transmitter is tentatively attached slightly less than 2½ feet up from the bottom of the stub and slid up and down to find the point at which standing waves on the line are at a minimum. The line can be checked for standing waves by observing the current excursions along the line by means of an r.f. galvanometer, or a low range milliammeter and rectifier connected to a pickup coil. Another method of checking (if the sun is not too bright) is to slide a neon bulb along one of the feeder wires; variation in brilliancy indicates voltage excursions. It is *not* necessary to remove the standing waves *completely;* the line will operate satisfactorily so long as the current and voltage variations are no more than just barely detectable.

After points "Y-Y" are found, a length of line is soldered to the stub and run to the relay box, where it connects to one set of contacts.

While the stub for the second radiator can be made by merely duplicating the measurements of the stub that is already working, attaching the feeders the same distance from the base of the stub, it is somewhat better to go through the same procedure as for the first radiator.

When finished and properly operating, the top portion of the pole is held in place by the wires extending out from the four junctions of the top and bottom legs of the radiators. The radiators themselves form two perfect squares, exactly at right angles to each other. The lower section of the pole is guyed three ways by virtue of the two stubs and the transmission line leaving the pole with approximately 120-degree separation.

The current and voltage along the transmission line should be practically uniform, and there should be no change in transmitter plate current when switching from one radiator to the other. There should be no current induced in the non-operated element. This can be checked by clipping the test jumper-indicator used in tuning up the stubs across the *line* (not the stub) about 2 or 2½ feet from the junction of the line and the stub on the *non-operated* radiator. If the lamp glows, it indicates coupling between the elements, probably due to slightly unsymmetrical orientation of the radiators. The guys to the radiator legs (top guys) should be swung around experimentally a few inches either way for *minimum* brilliancy of the lamp.

If less than about 75 watts input is used, it is advisable to check for coupling between radiators by opening the non-operated stub at the bottom and and in inserting the lamp bulb indicator. This provides a more sensitive indication.

It is not necessary to cross check for undesired coupling by repeating the procedure for the other stub. If radiator "1" does not induce current into radiator "2", then it is unlikely that "2" will induce current into radiator "1".

Don't Let It Scare You

The foregoing detailed instructions are given for the amateur who is not satisfied unless he knows his equipment is operating at peak performance. Actually the adjustments are *not critical,* and excellent results can be obtained

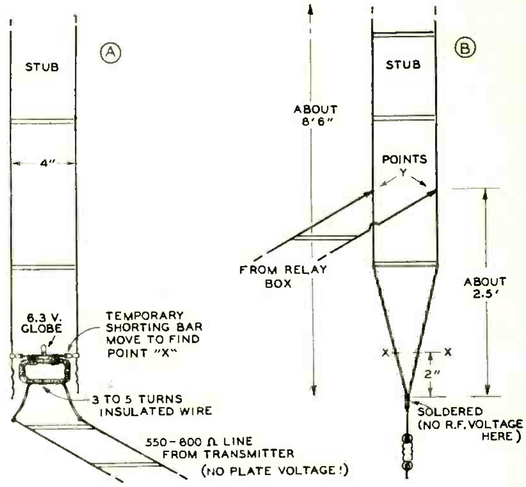


Figure 2. The stubs are resonated as illustrated at "A". After points "X-X" are found, the stub is terminated as shown at "B". The feeders from the transmitter (plate voltage isolated!) are then clipped up and down the stub to find the point of which standing waves are at a minimum. The line from the relay box is then soldered to this point on the stub ("Y-Y").

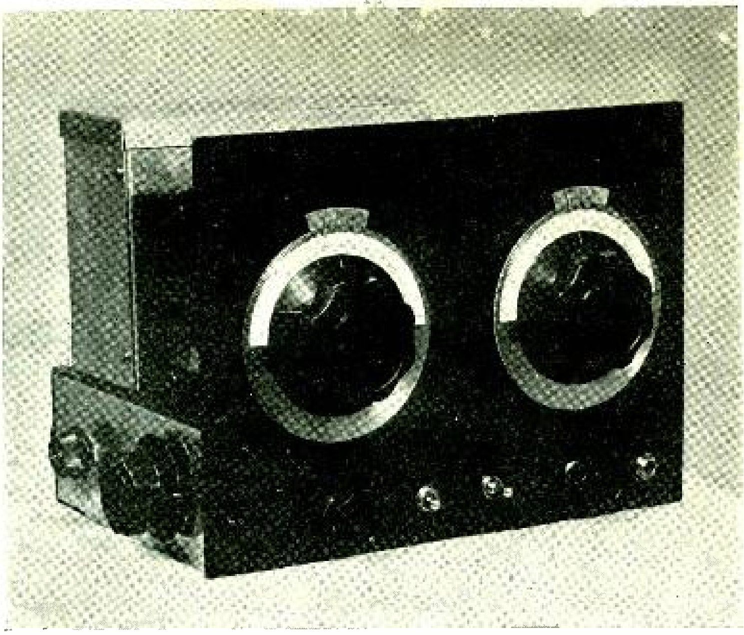
by merely cutting the array to the dimensions specified and letting it go at that. It will outperform most of the simpler arrays, and compare favorably with the more elaborate ones, without one's taking the trouble to get everything "on the nose". The more meticulous amateur who obtains satisfaction from the knowledge that all dimensions are precisely correct can make the cut-and-try adjustments previously described, usually with a slight, but not marked, improvement in performance.

20-Meter Operation

To realize the full capabilities of the "bi-square" beam on 20 meters, a rather high pole is required, especially if there are surrounding buildings or trees of appreciable height. This is desirable because the performance is somewhat better when the whole radiating portion is up and in the clear. Offsetting this is the fact that a single 75-foot pole is about as easy to erect as the three 50-footers required for a couple of conventional bi-directional arrays giving complete coverage.

If a 75-foot pole sounds too formidable, the antenna may be supported from a pole as short

[*Continued on Page 72*]



THE HAMSET RECEIVER

By J. W. BIRDWELL,* W4EDH-4

For the amateur not in a position to buy or build one of the later-model superheterodyne sets but who is contemplating a new or different set, the Hamset receiver will no doubt be of interest—that is, if the conveniences of band-switching, single-signal selectivity and automatic volume control may be omitted in the new receiver design. For the amateur who wants a receiver which offers high sensitivity, good selectivity and adequate audio output for loudspeaker operation even on the ten-meter phones, this set will fulfill the requirements to a surprising degree.

As will be noticed from the diagram of the receiver circuit, it is a regular tuned-radio-frequency amplifier regenerative detector circuit except for the first stage of what we will call regenerative preselection. In the beginning this receiver did not incorporate this stage of regenerative radio frequency amplification. Even so, the operation was very good except that not quite the output desired was obtainable on the ten-meter phone band.

To add the necessary radio frequency amplification on the high frequency bands, a regenerative amplifier stage was added onto the already-built set by a few simple changes.

For the dx man in particular, this set becomes even more desirable in view of the high r.f. gain and, especially, of the extremely low inherent noise level of the set. Since the receiver is of the tuned r.f. type, the higher noise-to-signal ratio of the superheterodyne receiver is averted. Comparison in this respect with any of the existing superhets is immediately apparent.

As the object primarily desired in the design of this receiver was adequate operation on the ten- and twenty-meter phone bands, it goes without saying that the set will be satisfactory for any other uses. The incorporation of the preselector stage gave remarkable results and really added that necessary something which lifted this set out of the ordinary t.r.f. class.

A pleasing appearance was obtained by using both a natural aluminum finish and a black

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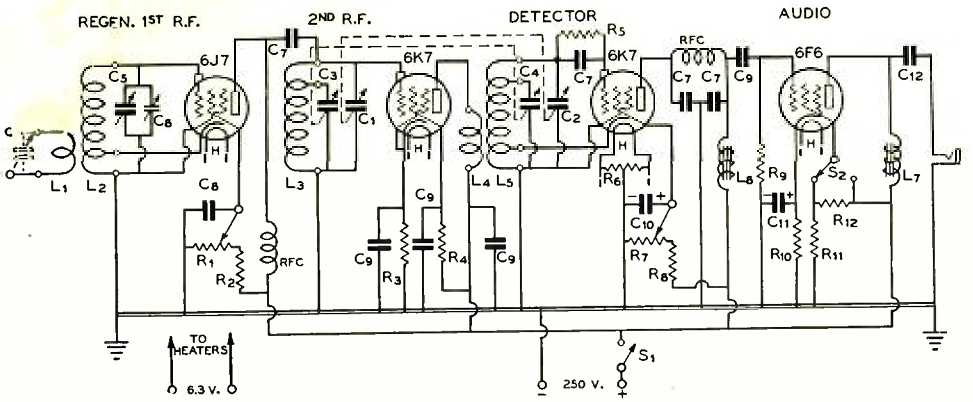
*ex-4AHL, ex-4CD, 302 West Unaka Avenue, Johnson City, Tennessee.



C_1, C_2—Dual 100 μμfd. per section bandset condenser.

C_3, C_4—Same as above, bandspread condenser

C_5—100 μμfd. midget variable; r.f. bandset

C_6—40 μμfd. midget variable; r.f. bandspread

C_7—.0001 μfd. mica

C_8—0.1 μfd. 400-volt tubular

C_9—.01 μfd. 400-volt tubular

C_{10}—2 μfd. tubular electrolytic, 400 volt

C_{11}—10 μfd. 25-volt electrolytic

C_{12}—0.5 μfd. 400-volt tubular

R_1—50,000-ohm potentiometer

R_2—20,000 ohms, 2 watts

R_3—300 ohms, 1 watt

R_4—100,000 ohms, 1 watt

R_5—5 megohms, 1 watt

R_6—50-ohm c.t. resistor

R_7—50,000-ohm potentiometer

R_8—20,000-ohm 5-watt wirewound

R_9—500,000 ohms, ½ watt

R_{10}—400 ohms, 2 watts

R_{11}—10,000 ohms, 1 watt

R_{12}—18,000 ohms, 5 watts

RFC—2½ mh., 125-ma. r.f. choke

S_1—On-off switch; s.p.s.t. toggle

Coils—See coil table

L_6—Detector plate feed choke; 1000 my., low current

L_7—30-hy. 50-ma. choke

crystallite finish in the set. The front panel and chassis evolved from two pieces of scrap ⅛" sheet aluminum that were coated on one side with a baked-on bakelite finish of considerable thickness. A visit to the local tombstone cutter and a dash of sandblasting with a fine-grained sand quickly put the sheets in first-class shape. This type of finish itself is quite attractive but rather hard to keep clean.

Next the panels visited the local tin shop where they were cut and bent as desired. The front panel is 8"x11". The chassis is 7"x10¾" and 2⅞" deep. These pieces are finished in black crystallite. As will be seen in the photographs of the set, the shield box mounted on the chassis and the two small panels of the chassis are of natural finish. These pieces are of 1/16" sheet aluminum. The shield box is 3"x 6¾" and is 5" deep. It is partitioned into two equal-sized sections.

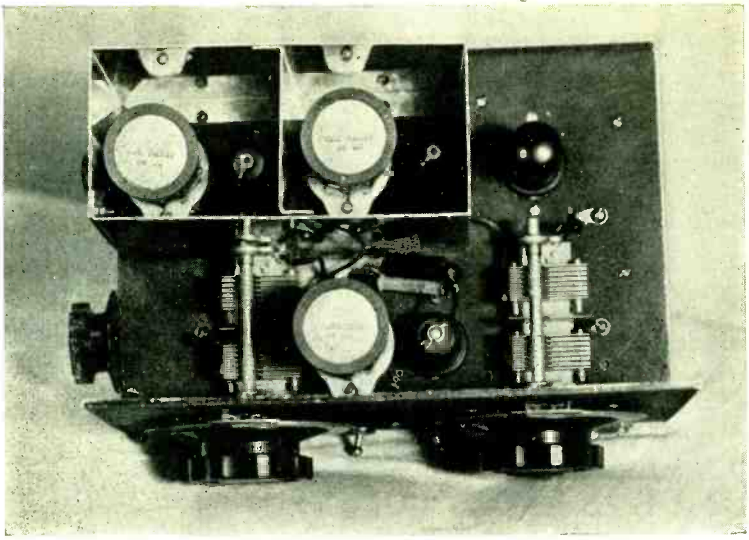
Tuning Controls

In the photograph showing the front panel layout, the dial on the left tunes a dual-section condenser which acts as the bandset tuning condenser for the second r.f. stage and the detector. The right hand dial also tunes a dual-section, bandspread, tuning condenser for these two stages. Immediately below each of these two dials will be seen two other controls. The one on the left is the regeneration control for the first radio-frequency stage. The other controls the detector regeneration. The two toggle switches located between these two controls are for the purpose of placing the set in a receive or stand-by condition and for reducing the audio output of the set on extremely loud signals.

As the set was originally built without the preselector stage, it was necessary to make a few small changes in the physical layout and to locate the additional controls wherever space permitted. The left hand side panel of the receiver chassis seemed the only practical location for these controls. They were so located and even though not following the standard layout practice they were found to be satisfactorily situated as far as convenient tuning was concerned. In fact, such a location has several advantages. The control toward the front of the panel is the bandspread tuning condenser of the preselector stage. The rear control is the bandset tuning condenser.

Shielding

A glance at the photograph depicting the top



Under-chassis view of the receiver. Note the symmetrical layout of the parts.

view of the receiver shows the shield box containing the tubes and coils of the first two stages. As metal tubes were used, they required very little space for mounting and had the advantage of efficient shielding.

The left half of the shield box contains the preselector unit and the other side is for the second stage. It is recommended that in a new layout of this receiver more space be incorporated in such a shield box in order to provide a distance of at least the coil's diameter from the coil itself to the inside of the shield. No difficulties have been experienced, though, with the present shielding although it is in the immediate proximity of the coils.

Between the two dual-tuning condensers on the front panel will be seen the detector coil and tube. This coil is not shielded as there is no danger of coupling to the other two. As this circuit is rather sensitive itself, it is advisable to shield it also if the set is to be used in the same neighborhood as another ham station. As has been said, the dual condenser to the left is the bandset while the other is the bandspread tuning condenser. The tube noticed immediately to the right of the shield box is the audio stage.

Parts Placement

A symmetrical layout of the parts mounted under the chassis not only provided short termination of the various leads but also permitted the necessary parts to be contained in the rather limited space. The detector plate impedance is situated immediately behind the preselector regeneration control. The choke in the plate circuit of the audio stage is also mounted below chassis. The antenna terminal strip is on the rear side panel of the receiver chassis.

[*Continued on Page 73*]

COIL CHART

BAND	L_1	L_2	L_3	L_4	L_5	Bandspread taps	Cathode taps
3.5 Mc.	12 t.	27 t.	27 t.	12 t.	27 t.	14 turns	1¼ turns
7.0 Mc.	7 t.	13 t.	13 t.	7 t.	13 t.	4½ turns	1 turn
14 Mc.	5 t.	6 t.	6 t.	5 t.	6 t.	1¼ turns	¾ turn
28 Mc.	3 t.	3 t.	3 t.	3 t.	3 t.	½ turn	⅓ turn

L_1's and L_4's (primary windings) are wound with number 36 d.s.c. wire and are not spaced. L_2's, L_3's and L_5's (secondary windings) are wound with number 24 d.s.c. wire. The length of each secondary is 1½ inches. The taps are counted from the ground end up. The coils are wound on forms having an outside diameter of 1½ inches.

A CARD INDEXING SYSTEM

for Amateur use

By **GEORGE W. CURRAN,* W6CBK**

With the wealth of information made available in recent years by the various magazines in the field of radio communication, a system of filing this material for easy and quick reference is quite important. In this article, Mr. Curran discusses his adaptation of the Dewey System of Decimal Classification, a systematic method of filing, to the needs of radiomen.

If enough interest is shown in the subject, Mr. Curran has agreed to prepare duplicates of his index, covering the material that has been published in RADIO, QST, and PROCEEDINGS of I.R.E. for the past ten years (with occasional references to particularly important articles that were published before), for interested persons. These files would be obtainable from RADIO for a nominal fee to cover the cost of preparation. They would have provision for the addition of new references to the file as the articles are published.

Your back copies of RADIO, *QST, I.R.E. Proceedings,* or whatever your favorite technical radio magazine may be, constitute a very valuable source of information. In these back files will often be found material unpublished in text books or elsewhere. To prove their value to yourself take twelve issues from a year or two ago and glance through their pages. You will invariably find a number of articles containing material pertinent to some problem recently at hand and which would have been very useful had you been able to find them at the time.

As your file of back copies increases in size, it also increases in potential value, but unfortunately a new condition also develops which tends to minimize its value. The quantity of reference material becomes so large that a search for any particular information becomes a considerable task.

As a solution to this problem, the writer has been using for several years a system of card indexing which is simple and easy to maintain and which makes the finding of any given reference an easy matter. All of the articles as they are published are cataloged on cards according to subject matter. This places all of the references pertaining to any one subject in a group by themselves with the date and page of publication quickly available.

The system used is the same as that used by the Bureau of Standards in compiling the "Radio Abstracts and References". It is known as the Dewey Decimal System and details of the classification may be obtained from the Bureau of Standards Circular no. 385 or by consulting the August, 1930, issue of the *Proceedings,* page 1433. These published forms also include an alphabetical index which is convenient to have but not necessary.

The Dewey classification extends over the whole general field of knowledge. The subject that we are interested in, radio, is placed thus:

Class	600.	Useful Arts
	20.	Engineering
	1.	Mechanical
	.300	Electrical
	.080	Communication
	.004	Radio

Hence all of the references pertaining to radio would be cataloged in a large library under the general number heading of (621.384). In an indexing of radio subjects only, however, it

*Engineering Dep't., KFI-KECA.

would be superfluous to write this number each time and it is the practice to abbreviate the number (621.384) by the letter R.

An idea of the form taken by the classification table for radio may be had by considering its main divisions:

R000. Radio
R100. Radio Principles
R200. Radio Measurements and Standardization
R300. Radio Apparatus and Equipment
R400. Radio Communication Systems
R500. Application of Radio
R600. Radio Stations
R700. Radio Manufacturing
R800. Nonradio Subjects
R900. Miscellaneous Radio

The classification (R000) is for material of a general nature which cannot very well be placed under a specific heading. (R100) is for articles dealing mainly with theory and not with particular apparatus or methods. (R200) is for the filing of all articles having to do with the measurement of any of the fundamental quantities of radio. (R300) is one of the large departments in indexing the contents of your references as thereunder will appear all of the articles on equipment construction.

(R500) and (R600) are of small use to the amateur. Under (R700) might be filed shop hints. (R800) has been reserved for subjects which cannot strictly be classed as radio subjects. Examples are articles on batteries or motor-generator sets. (R900) has never been used by the writer although it would undoubtedly have use in more elaborate filings.

Each one of the above general headings is subdivided again and again, narrowing down so as to cover specific items. Consider for instance R200-Radio Measurements. The main subdivisions are:

R210. Frequency
R220. Capacity
R230. Inductance
R240. Resistance; Current; Voltage
R250. Generating (transmitting) apparatus
R260. Receiving apparatus
R270. Intensity (field intensity, signal intensity, noise, etc.)
R280. Properties of materials
R290. Other radio measurements

In turn the sub-headings under R210-Frequency Measurement, are:

R211. Circuit resonance methods
211.1 Frequency meters
212. Parallel wire methods
213. Harmonic methods
213.1 Harmonic amplifiers
213.2 Multivibrators
214. Piezo-electric standards

Space does not permit the presentation of the entire classification but its completeness can be appreciated by observing that altogether there are about 480 items in the table covering everything in radio from A to Z. Further, the system is flexible so that any one of the 480 can be further extended to suit the individual needs of the user. In case you do not have the August, 1930, issue of the *I.R.E. Proceedings* or do not wish to send for the Bureau of Standards circular, the former could be consulted at a public library and the table copied down for future use. There are also a number of explanatory notes regarding the use of the table which will be found helpful.

Now as regards the use of the system.

The cards in the index used by the writer are the standard 3″ x 5″ lined filing cards which are kept together in a heavy cardboard filing case which is approximately 5″ wide by 4″ high by 11″ deep. The unit is very similar to ones found in the card index files of public libraries.

The box with index tabs and a supply of cards can be purchased at a book or stationery store at a nominal price. The only identification to be found on the one in use here are the words "Weis Re-order No. 35"; however it is a standard item and should be obtainable without difficulty. This particular size of card has been found convenient; however, one of larger dimensions, say 5″ long by 4″ or 5″ high, might be more suitable since more entries could be then placed on one card.

The index tabs are labelled R000, R100, R200, and so on through R800. These are placed in the box with R000 in front and the rest following in order. The cards of the index are filed behind the proper index tab. This segregates the cards into groups according to the main divisions of the system.

As an illustration of the use of the system, let us take the April, 1937, issue of Radio. The first article appears on page 8 titled "The Bi-Push Tri-Band Exciter or Transmitter". Vacuum tube transmitters appear in the classification table under the number R355, with further subdivisions according to frequency, viz.,

355.1 Low frequency (10-100 kc.)
355.2 Medium frequency (100-1500 kc.)
355.21 Broadcast frequency (550-1500 kc.)

and so on. However the writer has been using a different subdivision which has been found more suitable:

355.1 C.w. Crystal controlled
355.2 Telephone
355.3 Portable (and transceivers)
355.4 Keying methods and devices (break-in)
355.5 General and miscellaneous

with the remainder of R355 the same as in the published table. Most of the present day transmitters are crystal-controlled so that most of the transmitter articles will be indexed under 355.1, excepting telephone, of course. The few that are self-excited may be filed under 355.5, or if portable under 355.3.

According to the above then, the first article on page 8 should be indexed under the number 355.1. A card would then be made out, to be put in its proper place behind the index tab R300, as follows:

```
355.2 VT Transmitters-Crystal
         controlled.

    Bi-push, 3 band, 6A6, 6A6,
    PP 6L6's
                 April 37 Radio-8
```

This would be the first entry on that card; subsequent articles having the same classification number would be entered below until the card was full, when another would be started. It is desirous to have the entry contain the maximum amount of information, at the same time making it as brief as possible in order not to occupy too much space on the card. Whenever possible, the title of the article should be used, but where it does not contain the necessary amount of information the writer has been making substitutions as illustrated above. The tube complement is usually included, since that is usually one of the most important details and at the same time it gives a clue as to the kind of transmitter being written about. The number 37 is used as an abbreviation for 1937 to save space; the 8 is of course the page number. If the reference being indexed was from the Institute *Proceedings,* the letters "IRE" would appear instead of "Radio". Abbreviations in the text of the entry are also useful in saving space, but they should not be carried to the extreme. Future deciphering might be difficult.

Since we are considering references having to do with transmitters, we will skip the article about "Q" antennas (it would be filed under R320) to the one on page 18 titled "Reducing Harmonic Radiation". The information in this article applies to all transmitters in general and therefore belongs under 355.5. The card would look like this:

```
355.5 VT Transmitters-General
         and Miscellaneous.

    Reducing harmonic radiation
              April 37 Radio-18
```

The next transmitter article is on page 22, "Ten-Meter Mobile Crystal Control". This would be indexed under 355.3 as follows:

```
355.3 VT Transmitters-Portable
         (Transceivers)

    10 meter, xtal, 6A6 PP osc
    to 6A6 PP, phone
                 April 37 Radio-22
```

If any of these transmitter articles had contained special items of interest, as for instance a new way of keying or a power supply of special design, the references should be entered again on other cards under the index number for keying (355.4) and for a.c. power supplies which is (356.2). Cross indexing of this kind greatly increases the utility of your card index.

The above outlined procedure is followed for the remainder of the articles in the issue. The

325.1 Beam antennas (cont'd)	
Simple rotary, 28mc	Jun 37 QST-50
Flat-top beam	Jun 37 Radio-10
Push-button directivity	Jun 37 Radio-56
Multiple unit, steerable for s-w reception	Jul 37 IRE-841
Notes on flat-top beam	Jul 37 Radio-14
Feeding the push-button ant with concentric line	Jul 37 Radio-15
Mechanical suggestion for amateur rotatable	Jul 37 Radio-49
Erecting Bruce folded array	Jul 37 Radio-51
"Flop-over", reversible horizontal directivity	Nov 37 Radio 16

How a typical index card on beam antennas will look. Note the general method of recording the references.

ten or fifteen entries necessary for one issue will take only a short time, especially after you become more familiar with the system. The complete classification table may look rather lengthy or complicated but its arrangement is logical and soon seems comparatively simple. The articles appearing in the Institute *Proceedings* are handed out on a silver platter, so to speak, inasmuch as the publishers furnish the Dewey classification number at the bottom of the first page of each article.

Reproduced herewith is a sample of a completed card, this being 325.1 Beam Antennas. An inspection of this sample card will indicate the general method of recording the references. The (*cont'd*) alongside the heading indicates that this is not the first card under 325.1, Beam Antennas. There are other cards before this one, and, as the card is filled, there are probably other cards listing the same subject following this one in the file.

You will be surprised to note how rapidly the number of entries in your file will increase, especially if, having the time available, you extend your indexing to include issues from the preceding year or so. When done an issue or two at a time, this will not take long to accomplish; the time expended will probably be small compared to the time saved in the future when you come to search for some badly wanted reference.

The writer attaches a great deal of value to his index which now has approximately 3000 entries under about 270 different headings, some of the references from as far back as 1921. With a reasonable amount of work anyone could soon build up a similar index of great usefulness.

•

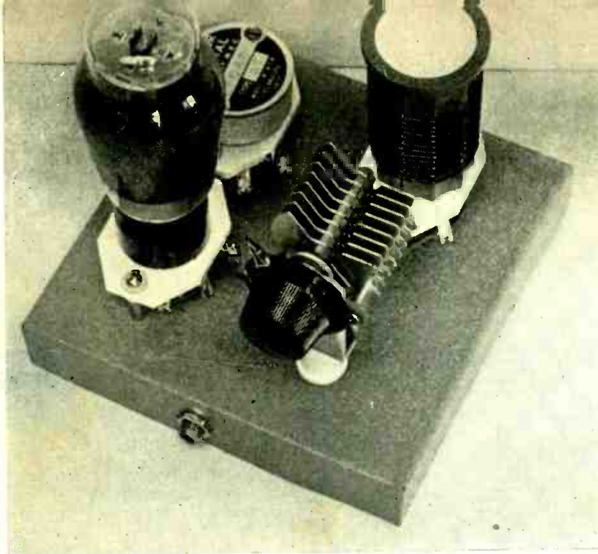
100 Cycles

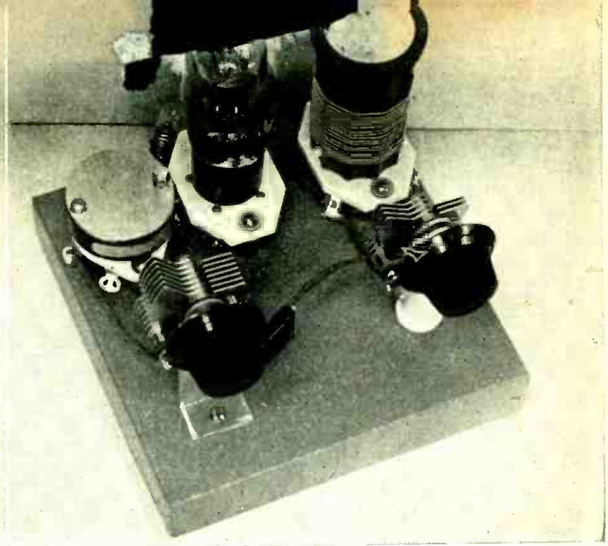
There has been a deluge of suggestions for obtaining a 1000-cycle tone for test purposes. A constant tone is very useful in checking a transmitter or its speech amplifier and modulator.

A few months ago RADIO published a little squib saying that an approximate 1000-cycle note could be obtained by first whistling the lowest note possible, and then raising this note one octave. Of course this is indeed an approximate method but it will give a note somewhere between 750 and 1500 cycles.

S. F. B. Morse, W6FZZ, made some measurements on the "1000-cycle" tone obtained by the above method and found a very large factor of error. To obtain a more accurate, though still simple, standard of frequency, he found that the resonant frequency of the air column contained inside a ½"-inside diameter tube,

[*Continued on Page 80*]





A "Sure-Fire"

CRYSTAL OSCILLATOR

● *By* **FRANK C. JONES,* W6AJF**

A great many experiments with all kinds of crystal oscillator circuits have been made by the writer recently in the quest of a good circuit for any kind of crystal. The untuned Pierce crystal oscillator circuit using either pentodes or triodes has certain advantages of simplicity and works well with 160- and 80-meter crystals. But this circuit in any of its various forms is inclined to be rather critical with 40-meter crystals and will not work at all with the 10- and 20-meter variety. Often some slight change such as reversing the crystal holder prongs in the socket will result in strong oscillation or a total lack of it.

Many straight pentode or tetrode tubes were tried in the conventional oscillator circuit. The 6L6 gave the most power output, but a 6V6 produced less crystal r.f. current at the same plate and screen voltages although the output was somewhat less. The 6F6 produced even less r.f. crystal current with nearly as much output as the 6V6. The metal shells were grounded on these tubes which resulted in a little lower value of crystal current than in the corresponding glass type of tubes.

The 6L6G harmonic oscillator proved to be very good for all crystals from 160 to 10 meters. This circuit uses a small semi-variable condenser from cathode to plate, a fixed .0004-μμfd. condenser and an r.f. choke from cathode to ground. This circuit produces excellent second harmonic output simply by changing the plate coil when using 160- or 80-meter crystals. Twenty-meter output can be obtained from most 40-meter crystals if the latter are quite active, such as the X-cut variety.

The 6A6-53-6N7G oscillator-doubler circuit functions quite well with nearly all crystals and has low crystal current when cathode bias is used with only an r.f. choke across the crystal. This circuit has the advantage of being less critical in adjustment and it will work easily and smoothly with all good 40-meter crystals. Its disadvantages are that less output is available from it than from a 6L6G, and that two tuned circuits are required as against one for the 6L6G harmonic oscillator.

The Resulting Oscillator Circuit

The final result of all the above experiments produced the circuits shown in figures 1 and 2 which are essentially alike. The simple circuit of figure 1, with a triode such as a 76, will deliver as much as 2 or 3 watts with an r.f.

*Engineering Editor, RADIO.

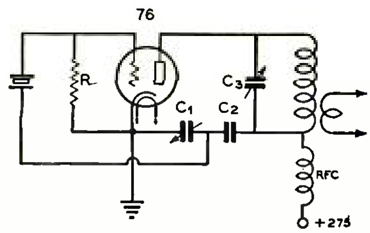


FIGURE 1

R—50,000 ohms, 1 watt
C_1—100-μμfd. midget variable
C_2—.001-μfd. mica.
C_3—50-μμfd. midget variable

crystal current of between 10 and 60 ma. for crystals from 160 to 10 meters. The triode circuit is excellent to drive a 6L6G buffer-doubler and the screen supply voltage for the 6L6G tube may be applied to the 76 plate circuit. This type of circuit is the only one which worked with all crystals, 10, 20, 40, 80, and 160 meters, whether they were extremely active such as a good X-cut or relatively inactive low-drift type or high-frequency crystals. The triode will furnish from 1 to 2 watts at twice crystal frequency when used with 160-, 80- or 40-meter crystals by tuning the plate circuit to the second harmonic. The circuit oscillates vigorously also with 10- and 20-meter crystals although harmonic operation is not possible with them. The latter varieties are generally cut to 30 or 60 meters and will operate on none but their odd harmonics. The regenerative cathode circuit in either figure 1 or 2 aids greatly in increasing the output from inactive crystals. The coil also reduces the r.f. current flowing through the crystal.

The Cathode Condenser

In figure 1, the cathode condenser C_1 is usually left at some setting of from 40 to 50 μμfd. for 40-, 80-, 160-meter crystals. A lower setting is desirable for 10- and 20-meter crystals. The .001-μfd. mica condenser merely isolates the d.c. plate voltage from the crystal and cathode by-pass condenser. The latter, C_1, provides an r.f. path from plate return to cathode and the reactance of this condenser is common to both grid and plate return circuits. The 76 triode can be capacitively coupled by means of a 100-μμfd. condenser to a 6L6G, 807, RK25 or similar doubler stage. It can be link coupled to another tuned circuit if desired.

The coupling to the circuits of figure 1 or 2 may be identical. Other types of triodes may require higher values of C_1 to prevent self-excited oscillation not controlled by the cryst

If more power output is required, an or nary pentode, tetrode or beam tetrode tube be substituted for the 76 triode. Very lo crystal r.f. current flows with any of these tubes, the maximum value being less than 100 ma. even for power outputs of 15 to 20 watts. Normally, r.f. grid currents of from 10 to 60 ma. were encountered with the circuit of figure 2. The main difference from figure 1 is in an extra tube element, the screen grid, which must be by-passed to the common ground bus. Since a higher gain tube is used, the condenser C_1 should be larger to provide less common reactance for the grid and plate circuit return leads to the cathode.

A fixed value of .00025 μfd. is suitable for heavily loaded oscillator circuits where they are coupled to a high-mu triode such as a T20 or 809. For medium loading, C_1 should

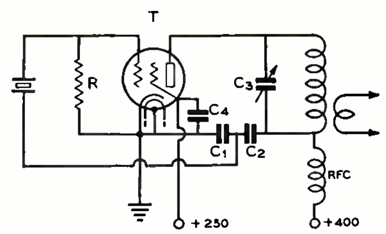


FIGURE 2

R—50,000 ohms (see text)
C_1—.0001 to .0004 μfd. (see text)
C_2—.001- or .002-μfd. mica
C_3—50-μμfd. midget variable
C_4—.01-μfd. 600-volt tubular
T—Any tetrode or pentode such as 6L6G, 42, etc.

be made .0004 μfd. to prevent self-excited oscillation. C_1 can be a .0005-μfd. variable condenser if desired and its setting will provide convenient excitation control when the plate circuit is tuned to the second harmonic. Efficiencies of from 50 to 60% are easily obtained in the plate circuit for either fundamental or second harmonic operation.

The value of R in figure 2 is not critical. Fifty thousand ohms was an average value which produced a fairly strong second har-

[*Continued on Page 75*]

MORE SPEECH POWER

from Class B Modulators

By
DOUGLAS FORTUNE*
W9UVC

Without a doubt the most conservatively-operated section of the average amateur transmitter is the class-B modulator. When other equipment is operated at maximum ratings, the class-B modulator, when used with speech, is actually being operated at only 50 per cent of its capacity. The generally accepted fact that the average modulator power must be one-half the class-C input is correct only if the wave form of the modulating power is a sine wave; however, for amateur purposes, where the modulator wave form is speech, the average modulator power for 100 per cent modulation is considerably less than one-half the class-C input. If a modulator is to be used with speech, it seems logical to assume that its design be based upon the peculiarities of speech rather than on the characteristics of the sine wave. The difference between speech and the sine wave is so pronounced that a 100-watt modulator, if properly designed for speech, may be used to modulate fully an input of from 300 to 400 watts.

Power Relations in Speech Waveforms

It has been determined experimentally that speech is equivalent to two simultaneous equal amplitude tones of different frequencies, having a total amplitude equal to that of the sine wave with which the speech is being compared. It follows from this that, for speech, the *average* modulator plate current, plate dissipation and power output are just one-half the sine wave values for a given *peak* power. In other words a 100-watt modulator, if used to modulate 100 per cent an input of 200 watts, delivers an average power of only 50 watts and the average plate current and plate dissipation are only one-half the permissible values. In order to take full advantage of the tube ratings, the design should be altered so that the *peak* power output is increased until the average plate current or plate dissipation becomes the limiting factor. It will be shown later that class-B design lends itself admirably to this change. First, however, it is necessary to point out the difference between peak power and average power.

Both peak power and average power are necessarily associated with wave form. *Peak* power is just what the name implies: the power at the peak of a wave. Peak power, although of the utmost importance in modulation, is of no practical significance in a.c. power work, except insofar as the *average* power may be determined from the peak value of a known wave form. There is no time element implied in the definition of peak power; peak power may be instantaneous and for this reason average power, which is definitely associated with time, is the important factor in plate dissipation. It is possible that the peak power of a given wave form be several times the average value: for a sine wave the peak power is twice the average value, and for speech the peak power is approximately four times the *average* value. For 100 per cent modulation the audio power must equal the class C input, although the average power for this value of peak varies widely depending upon the modulator wave form. The problem then of obtaining more speech power consists in obtaining as high a *peak* power as possible without exceeding the *average* plate dissipation or current rating of the tubes.

Peak Power Calculation

Peak power is developed in a class-B circuit by virtue of a voltage developed across the plate load. In figure 1 is shown the plate characteristic of the RCA 809. The normal load line which is one-fourth the plate-to-plate load of 8400 ohms is shown at AB. This load line

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*Thordarson Electric Mfg. Co., 500 W. Huron St., Chicago, Ill.

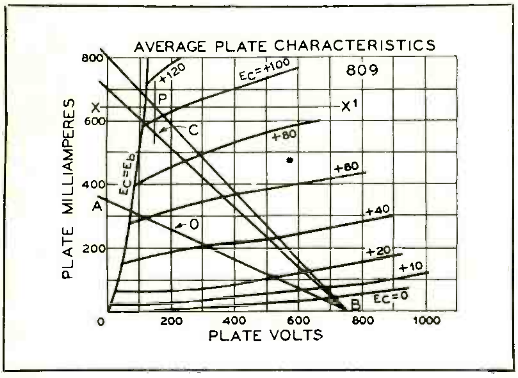

Figure 1 shows the plate characteristics of the RCA 809.

AB is drawn through B directly below the operating point, and point A, which is determined by dividing the operating voltage by one-fourth the plate to plate load. This line AB (except for values near the operating point) is the instantaneous relationship between the tube loss and the useful peak power output. At point O, for example, the voltage drop across the load is 750–200 or 550 volts. The tube current at this point is 262 ma. and the peak power output is 550 x .262 or 144 watts. The voltage drop across the tube is 200 volts and since the plate current is 262 ma. the instantaneous plate loss is .262 x 200 or 52.5 watts. At this point the difference between peak power and average must be recalled to mind. So far as modulation is concerned, the *peak* power output is the important factor, whereas the *average* power is the important consideration in plate dissipation. Although the instantaneous plate dissipation of 52.5 watts is above the normal plate dissipation, the plate loss averaged over the cycle is well within the limits of the tube. Returning to figure 1, the 550 volts across the load is equal to the product of the plate current, 262 ma., and one-fourth the plate to plate load which is 2100 ohms.

The *peak* power output, P.O., is

$$.262 \times 550 = 144 \text{ watts}$$
$$\text{Since } 550 = .262 \times 2100$$
$$\text{P.O.,} = .262^2 \times 2100,$$

or P.O. $= I^2R$ if .262 be replaced by I, the dynamic peak plate current, and R by one-fourth the plate to plate load. It must be remembered that I^2R is peak power output; this value must be divided by 2 for the average sine-wave power and divided by 4 for the average speech power.

With a dynamic peak plate current of I the average plate current as read by a d.c. meter is .636 I for a sine wave or .636 I/2 or .318 I for speech. The average plate input for speech is .318 IE, where E is the plate voltage. The average speech plate dissipation is thus: .318 IE $-I^2R/4$ for both tubes or one-half of this value for each tube.

Increasing Peak Power Output

Since the power output varies as the square of the peak current, the most logical thing to do in order to obtain high peak power is to increase the peak current. This may be done by decreasing the class-B plate-to-plate load.

At this point it might be assumed that this increase in peak current is nothing more or less

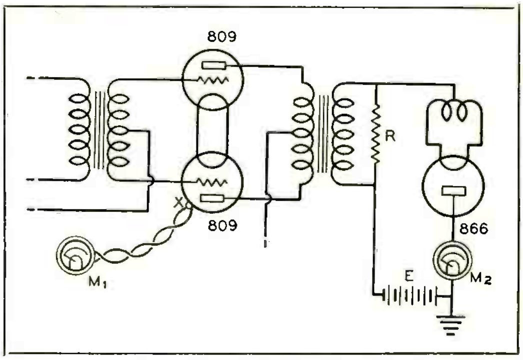

Figure 2. The circuit used to check plate dissipation.

than a gross overload without regard for the manufacturers' ratings. However, a little reflection will show that the manufacturers' rating is given as *average* current and that the actual *peak* current varies widely with the mode of operation. An average plate current of 100 ma. in class-C operation may call for a dynamic peak plate current of 1 ampere, whereas in class-B service this same 100 ma. per tube represents a peak of only 315 ma. No ill effects will result if the peak plate current is increased to such a point that the average plate current with speech is equal to the sine wave value as specified by the manufacturer. With this in mind the peak plate current may be safely doubled assuming that the plate dissipation does not become the limiting factor.

In the case of the 809, since the average class-B plate current is 200 ma., the dynamic peak plate current may be (200/.636) 2 or 630

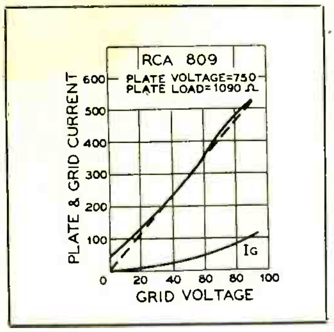

FIGURE 3. 809 Dynamic Characteristics.

ma. A new load line may now be drawn. One end of the load line is point B and the other end some point on the line X-X¹, which corresponds to 630 ma. The exact point on X-X¹ should be such that the voltage across the tube at peak output is at least 1.5 times the peak positive grid voltage at the same time. Since the grid voltage is approximately 100 volts the minimum plate voltage should be 150 volts. This corresponds to point P, and the load line should be drawn from B through P.

Calculations may now be made to determine the power output and plate dissipation. The peak power output is (750-150) .636 or 378 watts. The average d.c. power input is .318 IE or .318 x .630 x 750 or 150 watts; the average power output is one-fourth the peak power or 378/4 or 95.5 watts. The plate dissipation per tube is thus (150-95.5)/2 or 27.75 watts which is slightly above normal.

The plate-to-plate load should now be increased, in order to bring the plate dissipation within the 25-watt limit of the tube. At point C the plate current is 550 ma. and a load line BC indicates that the peak power output is 330 watts, the average plate current is 175 ma. and the plate dissipation per tube is 24.25 watts. In actual practice the minimum plate voltage should not be allowed to drop to too low a value; a.c. line regulation, power supply regulation, and the voltage lost in the output transformer itself due to the high *peak* current all tend to reduce the effective supply voltage. This is a very common occurence with class-B since the theoretical plate-to-plate load in no way accounts for practical limitations of power supplies and output transformers.

Laboratory Check of Performance

In order actually to check plate dissipation against peak power output, the circuit of figure 2 was set up. A thermocouple X was attached to the envelope of one of the 809 tubes and the microammeter M_1 was calibrated against plate loss by applying d.c. to the plate of the tube. The 886 acts as a peak rectifier which causes M_2 to read as soon as the voltage across R exceeds E. The values of R and E were adjusted to reflect the correct plate-to-plate load and to indicate the correct peak power. A voice signal was applied to the 809 grids until M_2 showed on peaks; the signal was applied until the reading of M_1 became steady. For a peak power output of 300 watts, the average plate dissipation was 23 watts and the class-B plate kicked up to 160 ma. In figure 3 are shown the dynamic characteristics of the 809 with a plate load of 1090 ohms. The correct bias for minimum distortion is found to be zero volts; however at this bias the idle plate dissipation is too high. For all practical purposes the bias may be such that the no signal plate dissipation is 25 watts; this condition would call for a bias of —1½ volts.

More *peak* power may be obtained from the 809's by raising the plate voltage. Since the 809 may be safely plate-modulated at 600 volts, it seems reasonable to assume that at least 1000 volts may be safely used for class-B operation. With a peak current of 470 ma. and a minimum plate voltage of 150 volts, the peak power output is (1000-150) .470 or 400 watts and the plate dissipation is 25 watts per tube. Care should be taken that the average plate current of the 809's with speech does not exceed 200

[*Continued on Page 76*]

Peak Power Capabilities (Class-C Input That Can Be Fully Modulated) For Various Tubes

Tubes	Peak Power Output	Class-B P-P Load	Plate Voltage	Average Speech Plate Current	Class-B Bias	Driver Tubes	Average Driving Power	Driver Transformer Ratio Pri. to ½ Sec.
TZ-20	250	4850	750	145	0	2-2A3	7	2.6:1
809	300	4800	750	165	—1½	2-2A3	5	4.5:1
809	400	7200	1000	150	—8	2-2A3	5	4.5:1
TZ-40	500	5100	1000	200	—5	2-2A3	8	2.6:1
TZ-40	600	7400	1250	182	—9	2-2A3	7	2.8:1
203Z	800	5500	1250	250	0	4-2A3	15	2.75:1

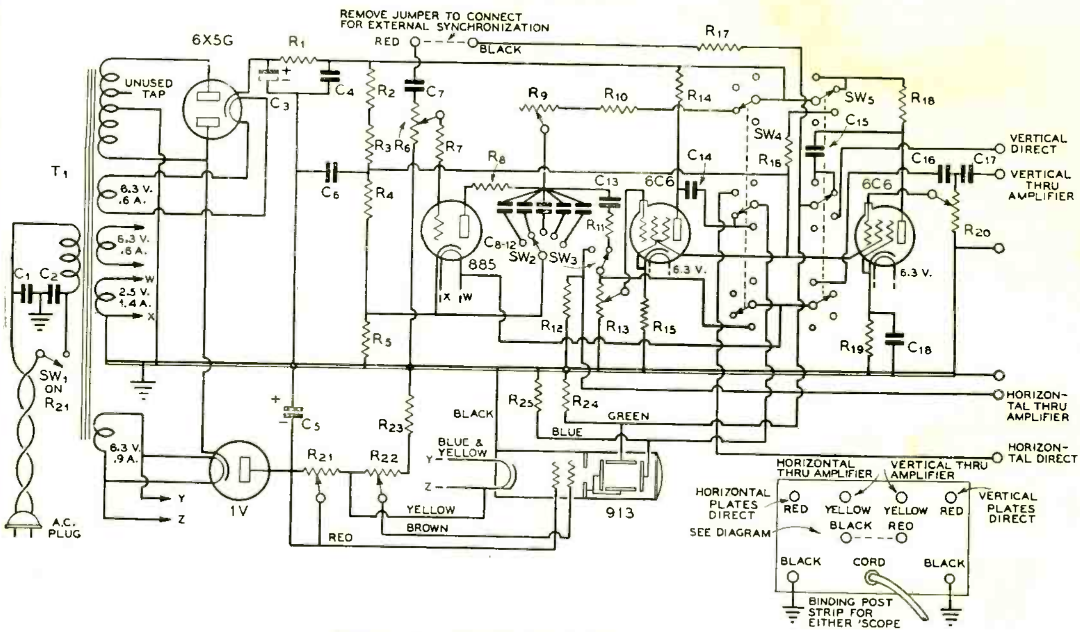

Figure 7—Circuit for 1-inch oscilloscope

PARTS REQUIRED FOR EITHER MODEL

R_1—5000 ohms, 1 watt
R_2, R_3, R_4—40,000 ohms, 1 watt
R_5—1500 ohms, ½ watt
R_6—50,000-ohm potentiometer
R_7—25,000 ohms, ½ watt
R_8—200 ohms, ½ watt
R_9—5-megohm potentiometer
R_{10}—750,000 ohms, ½ watt
R_{11}, R_{12}—1 megohm, ½ watt
R_{13}—3-megohm potentiometer
R_{14}—100,000 ohms, 1 watt
R_{15}—1000 ohms, ½ watt
R_{16}—200,000 ohms, 1 watt
R_{17}—2 megohms, ½ watt
R_{18}—100,000 ohms, 1 watt
R_{19}—1000 ohms, ½ watt
R_{20}—500,000-ohm potentiometer
R_{21}—25,000-ohm potentiometer with a.c. line switch
R_{22}—50,000 potentiometer
R_{23}—150,000 ohms, 1 watt
R_{24}—2 megohms, ½ watt
R_{25}—4 megohms, ½ watt
C_1, C_2—0.1-µfd., 400-volt tubular
C_3, C_4, C_5—8-µfd., 450-volt electrolytics
C_6—2-µfd., 200-volt electrolytic
C_7—0.1-µfd., 400-volt tubular
C_8—0.5-µfd., 400-volt tubular
C_9—0.1-µfd., 400-volt tubular
C_{10}—.02-µfd., 400-volt tubular
C_{11}—.005-µfd. mica
C_{12}—.001-µfd., mica
C_{13}, C_{14}, C_{15}, C_{16}, C_{17}—0.1-µfd., 400-volt tubulars
C_{18}—.05-µfd., 400-volt tubular
T_1—Cathode ray transformer as described
SW_1—Line switch on R_{21}
SW_2—5-position, single-pole switch
SW_3—S.p.d.t. toggle switch
SW_4, SW_5—3-circuit 4 position, non-shorting switch
C.r. tube mounting—Amphenol 913 plug and bracket assembly

A saw-tooth oscillator in its simplest form consists of a condenser which is intermittently charged at a uniform rate and discharged instantaneously. In our practical circuit a resistor is used to vary the flow of charging current. This is variable, and there is a selection of various condenser values, giving a wide range of available saw-tooth frequencies. When the condenser selected is charged to about 25 volts potential, the 885 gaseous-discharge tube ionizes, acting as a short-circuit across the condenser, and discharges it to nearly zero. At this point the 885 ionizes and becomes an insulator and the saw-tooth cycle begins anew.

The negative bias voltage on the 885 grid determines its break-down voltage, this value being a little over 3 volts in these particular oscilloscopes. Operating with this low breakdown voltage produces a wave having excellent linearity, but instability will result if the grid bias is very much lower.

The frequency-determining condensers shown were selected because they are a combination of popular sizes which will cover the desired frequency range (about 9 to 20,000 c.p.s.) without gaps, when used with a 5-megohm rheostat and 750,000-ohm maximum charge limiting resistor. None of these values should be altered as they work together as a unit.

Operating as stated above, the output voltage of the oscillator alone is insufficient to swing the beam very far across the screen so a "horizontal amplifier" is used to increase this voltage to the proper potential.

Dual Power Supply

The saw-tooth oscillator and amplifiers require a positive voltage of 350 to 450 volts. Small cathode-ray tubes operate with their anodes at ground potential and a *negative* voltage of 300 to 500 volts on their cathodes. Such a dual power supply may operate from a single secondary winding by connecting one rectifier "backwards" as shown.

A Thordarson T-9233 transformer was used in the original 'scope and Hadley's number 3836A used in the two instruments shown. Either transformer is satisfactory but *don't* use an ordinary receiving transformer. These have strong magnetic fields and are likely to cause no end of trouble.

The Thordarson transformer has a high-voltage extension tap for the cathode-ray tube. However, this gives too much voltage for electrolytic condensers so is better left unused, following the circuits shown. Either transformer will give ample voltage for either tube.

The Hadley transformers have a tap about 160 volts above center, which may be used for 60-cycle sweep in "basic" 'scopes not equipped with a saw-tooth oscillator. The entire 350 volts r.m.s. (approx.) might be too much for a small potentiometer. An optional method, applicable to the former transformer, would be to form a voltage divider with a couple of 1-megohm resistors in series.

The current drain of the negative supply is under 2 ma., while the c.r. tube draws less than a single milliampere. A single 8-mike condenser gives more than ample filtering for this circuit.

Since the total current drawn from the positive supply is around 10 ma., a resistance-capacity filter was preferred as it occupies less space and can't cause field trouble.

If a complete 'scope is too great an investment, one may build only the basic unit, which consists of power supply and c.r. tube circuits, with the idea of adding the balance later. An a.c. sweep may be obtained as stated. This is not nearly so good as a saw-tooth sweep but will do temporarily. Such a simple 'scope will show trapezoidal patterns and can be extremely

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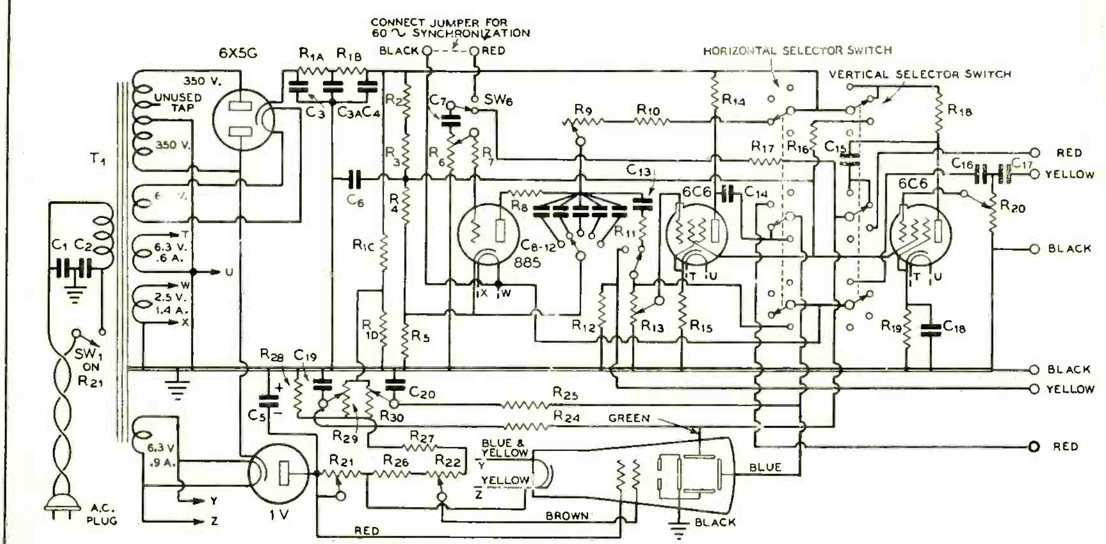
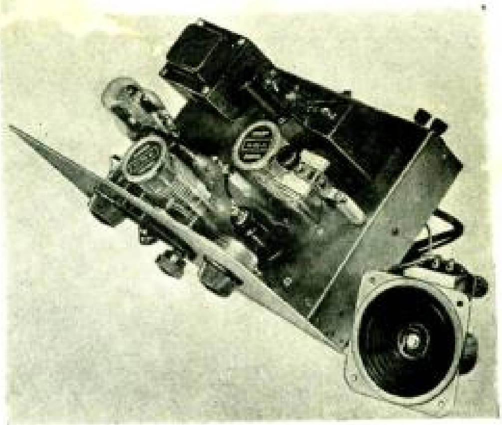


Figure 8. Circuit for the oscilloscope using the XH-24 two-inch c.r. tube

ADDITIONAL PARTS REQUIRED FOR 2"-MODEL ONLY

R_{1A}, R_{1B}—2500 ohms, 1 watt
R_{1C}—250,000 ohms, 1 watt
R_{1D}—50,000 ohms, ½ watt
R_{26}—25,000 ohms, ½ watt
R_{27}—100,000 ohms, 1 watt
R_{28}—100,000 ohms, 1 watt
R_{29}, R_{30}—100,000-ohm potentiometers
C_{3A}—8-μfd., 450-volt electrolytic
C_{19}, C_{20}—0.1-μfd. 400-volt tubular
SW_6—S.p.d.t. toggle switch
(See page 54 for other parts)



A simple superheterodyne with controllable regeneration solves the problem of attaining good performance at low cost.

A SIMPLE SUPER WITH "SOUP"

By **JOHN T. WILCOX,* W2CLS**

This receiver is a superheterodyne of such merit and simplicity that it will surely appeal to every amateur, either as the regular receiver or as an auxiliary one for certain bands. The fact that it is a superhet may immediately lead some readers to the false conclusion that the poor old pocketbook will be badly taxed. However, such is not the case.

Faced with the problem of squeezing a good receiver into a compact arrangement at the lowest possible cost, the writer tried all the usual hook-ups. Needless to say, the results in all cases were just better than mediocre, most circuits having the common faults of hand capacity, poor sensitivity, and broad tuning. As a result of these experiences, it was finally acknowledged that a simple superheterodyne with controllable regeneration would be the best solution to the problem. The finished product is shown in the photographs.

This circuit was decided on after every value of resistor and condenser and different types and sizes of tickler coils were tried. In all probability this detailed procedure is the real reason why the final results were so very gratifying. Therefore, it is suggested that the circuit constants be strictly adhered to when building this receiver.

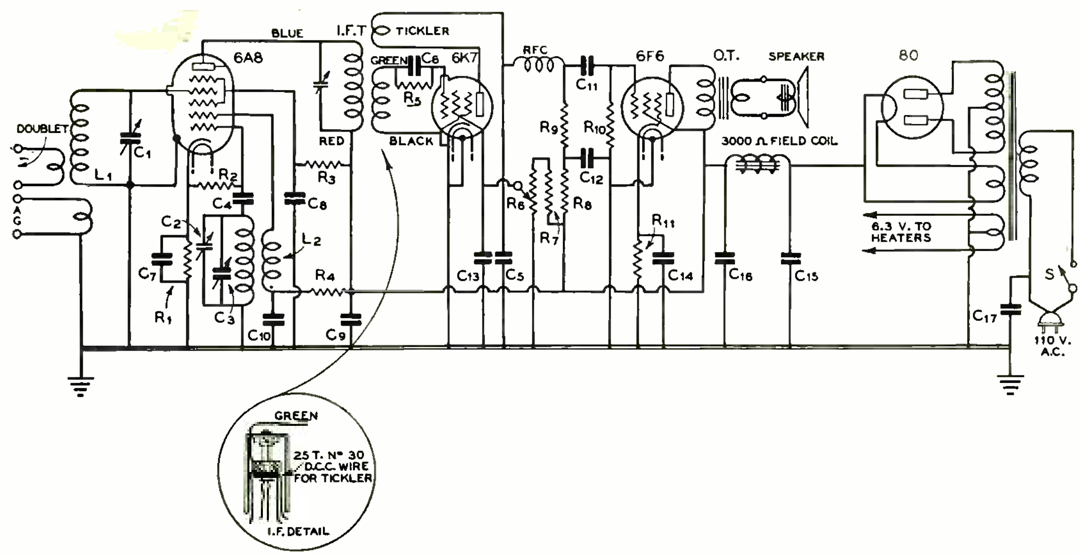
*Wholesale Radio Service Co., Inc., 100 Sixth Ave., N.Y.C.

All parts used are conventional, and no odd values of condensers or resistors will be found in the list of parts. In fact, the only difference between the cost of parts for this superheterodyne and the average r.f. regenerative receiver is due to the i.f. transformer.

The Special I.F. Transformer

While on the subject of the i.f. transformer it might be well to mention its type and the method of adding the regeneration coil. The transformer should be the one specified in the parts list to provide maximum gain, but if you do not use the one recommended, make sure the one you select has a closely coupled primary and secondary. A "tickler" coil must be wound on the lower end of the coil form as illustrated in the circuit diagram. This consists of 25 turns of no. 30 d.c.c. copper wire, jumble wound close to the i.f. coil. The exact number of turns has been determined (for the specified i.f. coil) after considerable experimentation, and is correct for the screen and plate voltages used. The direction of winding is not critical; if the set does not oscillate after it has been completed, merely reverse the connections to the regeneration coil.

A three-inch dynamic speaker has been selected for reasons of economy. However, a larger speaker could easily be used as the 6F6 output tube can produce about three watts of audio power.



C_1, C_1—Dual section, 140-μμfd. per section variable
C_2—25-μμfd. trimmer condenser
C_4—.00025-μfd. mica
C_5—.0005-μfd. mica
C_6—.0001-μfd. mica
C_7, C_8, C_9, C_{10}—0.1-μfd. 400-volt tubulars
C_{11}—.01-μfd. 400-volt tubular
C_{12}, C_{13}—0.5-μfd. 400-volt tubular
C_{14}—25-μfd. 25-volt tubular
C_{15}, C_{16}—8-μfd. 450-volt electrolytics
C_{17}—.05-μfd. 400-volt tubular
RFC—2½-mh. 125-ma. r.f. choke
R_1—300 ohms, ½ watt
R_2—50,000 ohms, ½ watt
R_3—75,000 ohms, ½ watt
R_4—25,000 ohms, ½ watt
R_5—5 megohms, ½ watt
R_6—25,000-ohm potentiometer and switch
R_7—100,000 ohms, 2 watts
R_8—50,000 ohms, ½ watt
R_9—250,000 ohms, ½ watt
R_{10}—500,000 ohms, ½ watt
R_{11}—500 ohms, 2 watts
IFT—Re-wound i.f. transformer (see text) Meissner 6762
Coils—Standard factory-wound coils

Parts Layout

The parts layout is not critical as each tube circuit operates at a different frequency. This reduces the possibility of instability caused by interstage coupling. The noise level is exceptionally low, and even very weak signals are received with complete stability and no hand capacity effect whatever. Its selectivity is something to marvel at, as only one intermediate frequency transformer is used. A major part of this selectivity is due to the use of regeneration in the second detector.

Construction

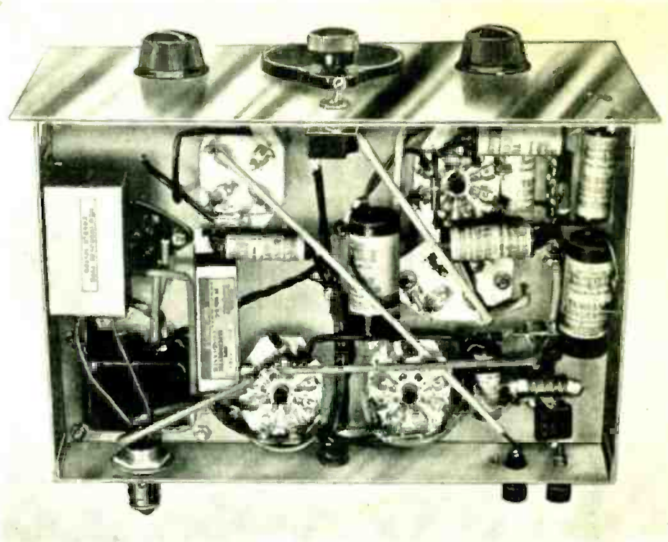
Although parts placement is not particularly critical, since each circuit is operating on a different frequency, it is probable that a minimum of "bugs" will be encountered if the layout as shown in the two photographs is followed quite closely. This particular layout has been found to give best results.

The chassis should be drilled first and then the various components should be mounted. The wiring procedure is simple, as there is but a minimum of it, but it will be found best to wire first the filament circuits, then the power supply and plate voltage leads, and last the r.f., i.f. and audio circuits.

It will be advisable to mount and connect the various resistors and condensers grouped around the socket of the 6A8 oscillator-first detector substantially as shown in the photographs. Much of the success of the receiver depends upon the efficient operation of this first tube.

Adjustment and Operation

The initial adjustments and operating procedure will be as follows: Turn on the switch and slightly advance the regeneration control; adjust band spread condenser C_2 to about half maximum capacity; rotate oscillator condenser C_3 until a station is heard, then adjust antenna condenser C_1 for maximum volume. There will be more than one setting of the oscillator condenser, C_3, at which the same signal will be heard; select the one at which the condenser plates are farthest out of mesh. Once adjusted, these controls will not need further at-



The parts layout is not critical as each tube circuit operates at a different frequency. However, a minimum of "bugs" will be encountered if the layout is followed closely.

tention, and it will now be possible to tune band spread by merely using the condenser on the main dial (C_2), the oscillator condenser. When changing bands, of course, it will be necessary to readjust condenser C_1.

There is very little adjustment to be made on the intermediate frequency transformer; while adjusting the condenser on top of this transformer, rock the main tuning condenser back and forth for maximum volume.

The regeneration control regulates the screen voltage of the 6K7 second detector, and thus is also a volume control. For normal operation to provide maximum gain, it should be adjusted to a point just below regeneration. However, for c.w. reception the control should be advanced somewhat further to produce regeneration, thus acting like a beat frequency oscillator.

This receiver will work with a conventional antenna or a doublet. The doublet is recommended for the best performance and may be loosely coupled to the set by looping two turns of push-back wire loosely around L_1, the primary of the antenna tuning coil. The method of operating the receiver will remain the same, regardless of the antenna used.

The completed receiver will not, it is acknowledged, compare with the commercial multi-tube crystal-filter superhets, but it is capable of giving quite satisfactory operation. Anyone duplicating the construction of this set will be well repaid considering the small expenditure involved.

Radioddities . . . .

First color in the callbook—W8RED.

•

Most of the world's hams are north of the equator.

•

A Philadelphia meat market (tnx to W3HFP) is advertising X-cut roasts at fifteen cents per pound.

In code, 73 reads the same backward.

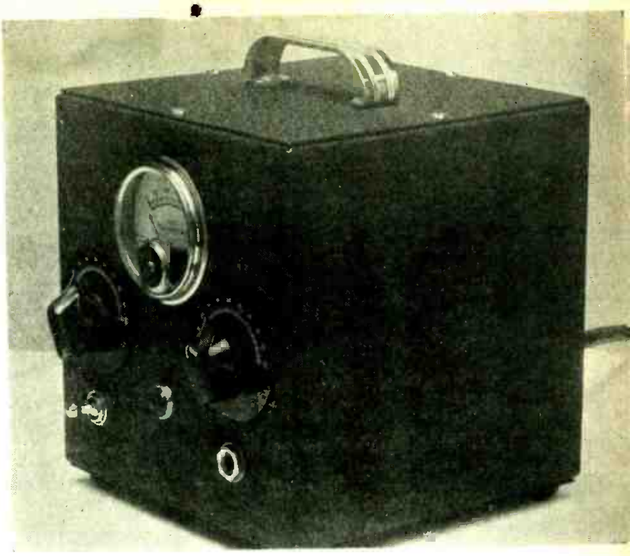
•

Among the recent applicants for broadcast licenses is one *C. Sharpe-Minor.*

•

According to one QSL printer's samples, a W7 is located in California and a W4 in New York City.

A 20-Watt
MIDGET PORTABLE

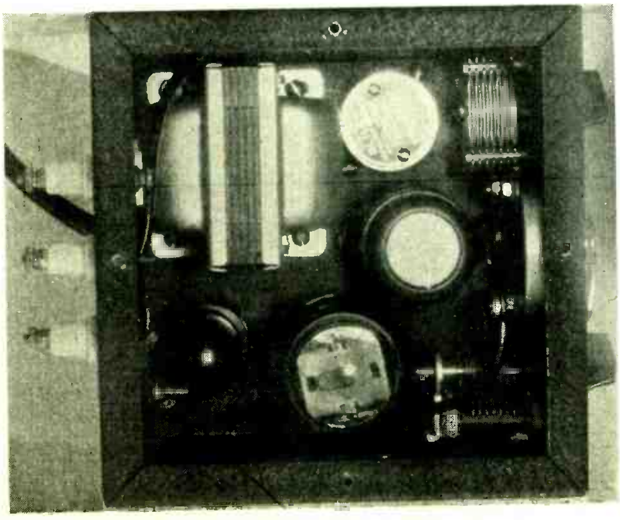


By
**L. V. BRODERSON*
W6CLV**

After several weeks of poring through articles on "How to Build a Portable C.W. Transmitter," it became apparent that none of them met all the author's requirements. Some were small but lacked output; others were portable with the aid of a Mack truck and trailer; still others necessitated the use of an external power supply — and those that did meet most of the requirements fell down on the financial outlay. From this it was decided that a portable would be built with the following specifications in mind:

1. Lightness; 2. Compactness; 3. Efficiency of operation; 4. Output capabilities; 5. Appearance; 6. Expense.

*515 Salinas Nat'l Bank Bldg., Salinas, Calif.



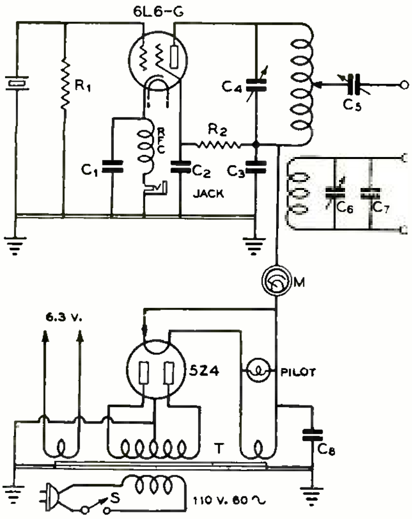
The lid removed to show constructional detail.

Checking back, it was surprising to find that the rig to be described really fulfills the above. It weighs 7 pounds complete, measures six inches square, and has consistently contacted stations in Australia and New Zealand from Pacific coast points. Its input averages 24 watts and it certainly can take its place alongside the parlor furniture—and it can be constructed for less than $18.00.

A glance will show that there is nothing intricate about the circuit—it is our old friend the 6L6G chosen for its excellent past performances. It can be heavily loaded, crystal r.f. current is low and its efficiency is quite high. It is standard in every respect with the exception of the resistor across the crystal. With the 7-Mc. crystal on hand this value worked out best. However, it may be necessary to substitute a higher value than this for crystals that are less active to allow them to "start" each time the key is closed. Although designed primarily for the 7-Mc. band this midget transmitter performs equally well on the 14- and 3.5-Mc. bands providing the appropriate crystals are used.

Construction

The entire unit is housed in a black crackle-finish metal cabinet six inches square with top and bottom plates removable. A chromium-plated handle is centered on the top lid and fastened with two bolts. This is an ordinary



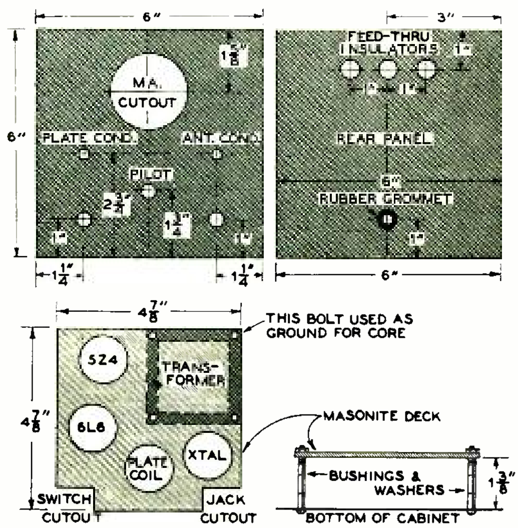
C1—.00025 μfd. mica
C2—.01 μfd. mica
C3—.002 μfd. mica
C4—100 μμfd. midget variable
C5—50 μμfd. midget variable
C6—100 μμfd. midget variable
C7—.00025 μfd. mica
C8—8 μfd. 450-volt electrolytic
R1—10,000 ohms, 2 watts
R2—15,000 ohms, 5 watts
T—660 c.t., 75 ma.; 5 v., 2 a.; 6.3 v., 1 a. power transformer
M—Plate milliammeter
S—S.p.s.t. on-off switch
RFC—2½-mh., 125-ma. r.f. choke
Jack—Keying jack

3" drawer-pull handle obtainable at any hardware store. The rear panel contains the three midget feed-through insulators and the a.c. outlet grommet. These can be placed as the builder desires but the layout diagram works very nicely. The bottom plate of the cabinet holds the four bolts which, in turn, build up the chassis. Four rubber feet glued to this plate prevent scratches in addition to cushioning the entire transmitter.

The front panel presents a symmetrical appearance with a minimum of parts. A Readrite 0-100 milliammeter occupies the upper center position. Below and to the left is the plate tank tuning condenser. Opposite this is the antenna tuning condenser. At the lower left is an a.c. on-off switch and to the right, the keying jack. The 5-volt pilot light is directly below the milliammeter.

The chassis is constructed from a piece of masonite 4⅞" square by ⅛" thick. A clearance cut is made just large enough to allow the on-off switch and keying jack to clear this deck. A short-shank switch and midget jack are used in order to conserve as much space as possible. The masonite deck is built up to a height of 1⅜" by means of bushings and washers. The plate tuning condenser and antenna ... are both insulated from the front panel by insulating washers. All other parts are fastened directly to the metal, one side of the keying jack going to ground. The meter, a.c. switch and pilot light bracket are already insulated from their terminals.

The layout diagram of parts placed above the masonite deck need not be strictly adhered to. This will be governed mostly by parts one already has on hand or can salvage from the usual "junk box". In general, the



transformer is placed at the rear right corner with the 5Z4 rectifier tube directly opposite. In front of the 5Z4 is placed the 6L6G socket. At the right front corner the socket or jacks for a plug-in crystal is placed and next to this is the coil socket. The furthest right mounting lug on the transformer is held in place by the upright bolt running from the bottom plate through build-up bushings. This automatically grounds the transformer core. Likewise, the right front upright bolt is used as the ground lead for one side of the crystal.

Underneath the masonite deck and below the transformer is mounted the 8 μfd. paper filter condenser, midget size. This is held in place by heavy twine run through holes drilled beneath the transformer and hidden from view. Resistors and by-pass condensers may be mounted wherever convenient. There are several midget fixed condensers and resistors that

[Continued on Page 83]

● VE2DM (left) grimly keeps the wire tight while VE2FG (right) expresses astonishment that a half-wave looks so long.

DEPARTMENTS

- **Dx** *(See front of book)*
- **Yarn of the Month**
- **Postscripts and Announcements**
- **Radio Literature**
- **Question Box**
- **Calls Heard**
- **56 Megacycles**

YARN *of the* MONTH

"Vapor . . . drifted lonesomely across the red sky"
Shishaldin, Alaska's beautiful volcano, puts on a show that few people ever see. The dark land, left foreground, is part of Sanak Island, the scene of this story of amateur radio to the rescue.

WHITE SLIPPERS, RED HEELS BEHIND[1]

By LOUIS R. HUBER,[2] W9SU

Vapor from the nearly-perfect cone of Shishaldin Volcano, 40 miles across the north Pacific, wavered upward, hesitated, and drifted lonesomely across the red-bannered sky. Foster Mason, cheechako visitor to Sanak Island, paused in the early Aleutian twilight and drank it all in.

"You beginners allus stand a-watchin' the mountain."

It was Jimmie Olson, Mason's friend, criticizing from the low doorway. But Mason paid no heed.

"Boy, when the weather's good up here, I mean it's *good!* You don't see a smoker like that in the States every day—or any day." He turned toward Jimmie. "And when you go down with me on the next trip of the Starr, don't let me catch you ogling any high buildings!"

"Okay." Jimmie grinned. "I'll be good."

Jimmie, 17, son of a Swedish father and an Aleut mother, was Mason's host. They had worked together in Bristol Bay, southwestern Alaska, during the salmon season the previous summer. Mason was staying in the Territory for the winter; Jimmie had earned $1,000 and wanted to go "outside" for the first time in his life; so they struck a bargain: Mason and Jimmie trapped till the end of the season; then they were ready to take the furs and go south—Mason to his home in Seattle, and Jimmie for his first visit to outside civilization. That day had brought in the last of the traps; they had a good bunch of raw furs; and the next trip of the mail boat Starr would take them south.

As usual at the end of the trapping season, the little settlement on Sanak Island held its mid-winter "prom" in Pabloff Harbor—a sturdy village of 25 souls. To appreciate the setting, you must realize that Sanak Island is a tiny dot among the Aleutian Islands, probably the most barren string of grass-covered

[1]With the exception of Lily Osterback Evans, K7ANQ, names in this story are fictitious. The station calls and essential truth of the story, however, are retained. —Editor.
[2]119 S. Chelsea Lane, Bethesda, Md.

It's home to the Osterbocks
It doesn't look like much, but this barren-looking spot of the northern Pacific ocean is home, farm and factory to the Osterbacks. For three generations they have raised foxes, fished, and sold their produce to the outside world.

rocks on the face of the earth—treeless, swept by relentless winds, and set about by treacherous rocks and tidal currents. Yet in this forsaken spot the world's greatest fishing is done. For six weeks every year, the graceful salmon come. Thousands of workers jam the ships of the salmon fleet, bound north from San Francisco, from Seattle, for the salmon catch. For six weeks this tail end of Alaska comes to life.

Then, as quickly, as completely, it subsides. The thousands of workers go home, the ships return to United States ports, the land and the sea are desolate. Yet a handful of hardy souls stay on: the lonely adventurers, like Jimmie's deceased father, who one year sailed up the Pacific and found an isle and called it home; the Aleutian natives who had always been there, whose women often became the wives of the adventurers and the mothers of their children; and last the occasional outsiders, like Foster Mason, who find southwestern Alaska a grand, awful spot in which to linger.

Mason looked again at the mellowing sky, at the dark banner floating from the crater of Shishaldin, and at Jimmie.

"You've got something over there," he said. "The rarest bit of scenery on this continent; yet nobody ever sees it but the home folks. Too bad the weather bureau doesn't bring more fair weather when the tourists go by."

He referred to the fact that Unimak Pass, lying just to the left of the smoking cone, was the gate into Bering Sea, providing the shortest route from the United States to the Orient.

"No care for tourists," growled Jimmie, playfully aping the speech of the halfbreeds—something he knew better than to do—"no care for tourists; want go to dance tonight!"

"Oh, so that's it?" Mason laughed. "And I suppose you'll be wanting to buy somebody a pair of white slippers with red heels behind, too!"

This was the ambition of all halfbreed, dark-haired maidens, voiced from Ketchikan to Nome.

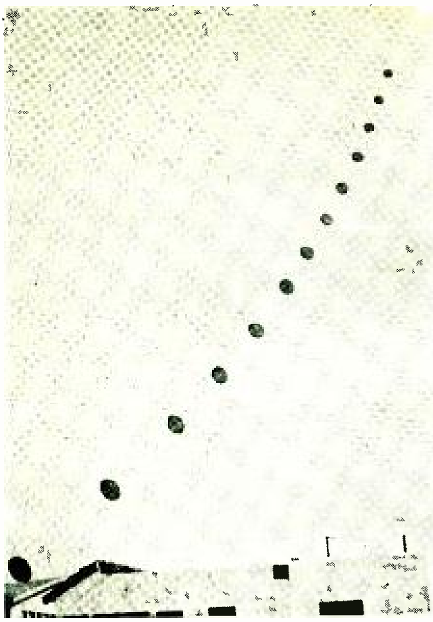
"What time is the dance?"

"Starts about eight. But I'll have to stay for my schedule with Lily."

They moved toward the house. Inside, Jim-

[*Continued on Page 80*]

Anyone who knows anything at all about radio in Alaska knows Lily Osterback Evans, shown here in her homespun radio shack on Wosnessenski Isle.



W6QD's four-wire Q-section is a puzzle to neighbors and birds alike.

Hamfests

Newark, N. J.

Transmission and reception of television will be demonstrated at the third annual hamfest sponsored by Union County Amateur Radio association on April 9. Between 1100 and 1500 amateurs are expected to attend. Stanley Allen, W2CZS, hamfest committee secretary, can give further details to those interested.

Wichita Falls, Texas

Texans and Oklahomans are planning to attend the annual banquet and hamfest of the Wichita Falls Amateur Radio club on April 23 in Wichita Falls. Detailed information may be obtained about the meeting by calling any Wichita Falls amateur or getting in touch with Champ Smith, W5AAM, club secretary.

Charleston, W. Va.

Annual Charleston hamfest will be held on May 21 and 22 in the Ruffner hotel, Charleston, W. Va., under the auspices of the local amateur radio club. Mel Swillinger, W8NLT, heads the committee in charge.

A Word of Explanation

A word of explanation might be in order in response to the many inquiries as to why RADIO was "later than usual" last month. Because of the flood, for several days there was no rail service from Los Angeles. When service was resumed, a large amount of mail had accumulated in the local postoffice. As first class mail holds precedence over other kinds, magazines and other second class mail had to wait until all first class mail was taken care of. This combined delay was the occasion for many eastern subscribers getting their copies considerably in arrears.

POSTSCRIPTS...

and Announcements

We Regret . . .

We regret to state that we were in error concerning an announcement of the National Amateur Convention to be held this year. We are in receipt of a letter from G. L. Dosland, Chairman of the Convention, which will correct this previous statement:

"While it is true that the Chicago Area Radio Club Council has presented the Board of Directors of the League with a bid for a National ARRL Convention in Chicago to be held on September 3, 4 and 5, the same has not yet been approved by the Board of Directors, as such approval can only be given at the actual meeting of the Board to be held in May of this year. Until such approval is obtained, the Council has designated the Convention as a National Amateur Convention and Amateur Radio Trade Show."

We hope that League sanction will be given following the Board meeting; until it is obtained, however, the status mentioned above will be maintained.

Stamp Collecting

RADIO adds the following names to its list of radio amateurs interested in stamp collecting:

Russell S. Smith, W3HAC, 30 East Sixth Street, Pottstown, Pa., who specializes in French, German and Polish stamps.

John Gruble, W7RT, 1931 Atlantic Street, Seattle, Wash., who collects, particularly, U.S. commemoratives.

Frank L. Baker, W1ALP, 233 Atlantic Street, Atlantic, North Quincy, Mass.

R. A. Bartlett, G6RB, 31 Kings Drive, Bishopston, Bristol, Gloucestershire, Eng.

NEW BOOKS

AND REVIEWS of CATALOGS

RADIO OPERATORS MANUAL, 2nd edition. Published by the General Electric Company, Radio Department, Schenectady, N. Y. 5¼" by 7¾", 181 pages, price $1.00 in U.S.A.

The "Radio Operators' Manual," a completely rewritten edition of the previous "Police Radio Operators' Manual" which proved so popular with prospective radio operators, has just been published and will be distributed by the Radio Department, General Electric Co.

The scope of this manual has been expanded to include not only broadcast transmitters and police radiotelephone and radiotelegraph systems, but also radio systems for land and marine fire departments, transit and electric power companies, and conservation departments.

Its publication has a triple purpose: to assist those who wish to qualify for commercial radiotelephone and radiotelegraph operator licenses; to assist prospective station licensees in obtaining Federal authorizations; and to present general information on radio systems in various fields of application.

The book describes radio systems in use; outlines the organization and function of the Federal Communications Commission; lists numerous questions and answers relevant to Federal examinations; and includes sections on maintenance, definitions, study references, radiotelegraph code, and "Q" abbreviations.

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TT-3 AIR-COOLED TRANSMITTING TUBE MANUAL. Published by the RCA Manufacturing Company, Harrison, N. J. 192 pages, 5½" by 8½", price 25 cents in U.S.A.

The RCA TT-3 Transmitting Tube Manual covering air-cooled tubes has been introduced to most amateurs through a direct-mail offer whereby any amateur writing to the manufacturers before the expiration date of the offer could obtain a free copy. That offer, however, expired on March 15 and any amateurs who did not avail themselves of it and who desire a copy of the manual may obtain one by sending 25 cents to RCA Mfg. Co. at Harrison, N. J. Copies may also be obtained from your local RCA distributor.

The manual is far more than merely a tube catalog; it is really a handbook on tube types, their theory of operation, the circuits best suited to them, and considerations in proper transmitter design around their specifications. Only approximately half of the book is devoted to a listing of the actual tube characteristics; the other half is devoted to such pertinent subjects as General Vacuum-Tube Considerations, Transmitting Tube Installation, Transmiting Tube Application, Transmitter Design Considerations, Useful Formulas, Transmitting Tube Charts, Rectifiers and Filters, and last, the Circuit Section.

•

The Yaxley Division of the P. R. Mallory Co. has released a catalog describing their new line of Multiple Push-Button Switches. The pamphlet describes the switches in some detail, shows their mechanical construction, and gives a number of typical applications illustrating the possible uses of the switches.

The switches are described as being of the "ladder" type, meaning that when one is depressed, any other one that has previously been depressed is released to the normal position. The pamphlet is available on request from the manufacturer, P. R. Mallory & Co., Indianapolis, Indiana.

•

Allied Radio Corporation of Chicago announces the release of its new 164-page spring and summer 1938 catalog. Featuring important new developments in every field of radio, the new catalog forms an exhaustive index to modern radio equipment. The book devotes separate sections to radio receiving sets, service equipment and replacement parts, public address, and amateur gear.

New developments in typography and illustration have been incorporated to make the new catalog more legible and easier to use. A free copy may be obtained by writing to Allied Radio Corporation, 833 West Jackson Boulevard, Chicago.

Question Box

I am building a close-spaced antenna-director-reflector array somewhat similar to the one described by Roberts in the January issue of RADIO. *But, since I intend to use a reflector as well as a director, the dimensions given for the feeder spacing in his case will not be usable. How will the radiation resistance be affected by this additional element and what would be the best method of feed in this case?*

The addition of an additional reflector to the array described by Roberts will lower the radiation resistance still further. Measurements of the resistance at the center of the directly-driven dipole in arrays such as these have shown the radiation resistance to be approximately 14 ohms for a director spaced 0.1 wavelength from the directly-driven dipole, and approximately 8 ohms if an additional reflector is spaced 0.15 wavelength behind the other two.

This still further lowering of the radiation resistance will mean that the feeder spreading will have to be reduced from the values given by Roberts. Actually, the best method of determining the correct distance will be to place a pair of clips on the ends of the feeders and then to slide these clips back and forth on the directly driven dipole until standing waves are removed from the feeder system. The distance of fall of the "Y" in the two feeders should be kept approximately the same as the spacing between the two taps on the antenna. This, however, is not a particularly critical adjustment and might be used to trim up the antenna to remove completely the last trace of detectable standing waves.

Incidentally, the array should be tuned up for an operating frequency in the center of those to be used as a very large range of frequency cannot be covered. An array with a radiation resistance as low

[*Continued on Page 91*]

Calls Heard

Numeral suffix indicates "R" strength. Send Calls Heard to Calls Heard Editor, not to Los Angeles.*

Reseau Belge, ON4AU, 23 ave de e'orea', Brussels, Belgium

(14 Mc.)

W—5AAA; 5BGK; 5BQR; 5CJZ; 5ECO; 5FSK; 5FWN; 5GEC; 5GIH; 5HJ; 6ACE; 6ACL; 6ADP; 6AIX; 6AM; 6AN; 6AZO; 6BAM; 6BJM; 6BXB; 6CEO; 6CFM; 6CIA; 6CLD; 6CMQ; 6CRI; 6CUQ; 6CZE; 6CX; 6DEC; 6DIO; 6DL; 6DOB; 6EHJ; 6EKQ; 6EKT; 6ELC; 6EML; 6ERT; 6EYR; 6FHE; 6FIV; 6FKG; 6FOW; 6FTU; 6FWR; 6GBG; 6GCX; 6GKC; 6GKZ; 6GPB; 6GQK; 6GRB; 6GRL; 6GSL; 6GT; 6HIW; 6HJT; 6HYT; 6IES; 6IMV; 6INZ; 6IPH; 6ITU; 6JGC; 6JNM; 6JPE; 6JSG; 6JWT; 6JYA; 6KAV; 6KEV; 6KEX; 6KIN; 6KIP; 6KJK; 6KPE; 6KUT; 6KWC; 6LDM; 6LEE; 6LEV; 6LHN; 6LIX; 6LAY; 6LPK; 6LQX; 6LSX; 6LUR; 6LXC; 6MCG; 6MDD; 6MEK; 6MHW; 6MJY; 6MR; 6MRB; 6MVW; 6MX; 6MXN; 6MZH; 6NC; 6NDQ; 6NHQ; 6NIK; 6NKT; 6NLS; 6NLZ; 6NOT; 6NPL; 6NPY; 6NYA; 6OAF; 6OFC; 6OGB; 6OGF; 6OMV; 6OR; 6OS; 6OSG; 6OSS; 6OVC; 6OXS; 6QJ; 6UF; 6UFB; 6UR; 6VB; 6WN; 6XE; 7AAF; 7AAT; 7ADU; 7AMX; 7AQB; 7AVV; 7AWE; 7AYO; 7BMJ; 7BNG; 7BPE; 7CJR; 7CMO; 7CSF; 7DL; 7DSZ; 7EJD; 7ENW; 7ENY; 7ETK; 7EVE; 7EZC; 7EZS; 7FAU; 7FHW; 7FQT; 7FWR; 7FZA; 7FZR; 7GBC; 7GEW; 7GK; 7IJQ; 7RWR; 7SS; 7XFI; 7YLP. CE7AA. **CM**—2AV; 2CH; 2FK; 2PM; 2WD; 7AB; 7AI; 7CX; 7FR; 8AF. CR7PN; CR7AC; CR7AJ; CR7AU; CR7AW; CR7AY; CR7RB; CX1BG; CX2AJ; CX2BK; CZ7G; EL2M; F1AA; FB8AA; FI8AC; FM8AD; FK1CC; FP2FK; FP8PX; FQ8AB; FR8VX; FY8E; HC1JW; HC1PZ; HH2LD; HH3I; HH4A; HH4AS; HI1M; HI6O; HK4EV; HK4GE; HK4RM; HK5DB; HS1BJ; J2CE; J2JJ; J2NA; J2OV; JBCF. **K**—2BR; 4DTA; 4EF; 4EGZ; 4EIL; 4EJF; 4EKC; 4EPO; 4EYN; 4GZ; 4VG; 5AA; 5AC; 5AG; 5AY; 5PN; 6BNR; 6BTR; 6EO; 6FAZ; 6HAA; 6ILT; 6IXT; 6JPD; 6JYA; 6MVF; 6NZC; 6OGX; 6OJI; 6OJV; 6OKN; 6OQV; 6QU; 6TE; 7BGE; 7COI; 7DNL; 7EVM; 7FJC; 7FNL; 7FYI; 7GG; 7GIE. KA1AN; KA1FM; KA1SL; KA1SP; KA1YL; LU2FP; LU3DH; LU4DH; LU4BB; LU5AN; LU5CZ; LU6AM; LU7AZ; LU8EN; NY1AE; OA4AQ; OA4JA; OM2BC; OQ5AE; OX7GE; OX7A; PK1HP; PK1MF; PK1MR; PX1B. **PY**—1AZ; 1BR; 1CI; 1FF; 2AL; 2AM; 2DO; 2HM; 2HU; 2HQ; 2HT; 2KT; 2KX; 3AW; 3CM; 3EL; 4AP; 5AP; 5AQ; 8AB. ST2CM; ST2LR; TF3AG; TG1S; TI3MR; TQ8VA. **VE**—4AAJ; 4AAL; 4ABP; 4AIP; 4AU; 4BF; 4DC; 4ED; 4JV; 4KO; 4KX; 4LK; 4OX; 4SY; 4UN; 4UT; 4ZC; 5ABU; 5ACN; 5AES; 5AM; 5BI; 5EC; 5GQ; 5HA; 5HR; 5KC; 5KG; 5KI; 5LD; 5MZ; 5OJ; 5OM; 5PT; 5RW; 5UW; 9AL. **VK**—2ADE; 2AFM; 2AEZ; 2AH; 2AOE; 2BR; 2CY; 2DA; 2EG; 2GX; 2HF; 2HV; 2HZ; 2LP; 2NA; 2OQ; 2OX; 2PX; 2RB; 2TF; 2TI; 2TT; 2XT; 2YL; 2ZC; 3AH; 3BZ; 3KQ; 3MR; 3NS; 3NY; 3OC; 3QE; 3SB; 3TU; 3VB; 3VJ; 3VQ; 3XP; 3XU; 3ZB; 3ZR; 4AL; 4BB; 4EL; 4HJ; 4SD; 4TK; 4UJ; 4UR; 5AB; 5FM; 5HC; 5HG; 5HM; 5HX; 5JS; 5JT; 5LL; 5RX; 5YF; 7AB; 7AG; 7CM; 7KR; 7KV; 7LJ; 7LZ; 7YL. VO1P; VO3OP; VO4Y; VO6D; VO6JQ; VO7F; VP1RB; VP3BG; VP5AD; VP5PZ; VP6MO; VP6MY. **VQ**—3ALT; 3FAR; 3HJP; 3TOM; 4CRI; 4CTF; 5KLB; 8AB; 8AE; 8AS. VR4OC; VR5CD; VS7RB; VU2BA; VU2BB; VU2DA; VU2DB; VU2FD; VU2FH; VU2FV; VU2FX; XE1AA; XE1AB; XE1AG; XE1CM; XE1DA; XE2AN; XE3AC; XSM7YN; XZ2C; XZ6KR; YH6BR. **YV**—1AK; 2CU; 2CV; 5ABJ; 5ABW; 5AC; 5ACC; 5AL; 5AN. **ZL**—1AB; 1AD; 1AV; 1BI; 1CX; 1DM; 1DS; 1DV; 1FT; 1GG; 1GI; 1HY; 1IM; 1JI; 1JV; 1JZ; 1KE; 1LM; 1MQ; 1MR; 1NT; 2AZ; 2BI; 2CI; 2CP; 2CT; 2DS; 2FX; 2GA; 2GI; 2GN; 2GO; 2GS; 2II; 2KR; 2IY; 2LB; 2MN; 2NM; 2OA; 2OU; 2PM; 2QA; 2QM; 2SC; 2SH; 2SM; 3AB; 3AZ; 3FH; 3FZ; 3GR; 3KG; 3KZ; 4AC; 4AE; 4AF; 4AU; 4BQ; 4BR; 4CK; 4DQ; 4FR; 4FS; 4GM; 4GN. **ZS**—1AH; 1AN; 1AS; 1AV; 1B; 1Z; 2F; 2J; 2X; 2Y; 3F; 5AH; 5Q; 6AA; 6AM; 6AZ; 6G; 6J. **ZT**—1Q; 2Q; 2SP; 2V; 2Z; 6AH; 6AL; 6KZ; 6Y. **ZU**—1D; 1T; 1V; 2B; 2G; 5AQ; 6D; 6J; 6N; 6V.

●

Bob Everard, Oakdene, Lower Sheering Road, Sawbridgeworth, Herts, England

(14 Mc. phone)

CO6OM; CR7MF; CT2AB; CT2BC; FB8AB; FB8AD; FB8AF; FR8VX; HH2B; HI1C; K4BAY; KA1BH; KA1ME; KA1YL; OQ5AA; PK1GL; PK1MX; PY7LC; VE3XX; VO4Y; VO6D; VO6JQ; VP3PHE; VQ4CRE; VQ4KTB; VS2AK; YV5AK; ZE1JA; ZS1AX; ZS1K; ZS2N; ZS6AA; ZS6AK; ZT1M; ZT6AK; ZT6AL; ZT6AM; ZT6AS; ZU5L; ZU5Z; ZU6N; ZU6P.

(28 Mc. phone)

W—1ADM; 1AUT; 1BEF; 1BJC; 1BLV; 1CAA; 1COA; 1COV; 1DAY; 1DQK; 1ELR; 1EYS; 1HHU; 1IAD; 1IFD; 1ILQ; 1IBU; 1IXP; 1JGU; 1JLK; 1JIZ; 1JU; 1KBT; 1KJJ; 1KUD; 1SE; 1WV; 2AHX; 2ALK; 2AMM; 2BAA; 2COT; 2DVV; 2FGH; 2FQD; 2FWK; 2GMR; 2GSQ; 2GUM; 2JIH; 2JRV; 2JXI; 2JYS; 2KHR; 2KLV; 2KOX; 3AKX; 3AXU; 3CBT; 3CKT; 3DQ; 3EDZ; 3FAR; 3FMQ; 3FVO; 3FXU; 3GEX; 3GIO; 3GHS; 3GPM; 3GSE; 3GSV; 3GUF; 3GZG; 3GZN; 3HDA; 4AQ; 4AZB; 4BUD; 4CJN; 4CPB; 4CYT; 4CUU; 4DDT; 4DRZ; 4DV; 4ECI; 4EDQ; 4EEV; 4EKI; 4EKR; 4FT; 4GB; 4NN; 4YC; 4ZF; 5BAT; 5CHG; 5EGU; 5EHM; 5EME; 5ESI; 5FDE; 5FMY; 5FPZ; 5GKZ; 5VQ; 5WR; 5ZA; 6CGY; 6CKR; 6ERT; 6GCX; 6LUB; 6MDN; 6NLS; 6OZL; 8ALT; 8ANO; 8ARA; 8AUW; 8AV; 8BIQ; 8BTO; 8BWB; 8BYP; 8CFA; 8CFD; 8CHQ; 8CIR; 8CKY; 8CLG; 8CLS; 8DTK; 8EBS; 8EPM; 8EUK; 8FMN; 8HER; 8HHZ; 8HM; 8HSP; 8IWC; 8JFC; 8JLW; 8JVI; 8JVY; 8KWI; 8KYY; 8LAC; 8LGO; 8LSL; 8MAP; 8MID; 8MRK; 8NDB; 8NK; 8NMM; 8NMU; 8ODE; 8OE; 8OG; 8OQG; 8OQW; 8OTG; 8OTK; 8PEN; 8PHB; 8PNJ; 8POP; 8PPA; 8PZX; 8QBO; 8QGZ; 8QKI; 8QLK; 8QOV; 8QUR; 8QWZ; 8QXT; 8RAE; 8RIS; 9AGO; 9AKJ; 9ARK; 9ARN; 9AVS; 9AZE; 9BBR; 9BBU; 9BHT; 9CCI; 9CHI; 9CLH; 9DHK; 9DUU; 9DWU; 9EMB; 9WYI; 9EW; 9FAA; 9FWL; 9GEG; 9GGY; 9GQP; 9GWM; 9HDY; 9ILQ; 9JBO; 9JKK; 9KQE; 9LIG; 9LZP; 9MMM; 9NKX; 9OQN; 9PBY; 9PQH; 9PZI; 9QI; 9QUH; 9ROQ; 9RUK; 9RZM; 9TEJ; 9TFY; 9TII; 9TMH; 9TMP; 9UDO; 9UGR; 9UQJ; 9UVV; 9VFB; 9VFZ; 9VID; 9VOF; 9WAA; 9WCP; 9WDH; 9WNQ; 9WOW; 9WTQ; 9YDC; 9YHQ; 9YWN; 9ZGA; 9ZHB; 9ZKD; 9ZNA; 9ZUZ; 9ZWW; 9ZYR. CN8AN; CN8MI; CO7CX; CO8RQ; HI7G; K4EIL; K4EMG; K4EPO; K4ESH; K4EZR; K4FAY; SV1CA; SV1KE; TI2FG; TI2RC. **VE**—1AU; 1BR; 1DR; 1EA; 1JA; 1W; 2HG; 2ID; 2KX; 3AF; 3AIW; 3BV; 3LY; 3NH; 3QL; 4ADV; 4AW; 4KX; 4OK; 4SN. VP6YB. YR5TI.

●

Eric W. Trebilcock, (BERS195), Darwin, North Australia

December, 1937

(7 Mc. phone)

G8TI.

(14 Mc. phone)

W4AUS; W4DLH; HI7G; J1NF; K4DIH; K6CMC; K6NZ; KA1AF; KA1CS; KA1ER; KA1HS; KA1ME; KA1YL; PK2AY; TI2RC; VS2AS; VS7GJ; ZE1JR; ZU6AF.

(7 Mc.)

W 1BFR; 1GCL; 1JSK; 2ESX; 3ADO; 3CBV; 3HFJ; 6OUW. CR7BC; D3ZMI; EA8AK; F8IG; G5LP; G8BH; G8KB; G8LV; G8NH; G8OM; G8WP; GW3AX; HA2N; KA1AX; KA1EL; KA1FB; KA1RC; ON4IW; ON4JC; PA0AZ; PX2B; VR4AD; VT3AB; XU7CK; XU8CV; XU8LM; XU8WT; YR5HC. **ZS**—1BE; 1CX; 5AK; 5AS; 5G; 5K; 6D; 6M; 6EJ; 6EQ. ZT2G; ZU6G.

(14 Mc.)

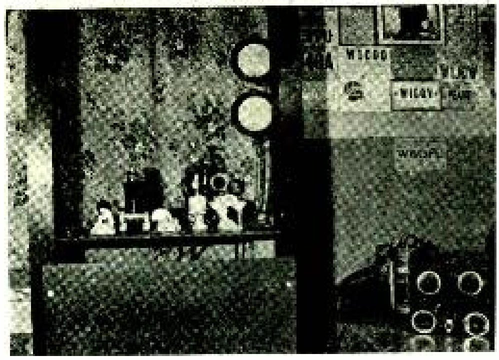
W—1ABW; 1BFA; 1BLA; 1BXC; 1DUK; 1FTR; 1GLX; 1IBL; 1IHL; 1JRJ; 1KKA; 1KHE; 1KN; 1VN; 2APT; 2ARB; 2CJM; 2CYS; 2DPA; 2DTB; 2FMP; 2GW; 2GTZ; 2HMJ; 2IFZ; 2JNY; 2KAK; 2KEZ; 2KL; 2OA; 2PY; 2UQ; 3ATR; 3AWH; 3BIU; 3BM; 3BSB; 3SVK; 3DAL; 3CKT; 3DDM; 3DI; 3DRJ; 3ENX; 3EYP; 3EYU; 3FAB; 3FEI; 3FRE; 3GTL; 3JM; 3TR; 3ZB; 4ADA; 4AWY; 4AIH; 4ACV; 8BVD; 4BYF; 4DBF; 4DTR; 4DXM; 4DZB; 4DZO; 4EJN; 4EOY; 4EQM; 4ETP; 4MR; 4ZH; 5CUJ; 6OEG; 6PFQ; 8BMK; 8BTI; 8CKU; 8CUO; 8CRA; 8DFH; 8ERA;

[Continued on Page 84]

*George Walker, Assistant Editor of RADIO, Box 355, Winston-Salem, N. C., U.S.A.

56 MC....

By E. H. CONKLIN*



The automatic transmitter at W6OFU . . . runs 10 watts input.

Rumor is flying around these parts, and we have tried everything except telegraph, cable, and transatlantic phone calls to check what we hear. W9QDA was listening to GM6RG on 28 Mc. February 22 and reported to us parts of the conversation. The way we get it, GM6RG has been using 400 watts crystal controlled on 56 Mc., and a whole tape transmission was copied recently by W2JCY. As soon as we can get the details of this, we'll let you have them.

On Saturday, February 26, between 9:15 and 9:30 a.m. Central time, W9QDA heard a weak code signal of which he could copy only a V and an 8 of the call. It wasn't W8CVQ, and unless it was a harmonic of some local transmission, it may have been dx.

The National Bureau of Standards has checked the ionosphere records for the time of the most recent reception of VK2NO in Wales, British Isles, and writes as follows:

"This was a period of very high daytime F_2 critical frequencies and it would appear that transmission over the daytime part of the path was probably by way of the F_2 layer. We have no reports of the occurrence of sporadic E in Australia although ionosphere measurements are being made there, but it would seem that transmission over the night part of the path must have been by sporadic E."

We also checked up on the reason for some 600-mile 28-Mc. transmissions around the first of February when sporadic E reflections are relatively rare. The only explanation that the Bureau offers is that they were by scattered or G-layer reflections (a very high layer above the F_2—ED.). These support weak, poor-quality transmissions over moderate distances at frequencies considerably above the F-layer transmissions. The Bureau does not consider the G-layer in calculating maximum usable frequencies.

Conditions have not been good to us for 56-Mc. dx since the first of the year, though there was measurable improvement in the middle of February. We present boiled-down F_2 layer data for recent weeks:

	Noon vertical critical frequency	Max. usable frequency (2200 miles)
February 2	13,600	42,700
February 9	14,400	45,100
February 16	13,500	41,600
February 23	13,200	39,000
March 2	13,400	40,200

Thus it will be seen that on Wednesdays, the theoretical maximum frequency for dx communication has been around the European television frequencies.

The F_2 layer is a winter phenomenon, the change to summer not being gradual but with a few days of summer conditions alternated with a few of the winter type. This is the thing that discourages the 28-Mc. gang before the last dog has died. In April or May, sporadic E-layer reflections should pop in again and 500 to 1200-mile five-meter dx should put in its 1938 appearance.

W6OFU Beacon

The automatic transmitter at W6OFU, Jerome, Arizona, is running at 10 watts input week-days from 8:30 a.m. to 5:45 p.m. Mountain time, and Sundays from 9:30 a.m. to 5:00 p.m. or later. Mrs. Sampson often stops the rig on Sundays long enough to listen carefully over the band.

The receiver is at the right in the accompanying picture of the rig at Jerome. The r.f. tube is a 6K7, followed by 6C5 detector and 6C5 audio. Self-excited signals are hard to copy on it but it seems very good on crystal control.

[Continued on Page 76]

*Assistant Editor, RADIO.

Super-Regenerative Receiver

[*Continued from Page 22*]

power of the tube is barely great enough to furnish a grid excitation voltage of sufficient magnitude to maintain the output at a constant level. If the grid-leak resistance is relatively low, this equilibrium condition is stable, because any slight decrease in grid-excitation voltage is accompanied by a slight decrease in the bias voltage produced, which allows the output to rise to its original level. If, however, the resistance of the grid leak is very high, the equilibrium is unstable. The slightest decrease in output power, such as might be caused by a circuit noise voltage acting in opposition to the u.h.f. oscillations, causes a decrease in the grid excitation, which then causes a further decrease in output, thus tending to make the effect cumulative. The time required for the grid condenser to discharge through the grid leak is great enough to prevent the bias voltage from dropping to a value which allows the oscillations to build up again, until after they have fallen to a negligible amplitude.

The condition of incomplete quenching, sometimes used in the separately-quenched receiver for reducing the characteristic noise, can also be obtained in the self-quenching receiver by using a continuously variable grid-leak resistor. Because most small variable resistors have considerable stray capacitance, a fixed resistor should be connected in series with the variable resistor, on the grid side. In one receiver, satisfactory results were obtained with a 25,000-ohm fixed resistor in series with a 3-meg. variable resistor. A .00005-μfd. grid condenser was used.

Design Considerations

Every superregenerative receiver used in the 5-meter band or above, except those used for transceiver service, or where extreme portability is required, should be equipped with a radio-frequency amplifier, to prevent radiation from the detector circuit through the antenna. Obviously, there should be no regenerative coupling between the plate and grid circuits of the r.f. amplifier, as this would tend to defeat the main purpose of the amplifier.

Even when a pentode r.f. amplifier is used, a little energy gets through from the detector to the r.f. amplifier input circuit. This can cause some confusion if the receiver is first tested with the antenna disconnected, because under that condition the damping of the r.f. input circuit is low, and the energy stored in this circuit during the class-C period remains at the beginning of the next build-up period to

LEADING MANUFACTURERS CHOOSE EIMAC
for important Ultra High Frequency work

For the past two years the nation's leading radio engineers have been carrying on extensive experiments in the field of Ultra High Frequencies. Among other outstanding achievements, has been the development of a group of powerful transmitters which will enable transport and other aircraft to accomplish a safe blind landing. The importance of *dependability* in an instrument of this type is obvious.

Equipment for this work must perform its function perfectly all the time. It must work without the help of the operator, for it is sealed from the weather and handled by remote control. The tubes, as in all transmitters, are the most vital part. They must be rugged, dependable and highly efficient.

It is significant to note, that practically every firm now engaged in this difficult task, uses Eimac tubes. Certainly this endorsement should mean much to the radio amateur. It offers convincing proof that Eimac tubes will give superior performance in your transmitter.

Eimac TUBES

EITEL-McCULLOUGH, INC. • San Bruno, California

a great enough degree to interfere with the quenching action, and suppress the characteristic noise. This trouble usually disappears when the antenna is connected.

Some provision should be made for adjusting the quenching action. In the separately-quenched receiver, this can be done by varying the plate voltage on the quench oscillator, and in the self-quenching receiver by using a variable grid-leak resistor, as previously mentioned.

When a new design of a superregenerative receiver is first tested, various values of regeneration, quench frequency, quench voltage, and grid-leak resistance, should be tried.

Unlike the regenerative receiver, the superregenerative receiver becomes less selective as the regeneration is increased.[1] Too little regeneration, however, makes the receiver too insensitive, and necessitates a very low quench frequency, which cannot be lowered indefinitely without coming within the audible range.

When a new design of superregenerative receiver is first tested, the detector should be operated at a low plate voltage, or a "Littelfuse" used in the plate circuit, because, like any other grid-leak-biased oscillator, it can be damaged by excessive plate current if it fails to oscillate. If the characteristic noise is not heard, bring the hand near the detector circuit and observe whether the plate current fluctuates. If the detector seems to be oscillating but the characteristic noise is not heard, the quenching is probably incomplete, and the trouble probably can be cured by using a quench voltage of greater amplitude or lower frequency, in the case of the separately-quenched receiver, or by using a higher resistance grid-leak or a higher capacitance grid condenser in the case of the self-quenching receiver.

[1] loc. cit.

A Beam Without Insulators

[*Continued from Page 23*]

behind the antenna. The reflector tuning may react upon antenna length, so the antennas can be adjusted last. It may make little difference in tuning whether the transmitter is coupled to the antenna and a field-strength meter used, or whether a receiver is hooked on and a portable transmitter used. Reflector length for lowest rear-end radiation may be slightly different from that for best forward gain.

A gain of about 10 db is claimed for the 8-element R.C.A. antennas, while about 7 db gain can be expected of four antennas with no reflectors. The signal is concentrated along the

very low angles, and the beam is not particula ly sharp.

There is some unwillingness in amat circles to use horizontal antennas on ultra-h frequencies. Measured data sho little difference between horizontal and vertical polarization for overland transmission, although vertical polarization is superior to horizontal over sea water, at least for moderate distances with relatively low antennas. The use of the horizontal arrangement may reduce noise pickup.

The "Bi-Square" Antenna

[*Continued from Page 39*]

as 50 feet with satisfactory results, especially if it is not "boxed in" by trees and houses. The performance will not be as good as with a higher pole, but will still compare favorably with the best.

With the lower pole it will be necessary to run the stubs out from the pole parallel with the earth.

To hit the center of the 20-meter band, the 10-meter dimensions specified in the diagram should be doubled and then increased by about 5 per cent.

W9UAQ 56 Mc. Beacon

[*Continued from Page 35*]

Streamliner could have been used with a 14-Mc. crystal, it was felt that frequency drift might be less with an AT-cut 7010-kc. crystal. As a result, the 6L6 crystal stage was converted into a tritet by replacing the cathode choke with a coil. The plate circuit is tuned to 14,020, and a 6L6 doubler to 28,040. The balance of the circuit is the recommended one, with a T20 doubler to 56,080 and a pair of T20's in the final with 125 watts input. All grid, cathode and screen resistors are twice the recommended wattage rating because of the requirement for continuous operation. The feeders, parallel tuned, run up to four vertical half-wave wires arranged at the corners of a square, and feed a combination broadside and end-fire bi-directional array which by means of a relay in a weatherproof box can be changed 90 degrees in direction.

A modulator using four 6A3's is driven optionally on phone, or by a tone oscillator keyed manually or automatically with a tape device cut to send, "VVV W9UAQ W9UAQ." While only the modulation is now keyed, this is to be changed to carrier keying soon. There is available a play-back record for continuous phone announcements.

At W9UAQ, Al Cox has a kilowatt transmitter using a pair of T200's in the final, ready on the same frequency to contact any dx that may come through. Several receivers are available, one being a special Ultra-Skyrider built with only 56-Mc. coils and peaked for operation on that band. W9QDA also has 700 watts on a pair of 100TH's operating on the same frequency as the "beacon," or on 58.16 megacycles. The receiver at W9QDA at present has acorn tubes in the r.f. and conversion stages of a superheterodyne using resistance coupled i.f. stages.

With 500- to 1200-mile dx expected to start any week now, running through the summer, we look forward to receiving many reports on these signals. It is hoped that this transmitter proves very helpful to others in indicating when the five-meter band is "open" to Chicago.

●

The only actual non-metallic element which finds its way into radio construction is *carbon*.

Take "Radio"—It's Complete

The Hamset Receiver

[*Continued from Page 42*]

A 6J7 is used in the preselector stage in order that advantage may be taken of its sharp cutoff feature. Greater sensitivity to weak signals is obtainable, of course, when using a tube of this type. The only suggestion to be made to the builder of this receiver with reference to this particular stage is in regard to the degree of antenna coupling. If too much coupling is used, the preselector stage cannot be made to oscillate with the regeneration control at maximum and the point of greatest sensitivity is lost. When the grid circuit of this stage is insufficiently coupled to the antenna, the circuit will oscillate much too easily with very little applied regeneration. For the most satisfactory operation, the antenna coupling should be adjusted by varying the distance between the primary and secondary of the first coil until the circuit will oscillate slightly before the regeneration control reaches maximum.

The second radio frequency amplifier stage is capacity-coupled to the preselector stage and employs a 6K7 tube in its circuit. Inductive coupling is used between this stage and the detector. Here again the best operation can be obtained by experimenting with the degree of coupling. The detector stage, as well as the second radio frequency amplifier, is of the usual standard design. The detector also uses a 6K7 tube and regeneration is controlled here, as well as in the preselector stage, by variation of the screen-grid voltage. The grid leak resistor is of 5-megohms resistance.

Impedance coupling is used between the detector and the following audio stage. The pentode 6F6 type of tube is used as an audio amplifier. Sufficient detector output on ten-meter phone signals is available to drive the pentode to its full undistorted output of 3 watts. This is more than sufficient audio output for most purposes. The audio output is controlled either by a reduction of the gain of the first stage, the detector output or by the switch so placed in the circuit in order that the screen grid voltage of the pentode can be reduced to a value that will limit its output to a desired value. Other systems, of course, can be employed to reduce or control the audio signal level.

The frequency stability of this receiver is of high order. The preselector stage is in no way disturbed when adjustments are made in its gain. With the regeneration reduced to a normal value, this stage tracks with the main bandspread tuning condenser over most of the band so that it is not necessary to tune this circuit until the desired signal has been located. With a variation in the detector regeneration over its usable range when receiving c.w. signals, the only effect noticed is a slight change in the audio frequency note of the incoming signal. In many instances this occurrence can be used to advantage as the c.w. men well know.

Dials of the type shown which permit the reading of degrees of rotation to a tenth part are well worth while. With this particular set, calibration was accomplished by the use of a 100-kc. oscillator. The favorite band was calibrated directly in kilocycles by pasting a strip of paper so cut as to follow through the 180 degrees of rotation immediately below the dial markings. On this the frequency in kilocycles was marked. For the other bands calibration charts are used. Without the particular type of dials used it would be extremely difficult, if not impossible, to hold this calibration after changing about from one band to the other. As the receiver is quite stable, calibration can be maintained by resetting the dials back to the original settings to the tenth part of a degree. A small indicator was glued to the upper section of the main bandspread dial in order to aid in reading the frequency in kilocycles on the printed dial.

A well-filtered power supply is essential to the satisfactory operation of the set. Its output should be from 225 to 250 volts. Care should also be taken in regard to proper filament voltages as improper voltages quickly introduce hum or decrease the receiver's output.

A bit from a Vancouver daily sent in by VE5AS says, "When one amateur desires to call another one, he transmits CQ continuously until he is picked up by another ham."

A "Sure-Fire" Crystal Oscillator

[*Continued from Page 48*]

monic and yet kept the crystal r.f. current to a low value on fundamental operation. Higher values result in greater harmonic output but in higher r.f. current on the fundamental. Values from 10,000 ohms to 250,000 ohms were used with various tubes and 50,000 ohms was found to be a good compromise value for all ordinary pentodes or tetrodes. A 100,000-ohm resistor is slightly better for beam power tetrodes such as a 6V6G or 6L6G.

The 6F6 or 42 work very well in the figure 2 circuit with a C_1 value of .0001 μfd. if heavily loaded. Eight to 12 watts output can be obtained easily from 160 to 20 meters and about 5 watts on 10 meters. A 6L6G tube requires a higher value of C_1, about .0004 μfd. unless heavily loaded. Outputs from 10 to 20 watts can be obtained without appreciable crystal heating or drifting. A lightly loaded 6L6G may be too regenerative unless the condenser C_1 is as high as .0004 μfd. The length of leads, type of construction, and types of oscillator and buffer tubes determine the best value of C_1 and to some extent, R, in figure 2. The tetrode and pentode tubes are less critical than triodes as far as values of C are concerned which means that small mica fixed condensers may generally be used in the circuit of figure 2. Several .0001- or .00025-μfd. mica condensers can be connected in parallel for C_1 when testing the oscillator.

A single spaced 50-μμfd. plate tuning condenser is satisfactory for the circuits of figures 1 and 2 unless the plate voltage exceeds 400 volts in figure 2. An 807 or RK39 can be used to provide over 30 watts output with a 600-volt plate supply with 160- and 80-meter crystals. At high plate voltage, the crystal current may be excessive on fundamental operation when the plate tuning condenser is left at too low a capacity setting. In general, the plate circuit is always tuned to the point of minimum plate or cathode current. This applies even to fundamental frequency operation since the common feedback circuit prevents the oscillator from being critical in its tuning adjustments. An ordinary pentode or tetrode crystal oscillator circuit will usually stop oscillating very near the tuning adjustment which provides minimum plate current and lowest r.f. current in the crystal.

A radio frequency choke is needed in the plate voltage supply lead and the ordinary 2- or 2½-mh. pie wound 125-ma. r.f.c. is satisfactory for all band operation. A 2-volt 60-ma. or 6.3-volt 150-ma. Mazda pilot lamp can be soldered in series with the tube grid lead to act as an indicator of r.f. current flowing through the crystal. The coil turns are similar to those listed for any 6A6 or pentode oscillator of doubler circuit.

Enough capacity should be used for C_1 to cause the oscillator tube to stop oscillating abruptly when the plate tuning condenser is rotated to high capacity settings. Too small a capacity in C_1 will cause self-excited oscillation. Too large a capacity in C_1 will result in low harmonic output when the tube is used as a doubler. When the correct value of C_1 is chosen for any particular transmitter design, no further changes are necessary when changing tubes or crystals providing the tubes or crystals are in good condition.

More Speech Power

[Continued from Page 51]

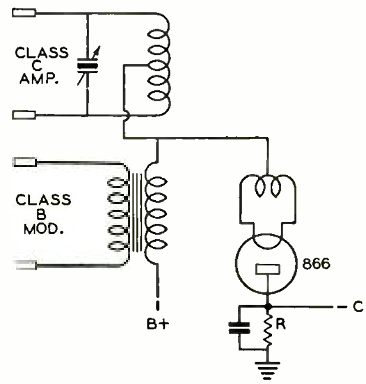


FIGURE 4

ma. The amplifier is actually capable of a sine wave output of one-half the peak power although the plate dissipation is exceeded by about 100 per cent. *At no time should the familiar whistle test be used to check the percentage of modulation* as it is possible to kick up the plate current to over 400 ma.

The use of an inverse rectifier is suggested for use on the modulated class-C stage. This rectifier may consist of a single 866 or of an 879 (figure 4) so arranged that a voltage is developed across R when overmodulation occurs. Point C may connect to a 6E5 "magic eye." As well as being the only reliable means of determining whether or not the class-B stage is being overloaded, this method provides a very efficient overmodulation indicator.

Following the steps outlined above it is possible for any amateur to double effectively his peak audio power; however, for those who do not care to make the necessary calculations, a number of popular tube types are listed in the table on page 51.

56 Mc.

[Continued from Page 67]

The transmissions are usually on 56,800 kc., but occasionally 57,864 is used on scheduled contacts with W6OZM, who is now in Albuquerque, 130 miles away, R5 signals at both ends with 50 watts input. A temporary two-section Franklin antenna is being used.

From Michigan

Walter G. Marburger, W8CVQ, writes us from the Western State Teachers College in Kalamazoo, Michigan, where he is in the Department of Physics. There has not been much five-meter activity around Kalamazoo since the Detroit five-meter contest in January and since W9CLH in Elgin, Illinois, has been off the air. The schedules with W9CLH held up fairly well all through the fall and until late in January. Signals seemed to get weaker as the winter progressed, and fading was especially annoying. With the coming of spring weather, real dx both of the lower atmosphere and sporadic E-layer types are expected. In fact, W1SS has already sent a card promising a 56-Mc. contact in May.

The transmitting frequency at W8CVQ has been shifted to 58.02 Mc. with a new low-drift crystal, so that the c.w. signal is much steadier than formerly. With an 807 in the driver stage, the final input has been boosted to 200 watts.

During the Christmas vacation, a new bi-directional rotary beam antenna was installed on the roof. It uses a broadsided pair of double-section W8JK flat top antennas standing on end and fed from the bottom, giving vertical polarization. It has produced very satisfactory results. According to measured horizontal field patterns, practically all of the signal is within about 22 degrees of the nose in either direction and, of course, the stacking of the half-wave elements gives some vertical directivity.

W4EDD Automatic

H. H. Robinson, W4EDD, is located in Coral Gables, Florida. He is ideally located to work the Boston-New York-Chicago stations during the spring and summer sporadic E-layer dx, and last summer worked W5EHM cross-band. A new transmitter and beam for 56-Mc. work has just been completed, and automatic transmission has already been scheduled to start. During the third week in February, several five-meter signals were heard indistinctly but they were not identified. With several superhets and a 1-10, none of which seems satisfactorily sensitive, Robie plans to purchase something extra special in the near future.

Buffalo-Rochester Area Active

The northwestern corner of New York state is very flat, and 56-Mc. contacts of 35 miles are considered good, although W5EHM was heard up that way last summer. Ralph Janowsky, W8NOR, teamed up with Donald Buck, W8CDM, to do something about it. They moved W8NOR's 100-watt crystal-controlled transmitter over to W8CDM's Yagi array which has 3 reflectors and 3 directors. The first schedules were with Erie, Pa.; Toronto, Ontario, and Rochester, N. Y. While there was no response to the beam-cranking and i.c.w. calling on the first evening and during the arranged schedules on the second, W8PK near Rochester listened beyond the scheduled time and heard W8CDM. He called W8AGU in Rochester on the land line, who also picked up the signals. A phone call from Rochester to North Tonawanda confirmed the fact that the 100-mile signals were getting through. There wasn't any luck making the contact two-way until W8PK was told to use 75-meter phone, and he replied on c.w. in the middle of the phone QRM. It was found that a slight adjustment of the beam had a large effect on the signal strength.

W8NOR usually operates on 57,844 kc., and is looking for schedules.

The only communication received from W8IPD in Niagara Falls lately is an envelope full of pictures of "the bridge that failed."

Television in Arizona

We have received a couple of letters and a log from Clyde Criswell who has charge of the Dairy Experimental Station at the large Mission Ranch, near Phoenix. He has been hearing HRX7 and HRX2 in Honduras on about 43 and 48 Mc. Mr. Ellinson, superintendent of Tropical Radio and Telegraph, La Limon, Honduras, has confirmed the transmissions. The signals often come through when no other signals are heard at the same frequency, a peculiarity common to 28-Mc. signals over a north-south path to Central America.

Criswell is most interested in logging transatlantic conditions on the frequencies used by the European television stations. London came in every day from October 19 to December 1, with R9 signals from November 1 to 7, the week during which there were several reports of transatlantic 56-Mc. reception on the east coast. The London signals were in again from February 15 to 22.

A harmonic of W2GMM has been heard several times on c.w. on 42 Mc., and on February 18 he was heard just above 56 Mc. along with other harmonics out to 58.2 Mc. About February 18, a W9 phone was heard discussing verticals vs. horizontals, but the fundamental was not checked for an identification of the call because the French television had been coming through—it was R9 at 9:30 a.m. Mountain time.

An east-west horizontal antenna was used before February 1, but now signals above 40 Mc. come through better on a north-south horizontal.

Indianapolis Ready

Charles Bivens, W9VLI, says that there are only three stations active on the band in Indianapolis, and it's a pretty big town (W9SLG calls it the world's largest small town). W9VLI, W9UZQ and W9OVF want schedules with other Indiana stations and will be on the look-out for dx. Give the boys a hand!

Harmonics, a publication of the Chicago Area Radio Club Council, says that in addition to W9UAQ (56.08 Mc.), the following are on quite regularly with tape transmission: W9TLQ (58.52 Mc.), W9FP, and W9ZEO.

Philadelphia News Sheet

Paul Thole, W3AUY, regularly publishes a 12-page booklet entitled, "Ultra-High Frequency News," devoted to 2½- and 5-meter activity. We learn from it that W3HI on 56,080 is actively looking for 200-mile QSO's for the R.S.G.B. contest, using 300 watts on a pair of T55's. W3GIO on 57,264 is also looking for dx. W3CGF was said to have heard G5BW last summer but has not yet received a confirmation. Some dx of the low atmospheric bending variety was worked on February 5 and 6: W1FHN worked W3GZB; W2JIG and W1EYN worked W3AXR, and W2HWX worked W3GQS. W1JJM, W2JIJ, W2CPZ and W2HWX were heard in Philadelphia. W2MO covered that city rather thoroughly; he is now using an eight-element rotary array, with 250-watts input and plans for increasing it to 800 watts. Some of the Philadelphia gang were heard by W3GLV in Leesburg, Virginia, suggesting that a Virginia to New England relay was possible.

Cubans Active

Did you ever work another country on 56 Mc.? Well, Havana is not too far from Key West, Florida, for dx of the low atmosphere type, and many CM-CO stations might be worked at a distance of 500 to 1200 miles this summer when the sporadic E layer is "right" for dx.

Justo Mahia, CM2JM-CO2JM, writes us that he is anxious to stir up interest in five-meter work. The Cuban publication *Radio Guia* (Radio Guide), is planning to encourage operation on several bands, with a view to relieving congestion. CM2JM is looking forward to collaborating the activities of the Cuban stations with those in the U. S., and hopes for QSO's on five meters this spring and summer.

We have written to CM7AB for schedule data. He is all ready with a crystal-controlled transmitter on "five" and is watching for dx.

If you have read this far in this column, you must be interested enough to write us about local activities. Remember that there is nothing sacred about the month of May—but that it is just one of the four best months for 500-1200 mile dx (May through August). Some dx of this type may be reported during April. While there is a slightly better chance for dx around noon and in the early evening, it may occur at any time of the day or night. Don't overlook the fact that when 28 Mc. is good at a distance of 300-500 miles, the five-meter band often opens up for 500-1200 mile work.

100 Cycles

[*Continued from Page 46*]

3" long and closed at one end, to be very closely 1000 cycles. The tube should be blown across to produce the tone in the same manner as a tone is obtained by blowing into a jug.

It is quite important that the dimensions be followed closely if a 1000-cycle note is desired. The tube itself may be made of any convenient material, fiber, bakelite, metal, hard rubber, etc.

Another source of a 1000-cycle test frequency is the telephone company. We understand that in the majority of large cities employing dial service there is a certain number that can be dialed for the test tone. The number to be dialed for the signal can probably be obtained from one of the installation or service men of the telephone company. In Los Angeles it is MUtual 3900. (Mr. Boyd also mentions this source of tone in his article on oscilloscopes appearing elsewhere in this issue.)

Yarn of the Month

[*Continued from Page 63*]

mie seated himself before his homemade radio outfit. The call letters K7BEJ stood above the array of coils and condensers.

"I'll see Lily about 8:15, and come over when I'm finished."

Mason looked over the intricacy of wires. It was a simple breadboard layout, neither crystal-controlled nor multi-tubed. Spare dollars in the Aleutian Islands usually are spent on boats.

"Who's Lily, Jimmie? You haven't been hiding a sweetheart, have you?"

Jimmie laughed.

"Nope. Lily probably is as much everybody's sweetheart as any girl could be. She was born on Wosnessenski Isle, about 200 miles east of here in the Shumagin group. She learned radio in the nineteen-twenties from an older brother who was a radio operator on a ship; and ever since, amateur radio has been indispensable to the Osterback family. And well-nigh indispensable to southwestern Alaska, too—because Lily handles the bulk of all the radio work that's done out here!"

Mason raised his brows.

"Tonight I'll ask Lily to tell the Starr, on her way down from Seward, that she'll have two passengers to call for at Sanak."

A dance in southwestern Alaska is the zenith of social contacts, worthy of inclusion among the strangest bits of Americana. The orchestra often consists of one banjo, or fiddle, or guitar, with probably a one-eyed player in a dirty hat. This "orchestra" plays with some difficulty not more than three recent jazz hits.

When the dance begins, the girls range themselves about the wall and the men gather in a knot by the stove. Everybody—including the dogs and the children of the village and surrounding territory—comes to the dance.

The "orchestra" strikes up his best semblance of a tune—something with a bit of rhythm left after all the mistakes—and the dancers whirl. They follow, definitely, a counter-clockwise rotation. Mason watched it begin, then grabbed the least homely girl—squaw is the usual term—and away he went.

"What's your name, girlie?" Mason felt conversational on the eve of his leave taking.

A giggle was the only response.

"Come on—tell me what's your name."

Another giggle. "Name's Hilda." She hid her face on his bosom.

"Oh, Hilda—that's a nice name!"

She giggled again.

"I say, it's deuced nice weather we're having. Did you see old Shishaldin smoking tonight?"

Giggle.

"You know those mountains blow up sometimes."

Giggle.

"Up near Kodiak, Mount Katmai on the mainland blew up in 1912 and scattered two feet of ashes all over the Island."

Giggle.

They were whirling the last bars of "No, No, a Thousand Times, No!" Mason thought to himself: "A thousand questions, and still she could only giggle."

The last series of squeaks rasped from the fiddle, and the dancers stopped. "I know," thought Mason, "I'll try her on the slippers. Always did wonder if it was true."

"Tell me, pretty maiden," he smiled, "would you like a pair of white slippers with red heels behind?"

The erstwhile coy young thing in his arms suddenly came to life.

"Oh, boy—would I?" She flung her arms about Mason's neck and kissed him, then fled. Mason, reddening under the focus of all eyes, likewise fled. It was, he decided, time for a cigarette.

The evening air outside refreshed him and made him a bit ashamed.

"Fancy me, playing the dandy to a squaw!"

He looked for Shishaldin's uncertain form across the water.

"Dumbbell," he thought, "waxing scientific about Katmai and the ashes!"

He threw down his cigarette as a shadow approached.

"You Foster Mason?"

It was one of the Aleuts from the dance hall. Mason could make him out but indistinctly.

"Sure, why—who is it?"

The figure strode up, raised its arm.

"You no buy Hilda white slippers. No. I got gun. I fix that!"

Flame leaped from the Aleut's hand and the report rang out sharply. A flash of pain shot through Mason's stomach. The Aleut ran.

The fiddle stopped its sawing and dancers, orchestra, children, dogs—barking—all streamed out to Mason.

"Who shot? You hurt?"

"I . . . don't . . . know. I guess not. He hit me in the stomach. I think . . . I'd better go home."

Jimmie kept the crowd out. Told them to watch for the man with the gun, lest he run amuck again.

"It was that crazy Joe Prassik. He goes be-serk when he gets a drink; and he thinks Hilda is his girl. Usually he passes out before he gets knocked out. But tonight apparently he went loaded for big game. Too bad it was you."

"I don't think I'm hurt much," said Mason. "It's only the stomach, I'm sure. But I wish I knew. Can you call a doctor on that radio gadget of yours?"

"That's just what I'm doing." Jimmie was pumping on his hand key. "Lily is still on—she's working somebody in Anchorage now. If I can only raise her, she'll get help—probably by tomorrow."

The flashlight bulb in Jimmie's antenna lead lighted up fitfully as he pounded out: "K7ANQ, K7ANQ, de K7BEJ, K7BEJ—RUSH."

Lily heard him. As it happened, K7BEJ's frequency was near that of the Anchorage amateur she was working.

"Someone plugged at a dance?" she queried. "Again? Well, the best thing I can think of is to have KFQD in Anchorage put it in the news at ten-fifteen. Just a minute—I'll tell 'em."

So she passed the urgent message on to her Anchorage schedule.

"Tell KFQD to call the Motor Vessel Blue Fox. She's probably at Unalaska now—300 miles westward; but she can take a doctor or nurse from the hospital there and run to Sanak Island—it's not so far—and pick up this would-be Romeo."

Lily knew the crew of the Blue Fox would be listening. Everyone in Alaska listens to KFQD's news broadcast. And more than once had messages gone out to isolated parts of the Territory, when human lives and safety were involved.

"I'll try to get it over to KNX in Hollywood, too," said Lily. "Then if skip is bothering KFQD, they'll get it from down south."

She got it over. Leave it to Lily. Mercy messages were nothing new to this young lady of the North.

KNX's "newspaper of the air, addressed to the Far West, Alaska, Hawaii, the Antipodes, and to all ships at sea," had the same message:

"Away off in the Aleutian Islands tonight a man's life depends on whether this message is received by the Motor Vessel Blue Fox somewhere in the vicinity of Unalaska. Foster Mason, trapper on Sanak Island, was shot through the stomach early this evening by a mad native. He needs hospital care, and the Blue Fox is requested to go to Sanak Island and pick him up and take him to the government hospital at Unalaska."

The message got over. The Blue Fox crew heard it each time, and soon were under way with aid from the hospital.

Three weeks later, cured, he and Jimmie

Olson stood on the venerable deck of the S.S. Starr. Shishaldin Volcano lay a few points to port of the bow of the ex-halibut fisher as she poked her nose into Unimak Pass, Seattle-bound. Mason looked up at the mountain, its hood of vapor, and the swirling curlicue the wind made of it.

"I'll take with me," he ruminated, mock-seriously, "this picture of Shishaldin. Behind me I'll leave the white slippers with the red heels."

Jimmie shot him a quick glance.

"What *you* need," he snapped, with a grin, "is one workable amateur radio station, with schedules—so *you* won't get left behind!"

20-Watt Midget Portable

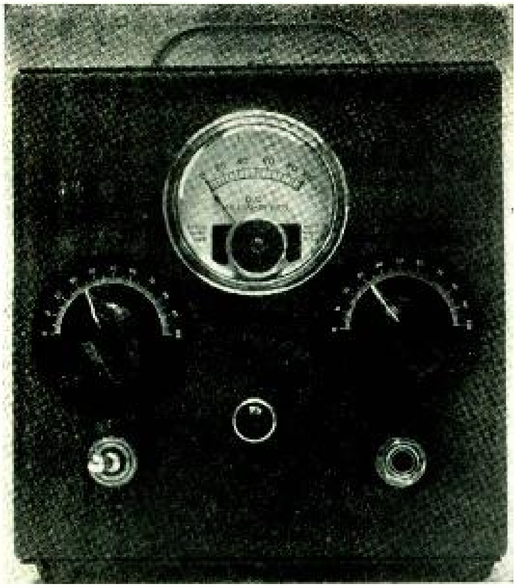
[*Continued from Page 60*]

lend themselves admirably to a rig of this type. When wiring, run leads as direct as possible and forget for the moment any visions of right angle bends.

Most of the wiring is done while the masonite deck is out of the cabinet. It is necessary to allow sufficient lengths for leads to the milliammeter, pilot light, plate tuning and antenna tuning condensers as these are wired into place after assembly. The a.c. switch and keying jack are wired when completing the under chassis job and can be guided into place on the front panel when assembling. Leads from the 5-volt filament winding to the pilot light should be twisted.

Power Supply

The complete power supply consists of nothing more than transformer, 5Z4 full-wave rectifier tube and a single 8-μfd. filter condenser rated at 450 d.c. working volts. The transformer used is an Inca type C-69 giving 330 volts each side of center tap at 50 ma. A 6.3- and 5.0-volt winding is also furnished. Although when fully loaded, plate current runs



Front view of the 20-watt midget portable.

to 75 ma., no signs of distress have been noted over a period of months, so this 25% overload apparently can be tolerated. The single-section filter condenser provides adequate d.c. even though no bleeder or choke is used. "Yoops", clicks and other attendant keying difficulties are entirely absent.

Antenna Circuit

The antenna winding on the coil goes to two feed-through insulators at the rear of the cabinet. A .00025-µfd. fixed condenser is shunted across these terminals as is also the 100-µµfd. variable tuning condenser, providing a capacity range from .00025 µfd. to .00035 µfd. The remaining feed-through insulator is connected through a small variable coupling condenser of from 20 to 50 µµfd. and terminated at the center tap on the plate coil. Although a perfect impedance match is not obtained by this coupling method, its usefulness in portable operation is apparent in that a single wire of any length may be used.

6L6 and 6L6-G Tubes

While the photograph shows a 6L6-G tube, there is no reason why the metal type 6L6 may not be used instead. In tests, slightly more output was obtained with the glass type. However, excellent operation has been obtained with both types.

Operating Data

On the 7 Mc. band with the antenna disconnected, the plate current will have a pronounced dip to 20 or 30 ma. When fully loaded, plate current runs approximately 80 ma. representing a power input of 24 watts. Plate voltage with key open should be in the neighborhood of 425 volts and should drop to 300 volts under load.

Calls Heard

[Continued from Page 66]

8FFY; 8GBF; 8GWF; 8INK; 8JEL; 8KVX; 8LDA; 8LUA; 8MEV; 8MQE; 8MRU; 8NLB; 8NNT; 8NNZ; 8OE; 8OKC; 8OXO; 8QDI; 8QXT; 8QGB; 9DII; 9JN; 9MAL; 9NSC; 9VAO; 9VM; 9VW; 9VSO; 9ZKV. CM2WD; CR7AY; FB8AA; FB8AD; FI8AC; FM8AD; G2YL; G8AP; J2IU; J2JJ; J2KO; J5CV; J8CF; K4FAY; K4DUZ; K4RJ; K5AN; K6NLD; K6OKN; KA1AF; PK1MF; PK1RI; ST6KR; U4AL; VE2AX; VE3AHN; VE2AJX; VE3FB; VE3AI; VP2TG; VP6LN; VQ3TOM; VQ8AB; VS1AA; VS2AS; VU2LJ; XU7C;K XU8AM; YV5AA; YV5AK; ZE1JG; ZE1JI; ZE1JV; ZE1JZ; ZL1HY; ZL1JI; ZL1KR; ZL3AJ. **ZS**—1AH; 1AU; 1J; 1Z; 5Q; 6AD; 6EQ; 6H; 6M; 6S. ZT1Z; ZT5F; ZT5Y; ZU2G; ZU5D; ZU5Q; ZU6AF; ZU6C; ZU6E; ZU6N; ZU6U.

●

Donald W. Morgan, 2CGB, 15 Grange Road, Kenton, Middx., England
December, 1937

(14 Mc.)

W—1BFA; 1CH; 1DZE; 1JRJ; 2EYO; 2KGB; 3CRW; 3EYT; 3FRT; 3FRY; 3TR; 4ZHW; 8AU; 8TMP; 9MED. CT3AB. **D**—4ATT; 4BEC; 4DNC; 4GIF; 4GWJ; 4JVB; 4OFT; 4SGK; 4SNP; 4TDB; 4VCH; 4VZV; 4ZGF; 4YTM; 4YUM. ES5D; HA2N; HA3H; HA3J; HA3P; HA5Z; HA7D; HA7N; HA8D; HA9R; HB9CC; I1IE; I1IY; I1LP; I1LT; I1MH; I1TKM; LA4K; LA5N; LA6R; LA7Z; LA8B; LY1J; OE3FS; OE7JH; OH1NV; OH2NG; OH2NM; OH2NQ; OH3AI; OH5FF; OH6NG; OH6NH. **OK**—1AM; 1DK; 1KA; 1KX; 1RW; 1ZB; 2BC; 2CC; 2LO;

[Continued on Page 90]

Two Easy-To-Build 'Scopes

[*Continued from Page 55*]

useful for r.f. circuit checking, as well as indicating modulation percentage.

With a general idea of oscilloscope operating principles you may assemble the parts and prepare for wiring. One thing: You will need plenty of tie points for supporting the various resistors and condensers. The small 'scope required 21 of these while the 2-inch model used 34 of them, mostly in multiple gangs.

All external connections are brought to a bakelite strip on rear of chassis, keeping all haywire out of the operating controls. This strip projects through a cut-out in back of cabinet.

The Cathode-Ray Tube Circuit

This circuit is easy to wire. Note that the c.r. cathode is internally connected to *one* heater lead. Be sure to bring this correct lead to the junction of the two potentiometers. This is the yellow wire in the cable specified.

It is a good idea to test your work as soon as the power supply and c.r. tube circuits are wired. Leave the intensity control at maximum resistance (to left) until the tubes are hot, otherwise the screen may be either temporarily or permanently damaged. Try different settings of the two potentiometers until a fine spot is focussed on the screen. But *never* make this any brighter than necessary and do not allow it to remain stationary except for brief periods as it will burn a dead spot on the screen. If the tube doesn't work, check your rectifier, remembering it is a *negative* voltage (with respect to ground) that is necessary. Also note that these rectifiers have cathodes.

When the larger job was tested, it showed

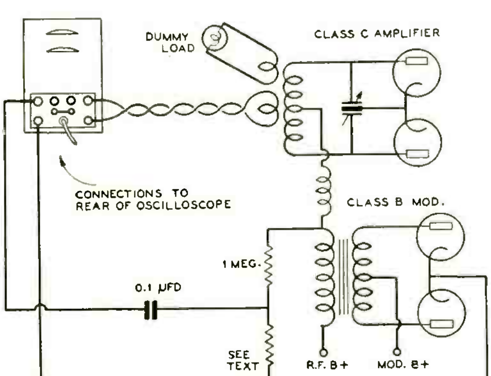


Figure 9—Diagram of oscilloscope connected to the transmitter for checking modulation either by the trapezoid or modulation-envelope method.

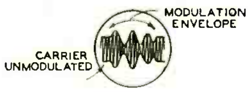


FIGURE 10

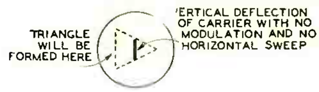


FIGURE 11

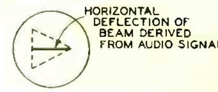


FIGURE 12

a slight horizontal a.c. deflection, due to a small amount of a.c. pickup and due to the free plate being four megohms above ground. When connected to its normal load, this slight fault entirely disappeared, so don't worry if you get the same minor trouble.

Spot positioning controls are quite desirable for the larger tube but the smaller job is satisfactory without them. A separate positive-voltage divider was necessary on the larger model, since the positioning controls caused bad variation of amplifier screen voltage when signals were applied.

Horizontal Amplifier

With this much working, go ahead and wire in all remaining parts, checking the circuit carefully as you go. *Do not* change any of the specified values. All resistor and condenser values in the oscillator and amplifier circuit are rather critical if one is particular about performance. Some other values may work but the chances are you will spoil the job by substitution. Several of the values given are not what one would expect—but follow them just the same.

Don't by-pass the horizontal amplifier cathode resistor; it usually puts bad tails on the sweep or destroys sweep linearity, or both. This amplifier is required to amplify a saw-tooth wave, which is quite different from the usual sine wave.

Don't use a smaller gain potentiometer than specified. It is a characteristic of saw-tooth waves to lose their shape when working into any load, even a small one. They would prefer working into five or ten megohms but with these values trouble will be experienced with phase distortion. This also applies to the horizontal deflector plate return resistor.

In some oscilloscope diagrams a half-megohm potentiometer is specified as the horizontal gain control and some commercial 'scopes use that value. If their users will change these to three or four megohms, the sweep linearity may be greatly improved.

In the first 'scope built the horizontal amplitude control was placed in the horizontal deflector plate circuit so the width of trapezoidal patterns might be adjusted. However, when this control was large enough for good sweep linearity, it caused bad phase shift on trapezoidal patterns. So this control was replaced in the horizontal amplifier grid circuit.

Provision has been made for running external test voltages through the horizontal amplifier, although this feature is seldom used. A toggle switch is located on the panel of the two-inch 'scope and inside the cabinet of the smaller job.

There is little to be said about the vertical amplifier as it is fairly conventional. A potential of about 2½ volts r.m.s. on its grid is all that is required for full screen deflection. Don't omit R_{16}. This compensates the amplifier screen and 885 cathode voltage when the vertical amplifier is not in use.

Operation

With all wiring completed you can now test the oscilloscope, with the saw-tooth oscillator sweeping the beam horizontally and the a.c. voltage on the vertical plates. If your wiring is correct and if you haven't changed any values, the 'scope should work immediately. But if you have missed a wire or two, the 'scope will point it out for you, since it will show its own faults as well as that of other apparatus.

At low sweep frequencies you should get several cycles on the screen. These may be stopped from drifting by turning the synchronizing control and slightly readjusting the fine sweep frequency control.

Internal synchronization is obtained by connecting a jumper on the one-inch 'scope and by flipping a switch on the larger model. External synchronization may be had by removing this jumper. Synchronization to the line frequency has been added to the larger 'scope as an extra convenience, though by no means a necessity. These connections will be made clear by inspection of the diagrams.

Practice "making pictures" with a.c. on the vertical plates and using various sweep frequencies to become familiar with the various controls. With high sweep frequencies you can make all kinds of pretty patterns.

Now hook the 'scope to your transmitter and have a look at some signals. The connections are shown in figure 9. The r.f. is picked up by a couple of turns coupled to the final tank and the two ends connected to ground and the direct vertical binding post. This one "double-ended" piece of wire is all that is re-

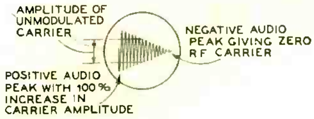


FIGURE 13

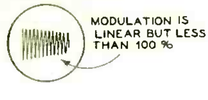


FIGURE 14

FIGURE 15

quired for observing carrier wave forms, the saw-tooth oscillator furnishing the horizontal deflection.

Set the oscilloscope switches and feed a tone of constant frequency and amplitude (and having no distortion) to your speech amplifier. If your wave form is good and modulation is 100%, you will see a pattern like figure 10.

A simple audio oscillator having good wave form was described in the November, 1936, issue of this magazine.[1] Some code practice oscillators are good while others produce a ragged wave form. But if no oscillator is at hand, practice whistling loud and long. It's good lung exercise!

Another good substitute is to obtain a few "tone" records for the turntable. Or you may get a gen-u-wine 1000-cycle tone from the telephone company. Their oscillator runs all day. In Los Angeles it is MUtual 3900.

Notice the dummy antenna in the diagram. You ought to have one already but if not, just get a lamp socket and bulb (or bulbs) sufficient to carry your output under modulation. Oscilloscope testing and adjustment usually requires some time as several checks may be made. So for the love of the old man's whiskers, don't let this stuff go out on the air! Your testing sounds just as bad to the other fellow who is trying to work a station, as his testing sounds to you!

For transmitter checking, r.f. is applied directly to the vertical plates—not through the vertical amplifier. Vertical deflection is controlled by varying the amount of pick-up. Potentiometers burn up quickly on r.f. so don't try to use one.

With saw-tooth oscillator going you will see what r.f. patterns look like. See figure 10. The individual r.f. cycles are shown in the sketches so you may more clearly understand pattern formation. Actually you will see a solid pattern due to these r.f. cycles being so close together at amateur frequencies.

Trapezoidal Patterns

The linearity of r.f. circuits under modulation is more clearly shown by means of trapezoidal patterns than by observation of modulated carrier wave forms. Both are necessary for a really complete analysis.

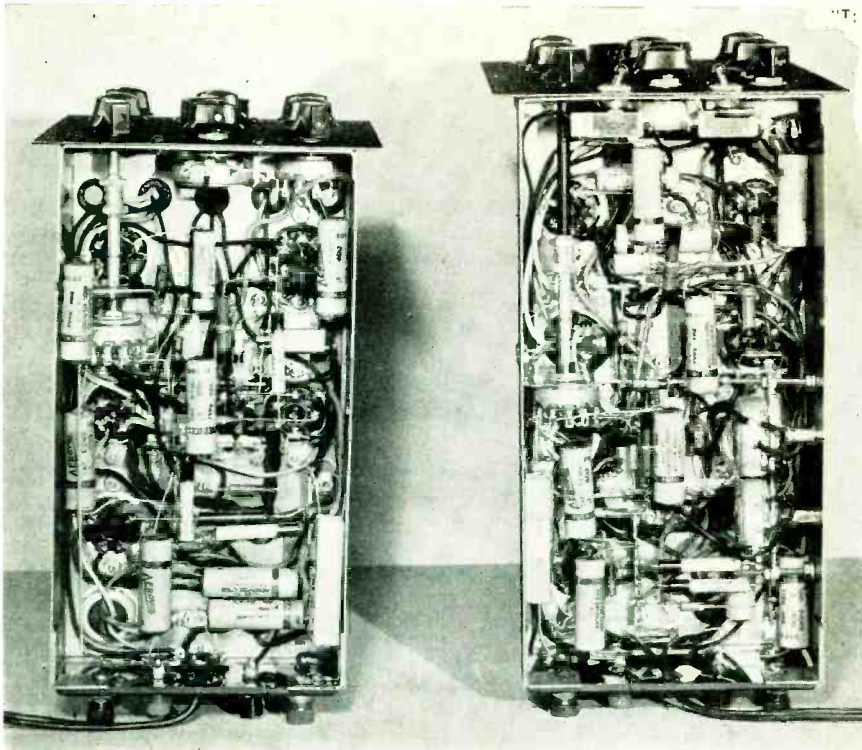
For these patterns the saw-tooth oscillator is not used, horizontal deflection voltage being taken directly from the class-B (or other) modulator.

This audio voltage for horizontal deflection is obtained from the "high" side of the class-B modulation transformer or modulation choke, or from the grid modulation transformer in grid- or suppressor-modulated circuits. It *must* be obtained at the final point of audio; not from some preceding stage.

Either oscilloscope requires about 100 volts for deflecting the beam from its normal center position to one side but this would carry some of the pattern off the screen. Around 50 or 60 volts will give the best size image. If the final r.f. amplifier runs at 1000 volts d.c., an audio peak voltage of 1000 volts will modulate it 100%. A suitable voltage divider to tap off 50 volts, then, will have about 1/20th as many ohms in the lower leg as the upper resistor. (1000/50 = 20, or 1/20th.)

[1] "A Portable Audio Oscillator of Many Uses," by Ray Dawley.

"T: ZL2OD; ZL4BQ;
S1BJ; K4EYP;
2AC; PY2KT;
LAA; VP2CD;
ZL—1IY;
BR; 4DQ;



Snail's-eye view showing how resistors and condensers are mounted on tie points. Note that vertical selector switch is located away from panel, to avoid piping r.f. all over the set when testing r.f. amplifiers. The beam-centering controls for the larger 'scope can be seen under the chassis of this model.

The total resistance of this divider should be somewhere around one megohm. Larger values will bring forth an oscilloscope's mortal enemy—phase shift. It is convenient to use one megohm for the upper leg and around 50,000 ohms for the lower leg. The latter may be changed by experiment for the most desirable size pattern. The upper resistor should be made up of two half-megohm, one-watt resistors since 500 volts is about the maximum for a single unit.

Some diagrams show the blocking condenser at the top of the upper leg. This is quite o.k. if you have a condenser of twice the d.c. voltage used and enough capacity to pass all audio frequencies. It is more economical to use an ordinary 400-volt, 0.1-µfd. paper condenser at the voltage divider junction as shown.

The way these triangular and trapezoidal patterns are formed is best shown by figures 11 to 18. If the modulated amplifier is operating linearly, the top and bottom sides of the trapezoid will be *perfectly straight*. When modulation is less than 100%, a perfect trapezoid will be formed. See figure 14. With complete modulation the pattern will be a perfect isosceles triangle. (It is not necessary, however, that the left side of this triangle be equal to the two other sides, but the two sloping sides must be straight and equal.

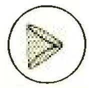
A tail on this triangle indicates overmodulation, as seen in figure 15, and as heard on lots of amateurs' phone signals.

If you get a pattern like figure 16, it indicates phase shift between the audio source and the carrier. Look for (1) Audio connection made at wrong point; (2) Insufficient capacity in coupling condenser; or (3) Too much resistance in voltage divider.

Another trouble sometimes experienced with "traps" is that the image will drift from the center of the screen. This is due to some d.c. leakage in the coupling condenser. There is some slight leakage in a good new one, and this small current across a large value of resistance will cause a d.c. bias on the free horizontal deflection plate. No trouble should be experienced if the circuit and values given are followed.

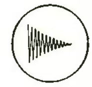
If the modulated amplifier has regeneration, it will modulate upwards in greater proportion than the increase in plate voltage during modulation. The pattern will look like figure 17.

When modulation begins linearly and then flattens out on peaks, it is apparent that the



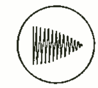
PHASE SHIFT RESULT OF IMPROPER CONNECTIONS

FIGURE 16



INDICATES REGENERATION OR OTHER NON-LINEARITY

FIGURE 17



NEEDS MORE GRID BIAS OR EXCITATION

FIGURE 18

amplifier is not capable of complete modulation. This is usually due to insufficient grid drive to this stage. See figure 18.

Space does not permit a thorough discussion of all patterns. A number of examples will be found on page 298 of the 1938 edition of RADIO Handbook; RCA Cathode-Ray Tube Manual TS-2; R/9 for September and November, 1935; *QST* for March and April, 1934; The A.R.R.L. Handbook, or in Rider's "The Cathode-Ray Tube at Work."

Seeing the Other Fellow's Signals

Earlier in the article it was mentioned that these 'scopes may be connected to receiver and transmitter at the same time and either one monitored by turning a switch to the vertical and horizontal selectors. Tests were made by taking i.f. voltage from the diode transformers in two receivers and from the last i.f. transformer in another receiver which worked into a type 57 detector.

Working through the vertical amplifier binding post, a fairly good signal was obtained on the screen. But if the regular grid cap is removed and this i.f. signal fed direct to the vertical amplifier grid, about twice as much deflection is secured. The wire carrying this signal may be taken through a louver in the cabinet. This wire is attached, through a small condenser, to the last i.f. transformer. A grid leak of one or two megohms is also attached to the grid clip for ground return.

On one receiver, attaching to the last i.f. *plate* seemed to work better. Slight retuning of the i.f. circuit is necessary and the condenser must withstand the B+ voltage in the latter case. It is also necessary to provide a common ground connection to the receiver. When doing so there may be a small spark due to the condensers across the primary of the oscilloscope power transformer. Reversing the line plug usually stops this but if not don't worry as it does no harm.

Incoming signals are plotted against the sawtooth sweep, resulting in a picture of the received carrier. But don't tell anyone his signals are lousy until you have done some experimenting on broadcast signals and have learned how to set your receiver controls so as not to produce distortion! After you get it down pat, you can read percentage modulation of the other fellow with a good degree of accuracy, provided he can give you a good, steady tone for the test.

In the diagrams there is a vacant switch position on both vertical and horizontal selector switches. We may later add a tuned circuit to the former and a phase-splitting circuit to the latter. The idea is not completely hatched as yet but there will be something written about it if the thing works. Leave some space behind the vertical selector switch so a small can, about 1¼x1¼x3 inches, may be added if desired.

Checking Audio Amplifiers and Modulators

These are checked by feeding an audio signal into the apparatus being tested and picking up its output voltage at any point desired, either through the vertical amplifier or direct to the vertical deflector plate. The saw-tooth oscillator is used for horizontal sweep and the signal made to remain still by internal synchronization.

Unfortunately, space does not permit all details to be given but if one will build an oscilloscope many uses will suggest themselves to the operator. And an intelligent analysis is only a matter of using the old bean, after all.

Calls Heard

[*Continued from Page 84*]

2MM; 2PN; 3TW. OX5C. **OZ**—1F; 1P; 2JW; 3J; 3K; 4L; 5P; 5X; 5XY; 7FK; 7U; 7UU. PA0CX. **SM**—5CT; 50F; 5AU; 5QZ; 5SV; 5UV; 5VJ; 5WD; 5YU; 60B; 6UP; 6UQ. SP1FD; SP1FW; SP1IE; SP1LM; SP1LN; SP1MX; ST6KR; SU1DU; SU1SW; VE1FG; U1BC; U1AE; U3DY; U3DS; YM4AA; YT7TJ; ZB1J.

●

John G. Kuespert, W9WCE, 706 29th Street, South Bend, Indiana

December-January

(7 Mc.)

CM2OP; CM7AE; F3KH; G2PL; GM8AT; HK3AL; **K**5AG; 5AM; 6EO; 6GQF; 6MOJ; 6OPL; 6ORA; 6OVJ; 6PAH; 6PDQ; 5PKJ; OE3AH. **VK**—2AX; 2HZ; 2QP; 2ZR; 2AHP; 2AHQ; 2AHR; 3DJ; 3ZD; 4AB; 4FW; 5LW; XE1B; XE1H; XE3Y; YV1AC; YV1AK; YV5AO; ZL [torn] ZL2[torn] ZL4FB.

(1[torn] Mc.)

CM2DO; CM2DW; CM5RY; CX2AJ; G6WY; H[torn] K5AA; K5AC; OX2QY; OZ2ZA; PY1AZ; PY[torn] VK2DK; VK2AHA; VK2AHG; VK7QZ; VO6J; V[torn] VP2TG; VP51E; YI2BA; YV1AC; YV5AK; YV5A[torn] 1JI; 1KR; 1MR; 2QM; 2SM; 2TO; 3AJ; 3BJ; 3KG; [torn] 4FW. ZS2X ZS3F.

●

Guy D. Lalic, W8OIV, Pittsburg, Pennsylvania

February 2-26

CE5AF **CM**—2AZ; 2KK; 2PN; 7AD; 7LR; 8FS; CO7CX; CT1GG; CT1ZZ; CT2BO; CX2AJ; D4GAD; D4GOF; D4GPF; EI6J; DI8J; DI8M; EI8J; EI8M; F3AD; F3AM; F8AS; F8AT; F8ER; F8GO; F8NR; FT4AE; **G**—2IX; 2LK; 2NH; 2NL; 2ZY; 5IU; 5SS; 6BS; 6JZ; 6LC; 6QX; 6VD; 8HF; 8IM; 8KD; 8LC; 8UD. GI5Q; GM6JH; GM6RV; HA7N; HB9AC; HH2B; HA5PA; HI2N; HI2T; HI2W; HK4LC; I1EP; I1IR; KA1AF. **K**—4EJF; 4FAY; 4KD; 5AA; 5AB; 5AH; 5AN; 6BHL; 6MV; 6OQV; 7FNE; 7GOM. LU7AF; LU1AZ; LU9AF; OA4R; OH1NP; OH1NV; OK1AW; OK2PN; ON4CD; ON4FQ; ON4HF; ON4NW; OZ2AU; OZ7AU; PAOAL; PAOGM; PAOGN; PY2P1; SM7SV; SP1KG; SP1LP; SV1RV; TI2LR; ULAD; U2NE; U9AV; VE5ACS; **VK**—2AH; 3HX; 3PL; 3BV; 4CD; 4YL; 6WZ; 7KR; VP2AT; VP5SS; VU3FV; XE1R; YV1AP; YV1AZ; YV5AB; ZL1MQ; ZL2BI; ZL2CI; ZL2SM; ZL3GR; ZL4AC; ZL4DQ; ZL4FR; ZS1AN; ZS2L; ZS5G; ZT2Q; ZT2U; ZT6AD; ZT6AM; ZU6P; ZU6U; ZU6AN.

●

W. C. Clark, W4BJX, 1420 Boulevard, N. E. Atlanta, Georgia

February 1 to March 1

(14 Mc.)

W10XAB; CN2PW; CN8AR; CN8MI; CN8NI; FI8AC; HS1BJ; HS1JE; I7AA; J2JJ; J2KS; J2OJ; J2OY; J8AC; K7DNL; K7FME; K7GOML;KA1AF; LY1AA; PK1VX; PK3BL; PK4MK; PK4RX; U1AD; U1CO; U2NE; U3AN; U3FB; U5LL; U6WB; U8ID; 7OAV; U9AW; VK6BW; VK6KP; VK6LJ; VK6MU; VK6SA; VK6WZ; VO6D; VQ8AA; VQ8AF; VS7AD; VS7AH; VS7RP; VU2AN; VU2AV; VU2DR; VU2FX; VU2FV; VU2LX; UK8IA; XU6MK; XU6NL; XU8LC; XU8MR; XU8RL; XU8RN; XU8RV; XZ2DY; YI2BA; ZB1R; ZZ2A.

●

VE3ER, 34 Olive Avenue, Northmount P. O., Ontario, Canada

December 12 to February 16

(14 Mc. phone)

HC1JB; HH2B; K4ENP; K6NZQ; K6OQE; K6RG; LU4CZ; LU8DR; OA4R; OA4C; OA4AL; OX2QY; TI2KP; ZE1DA; YV5AF; YV1AQ; YV5ABY; YV5ABS; ZU5M; ZS1AA.

(28 Mc. phone)

CO2RN; CO8RQ; CP9AA; HI7G; K4EPO; K4FAY; LU1GA; TI2FG; VP9R.

(14 Mc.)

CN8MS; CT2BE; CX2AJ; EI6F; F3KH; F3MM; F8NS; F8XY; G5MW; G8HA; G8KS; GM6JS; I1KN; LU1CA; LU5BL; LU7AZ; LU8DR; OK1CX; ON4NO; ON4PP; OX2ZA; VP1JR; VP2CD; YV5AG; YV6MC; ZE1JI; ZP7L; ZS2G; ZS5AH; ZT6Y; ZU6U; ZZ2A.

(28 Mc.)

D3CSC; D4VZV; D4XQF; EI6G; F8CT; F8QD; F8RR; G2YD; LU9BV; OK1FF; ON4FT; ON4RX; PAOFE; PAOOTB; PAOGG; PAOUN; PAOVH.

●

William Gaffney, 42 Bridge St., South Hadley Falls, Massachusetts

January 16 to February 28

(14 Mc.)

CM2BG; CM7AB; **CO**—2AU; 2BG; 2CC; 2HS; 2JJ; 2KC; 2LY; 2OK; 2RH; 2WZ; 6OM; 7VP; 8YB. ES5D; G2QB; G5LU; G5QA;

G[illegible] G8BI; G8II; GI2CC; G[illegible] [illegible]4AS; H[illegible] HI2W; HI3N; HK50[illegible] K4ENY; K[illegible] K64NR; LU1DA; LU5CZ; N[illegible] [illegible]A2ZK; ON4CD; O[illegible] OZ7UU; TI1AP; VK2GU; VO1Y; VO6D; VO6U; VP6MR; V[illegible] VP9R; XE1GK; XE1LJ; YV5ABY; ZL2CL; ZL2FA; ZL[illegible] ZU9RQ.

Paul W. Nelder, W9VMV, c/o Fisher Dairy Products Co., Godfrey, Illinois
February 20 to February 28

(28 Mc. phone)

CN8AJ; CN8AV; F8AE; F8KI; F8QD. G—2AI; 2AC; 2ZV; 5BM; 5VM; 5RO; 5ZG; 6BW; 6DH; 6GS; 6VX; 6WU; 8TX; GM6RG; GM8RJ; HB9J; LU4BC; ON4AP; ON4KD; PA0FB; PA0DO; TG9AA; TI2FG; TI2RC; VP5GM; ZE1JR; ZL4AO; ZT2G.

The Open Forum

[Continued from Page 8]

the same. Laying all joking aside, some of you dx stations really should listen a little more on the high end of the band.

Now—about all that stuff about no code exams and fone vs. c.w. men. Well, here's what I think about it: Stop all this tommy rot and get together, as all fone men at some time or other were c.w. men.

As I see it, the fone man is just stepping up one notch in the art when he gets a fone rig on the air. As for me, I like c.w. as much as I ever did; I have had numerous c.w. rigs and now have one on 40 meters that gets about as much use as the fone ones.

About no code exams: Well, don't worry, fellows. The F.C.C. bunch is really smart and I don't think that they want to put on a jillion more inspectors to keep 'em in line. Do you?

ED HARRIS, W5TW.

The Question Box

[Continued from Page 65]

quite critical as to operating frequency. The whole system will go badly out of resonance if the transmitter frequency is shifted a very large percentage. This is a general fault of the close-spacing array. Another difficulty experienced with them is that the very high voltage experienced at the ends of the dipoles increases insulator troubles. Only the very best ones can be used under any conditions, and even these will throw the system out of resonance when they become wet. By far the best arrangement for an antenna system of this type is to support only the centers of the elements (where there is very little voltage) and to let the ends float free. This type of construction is exemplified by the array of Roberts and by the ones described in the February issue of RADIO under the title, "Let's Whip the 20-Meter Rotary."

An Inexpensive F.S. Meter

[Continued from Page 18]

the minimum-to-maximum variation in capacity across the coil (the sum of the condenser capacities plus the distributed circuit capacities) is from about 35 to 150 μμfd., it is possible to tune any two consecutive bands. (A capacity variation of four-to-one is necessary to tune across two consecutive bands with a single coil.)

In the unit shown one coil is used to cover 10 and 20, another to cover 40 and 80, and still another coil to cover the 160-meter band. All coils are wound on 1½" coil forms with the tops sawed off to make the forms themselves (exclusive of their plugs) about 1¾" in length. It is necessary to shorten the coil forms since they are mounted horizontally upon the back of the tuning condenser and between the condenser and the 1B4 tube. The 10-20 coil contains 4 turns spaced to about ¾"; the 40-80 coil is of 15 turns close wound, and the 160-meter coil is of 40 turns, close wound. All coils are wound with no. 20 wire; th[illegible] 1-20 one wound of enamelled and the other two are wound of d.c.c. Both of the two-band coils (10-20 and 40-80) will hit the lower-frequency band with the plates almost completely meshed, and the higher-frequency band with them almost separated. Enough range is left, however, so that the bands may easily be covered from one end to the other.

Calibration

When the unit is first turned on, if the batteries and the tube are all up to "snuff", the 0-1 d.c. milliammeter in the common plate and screen circuit of the 1B4 will indicate about 50 microamperes of plate current flow. In an r.m.s. voltage indicator (of which this meter is a special type) such as this, it is always advisable to have some no-signal plate current flow. As long as there is some plate current flowing through the tube when no signal is being impressed upon it, you can always be quite sure that the tube is not biased past cut-off. In a meter of this type it is quite important that the bias be slightly below the cut-off point if an accurate indication is desired.

Now, to return the meter to the zero position even with this .05 ma. flow going through it, it is only necessary to turn the zero-adjustment screw until the needle points to zero with the meter in operation. Then, the fact that the meter will always point to zero when everything is in adjustment will act as a check upon the calibration of the instrument. However, as soon as the meter is turned off, the pointer of the milliammeter will fall below the zero on the scale—actually it will hit the pin on the zero side of the meter.

The calibration of the meter is quite simple since the scale is quite linear as it stands. But here is the procedure (and incidentally, the calibration should be made at some time when the particular band in use is inactive, since the tests must be made with the antenna connected to the transmitter):

First, the transmitter must have a class-C amplifier stage feeding the antenna. If it is a plate-modulated phone rig or a c.w. transmitter, all is well and the final stage should feed the antenna as usual. But if the rig has a grid-modulated stage or a class-B linear in the final, one of the preceding class-C stages must be used to feed the antenna. In other words, the stage that feeds the antenna must be linear with [illegible]ations. Clas[illegible] stages [illegible]ansmitters us[illegible]ly answer to [illegible] re[illegible]—at least they usually quite lin[illegible] as [illegible] plate voltage *reduced* from the normal operating value, that is the important part in making a ca[illegible]tion of this kind.

With a class-C stage feeding the antenna, and with full plate voltage upon it, the first point of calibration can be made. A piece of no. 10 or 12 enamelled wire about four feet long is bolted to the standoff atop the f.s. meter. Then the meter is tuned to the operating frequency of the rig and carried around the back yard, over into the neighbor's yards, or through vacant lots and up and down the street until a location for the meter is found where the instrument indicates just 1.0 milliampere. Set the meter on the ground and walk away from it a distance to see if body capacity was disturbing its reading to any extent. If it was, move the meter to a spot where the meter just reads full scale when you are standing 6 or 8 feet from it. Body capacity to the pickup rod usually extends only about 3 or 4 feet from it, unless you are between the transmitting antenna and the f.s. meter.

Now, go back to the shack and reduce the plate voltage to half; check the plate current on the final to see if it also has dropped to half, and go out and read the meter again. Do not move it or touch it in any way, just note the reading on the milliammeter, from five or six feet away if any body capacity effects are noticeable. Keep all these readings and the plate voltage and plate current on the final that produced them in the notebook.

Now reduce the plate voltage on the final to half of the previous value. This still lower value of voltage can often be obtained by tapping the plate voltage for the final stage from one of the buffer supplies or possibly from the crystal stage. Note the reading on the f.s. meter as before and lower the plate voltage and plate current to a still lower value. Make another reading of the f.s. meter and note these conditions in the notebook. If it is possible to place still lower voltage on the final stage, do this to obtain another point for the calibration.

On page 93 is given the calibration chart for the f.s. meter shown in the photos. The calibration points were obtained by placing different voltages upon the plates of a pair of 35T's. The first and second voltages were obtained from the final power supply; the first with the two primaries on the plate transformer in parallel, the normal method of connection, and the second with the two primaries in series, the connections are used for 220-volt operation of the transformer. The third voltage for the final was obtained from the buffer plate supply, and the fourth from the crystal-stage supply. The last was obtained from the screen-voltage ta ...e crystal pow

ti... 6LK; ...t: 12UII; HC1FG; HH2B; H5PA; K4EJF; K4EN... 4FAY; ...2AF... N4N0; ...6YB; 2LB:

Pla...ge	Plate cu...	...er reading
	250 ...	1.0 ma.
	125 ma.	0.5 ma.
	76 ma.	0.3 ma.
	38 ma.	0.17 ma.
	16 ma.	0.06 ma.

... surprising linearity of the meter can be seen from the chart above. Linearity such as this was quite unexpected when the calibration of the f.s. meter was contemplated, but a further check of each of the points showed very closely the same readings. However, it is advisable that each person building the meter calibrate it as above to make sure that this is as linear as the one that was checked.

Now, upon looking at the above readings, it will be seen that the f.s. meter is directly a radiated voltage indicating device. (Incidentally, a calibration such as this, providing the f.s. meter has previously shown itself to be linear, is an accurate check of the linearity of the amplifier stage—at least as far as decreases in plate voltages are concerned.) Since we will be primarily interested in the *power* gain or loss of antenna systems expressed as a decibel ratio, the meter calibration, as found by experiment, can be converted into a decibel calibration.

Since the meter calibration has been found to be quite linear (other meters constructed the same as this one should have identical characteristics, and consequently they should be linear also, but it will be advisable to check the calibration just to make sure in each case), and since a decibel ratio can be expressed as db = ...0 log$_{10}$ ... we can make a calibration scale or a calibration chart for the completed meter. The scale shown has been made of the proper size to go on a standard-size 2" meter. If desired, the scale can be cut from the magazine and pasted upon the face of the meter. Or, for those who do not like to cut the pages of their copy, we have made up proofs of the cut. One of these may be had for the asking by sending a self-addressed stamped envelope with your request.

Use of the Meter

The use of the meter, when the scale that is shown is used upon it, is almost self-explanatory. For example, consider the tuning-up of a rotatable array of the close-spaced type. The meter is placed in a vacant lot some distance from the antenna (two or three wavelengths is usually ample distance), tuned to resonance with its small pickup antenna in place, and the array is pointed at the f.s. meter. The reading in decibels is noted. The meter should be near enough to the array so that the reading is close to full scale. Then the array is rotated and the new reading in decibels is noted. The front-to-back ratio of the array is then the difference between the two readings on the meter. If the meter reads −1 db with the array pointed at it and −15 with the beam pointed in the other direction, the front-to-back discrimination of the array is 14 db. The meter is calibrated in negative decibels simply to facilitate the accuracy of reading, since the meter will almost always be used at readings approaching full scale. The negative numbers can always be added or subtracted just as if they were positive.

If the meter moves down scale, the decibel ratio is negative and can be called a loss; if it moves up the scale the ratio is positive and there is a gain.

In a similar manner the meter may be used to compare the relative outputs of different antenna systems—as to the radiation pattern on the ground anyway. The meter is placed at a definite position in a neighboring yard or lot (always as far away as possible) and a reading made of the radiation of the one antenna. Then this antenna can be taken down, the other one installed, and a reading taken upon it. The db gain or loss in the new antenna can be determined.

The meter can also be used to plot field-strength patterns of fixed-direction beams. The f.s. meter is carried around the beam and readings taken from all angles. The readings should be taken in as nearly as possible a circle around the beam and the results plotted upon polar graph paper in decibels. This will provide an accurate way of comparing the gain and directivity of different antenna systems as to radiation at approximately ground level.

Amateurs and the L. A. Flood

[*Continued from Page 14*]

formation regarding high voltage transmission lines and condition of the Los Angeles aqueduct (main source of water supply). W6BLU at the Big Creek power house and W6CVL at the North Fork power house assisted in relaying similiar information.

The town of Victorville was thrown into a near panic when word went around that the Arrowhead dam above the town was going out. Information regarding the dam was quickly obtained via amateur radio and the rumor put down and fears allayed with a statement that no danger existed on that score and that none was likely to exist in spite of the high water.

An emergency developed at Camp Baldy, resort in the San Bernardino mountains, where 85 people were reported marooned without supplies, some in critical condition. Accordingly a relief party of doctors and amateurs set out at 6:30 a.m. Friday morning, March 4th, to effect a rescue. In the party were W6BNO, W6AYF, W6MDX, W6MXF, and W6IVG. In order to get to the camp it was necessary to hike about twelve miles through rain, snow and brush. The party arrived at 4:30 p.m.; the station was set up and contact made with the base camp at the foot of the trail. It was found that there were 65 people marooned at the camp; one person had been washed away in the flood; and one person suffered a broken arm. The food shortage was acute, and communication established by these amateurs effected the necessary relief. From the base camp traffic to the forest service ranger, Red Cross and the sheriff's office was handled until Sunday.

The public as a whole has been very appreciative of the work the amateurs did during the flood, probably because more people are familiar with amateur radio than was the case even as recently as a year ago. This is no doubt largely due to the great number of all-wave receivers now in use. But too easily overlooked is the work done by the *wives* of the amateurs who put in long hours of hard work that the public might not be without communication. In many an instance the "x.y.l.", as she is fondly referred to by the "o.m.", actually got less sleep than the amateurs who were dependent upon her for sandwiches and coffee, phoning of messages, taking down messages on a mill or in shorthand, and in many cases relieving at the mike or standing a watch at the receiver.

We know they are happy in the knowledge that they were able to do their bit along with the o.m.'s, but it would not be fair to praise the o.m.'s without asking them to share the credit with the wives who stood by them so valiantly through those many weary hours.

Dx

[*Continued from Page 16*]

with a multiplier of 14. Then there was FB8AB who did his share . . . ZB1H made the boys happy by showing up . . . and SU1WM outdid SU1CH for the Egyptian honors. VK2ADE sometimes would get their frequencies too close together and one of their signals would start to call a W just about the time their other signal was signing off from one.

All of us will remember for a long time those fellows who worked 'em one right after another . . . without moving off of his own frequency . . . such as HK1PA, K7PQ, K4KD, OA4J and others. Then, too, we must take our hats off to MX2B who was the only one on in his country. CT3AN and CT3AB gave many fellows a new country, and for Japan J3FJ was probably the most consistent on three bands with J2OV, J2KO, J2LL and J2MH in there with great signals, too. Lithuania was probably well handled by LY1J with LY1S and LY1HB rolling right along behind. As an odd sidelight it was noticed that at the time the newspapers were heralding the entrance of Hitler into Austria, that good dxer OE3AH was pounding away in the contest as though nothing was happening. Of course, you know he is the Archduke of Hapsburg. The only other OE heard, at least out here was OE7EJ . . . but that was

BUYER'S GUIDE

Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics usually may be substituted without materially affecting the performance of the unit.

AN INEXPENSIVE 'SCOPE

R_6, R_{22}—Yaxley Y50MP
R_9—Yaxley UC506
R_{13}—Yaxley UC504
R_{20}—Yaxley Y500MP
R_{21}—Yaxley Y25MP
R_{29}, R_{30}—Yaxley Y100MP
All Tubulars—Aerovox 484
Filter condensers—Aerovox GL450
C_6—Aerovox PBS200
SW_2—Yaxley 3215J
SW_4, SW_5—Yaxley 3234J

A SUPER WITH "SOUP"

C_1, C_3—Hammarlund MC140M
C_2—Hammarlund Star 25 μμfd.
RFC—Hammarlund CH-X
IFT—Meissner 6762 Transformer
Coils—Hammarlund SWK-4 Kits
R_6—Yaxley J or Y25MP
Power Trans—Thordarson

Dx Notes

only the first few days of the contest. Although there were not many Austrian stations on, there apppeared to be more HA's on than ever before. Maybe, some of the OE's moved across the border.

It is all very fine to ramble along here and talk about all you fellows . . . on how good you are and bragging for you . . . but how about myself . . . where do I come in? I think it's about time I did a little bragging about myself. First, you may not know it but I fiddled around in the contest. I slept on my desk, drank syrupy-thick coffee, took cod-liver oil, read the rules a dozen times to foreigners, raised stations that I couldn't hear, twisted my variable crystals 'till they have holes worn in them, almost lost my job twice, and did lose my temper 31 times, ate my meals in less than ten minutes, put up and took down five antennas, tossed out four alarm clocks, called a certain foreign station so many times that after he was raised, my arm wouldn't send anything else, . . . and now if you have not guessed it these are a few symptoms of a DX contest. Last year I scored 793 points and I knew this year I could beat it . . . so it ended up with near 62,000. When the contest started the x.y.l. took the first train out of town for a week's trip. Now I wish I had gone, too.

Seriously though, the battle was pretty good after it got warmed up and I got a bang out of it. There were just two obstacles in my way of running up more points . . . my boss couldn't see giving me 9 days off, and then this darn hill I'm setting on looks out toward the Pacific, making a perfect reflector for Oceania but equally bad for Europe. However, I will have that licked next year . . . we're going to have a convention down here and I'm inviting all the fellows to bring shovels and we'll spend the week end digging away this huge sand hill. (Ripley

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please note.) Toward the last of the contest I used the billiard principle of reflection . . . I figured if I could hit the hill hard enough with a signal it would bounce off and travel the long way 'round to Europe. The idea was OK but it didn't work. When we start digging we should uncover plenty of swell sigs buried in there somewhere.

All in all the gang had better control of their frequencies, although some of the more haywire EC gadgets did get a little beyond them once in a while. It was plain to see that there are plenty of EC oscillators scattered around the country . . . Some of them sounded good but on the whole they were pretty bad. W6AM being his own boss asked himself for 9 days off and rolled up 51,000 points. He would have done better he said, but it took till the fourth day of the contest to discover that his 300T's gave more output with a lot less input than his old water-cooled jug. Needless to say, the w.c. isn't being used any more.

Oh yes, here is a little item which should be brought out . . . W8BIS, who was the original EL2A, asks that *all* cards for contacts *made since January 1937* be sent to Lloyd Neville, Duside, Liberia, W. Africa. In order for you to get a QSL in return send to the present EL2A.

Next month we should have something on the outcome of the phone contest. At this time the boys are really doing their stuff. At least in the contest the phone boys don't take the time to give their "handles" and spring the "that's the dope on that" gag. Incidentally the awarding of the Upholstered Key and the "Handle" will be postponed until next month. They tell me that these big shots who are in the phone contest are using up plenty of throat gargle and mouth wash . . . Even so I'll bet they'll be a hoarse bunch when it's over.

Well, gang, I think we should have a contest so we could work all the W9's we want without the exchange of numbers . . . or better yet let's have a wide open dx contest with all the ops you want and as much time as you want . . . and as much power as you want. What say? That's all on the contest, and if you are heading toward Manhattan Beach, I'll be glad to see you . . . and bring your shovel (not just the "handle").

Here and There

I want to straighten something out about W2IOP . . . After checking over last month's reports I find that it was recorded that 2IOP worked a bunch of dx when I should have put it in as heard. In the hurry at the last minute I got 'em all mixed in together and just so someone won't come up to W2IOP and call him a big so-and-so we make this correction . . . W2IOP heard the following but did not work them . . . at least not yet . . . VS4CS, J2NA, FA8PW, VP2LA and a couple of Europeans. K4KD would like it brought out that all of you fellows who send cards to K4, it is not necessary to use more than the regular U.S. postage rates . . . that is, 1 cent for cards and 3 cents for letters . . . also if any of you fellows still need Porto Rico for a country (you know it is separate from Virgin Islands) here is something that might help. K4KD 3570, 7025, 7038, 7190, 14050, 14076, 14280, 14380 and 28100 kc. K4KJ 14360 and K4DTH is on 7025, 14050, 14376.

Doubtful Zones

I have a number of inquiries as to the different zones in U.S.S.R. Here is the way it stands, from all data available. Stations located in Omsk, Tomsk and Novosibirsk, such as U9AL, U9AC, U9AV are all in Zone 18. Stations located in Sverdlovsk, such as U9ML and U9MF, are in Zone 17. Don't forget that VU2AN is in Zone 21. It is true that the town of Omsk is apparently on the line of Zone 17 and 18 but upon looking carefully into every type of map it looks as though Zone 18 wins by a whisker.

W2AAL adds five countries: FQ8AB, CN1CR, VP3NV, I7AA and CR7AC. W2IXY now has 71 countries on phone, the latest being G6IA Isle of Man, VS7GJ, K4FAY, ES5D, YT6TJ, VR6AY, ZC2OP. Dorothy says that ZC2OP is on 14,360 kc. and is located on the uninhabited island

The Marketplace

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(i) We reserve the right to reject part or all of any ad without assigning reasons therefor. Rates and conditions are subject to change without notice.

SWAP—pair slightly used RK20's, excellent condition . . . for ham receiver, crystals, or what have you. W5EPW, Box 212, Greenwood, Miss.

SELL—thirty-watt fone-c.w. transmitter, $40. W9BFH/6, 1153 North Vista, Hollywood, Calif.

SACRIFICE sell 250 watt phone transmitter; complete $150. Details, Jack Marino, 1939 Hubbard St., Jacksonville, Florida.

DISTRIBUTORS wanted! Distribute novel call stands to local dealers . . . nothing to sell. Descriptive literature. W2KKC, Spencer Ave., Riverdale, New York City.

SELL, Trade: Class B audio input and output transformers. Two 203A's carbon plates. One RCA condenset head. Ford Philco auto radio. W6FTU, 308 South Clark, Beverly Hills.

METER Repair—D.C. Milliammeters, springs repaired $1.75. Change range, new scale $1.75. Thermocouples 1 to 5 amperes. $2.50. Change thermocouple range add 25c. All repairs reasonable. Braden Engineering Co., 305 Park Dr., Dayton, Ohio.

FABERADIO, after years of successful manufacturing, still sells "Y" 160 and 80 meter crystals for 75c each. More than 5000 users are satisfied. "X" cut $2.25. "A" cut $2.75. Molded holders $1.00. Variable frequency holders $4.95. Commercial crystals a specialty. FABERADIO, Sandwich, Illinois.

METERS repaired, Ham's prices, W9GIN, 2829 Cypress, Kansas City, Mo.

QSL'S — HIGHEST QUALITY — LOWEST PRICES. RADIO HEADQUARTERS, FT. WAYNE, INDIANA.

STANDARD 19″ racks. 69⅛″ high. 3″ channels. 4x6x⅜″ angle base. Bolted together. Dull black finish. Drilled and tapped. $17.50. Weight 100 pounds. Set of seven 14 gauge steel, gray wrinkle panels $7.50. Chassis. Brackets. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

REPLACEMENT coils for your burned-out power equipment wound to your voltages. Multi-filament transformer 6F6, TZ20, 2—TZ40's, $2.75. Michigan Electrical Laboratory. Muskegon, Michigan.

TRADE: AKC registered cocker spaniels. Value thirty to hundred dollars. Want new all-wave receiver chassis, speakers, new furniture, Leica camera. Marion Graham, Angola, Indiana.

ROTARY FLAT-TOP BEAM easily assembled now with our kit. "New-Device" one-line operation. New Devices. 1001 South Roosevelt, Green Bay, Wisconsin.

SELL: Two 830-B's, like new. Make offer. Bryce Bandy, 309 North 5th St., Muskogee, Okla.

MICROPHONES: RCA camera condenser with amplifier, cord, plugs, $10.00. Easily converted for AC operation. Excellent frequency response. Write for details. R. E. Brooks, 4700 Montgomery Ave., Downers Grove, Illinois.

FOR SALE: Collins transmitter, Model 30FXC—200 watts output c.w. or 'phone. Complete with tubes, crystal microphone, crystal and coils for operation 10-meter ham band. New condition . . . used less than 100 hours. Cost over $600.00, will sell to first taker for $300.00 cash, shipment f.o.b. Bridgeport, Conn. H. A. Crossland, W5JR, High St., Fairfield, Conn.

LABORATORY receiver described in October RADIO, page 30. Real DX on 10, 20, 40, 80—power supply, speaker, coils, tubes . . . Ready to go, $48.00, W6NYB.

SERVICE equipment to trade for high power modulation tubes and Class B transformers. Late Clough-Brengle oscillator, Supreme analyzer, Solar condenser and resistance bridge and others. Write W6PPK, 15861 Marlin Place, Van Nuys, Calif.

THREE Weston meters, Acme 600-watt power transformer, Acme filament transformer, Acme 30 henry choke. 1000 volt, 2 mike condenser, "Ultimate" bug, Vibroplex bug, Breting "12" receiver, Jensen p.m. speaker, 5000 volt meter, W. E. broadcast carbon mike. Ray Moore, 1335 Quintero St., Los Angeles, Calif.

FOR SALE: Volume indicator described p. 12 Feb. issue, $15.00 f.o.b. RADIO, Ltd., 7460 Beverly Blvd., Los Angeles.

FOR SALE: 500-watt rack panel c.w.-phone Xmitter, p.p. 805 final, coils 160 to 10, built by Hugo Romander. Price, $375. W8NWV, Uniontown, Penna.

WANTED: National SW-3 less power supply and accessories but with coils. State condition and lowest price. Box 9, care "RADIO."

QSL'S—Original designs—at reduced prices. Samples. Wilbur Printers, A1. 732 Federal Street, Chicago, Illinois.

6L6 MODULATOR or driver (push pull parallel) described in July, 1937 issue, laboratory model less tubes, $38.75 f.o.b. RADIO, Ltd., 7460 Beverly Blvd., Los Angeles.

FOR SALE: 160-METER 809 PHONE transmitter described in March issue. Laboratory model, less tubes, crystal, and microphone. $26.50, f.o.b. RADIO, Ltd., 7460 Beverly Blvd., Los Angeles.

W6KX prints QSL's! Keith LaBar, 1123 North Bronson Ave., Hollywood, Calif.

FOR Sale: PR-10 Patterson receiver and 10-meter converter in A1 shape—new tubes throughout, $40.00. W6PCA, 6133 Alamo, Maywood, Calif.

FOR SALE: New Universal Model X, double-button mike, used. Also Franklin plate transformer . . . 1000-750-0-750-1000. W6MSM, Acampo, Calif.

RADIO Parts: Transmitting and receiving. Everything must be sold. W6HUI.

BLUE Print Code Chart—both codes—dime—W9OC, Spencer, Iowa.

WANTED: Reliable volt-ohm manufactured tester, cheap. W6PKX, San Dimas, Calif.

QSL-SWL. Bargains! Outstanding Designs. FRITZ—455 Mason, Joliet, Illinois.

looking for treasure. There are 8 men, no women. W2IXY also says that sometimes VS4CS from North Borneo is a visitor at the shack of VK2HF quite frequently and sometimes it is he at the mike rather than Alan. W6ITH hooked a new one for him on 14-Mc. phone . . . YN3BG. Reg also says he got an R8 report from PA0GN using his South American beam. That proves something . . . or doesn't it???? New ones for W2GTZ are VS1AA, G8MF, XU6MK, XZ2DK, U9BC, XU8AG . . . He now has 38 and 121 . . . W9FM and W9SLG have been looking for a freighter trip somewhere. One of the possibilities involves the Dutch island of Curacao, just north of Venezuela. (How would PJ9FM sound????) The other is Guatemala, Salvador and Honduras. And now where is the guy who offered a dollar per country?

W8JK, Johnny "Flat-Top" Kraus sends this note of interest: "Doc Wescott, OQ5AA, announced a week or two ago the arrival of another junior op, a y.l. A couple of days later while I was QSO with him he put the then 2-day old baby girl on the air. Her "waa" modulated the transmitter nearly 100% and she received very clearly on this end. The baby's grandparents who live near here were listening at the time."

W5BB has a few new countries making a total of 107 now . . . VS6AG, VU2AN, PZ1JC, VQ8AS, VP8YB, ZB1J, OX2ZA, FY8AC, and I7AA. Another new one on ten-meter fone is TG9AA. Henceforth all TG hams will sign calls beginning with TG9 . . . that is if there are any others. To date TG9AA is supposed to be the only legitimate amateur in Guatemala. W5VV now has "36 and 111" thanks to VS1AI. While I think of it that old timer W1CH is now a proud "poppa" . . . 'twas a girl. W1BUX now has 130 countries and is moving back to his old location where he got his start.

"WAZ" HONOR ROLL

	Zones	Countries
ON4AU	40	148
G2ZQ	40	139
G6WY	39	138
W6ADP	39	137
W6CXW	39	135
W8CRA	39	135
W6CUH	39	132
W6GRL	39	128
W6HX	39	121
W8OSL	39	120
W2CYS	39	117
ON4FE	39	110
W6FZY	39	109
W6FZL	39	104
XE1BT	39	90
G6VP	39	
W8BTI	39	
W7BB	39	
W2SI	39	
W3ANH	39	
W4DHZ	39	
W8BKP	38	132
W1BUX	38	130
W2GTZ	38	121
G5BJ	38	120
W8DFH	38	119
W6AM	38	115
W8HWE	38	112
W2AAL	38	109
W2GT	38	108
W1CC	38	108
W5BB	38	107
W9ADN	38	106
W2GW	38	104
W9UQT	38	103
W9ALV	38	102
W9KG	38	101
W8LEC	38	100
W8AU	38	98
VE4RO	38	85
W9VDQ	38	79
G6RB	38	
W9TJ	38	
G5YH	38	
W4AJX	38	
W1ZB	37	124
W7AMX	37	119
W6KIP	37	118
W6QD	37	118
W8ZY	37	114
W6DOB	37	112
G2LB	37	111
W8DWV	37	109
W2GVZ	37	106
W6GAL	37	106
W2HHF	37	104
W9PTC	37	103
W8KPB	37	100
W6LYM	37	100
W9AJA	37	99
W3EXB	37	98
W8BOX	37	98
ZL2CI	37	97
W8OQF	37	97
W6FKZ	37	95
W7BYW	37	93
W5CUJ	37	93
W3AYS	37	91
VK2AE	37	90
G6GH	37	89
W6GCB	37	81
W9UBB	37	77
W2BSR	37	
W2GWE	37	
G6NJ	37	
W2DTB	37	
W3EMM	37	
LY1J	37	
W4AH	37	
W6VB	37	
W5VV	36	111
W9AFN	36	105
VK3EO	36	101
W6BAM	36	100
ON4EY	36	97
ON4VU	36	96
ZL1HY	36	95
W9KA	36	92
W6KWA	36	92
W6JBO	36	90
G2UX	36	83
W6GCX	36	76
W9CWW	36	71
W2BJ	36	71
W8KKG	36	
W9ARL	36	
W3EDP	36	
W2OA	36	
W6KBD	36	
U1AD	36	
W2BJ	35	105
W3GAU	35	104
W8CJJ	35	98
W2BXA	35	98
W3EVW	35	97
W1AQT	35	96
W9EF	35	94
W8EUY	35	93
ON4FO	35	92
ON4FT	35	92
W1GDY	35	89
W8AAT	35	87
W6MHH	35	82
W6ITH	35	78
G6QX	35	75
K6AKP	35	63
W6NHC	35	
W6GRX	35	
W2AIW	35	
W3BBB	35	
W2IOP	35	
W8BSF	34	94
VK2AS	34	94
W6EPZ	34	93
W3EVT	34	90
LU7AZ	34	89
W2IYO	34	88
G2QT	34	88
VE2EE	34	87
W8LZK	34	87
W6HEW	34	86
W6GHU	34	83
VK2TF	34	81
W6JMR	34	81
ON4SS	34	80
VK2TI	34	75
W8JK	34	74
W6LHN	34	71
VK2VN	34	63
W3EGO	34	
W2FAR	34	
W9PK	34	
W6TI	34	
W8CNZ	34	
W1RY	33	92
OK1AW	33	90
W3TR	33	88
W8DOD	33	88
W9LQ	33	84
W6LEE	33	84
W6LCF	33	78
G2IO	33	76
W7AYO	33	73
VE4LX	33	69
OK2HX	33	66
VK2RA	33	65
W8LDR	33	
K6JPD	33	
W6LDJ	33	
W9LBB	33	
W5AFX	33	
ON4TA	33	
G6CL	33	
VK2VQ	32	99
W5ASG	32	90
W9FLH	32	80
ON4NC	32	79
W8QDU	32	79
W3CIC	32	75
W6AX	32	74
W3GAP	32	70
W6KZL	32	67
W9DEI	32	66
ZU1T	32	65
W6KRM	32	62
W6DIO	32	
W8HYC	32	
W8BTK	32	
W5EHM	32	
W4MR	31	92
W6DRE	31	86
W3RT	31	86
W8FJN	31	85
W8HGA	31	83
W9LW	31	82
W6GNZ	31	81
W9RGQ	31	79
W6CEM	31	78
W4ELQ	31	66
VK2VA	31	62
VK2EG	31	60
W6IES	31	57
K6CGK	31	54
W6LCA	31	51
W3DCG	31	
W6HXU	31	
I1TKM	31	
VK2QL	31	
W5KC	30	81
W4DCZ	30	80
W3UVA	30	76
W2WC	30	72
W4DTR	30	68
W8MPD	30	66
W6MVQ	30	65
W9PGS	30	63
W6KEV	30	58
W8PHD	30	57
W6JJA	30	
W8MAH	30	
W7AVL	30	
W8DED	30	
W9IWE	30	
W1APU	30	

PHONE

	Zones	Countries
W6ITH	33	57
W6LLQ	31	68
W6AM	31	
W4AH	31	
W6OCH	30	63
W4DSY	30	
W6NNR	29	63
W6MLG	29	55
W3EMM	28	
W3FAM	27	55
W9ARA	27	53
W9TIZ	27	47
W9BBU	27	45
W2HUQ	27	
W5DBD	27	
W2IXY	26	71
VE2EE	26	53
W2IKV	26	52
W6FTU	26	50
W9NLP	26	48
W6BGH	26	
W8JK	25	47
VK2ABG	25	
W3SI	25	
W1BLO	24	50
W2IUV	24	41
W6LEE	24	28
W9NLP	24	
VE5OT	24	
W9QI	24	
G8MX	23	52
W6AAR	23	
W7AO	22	
XE1BT	22	
W2HCE	21	55
W8RL	21	49
W5ASG	21	42
W6GCT	21	30
W7ALZ	21	25
W6MVQ	21	22
W6MVK	21	22
YV5AK	20	45
W8QDU	20	40
W3AKX	20	32
W1COJ	20	
W6GRX	20	

If you have worked 30 or more zones and are ready to produce confirmation on demand, send in your score of zones and official countries on a postcard.

Phone stations need work but 20 zones, but stations must be raised on phone. Stations worked may be either c.w. or phone.

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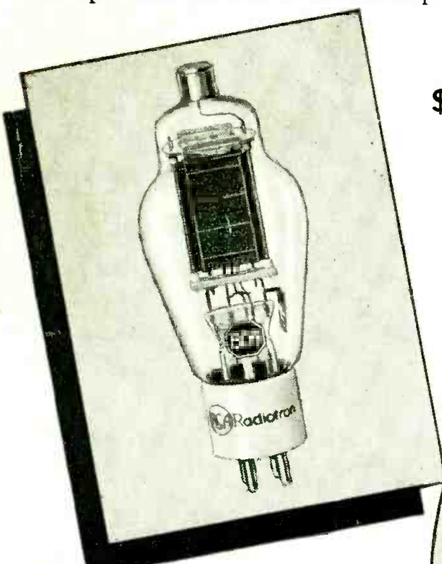
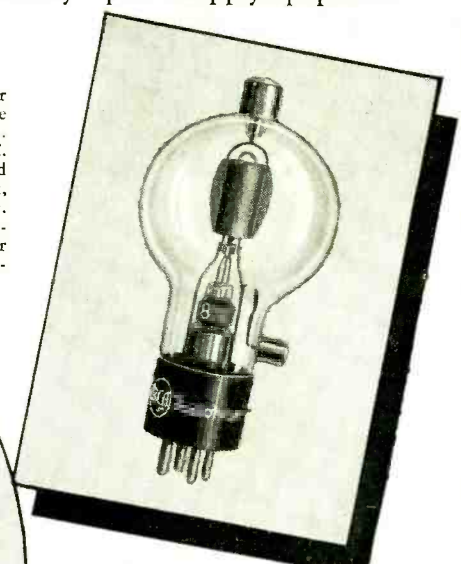
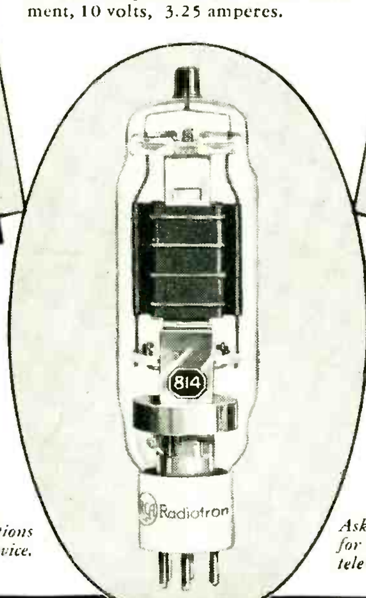


$17.50 RCA-814 Beam-Power Amplifier. D.C. plate voltage, 1250 volts. D.C. screen voltage, 300 volts. D.C. grid voltage, -80 volts, max. D.C. grid current, 10 ma. D.C. plate current, 144 ma. Plate input, 180 watts max. Plate dissipation, 50 watts max. Driving power (Approx.), 1.5 watts. Power Output (Approx.), 130 watts. Filament, 10 volts, 3.25 amperes.





$2.50 RCA-809 High-Mu Triode. D.C. plate voltage, 750 volts max., D.C. grid voltage, -60 volts. D.C. plate current, 100 milliamperes max. Plate input, 75 watts max. Plate dissipation, 25 watts max. Driving Power (Approx.), 2.5 watts. Power Output (Approx.), 55 watts. Filament, 6.3 volts, 2.5 amperes.

$7.75 RCA-808 Tantalum-Plate, High-Mu Triode. D.C. plate voltage, 1500 volts. D.C. grid voltage, -200 volts. D.C. plate current, 125 ma. Plate input, 200 watts max. Plate dissipation, 50 watts max. Driving Power (Approx.), 9.5 watts. Power Output (Approx.), 140 watts. Filament Rating, 7.5 volts, 4 amperes.

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