
QST
A Magazine published by the American Radio Relay League in the interest of Citizen Radio
QRM BABIES
TRANSATLANTIC TESTS THIS MONTH
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A.R.R.L.
December 1921
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Hyde Darr Sty.

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QST

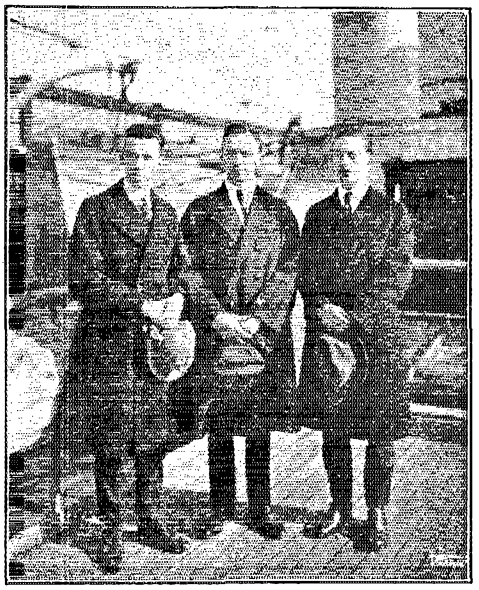
A Magazine Devoted Exclusively to the Radio Amateur

The Second Transatlantic Tests

ON the date this issue of QST probably will reach our readers the second series of Transatlantic Sending Tests will be in progress. In fact by that date we probably will have some word on the results being experienced and we are very hopeful that there will be some call-letters mentioned.

At this writing we have just returned from seeing "Paragon Paul" off on the S.S. "Aquitania" on November 15th. The evening before, a little dinner had been given in his honor in New York City, among those present having been, besides Mr. Godley, Messrs. Maxim, Schnell, Hebert, Camp, Stewart, Service, Goette, E. H. Armstrong, J. Andrew White, P. H. Boucheron, G. H. Burghard, W. S. Smith, and K. B. Warner. This was a ham-fest of old-timers most of whom had known Godley for many years, and it really took the form of a testimonial banquet. The gentlemen expressed the utmost confidence in his ability, Mr. Armstrong saying, "I'll stake my scientific reputation on Paul Godley", and so on until, as Mr. White remarked, "Paul, it looks like a cinch".

And so, the next noon, amid the waving goodbyes of a multitude who had gathered to see the big ship off, the "Aquitania" was backed out of her berth and Godley started on the second stage of a remarkable journey. Some interesting little incidents occurred at the pier. The radio gang had all been shooed ashore by the ship's deck-cops and were assembled in front of one of the large openings in the shed, thru which Godley could be seen on an upper deck some twenty-five yards away. All was inexpressible confusion, the usual last-minute pandemonium at the sailing of a big ship, and the air was full of QRM. But did it phase these radio birds? Not a bit! They just held an arm up straight, above the crowd, and opened and closed the hand to form good old Continential in heliograph style. It was a cinch to read and we talked that way for half an hour, rather to the perplexity of the surrounding crowd. Now it happened that Mr. H. H. Beverage, 2BML, Radio Corporation receiving engineer, was also on the "Aquitania" bound for Europe on business, but he and Godley had never met. To the surprise of the little radio crowd Beverage was discovered leaning over the rail not a great ways from Godley. This dope was promptly QSR'd to the latter by "hand-radio", who was thereby enabled to walk straight up to Beverage and introduce himself. Beverage, it seems, had been watching these pro-



On the "Aquitania" shortly before she sailed. Mr. Godley in center, Traffic Manager Schnell on the right and Secretary Warner on the left.

ceedings too, and as he shook hands with Godley with his right, he gave us a nonchalant "OK" with his left.

All Set for the Tests

The preliminary tests were quite successful, the contenders being favored with good weather, and a great pile of excellent station logs testified not only to the way signals were reaching out but to the interest as well. The participants have been advised of their showing and the final schedules completed. For obvious reasons we publish no detailed data thereon—the arrangements are secret and will be known to but two men in all the world:

Mr. and Mrs. Paul F. Godley

our Traffic Manager, and Mr. P. R. Coursey, in charge of arrangements in England. Mr. Godley carried complete information to Mr. Coursey in a sealed packet.

Let us briefly review the schedules, in order that there be no misunderstandings. For six hours each night for ten successive nights, December 7th to 16th, inclusive, watch will be kept on the other side. Each six-hour schedule is divided into two parts. The first part, from 7 p.m. Eastern Standard Time to 9:30 p.m., is a free-for-all, consisting of 10 periods of 15 minutes each, and in each period all the amateurs in a certain government inspection district are invited to call "Test" and sign; for example, "TEST TEST TEST de 7NN 7NN 7NN", repeated. The transmitting period for each district changes each night. See the schedule on page 30 of QST for this last October, and be governed strictly in accordance therewith. The second part of each night, from 9:30 p.m. Eastern Standard Time to 1:00 a.m. of the following date, is devoted to individual schedules for the stations who qualified in the preliminaries. Cypher combinatons have been assigned them but for the present no information will be given out to their identity.

We do not know the number of English amateurs participating but we understand there were some three hundred in the first tests and this number doubtless will be greatly exceeded this time. French and Dutch have likewise displayed high interest and have been given the schedules, and we understand that some of their best short-wave receiving stations will be listening. Godley takes with him equipment embodying the best American ideas in short-wave reception, so that the world's best talent is being brought to bear in Europe to help us. Godley will have with him at all times while on watch two qualified English listeners arranged thru the courtesy of Mr. Coursey, and these men must be able to verify the copying of call letters during the free-for-all periods and the copying of cypher combinations during the individual periods, the latter to be referred to Mr. Coursey for identification from the confidential papers.

Reports from MUU

Don't forget that MUU is going to hand-send a report from England every night at 7 a.m. Greenwich Time, announcing results. November QST, pages 10 and 11, gave detailed information on the reception of these signals. In addition, station 2BML, Riverhead, L. I., an amateur station owned by receiving operators of the Radiocorp's Long Island receiving station, will repeat MUU's report on 200 meters straight C.W., power 500 watts, immediately after its reception on this side.

In Appreciation

The A.R.R.L. wishes to express its grateful appreciation for the many courtesies shown it by the various Marconi interests in arranging for these tests. The engineering, commercial, and traffic departments of the Radio Corporation of America, the executive and engineering departments of the British Marconi Co., Ltd., and the officials of their allied publishing companies on both sides of the water, The Wireless Press, have placed all their facilities at our disposal and have been of immense help in making the multitudinous arrangements necessary in such an affair.

All Ready

Now we are all set. We believe we have done a good job of the arrangements and we are confident that, barring rottenly unfavorable atmospheric conditions the entire ten days, American amateur signals will be heard in Europe on schedule.

A High Efficiency C. W. Transmitter†

*By Cyril M. Jansky, jr.**

FOR the purposes of design, an electron tube transmitting set may be considered as a machine for converting direct current high voltage energy to high frequency alternating current energy for the transmission of electromegnetic waves. An ideal transmitting set or converter of this type should have the following characteristics.

(1) It should use a stated number of electron tubes having fairly uniform characteristics.
(2) It should be capable of adjustment over a moderate range of wave lengths.
(3) It should be capable of adjustment for maximum output at any wave length within this range.
(4) It should be capable of adjustment for maximum output with aerials of somewhat different constants.
(5) The circuits and apparatus used should be the simplest consistent with the above conditions.
(6) The adjustment of the set for maximum output at various wave lengths should require but a few seconds of time.

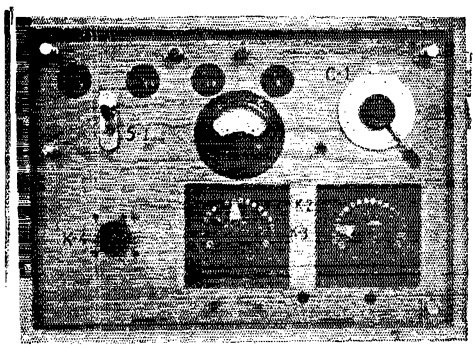
Conditions (1) and (2) are not hard to meet but it is the writer's experience that few transmitting sets in use today meet conditions (3) and (4) and these fail to meet conditions (5) and (6).

The question of efficiency, as it is ordinarily understood, does not enter into the consideration of the design of low and moderately powerful transmitting equipment as the supply of D.C. power available is usually considerably in excess of what is required. The electrical efficiency of an electron tube transmitting set may be defined as the ratio of the high frequency power dissipated in the aerial circuit to the D.C. power supplied to the tube circuits by the high voltage generating system. With proper circuits and proper adjustments this efficiency can be made as high as 75 percent.

The high voltage D.C. power supplied to an electron tube transmitter is dissipated in two ways: (1) in heating the plates of the tubes, (2) in producing high frequency energy which is absorbed by the resistances of the aerial circuit. Given a tube which will dissipate 25 watts as heat in the plates, it should therefore be possible to design a transmitting set using this tube which would consume 100 watts. Of this power 75 watts would be absorbed by the aerial circuit and 25 watts would be wasted in heating the plates of the tube. The factor which limits the power output of an electron tube transmitting set is, therefore, the amount of energy that the plates of the tube can dissipate as heat without endangering the life of the tube.

If for any reason the tube should cease to produce oscillations, the 75 watts energy previously absorbed by the aerial circuit would be dissipated in the plates and the tube would be quickly destroyed. This difficulty can be obviated by installing a protective device which will automatically disconnect the source of power in case of excessive heating of the plates.

In case the transmitting set is so designed and the power input so regulated



A photograph of the set herein described

that the total input to the set never exceeds the amount that can be safely absorbed by the tube alone, the input must never exceed 25 watts and the high frequency output will never exceed three-fourths of this amount.

Obviously the most desirable set, from an operating point of view, will be the one which is operated with maximum power dissipation in the tubes and as high an efficiency as possible.

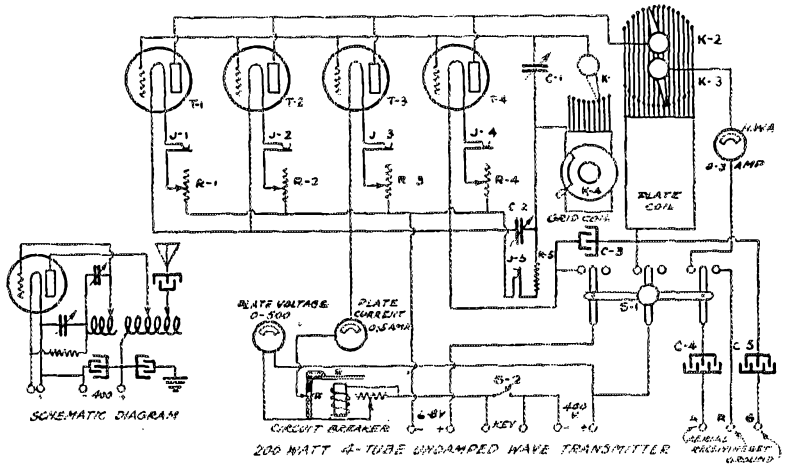
The circuit used in the set to be described was developed by the writer in 1918 and was tested at the University of Wisconsin Department of Physics Radio Station under the direction of Major C. A. Culver of the United States Signal Corps in the fall of that year. Both telephone and telegraph signals were easily transmitted as far as Chicago (130 miles) with an aerial input of 25 watts. The approximate efficiency of the set was 50 percent.

†Read before the First National A.R.R.L. Convention, Chicago.

*Asst. Professor of Electrical Engineering, University of Minnesota.

In the fall of 1920, work on the development of a standard continuous wave transmitter using four Signal Corps VT-2 tubes was begun at the Experimental Radio Station of the Department of Electrical Engineering of the University of Minnesota. The circuit diagram included with this report shows all apparatus necessary for an efficient transmitting set with the exception of aerial and D.C. power equipment for plate and filament circuits. In the set used at the University of Minnesota, the D.C. meters, filament rheostat, circuit breaker and grid condenser were not mounted in the set box.

By referring to the circuit diagram it will be seen that there are two dial switches for tapping the aerial inductance, one for determining the number of turns included in the aerial circuit, and the other the number of turns in the plate circuit. In operation the wave length is first adjusted to any predetermined value by the aerial tap and the plate tap set to include approximately the same number of turns as the aerial circuit. It is well known that when a tube is producing oscillations the A.C. plate voltage is 180 degrees out of phase with the A.C. component of the plate current. For this reason the tube absorbs less energy when it is producing oscillations that when it is not. The effect of including a large number of turns in the plate circuit is to produce a large A.C. plate voltage and consequently a low power dissipation in the plates. The total input to the set and the aerial output will also be low as though the impedance of the circuits as a whole was high. The fact that the energy input to the tube may be con-



Specifications for 200-watt 4-tube Undamped Wave Transmitter

T-1, 2, 3, 4—Electron tubes.
J-1, 2, 3, 4—Jacks for measuring filament current.
R-1, 2, 3, 4—Rheostats for controlling filament current. 2 ohms or larger to carry at least 3 amperes each.
C-1—Grid condenser, air variable, 0 to 1000 micro-mfds.
C-2—Modulation control (grid) condenser, identical with C-1.
C-3—High voltage mica condenser, 750 volts, 0.5 mfd. or larger.
C-4 and C-5—0.01 mfd. or larger, 1000 volts. If larger than 0.05 mfd., voltage may be lower.
G-5—Jack for measuring grid current and for modulator plug for telephony.
R-5—Grid resistance, 500 to 1000 ohms.
S-1—Special switch for controlling plate, filament and aerial circuits and for switching aerial to receiving set.
Circuit Breaker—Can be made from a telegraph sounder or relay, shunted by a 10-ohm variable rheostat for controlling release current.
Grid Coil—5 inches diameter, ball type, 3½ inches wide, wound with 30 turns of No. 18 wire tapped every 3 turns. Mounted in center of plate coil (aerial coil) and rotates 90 degrees.
Aerial Coil—20 turns of No. 10 bare copper wire wound on cylinder 6 inches diameter, tapped every turn and leads brought to two 20-point dial switches for varying turns in aerial and plate circuits.
K-1—Knob and 10-pt. switch for varying turns in grid circuit.
K-2 and K-3—Knobs and 20-pt. switches for varying turns in plate and aerial circuits.
K-4—Knob for varying coupling between grid and plate circuits.

trolled by the plate tap, *provided the set is adjusted to produce oscillations*, makes it safe to keep the key closed with a fixed D.C. potential of 450 volts or even higher. The plate tap is now changed so as to reduce the number of turns included in the plate circuit. This reduces the A.C. plate voltage applied to the tube, allows a greater power input to the set and also tends to adjust the ratio of transformation between plate and aerial circuits in such a manner as to increase the power output. Assuming a fixed plate voltage of 450 volts, the operator will adjust the set for maximum power output by reducing the number of turns included in the plate circuit until a maximum reading of the hot wire ammeter is obtained or until the energy absorbed by the plates nears the limit of safety.

According to a well known principle of physics, maximum power output *at a given plate voltage* will be obtained when 50 percent of the energy supplied by the D.C. source is absorbed by the aerial and 50 percent by the plates of the tubes. The effect of increasing the number of turns in the plate circuit beyond the adjustment for 50 percent efficiency is to increase the efficiency but also to decrease the total power input to the set. The net result is a decrease in the power output. Both efficiency and power output may be increased, however, by increasing the number of turns in the plate circuit and then increasing the plate voltage. A four tube transmitter using tubes which are dissipating 15 watts per tube will then radiate 180 watts if adjusted to 75 percent efficiency.

The following operating data are typical of what may be obtained for any wave length within the range of the set. While the radiation resistance varies somewhat with the wave length, the antenna current also varies and in such a way as to keep the power output and efficiency practically constant.

Plate voltage	450 volts
Power input	146 watts
Antenna current	2.5 amperes
Power output	93.75 watts
Efficiency	64.2 percent
Energy loss	52.25 watts
Energy dissipated in heat per tube	13.00 watts
Filament current per tube	1.35 amperes
Wave length	375 meters

[*There follow data on the radiating system used which had a resistance of 15 ohms at 375 meters. 9XI, it must be remembered, is a special station, and the set herein described was designed to cover 275 to 400 meters so that its physical dimensions are not correct for 200 meter work. On the other hand numerous good ideas will be secured from this article and the circuit used is the best we know for 200-meter work. It should also be remembered that Prof. Jansky is speaking of VT-2's, which are not available on the market and should not be confused with the type 203 five-watt tubes now on sale. The UV-203 has a normal filament current of 2.35 amp. and probably will safely dissipate considerably more energy at the plate than the VT-2, altho both are rated at 5 watts output.—Editor.*]

Tests made upon several VT-2 tubes showed that a tube of this type will easily dissipate from 17 to 20 watts continuously without danger to the life of the tube. In fact, if the set is used for continuous wave telegraphy in such a manner that raising the key cuts off the high voltage D.C. supply, each tube will safely dissipate 20 to 30 watts. A power dissipation of 13 watts per tube as indicated by the above data is therefore well within the limits of safety.

The construction work and testing of the University of Minnesota transmitting set was done by Mr. H. C. Forbes, Chief Operator of the Department of Electrical Engineering Radio Station. The data concerning the range and reliability of the set were determined by the station's staff of operators. Of necessity most of the test transmission work was done with amateur and other experimental stations.

The writer was particularly interested in determining the range and reliability of the continuous wave transmitter in comparison with the station's one K.W. spark transmitter. With this end in view accurate record was kept of all communication maintained by both spark and C.W. from the first of January, 1921, to the close of the school year. During this period the station was open and operating every evening from 8 P.M. until 11 P.M. or later. The operating staff contained seven operators each of whom operated the station one night per week. The following points concerning conditions governing the conducting of transmission tests will aid in interpreting the result obtained:

(1) The operation of most amateur and experimental stations is extremely spasmodic and haphazard, making it practically impossible to maintain communication between any two stations by means of schedules.

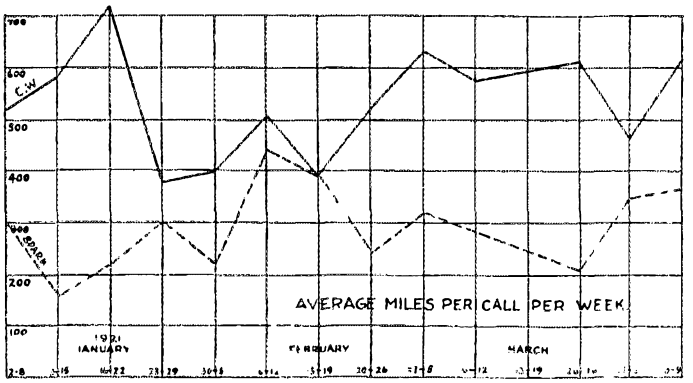
(2) Operators at the University station had the choice of using either the continuous wave transmitter giving 100 watts power output to the aerial or the damped wave transmitter giving 250 watts output to the aerial at a spark frequency of 1000 cycles. Lack of familiarity with the new C.W. transmitter led to the use of the spark transmitter in many cases where the C.W. transmitter might have secured better results.

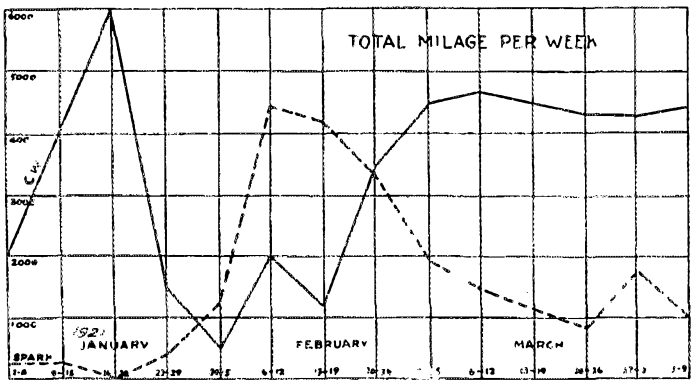
(3) The number of amateur and ex-

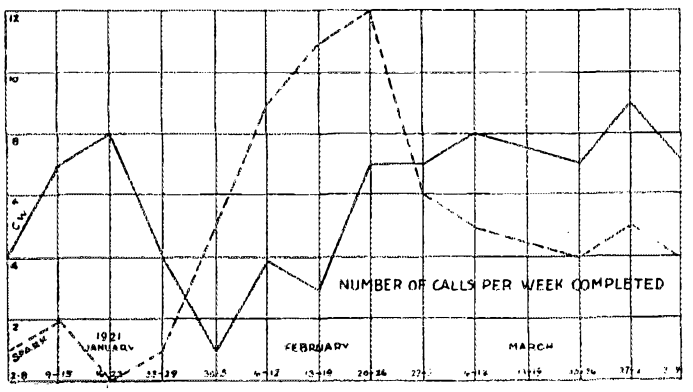
perimental stations equipped to transmit spark was far in excess of those equipped to transmit C.W. As stations transmitting by spark rarely listen for those transmitting C.W. it follows that communication by C.W. was limited to a relatively small group of stations. Nearly all of these stations were located east of Minneapolis.

(4) The reception of continuous waves on short wave lengths requires much more skill and experience than the reception of spark signals.

(5) Receiving sets used by most amateur stations were developed primarily for reception of spark signals and are not particularly adapted to C.W.







The day to day communication records of both spark and C.W. transmitting sets were collected and plotted by weeks on the charts which accompany this paper. Communication was said to have been established between the University station and another station when the two had exchanged greetings or messages. The duration of the communication was not taken into account.

The chart labelled "Number of calls per week completed" is self-explanatory. The distance covered by a communication is not taken into account. In the chart entitled "Total mileage per week" each completed call is rated according to the distance covered. It will be noticed that although there were nearly twice as many calls completed by spark during the week of February 20-28 the total mileage covered by C.W. is a little greater than the total mileage covered by spark. The third chart was obtained by dividing the ordinates of the second chart by the ordinates of the first. It is interesting to note that although the aerial input from the spark

set was two and a half times that from the C.W. set, the average miles covered per call for C.W. is in nearly all cases considerably in excess of that for the spark set. The relative effect of increased static disturbance in the spring is to some extent brought out by the data for March and April. In both of these months the number of calls per week and the total mileage curves for the spark set lie considerably below those for the C.W. set. This would seem to indicate that atmospheric disturbances interfere with C.W. communication less than with spark communication.

Throughout the next scholastic year, additional records will be kept for the purpose of determining the relative range and reliability of spark and C.W. transmitting equipment, and it is hoped that more exact conclusions can be deduced. The increasing number of stations using C.W. transmitters and the further development of short wave C.W. receiving equipment will tend to remove some of the limitations which up to the present time have existed in C. W. work. Most short wave receiving equipment in use today is too difficult to tune and not well enough shielded for the reception of beats at such high frequencies and a careful study of such apparatus will undoubtedly lead to many improvements.

The writer wishes to express his appreciation of the co-operation of the United States Signal Corps and especially of that of Major H. C. Ingles in furnishing the apparatus and equipment which has made this work possible. Credit it also due the operating staff of the University Radio Station (9XI) which under the direction of Chief Operator H. C. Forbes secured the communication data included with this paper.

Rotten Bunk

By The Old Man

SAY son, something's got to be done about this hog-wash stuff we wireless people pull on the unsuspecting public. It's got so I bust a button every time I bump into one of these modern wireless exhibitions. They are becoming so prevalent now-a-days, what with all the phones going, and Mother and Father, the hired girl and the neighbors getting interested, that before the police get busy upon us we should do something. The ethics of the daggone business are beginning to worry me.

I got tangled up in one of the rawest of these jobs I ever beheld the other night. By heck I just about sneezed a snipe over the bunk that one Radical pulled on a lot of perfectly respectable people. Radical is known to fame, as one of the old time members of our Radio Club. He is a scientific bolshevik, a radio anarchist, a manhandler, and he fears neither man, devil nor Radio Inspector. His heart is made of chilled vanadium steel. Suckers are his favorite dish. He devours them en bloc, and they intoxicate him. The more suckers he deceives the more he wants to deceive, until his exaggeration and untruthfulness become gawdawful.

Radical's parents gave a little party at their house and among a lot of middle-aged people the little wife and I were invited. As happens at all of these affairs we play cards, and after a lot of tobacco ashes and cigarette and cigar butts have been spilled around on the tables and a few hopeless articles have been passed out as prizes, the people file out into the dining room and tackle a set-up of those little wet sandwiches with the green lining on the inside, the cakes and the latest home brew. When these are disposed of, and it happens that the young hopeful of the family is interested in wireless, some poor gink who has become over-wrought by the wet sandwiches and the home brew asks the jayhawk sitting next to him if he has yet heard so-and-so's wireless. The jayhawk always gets interested and says no, but that he has heard lots about it and that it must be wonderful. The father of the young Marconi then always swells up and glances at his offspring and asks if things are working well tonight. The young hopeful, and in this case it is Radical, looks superior and guesses that they are, whereupon proud father invites the whole gang to come and see son's wireless, and to mother's horror they all stream into the back room or down-cellar or up into the garret or some where else that mother has to apologize for.

All this happened at Radical's house as per schedule. They did not miss one single item. Radical, however, was in the presence of his elders and was duly impressed, and I had hopes the impression might last. I was minded of his belligerent tactics at the Radio Club, but I did not believe there was any danger of their appearance under these circumstances. Little did I guess at the new slant which would be taken.

Several pairs of phones were hooked in and divided, and quite a crowd of excited

ladies and gentlemen stood around, bent over and held the little phones to their ears, while Radical adjusted the bulbs and frowned, and pulled switches and monkeyed with handles. He gave the impression that it took a great intellect to operate a wireless station. He monkeyed the B battery, I believe deliberately, and the bulb gave a squeal. Through two stages of amplification, this amounted to quite a little noise, and some of the ladies began to jump and threaten to yank the whole gear off onto the floor. One of the ladies yelled in a voice you could hear on the next block to the lady who was standing within six inches of her, that she heard something. You would have thought she had a bite.

Radical explained in a superior and patronizing manner that the noise was nothing—the bulb was just spilling. One of the ladies repeated after him, "Bulb spilling! How awful!" Then some kid on the next block with a badly deranged vibrator started up, and the stuff began to come in. "GRR - IK - GRRR - IC - RIZZLE - IC - ZWIPP-BIZZLE-GWISH-SH-SH-ZIC-ZAT-ZAP-IC." The vibrator stuck for keeps here. There was a pause, while the kid adjusted his sticky vibrator and then he began sending at the rate of about twenty-five, hoping that by going fast his vibrator would not stick. Radical copied him because he was noisy and the ladies and gentlemen were nearly trampling on him in their excitement to know what the signals meant. Radical's copy worked out like this:—"YAMM SPISH BIBBER FILAMENT CURRENT SPOILS FIRST GUM GAP INCREASED POWER QRM 8AMZ ZITTLE STARTED THINGS OM HW?"

Pressed to know what it meant, Radical leaned back and read it off just exactly as it sounds above. Honest, it made the daggondest garble that ever you heard. You just ought to have seen the ladies look at one another! Radical said that you have to know wireless expressions and abbreviations in order to understand. This message meant that a fellow by the name of Spish Bibber had some spoiled filament current on his hands and had gummed his gap trying to use it. The increased power had started 8AMZ's zittle doing strange things.

One of the ladies got hysterics over it. The others thought it was hot stuff. It certainly was wonderful to be getting such things out of the air. It sure was, thinks I.

Radical looked superior and tuned around a little, and all of a sudden 8AJB came *booming in*, calling 8UB. Radical grabbed his pencil and went at it while the ladies and gentlemen jostled each other in delighted amazement.

"TIDELLE ARSI ISHABIG LOST WIRE UR SINK SOUNDS SLIG WITH A PUSHWUV GESS HIBER STOUCKALED HIM IN THE MIDDLE—"

Of course 8AJB never sent anything like this. Radical made out it was straight goods, however. He read it off just exactly the way it looks above, and I swear, I nearly coughed a cat. One of the ladies' glasses fell off, she was so excited, and Radical went back over the copy and fixed it up a bit, and then interpreted it to the crowd as follows:—

"8AJB is telling 8UB—he's a fellow over in Frankfort, York State—that he has lost the wire off his ishabig arsi, but his sister Tidelle found it under the sink and he gave her a push, and it seems like she was a husky, because she came back at him and stouckaled him in his middle."

"Why! What queer language!", remarked one amazed lady. "They must be quarrelling!" Then turning to her friend, she said, "Stouckaled him in his middle! Don't you think that's a weird thing to do?"

While they were wrangling over this, a hoarse sixty cycle drone rumbled in, and Radical grabbed his plate variometer and his secondary, and got his bulb oscillating. "Ewee — oooupp — click — peep — squeep" —it whistled and gurgled and clicked. Every note in the musical scale was given a chance. The new noises caused everybody to perk up. Radical came back to regeneration and, faintly, I could hear a phone. The modulation was so rotten it sounded like a Chinaman on a drunk. "ONGONG—CLICKETY — UDDLE — IGGLE—GISHT —ZUP—SPISHHH—ONGAL HUMGONG SUNGONG ORNOFF—DIDDLE—DEE—DAH—DEE—DAH."

"Somebody talking!" bellowed Radical in a voice that made you wink. His unexpected and stentorian outburst scared one of the ladies blamed near into fits and gave her the fidgets for the rest of the evening.

"Wait a minute!" Radical yelled again, so loud that you could hear it in the next house. Reaching over to his transmitter, one of those infernal exposed rotary gaps, he threw the switch and the motor gave

a grunt and started. The visitors had the same impulse, only for the door. Reaching for the key, Radical called the fellow with the phone. The first crash from the gap stampeded the whole blame party. Old gentlemen bumped into old ladies, the door was too narrow, and things got rather mixed up. I had to take a hand and comb them out, tell them it was all right, and that it was not an accident that had happened. It was just Radical's gum gap that had been slightly stouckaled in consequence of the poor quality of the ishabig arsi he was using at the moment. This reassured one of the timid gentlemen who came back and nervously explained that he had thought something about the business had exploded.

Radical asked the guy with the phone to call him and give the visitors at his house a chance to hear a radio phone. The guy came back on the phone in a minute, and after hollering hello several thousand times, Radical got him where you could make out a little of what he was saying. Radical went back at him with the old screeching gap and asked him to call, on the radio phone, Mrs. Clarence Whitmore by name and ask her if she would like to hear a wireless concert, and then to play one or two records for her.

I could read all this, of course, as Radical clicked it off on the key, but the dear unsuspecting ladies and gentlemen knew nothing at all of what was going on. Radical got the timid creatures lined up again with the little telephones at their ears and told them that he had tuned the phone in and it was much better. They all listened, and smiled at each other. There came a squishing and clicking and a fizzing and a gawdawful blowing off of steam and a growling old sixty-cycle roar, and then through it you could hear: Hello-hello-hello-one-two-three-four-five-six-seven-eight-nine-ten—hello—hello—hello—just a minute please". The visitors eyes nearly popped out. They could hear the words.

"Why! It's somebody counting!—He's stopped!"

"Shhh" says Radical, who wanted to be sure that Mrs. Clarence Whitmore got the full benefit of her name being called through the air.

"Hello—hello—hello—one two three four five six seven eight nine ten—hello—hello—hello—Mrs. Clarence Whitmore—hello Mrs. Clarence Whitmore—hello—hello—hello—this is radio station 8ZZZ calling Mrs. Clarence Whitmore—hello Mrs. Whitmore—hello Mrs. Whitmore—would you like to hear a little music by wireless, Mrs. Whitmore—I say, would you like to hear a little music by wireless—hello Mrs. Whitmore—hello Mrs. Clarence Whitmore—I think maybe you would like to hear a little music by wireless, and I will play for you a couple of records so that you may hear how it sounds—just a minute please."

Mrs. Whitmore opened her mouth and took her phone from her ear and looked as though she had swallowed her gum-drop. She gave a startled yap and then, looking hard at the ceiling, she hollered for hubby, who was smoking and telling stories in the next room.

"Oh Clarence—Clarence—come quickly, Clarence—somebody called me by wireless telephone—Oh dear—I can't get over it—come quickly, and hear it—how in the world did he know where I was—"

"Sshhh" from Radical, for the jazz stuff had begun. It scratched and rasped and jangled away as we all know from a long and bitter experience. Some of the notes were forty times as loud as some of the others, and there were forty other different kinds of noises, and the selection was the rottenest bit of so-called music that had ever been composed, and it was so daggone loud it put your teeth on edge and made you want to commit murder. But it was the wireless telephone and that let it come in as a winner. The folks stood for it, rotten though it was, sucked it in, and rolled it over in their mouth before they swallowed it. When they got it down they thought it was the grandest thing that had happened since the signing of the Declaration of Independence. They thought Radical was a wizard. His father swelled up so he nearly burst.

"How far away is he?", somebody asked Radical. I happened to know that 8ZZZ

was something under half a mile away. I winced in anticipation of Radical's answer.

"Oh, he's a long way off—for a phone." If I had not been present I believe Radical would have told them the phone was in Japan. The way Radical answered left them with the belief that the fellow at the other end of the phone was at least a thousand miles away.

They hungered for more, and swapped the phones around so that those who had

come a-running could get a crack at it. In the meantime there were probably a couple of DX fellows waiting and cursing and frothing at the mouth. The guy with the awful phone played, and played, and played rotten selections, and the crowd clustered around Radical like flies around the bunghole of a molasses barrel. Relay traffic took a back seat while the unsuspecting public fought their way to the receiving set and Radical fed them hogwash about amateur radio. You could see the same daggone picture being repeated in ten thousand towns all up and down this great country. I suppose it sells wireless goods, but I want to tell you, it threatens the health of our kitty.

"How far can you send?"

Radical pursed up his lips and replied, "Oh—Texas, Georgia, Connecticut, Oklahoma, South Dakota. A fellow in Maine sent me a card the other day. Said he had heard me on galena."

"Heard me on galena!" Now, what kind of an impression do you suppose these unsuspecting people got from that sentence? Most likely some of them connected it up with a brand of hair oil, others with the name of some Pullman sleeping car, and still others with the name of a yacht. But they sucked it in, just the same, swallowed it line, hook, bait, sinker and would have taken the pole if they could have got it, because it was wireless. The public do not expect to understand anything a wireless man says. They just look flabbergasted and stand by for the next thriller.

"How far can you receive?"

This is our champion bone-head question, as we all know. It's like asking a man how deep can he drink, or how wide can he spit, or how thick can he smell. Radical acted as though he had never had the question asked him before.

"Oh—England, France, Germany, Italy, Mexico, all the ships on the Atlantic Ocean, the Lakes, the Gulf of Mexico. I hear them talking to one another over on the Pacific once in a while."

The lady with the fidgets nearly choked at this. She said she had a friend coming over from Europe next month, and she would love to send her a message. I thought Radical was going to go into the long explanation about amateurs being forbidden to work ships, but thanks be, he did not attempt it. Instead, the lady's remarks reminded him of the commercials and he told them to wait a minute and he would let them hear the ships on the oceans and the lakes. He tuned to 600 meters, and of course the great chorus of 500-cycle stuff came pounding in. It was a different kind of noise than the visitors had yet heard, and they all crowded in with their heads together, listening and pushing one another.

"What's that squeeky one saying?" squoke the lady with the fidgets. Radical copied madly, for it was commercial stuff and coming at twenty and better. He wrote a lot of stuff on the paper, and then hove to and glanced it over. It went something like this:— "WWK WWK DE FTR FTR WOTTELL 10 AND 3 STR 177 NYK LOST PREAMBLE AND ADDRESS AMBROSE CHANNEL PROCEED NEW YORK SPUT 2A.M. TOMORROW QRM QSY 500 K."

Radical read this off exactly as it appears above and gave the distinct impression that FTR was using profane language and was indignant over ten and three. Radical said this was in radio abbreviation and meant that something important had happened. He yanked open a drawer in the table and fished out a commercial call book. Looking up the calls he said:— "That's the Rochambeau, a French ship somewhere out on the Atlantic Ocean. She's asking the Western Queen what she means by giving him ten and three just because he has lost the preamble and address of Ambrose Channel, who is proceeding to New York to sput at 2 a.m. in the morning. The QRM QSY means too much interference, let's change to 500 meters."

This was more thrilling than anything yet. Here was the great Atlantic Ocean, with the ships all talking to one another, and out here in the interior of the United States, a young man was hearing them. It was "uncanny" as the stout gentleman said to the lady with the fidgets.

Just then a shrill 500-cycle note came tearing in, so you could read it all over the room. One of the ladies squealed, and wanted to know what this new one was saying. Radical grabbed his pencil and it went down something like this:—

"CLEAR SORMOR WEST GALE HEAVY SEAS ON LAKE LEAVING REPEAT CLEVELAND LOAD CONFIRM ASHTABULA—"

Some coarse grained commercial butted in here and Radical stopped copying. He read the message just as it appears, and said, "Of course that is plain to anybody."

The message was just about as clear as mud. If any man can say what is meant by the combination of words in this message, then I take off my hat to him. He rates a better intellect and a better standing as a radio operator than I do. And yet, because it was wireless, and because Radical looked as though he understood it, and read it off the paper as though only a boob would not get it, these good people accepted it. As a matter of fact it was 100%, double distilled BUNK.

Radical tuned back to 200 meters. It was getting late and the loud ones were commencing to boom in. 9CP growled in,

(Continued on page 44)

Improving the Relay Spark Transmitter

By Sumner B. Young, 1AE

This article won the third prize in our recent contest for articles on the ideal spark transmitter. As we said in announcing the winners, Mr. Young's article does not describe the construction of a station that appeals to us when we think of an Ideal Spark Set but as an experience story describing the author's ups and downs in his endeavor to achieve a DX station it is invaluable indeed. Success in spark work is largely a matter of perfection in details. Mr. Young drives that point home and teaches us where to look for trouble. Every reader of QST will find something in this article that will help him to have a better station.—Editor.

I DO not own an ideal relay spark transmitter, and I have never seen one, either; but there may be something in my experience which will suggest ways and means of improvement to other amateurs who are constantly striving to make their stations more efficient.

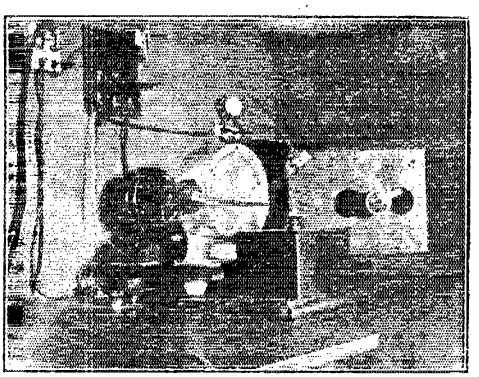
There are two ways to improve a wireless station. One can improve the radiating system, or strive to secure perfect co-ordination between the transmitting instruments. The ideal method is to do both, for the efficiency of a radio plant is a cumulative affair.

What puzzles a man most is where to begin. Co-ordination inside the operating room is easier, for standard instruments are available, and if one is a careful workman, such items as condensers and oscillation transformers can be built at home. Considerable practical and theoretical data is available, and it can be applied to almost any situation, for here we are dealing with matters little influenced by local surroundings. In this field, a good commonsense knowledge of the theoretical side of the art is especially valuable. Many stations are failures because their owners simply tried one thing after another without asking themselves *why*.

When we try to improve our radiating system, we are up against a more difficult proposition. To be sure, the ideal aerial is a vertical, absolutely symmetrical conductor having extremely low ohmic and high-frequency resistance. The ideal station is located on the level of the ground directly below the base of the antenna, and the perfect ground system is an enormous circular metal plate buried in permanently wet soil beneath the building. Its area is limitless, and the ground lead should be connected to the exact centre of the circle. Unfortunately, the amateur has to build his station where he can, not where conditions are ideal. Local, specific, individual difficulties must be overcome. Here, optimism is a great asset. Without it, you may worry so much about what is wrong with your location that you will overlook some of its natural advantages, but if you "cash in" on what you *do* have, you may counterbalance enough shortcomings to increase your range considerably.

When the practical work of improving existing apparatus confronts us, we naturally desire to spend our time and money to the best advantage. The usual procedure is to bring what apparatus one has up to its maximum efficiency by careful adjustment, and then remedy the most glaring defects both inside the station and out with thoroughness and dispatch. Refinements are instituted as opportunity affords.

No specific directions applying to all cases can be given. We are reminded of the "Safety-First" campaigners who started a



The Transmitter at 1AE.

contest to find out how a person could guard against accidents when crossing a street. A small boy sent in this answer: "When you get to the curbstone, stop and look both ways; if everything is all right, then go ahead." The judges knew this wasn't very specific. They decided, however, that it was up to the pedestrian himself to decide whether everything was all right or not, and that the main idea was to get him to pause and look around a bit, so the slogan was adopted.

Before you begin, know what has been tried before. Many disappointments can be avoided and many new ideas gained by assimilating the experience of others.

I first decided that optimism was a good thing when I was sent to Bath, Maine, in 1917 to serve as Electrician in Charge at a small U.S.N.R.F. station for a short time. The apparatus consisted of a one kilowatt transformer, a small rotary gap, moulded condenser sections of the familiar-

type, and a hinged O.T. It was all amateur apparatus, contributed by the City. The list sounded encouraging, but the apparatus was highly inefficient. The transformer proved to be one of those "trick" instruments that are sometimes let loose upon society. Somebody had wound into it an enormous secondary voltage, far beyond the value determined by its designers. The beautiful moulded condensers had been connected in series parallel to combat it, but they had been blown one by one, and now a few survivors were connected in parallel across the terminals of their tormentor, which had been restrained by an electric flatiron connected in series with the primary feed wires. On top of that, there was practically no insulation inside the station or out.

There was, however, one natural advantage that could be "cashed in". The Kennebec Yacht Club, where the station was located, was built partly on piles, for the tide covered a portion of the river bank. It was easy, therefore, to secure an excellent ground in permanently wet mud and shallow water directly underneath the operating room. Unfortunately, it was impossible to get requisitions for material filled for a station like ours. What was absolutely necessary had to be contributed by the station force.

Several hundred feet of copper wire were secured, and a ground system was built which made practical use of a hint which appeared in QST some time before the war.

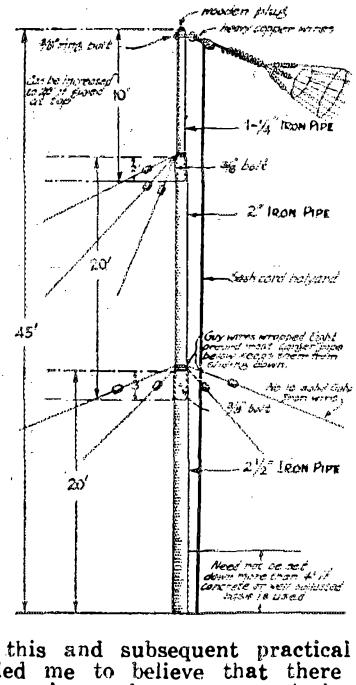
The Boy Scouts were called upon to help us out, and they certainly surprised us with their zeal. Every garage in Bath was canvassed for old dry cells, and between four and five hundred were collected. Then the station force began the tedious task of removing the pasteboard covers and scraping the zinc cases bright with a piece of glass. The copper wires were used to connect the negative poles together, and as fast as these chains of cells were completed, they were buried in the river mud.

The main ground lead was a piece of trolley wire fifteen feet long, leading directly upward to the station. The bottom of this wire was connected to a circular row of dry cells some four feet in diameter. The cells were crowded close together along the connecting wire to present plenty of surface to the earth at this point where the density of the ground currents was greatest. Concentric with this was another row of dry cells some ten feet from the foot of the trolley wire, and almost circular in shape. Here the cells were spaced a foot apart along the connecting wire. Extending radially from the trolley wire were four long wires connecting the two circular rows, and running out beyond toward the river. Dry cells were connected to these wires at irregular intervals. Some sixty feet away from the starting point where deep water was encountered, the wires were connected to bunches of ten or fifteen cells each and the ends tossed into the stream.

Additional ground connections were made to a radiator in the operating room and to a water pipe underneath the building.

When the station was being tested to see if the increase in "radiation" was very great, we were disappointed, for the insulation in the aerial had not been changed, but during that very test our signals were heard in Boston for the first time.

This experience made me appreciate the importance of a good ground more than any theoretical treatise I ever read. In



fact, this and subsequent practical work has led me to believe that there is no surer, easier, and more economical way of increasing a station's range than by putting in the very best ground that circumstances will allow.

My own station, 1AE, graduated from a one inch spark coil on December 21st, 1919. It is located on the third floor of my home, and its surroundings are probably typical of a large number of amateur stations, for there was little space to erect an antenna, and none of the various types of buried ground systems were practical, and an insulated counterpoise was out of the question. Furthermore, the appearance of the house could not be marred by masts which were too obtrusive, and noise had to be eliminated without resorting to remote control.

The house is on a hill, which is advantageous, but its exposed position called for a mast of unusual strength, and an aerial which would not blow down easily. Some years ago I designed and built an iron pipe mast to hold up one end of a six wire aerial 250 feet long. It was mounted on a flat roof in the rear part of the building, thirty odd feet above the ground. The photographs and diagrams show its constructional details clearly. It will be noticed that the sections are telescoped into each other and secured by bolts. This overlapping at the joints gives unusual strength. Reducing couplings are almost certain to snap while the pole is being raised. The mast should be erected so that the bolts passing through the pipes merely support the dead weight of the sections above them. Place them at right angles to the direction of the pull exerted by the antenna so that the sections can swing back and forth slightly, around the bolts as axes, and then all side stress is transmitted to the pipes themselves.

It is unsafe to attempt to mount a mast like this on a sloping roof where a good working platform for yourself and your assistants is lacking. It can readily be mounted in a concrete base in the ground.

It is obvious that this type of mast is good looking, and that it presents little surface to the wind. Rust is its greatest enemy, and great care should be taken to protect the pipes thoroughly with two coats of good metal paint before the sections are bolted together. The top of the mast should be carefully plugged with a piece of wood, and the joints below caulked with tar to keep water out of the inside of the pipe.

When the ban on amateur stations was lifted, the mast needed a new set of guy wires and a coat of paint. This was managed by hoisting a ladder to the top of the chimney and lashing it securely to the mast. Other ropes were fastened to the ladder like guy wires, but they were not called upon to bear much strain, for the mast held firmly, and the chimney supported the greater part of the dead weight.

Number ten galvanized iron wire was used in place of stranded wire, because the stranded kind had rusted out very quickly before, probably because water collected in the little crevices between the strands. The first section was guyed four ways, and the second three. The wires were insulated top and bottom with large porcelain cleats which were bought at a big electrical supply house in Boston for something like eighteen cents a pair.

I subsequently regretted that I did not replace the iron wire that fastened the pulley to the top of the mast. Later I had to climb the pole hand over hand and bolt a new block into the hole where the old block's fastening wire used to pass through the pipe. I did have inspiration enough to put an additional pulley onto the mast at the second joint just below the top section, and run a second halyard through it for emergencies.

The aerial was a conventional flat-top thirty-five feet long. It ran to a six foot mast on another flat roof a story higher than the one on which the iron mast was mounted, and a thirty-foot lead-in of number four copper wire connected it to the lightning switch on the window-sill of the operating room which is on the third floor of the house, and on the same level as the base of the iron mast. Inside the room, a ten-foot stranded cable made up of four No. 16 copper wires led to the instrument table. The lead-in insulator was an Electrose bushing fastened into a hole cut in a board placed across the bottom of the window. The lower window casement shut down tightly against this board, to keep out the weather.

Although the room was far above the ground, a good ground connection already existed. The instrument table was near a large chimney, and several pipes had been plumbed through the air space around it. Consequently connections to gas and steam pipes were available in the room, and an exposed water pipe in the attic above could be reached by a thirty foot length of copper ribbon. Connections to all three pipes had been made with copper ribbon, half an inch wide, run along the baseboard near the floor, and a main connection ran to the change-over switch on the wall above the table. In addition, there was the standard No. 4 lightning wire running on porcelain knobs down the outside of the building, and connected to a ground clamp on the water pipe in the cellar, on the street side of the meter. This was connected to the other grounds by a copper ribbon.

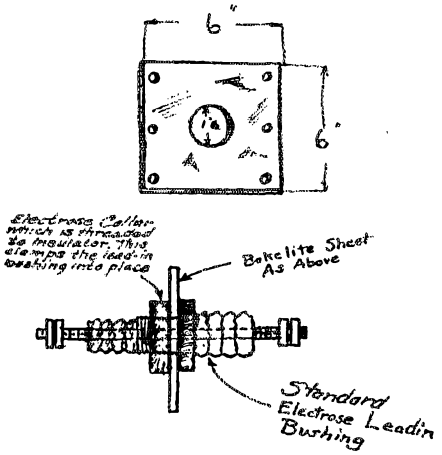
In my particular case, best results were obtained by grounding onto everything in sight, but this does not hold in every case. Whether it is the best policy or not can only be determined by the "cut and try" method.

After a "BX" cable was fished up through the wall by an electrician, and connection made to the lightly-loaded side of a three-wire system which was available down cellar, the transmitting set was assembled. Before the war, the instruments had been used at the Harvard Wireless Club, and later were sold to 1PM, West Newton, Mass., shortly before hostilities commenced. There was a glass plate condenser of the series parallel type, a small 12-stud rotary which gave a note of 720 sparks per second, and whose electrodes were filed to knife edges to give a super-quick "break", a "near-Telefunken" pancake O.T., a telegraphy key with extra heavy silver contacts, and a hot wire am-

meter reading up to three amps.

The finest instrument was an "old standby" transformer, one of four which as I understood it were built by Cutting & Washington for experimental purposes. Roughly speaking, it had a sixty-cycle primary and a 500-cycle secondary, and although the power factor was not very good, it worked perfectly at high spark frequencies, a radical departure at the time it was designed. The other instruments were not as efficient as could be wished. I planned to eliminate them as opportunity should afford.

The transformer was tapped to draw 250, 500, and 750 watts. When I tried to use the half-kilowatt tap, it became evident



A simple way to increase the carrying capacity of a small electrose leadin bushing

immediately that the insulation on the O.T. and the change-over switch (which had a wooden base) was totally inadequate. This was due to the fact that the station was located some distance above the ground, and the voltage in the secondary winding of the O.T. was much greater than it had been at 1LE and 1PM, which were both located in basements below the level of the ground. A Clapp-Eastham change-over switch and a hinged O.T. had to be installed immediately.

Then the antenna insulation broke down. The aerial was lowered, and four Electrose ball insulators in series were connected to the end of each wire at the farther end of the flat top where the pressure naturally was greatest, and a ten-inch Electrose insulator fastened to the halyard. At the station end two Electrose ball insulators were used on each antenna wire, and two more on the halyard. Now the insulators in the operating room which guyed the lead-in out from the wall began to spark. The lead-in made sharp turns at both places where these insulators (single porcelain balls) were attached, and the voltage at these bends was quite high. This was remedied by making the turns less abrupt, and insulating with three Electrose balls at the first bend just above the operating table, and with four Electrose balls at the second turn six feet farther on.

Thwarted there, sparks began to fly at the base of the lightning switch which had been mounted on blocks of hard rubber about an inch and a half square. As it was winter-time, I disconnected it altogether.

All these changes lessened fire hazard, but I didn't begin to do "DX" work. My log covering these first few days is rather incoherent, but one entry is significant:

> "Dec. 22nd. Re-insulated aerial. Grounded set on tin roof, grounding conductor pipe at bottom. Radiation runs up from 1.6 to 2 amp. on 250 watts....."

It is true that my hot wire meter is not of the thermo-coupled type, and therefore not quantitatively accurate, but this increase in its reading was large enough to be striking. The tin roof referred to is a narrow one about two feet wide which runs along outside the dormer windows on the third floor and extends about two-thirds of the way around the main part of the house. The conductor pipes leading down from it are copper, and the one I grounded made connection to this narrow roof and also to a much larger tin roof about 70' x 10' over the front piazza. As not all of the joints in the conductor pipe were soldered, such a marked increase in "radiation" had not been expected. I presume that the distributed capacity of these large surfaces of tin had not been properly appreciated.

It was not until January 17th that my signals were heard at any distance. On the 20th, a card from 2BK announced that I was QSA, but tuned to 175 meters, where few amateurs could tune their receiving sets.

I had tuned my transmitter by cutting in all six turns available in the secondary of the O.T., and bringing the closed circuit into resonance by holding down the key and varying the position of the sliding contact on the primary by means of the insulated handle. The coupling at the time was about 40 degrees, and the hot wire ammeter was used to determine when the resonance point was reached. No wavemeter had been used to check the wave.

Evidently a loading-coil was needed, and a Clapp-Eastham helix was immediately installed. This coil had a beneficial effect beyond merely enabling 200 meters to be reached. It "stiffened" the open circuit, sharpening up the wave. Small changes in wave length could be effected by cutting a turn or two in or out and

merely turning the handle on the primary of the O.T. until the hot wire meter registered a maximum. The coupling did not have to be varied, for the number of secondary turns in actual inductive relation to the closed circuit remained the same, and the latter could be brought to resonance with but a very small change in inductance. It would be possible, for instance, to cut out the whole loading coil and turn the handle on the primary of the O.T. to a predetermined spot if I wanted to drop down to 175 meters, but this was never done in practice as few stations could tune down that low.

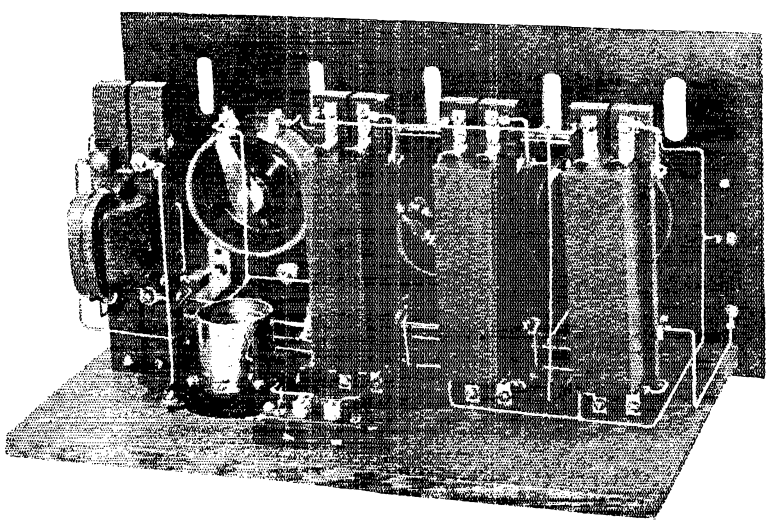
No more improvements were instituted for a few days; then followed a disastrous attempt to muffle the rotary gap by enclosing it temporarily in a cardboard box. The composition rotor melted into a grotesque mass, and my teeth still chatter when I recall the rasping sound she made when she hit the stationary electrodes going 3300 R.P.M. I bought a new rotor and "carried on", but there were other members of the household who regretted the failure of this "great experiment" more than I.

(To be concluded next month)

New Apparatus

THE piece of apparatus we have chosen for this department this month is the first thing of its kind that we amateurs have ever seen—a short-wave radio frequency amplifier designed for amateur communication, made by the Radio Instrument Co., Washington, D. C.

Briefly described, the instrument uses interchangeable iron-cored transformers for various bands of wave lengths for repeating between tubes, uses any standard tubes, either soft or hard detector, and is furnished in various combinations of r.f. amplification, detector and a.f. amplification. Our photographs and hook-up illustrate the type known as JM-3, employing three radio stages, a soft detector, and one stage of audio amplification.



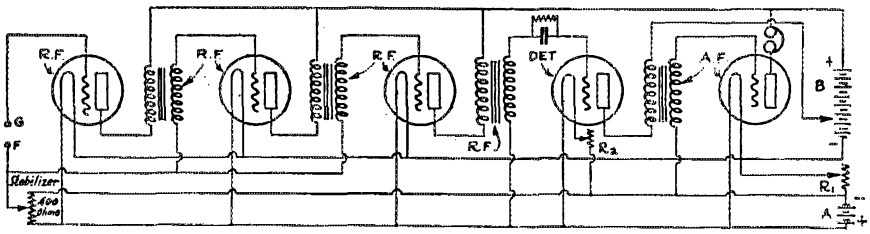
The r.f. transformers are the most interesting feature. They are the result of several years experimental work and we are told they work effectively on waves as short as 150 meters. The completed transformers are sealed into a case made of square bakelite tubing, with leads brought to contacts at the ends, so that they plug in to spring clip terminals whereby the transformers between each stage may be changed quickly for various wave length ranges. No details are available on the construction of the transformers but we are informed they can be duplicated effectively only by intricate machine work, so that even if generally known the information would be of little value to amateurs. The regular set of transformers covers 150 to 650 meters, with other sets covering up to 2,000, 5,000, and 12,000 meters, respectively.

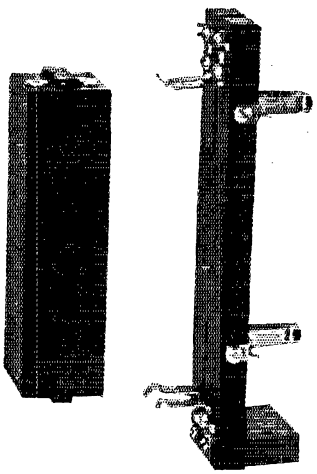
The best results are obtained with the use of Radio Audion Co.'s RAC-3 tubes as amplifiers, with a soft tube as detector.

The RAC-3 gets down to the short wave lengths effectively, because of its lower capacity, and the wave length ranges given in the preceding paragraph are with this tube. A-P tubes work well at 170 meters and Radiotrons as low as 180. A-P and Radiotron valves are preferable where high voltage amplification is desired, altho more careful construction is necessary for such operation. The sets are produced for either style of tube, our photographs illustrating the type employing RAC-3's, which snap into clips on the reverse side of the same mounting that carries the transformers. There are no critical adjustments on the set unless a soft detector is used, where voltage adjustment will be necessary. A hard tube may be used, at a slight loss in sensitivity.

The wiring diagram explains itself. All the amplifier filaments are controlled by one special rheostat, the detector filament by another. A fixed potential of 30 to 45 volts is used on the amplifier anodes but the detector voltage is variable. There is but one other adjustment—the "stabilizer", in essence a potentiometer controlling grid bias on the r.f. amplifiers.

Radio-frequency amplification of course is an extremely desirable thing and we have long awaited it. If this equipment lives up to its appearance and the claims of its friends it will find a ready place in DX stations. 5ZA, by the way, has been read four feet from the phones in Washington on such a set working on an overhead antenna.





One of the R.F. Transformers and the Mounting on which both it and the tube are help by clips.

Better Sending Set Arrangement

By Carlos S. Mundt, 6AJ

SO many amateurs make beautiful receiving cabinets and neglect their sending set, strewing the apparatus all over (and under) the table with the lead wires running everywhere that necessity or fancy may require. Just stop a moment, gentle reader, and call to mind the number of amateur friends who have good, efficient, compact sending sets to match the attractive receiving equipment! But there is no reason why every amateur should not make an effort to improve his arrangement, as the writer will attempt to show.

To be efficient a sending set needs just as much compact arrangement as a receiving set, assuming of course that the individual units are in themselves fairly good. The writer has rebuilt his set along the lines indicated in the diagram and with excellent results.

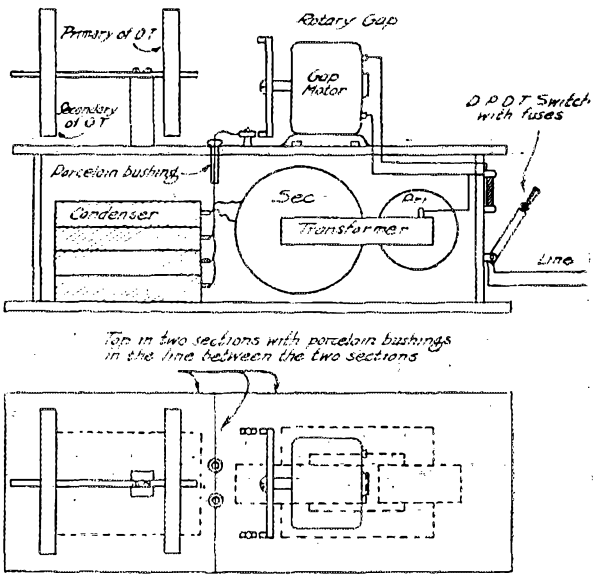
A cabinet 12 in. wide, 24 in. long, and 6 in. high was constructed of ½-inch maple, the top being cut in two to facilitate removal and the ends inset to allow for the 110-volt controls. This box was to house the transformer and condenser. The oscillation transformer and rotary were then mounted on the two sections of the top and leads from the inside are brought

thru porcelain tubes which are placed in holes drilled into the cut which separates the top sections. Thus either the O.T. or the rotary may be separately removed without affecting leads to itself or from the transformer and condensers.

Changes will undoubtedly have to be made in the dimensions to suit the individual needs of those who wish to use this plan. For example, an oil-immersed condenser would, because of its shape, require a different construction to house it than the moulded type which was used by the writer. A different type of O.T. probably would require a different length of box.

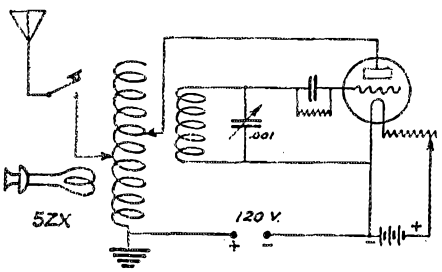
Whatever the changes in dimensions the advantages remain the same:

(1) Low tension leads all at one end, high tension at the other.
(2) Saving in table space (only 2 sq. ft. required.)
(3) Short leads, making for efficiency.
(4) Main switch starts gap as well as supplies current to transformer.
(5) Gap and O.T. always within easy reach for adjustment.
(6) The top instruments easily and quickly removable when necessary, and with their removal those within are exposed to view.

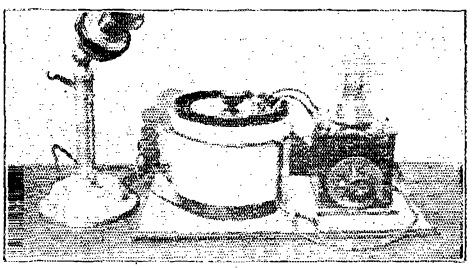


A Battery-Operated Radiophone

THE accompanying photographs are of a very simple yet efficient little phone set constructed by 5ZX, Houston, Tex., on which telephony over distances up to 97 miles has been attained. It uses a single 5-watt tube, absorption-loop modulation, and a storage "B" battery for anode supply.



The circuit is the justly-famous British aircraft hook-up originally described in these columns by 1DH in July QST. The outer coil is the antenna inductance, and is wound on a Quaker Oats box, while the inner form is of just the right size to slip over a Murdock 43-plate condenser. A detector grid condenser is used, with the grid leak consisting of a heavy pencil mark. The inductances shown were designed for rather long wave lengths, 5ZX



using the set on 375 m., but the circuit is capable of getting down to 200 nicely. It will work with any small power tube or any of the hard amplifier tubes.

Anode supply is obtained from a home-made B battery of 60 lead cells, giving 120 volts. The cells are made of 1" by 7" test tubes, the elements of plain lead strips that have been "gashed" with a knife to increase the active surface.

(Concluded on page 53)

The Design of Loop Antennae

By David S. Brown

Presented Before Radio Club of America, Columbia University, January, 1921.

THE use of loop or coil antennae for receiving is too well known to require any introduction. It is not believed, however, that the design of loops for specific wave lengths and for various uses is thoroughly understood. The purpose of this paper will be to explain the factors which enter into the practical design.

Loops serve a two-fold purpose. First, they function as antennae for either transmitting or receiving. Second, they may be used to determine the direction in which a wave is travelling.

It is fairly obvious that such factors as size and shape will affect both the directional and receptional qualities of a loop. Just how these factors together with others, such as number of turns and spacing, do control and limit the proper functions of a loop will be subsequently shown.

For convenience loops will be considered as either (a) spiral or (b) solenoid. (a) Spiral loops are those which are of the pancake type each turn of which encloses an area smaller than the preceding turn. (b) Solenoid loops are those which are of the helical type every turn of which encloses the same area. Two solenoids mounted at right angles to each other constitute a "crossed coil" loop."

In order to determine the effects due to various shapes many loops have been made and actually tried. In each loop the factors N (number of turns) and A (area enclosed by one turn) were kept constant so that the results served as a fair comparison between the different shapes. In each case the loop was shunted by a tuning condenser and connected directly to a vacuum tube detector set. The telephone receivers were shunted by a constant impedance resistance or "audibility meter". The transmitter consisted of a quenched spark set with an aerial of the "umbrella type".

After the signal was tuned in, the loop was rotated and audibility read at every ten degrees. The audibility readings were plotted on polar co-ordinates. Reproductions of the various shapes and windings are shown in Fig. 1. These curves are not drawn to scale and should be considered qualitatively only.

In Fig. 1 (a) is a square loop of the spiral type; (b) is a rectangular loop; (c) is the same loop as (b) except that it is turned in a vertical plane so that its longest axis is perpendicular; (d) is a triangular loop; (h) and (i) are "figure 8" loops. (e) and (j) are square loops with "figure 8" windings; loops (e) and (g) had parts of the windings entirely enclosed in a metallic shielding which was grounded.

The polar curves of loops (a) and (b) indicate rather broad maxima and sharp minima. Loops (c) and (d) indicate sharp maxima and rather broad minima. Loops (e), (h), (i) and (j), especially the last, show very little variation between maxima and minima. When the shield of (e) was ungrounded, the curve (f) resulted. In this case the loop effect was practically reversed. (Note: In each case the signal is supposed to be coming along the zero axis from right to left.)

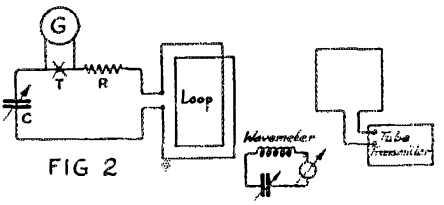


FIG 2

It was found that with almost every loop the signals disappeared when the loop was held in a plane about 30° to the earth as indicated in (m). When the loop is raised to a position parallel with the earth, as in (n), it is practically non-directional and acts as a simple aerial. Further tests were tried to ascertain the properties of loops elevated above ground and placed below ground. In the former case the actions were somewhat erratic; but the tests were too incomplete to be considered. In the latter case no loss in directional properties was noticed in a dugout some twelve feet underground.

The loop of Fig. 1 (k) differed slightly from (a) in that the turns were spaced more and the winding continued further until it nearly filled the area. This loop showed some very interesting features and will be more fully discussed later.

On the whole these tests showed that both for receiving and for direction finding the square loop gave the best signal and quite satisfactory directional qualities.

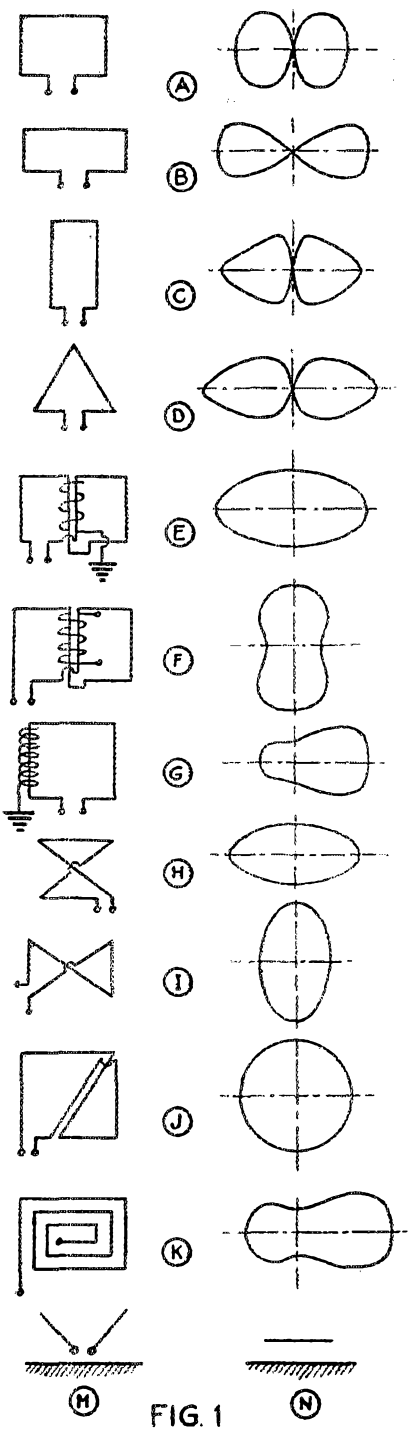


FIG. 1

It is apparent that for any given size of loop more turns can be got on a solenoid than on a spiral. Furthermore, the solenoid is less directional than the spiral. For these reasons the square solenoid will be considered hereafter as standard for ordinary receiving, while the square spiral may be used for direction finding.

In order clearly to understand the methods of design it is necessary to consider the theory of loop reception.

At any instant the value of e.m.f. induced in the loop is

$$e = N\frac{d\varphi}{dt}10^{-8} = NA\frac{dh}{dt}10^{-8} \; *$$

where N is number of turns, A is area of one turn, φ is the flux, e is instantaneous value of e.m.f., h is instantaneous value of field intensity, H_o is maximum h. For a harmonically varying field

$$h = H_o \sin(\omega t)$$

$$\frac{dh}{dt} = H_o\omega \cos(\omega t)$$

Then

$$e = NAH_o\omega \cos(\omega t)\ 10^{-8}$$

At resonance the instantaneous value of the current is $\frac{E}{R}$

$$i = \frac{e}{R} = \frac{NAH_o\ \omega\ 10^{-8}\cos(\omega t)}{R}$$

The effective (R.M.S.) current is

$$I = \frac{i}{\sqrt{2}\cos(\omega t)} = \frac{NAH_o\,\omega\,10^{-8}}{\sqrt{2}\,R}$$

The voltage across a condenser is IZ or $\frac{1}{j\omega c}$ so that the voltage from the loop across the condenser (i.e. the voltage which actuates the detector) is

$$E_c = \frac{NAH_o\ 10^{-8}}{\sqrt{2}\,jRC}$$

$$\lambda = \frac{V}{f} = V\,2\pi\sqrt{(LC)}$$

$$\frac{1}{c} = \frac{4\pi^2V^2L}{\lambda^2}$$

Substituting the value of $\frac{1}{C}$ in the equation for E_c and calling all the constant terms K

$$E_c = K\left(\frac{NAL}{\lambda^2R}\right)$$

The response to any signal, then, may

* For a spiral loop

$$e = \Sigma^n A \ldots\ldots\ldots$$

be said to depend on the value of $\left(\frac{NAL}{\lambda^2 R}\right)$ This term will be called the "Reception Factor" of a loop. The problem would appear to be to make the largest possible loop in order to have a large NAL term. But on the other hand it may be seen that the reception decreases as the wave length squared increases. And, furthermore, if the wave length is decreased (to increase the reception factor), the resistance becomes very high. It is obvious that the reception factor for each and every loop must be studied in order to determine the best size for any desired wave length.

In the expression $\left(\frac{NAL}{\lambda^2 R}\right)$ the terms N and A are arbitrarily fixed for any one loop. L (the inductance) may be either calculated or measured. λ is the wave length at which the loop is operated. R, the resistance of the loop at that wave length, is the only undetermined variable. By tests the actual resistances of loops of different sizes was determined. Fig. 2 shows a loop connected in series with a standard resistance, a low resistance thermo-couple and a standard variable condenser. The thermo-couple is shunted by a current-squared meter. A variable frequency oscillator and a wave meter are also indicated. The oscillator was tuned to any long wave length and the loop tuned in by means of the standard condenser. Readings of the meter were taken when various standard resistances were inserted in the circuit. The inductance was then calculated from the relation

$$L_{cm} = \frac{\lambda^2}{39.6^2 C_{\mu f}}$$

and the resistance by

$$R = \frac{R_2 - R_1\left(\frac{\delta_1}{\delta_2}\right)}{\left(\frac{\delta_1}{\delta_2}\right) - 1} - R_t$$

where R = *loop resistance*

$\left.\frac{R_1}{R_2}\right\}$ = *standard resistances*

$\left.\frac{\delta_1}{\delta_2}\right\}$ = *corresponding meter deflections*

R_t = *resistance of thermocouple.*

By making similar calculations of R and L at various wave lengths down almost to the fundamental of the loop circuit and by plotting the results, curves similar to those of Fig. 3 were obtained.

Both curves of Fig. 3 are in accordance with the known facts that near the fundamental period the resistance and inductance are very high and that at long wave lengths both approach the true low frequency values. The value of inductance was assumed to be that shown on the curve at

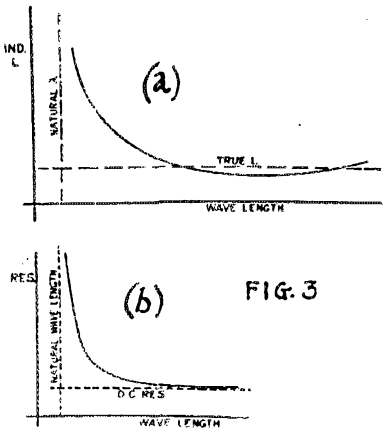


FIG. 3

a point corresponding to a relatively long wave length. The factors N, A and L being known, the values of R at various wave lengths were read from the curve and the corresponding reception factors plotted. As may be seen in Fig. 4, for any given loop there is a decided maximum in the value of the reception factor.

To determine the best spacing of turns, various spacings were tried. Loops of each size, from four to fifteen feet square, were made and the turns were spaced by successive fractions of an inch from one

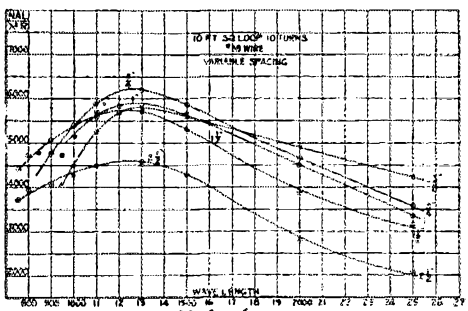


FIG 4

quarter to one and one half inches. At each spacing, the reception factor curve was determined. Fig. 4 shows a representative series of curves for the reception factors of a thirteen foot square loop. The greatest maximum for that loop occurs when the spacing is one inch (center to center of turns). Consequently, one inch may be considered as the best spacing for a loop of that size. The best spacing of all sizes up to fifteen feet is shown in the

curve Fig. 5 and similarly in Table A. In all subsequent tests, the loops were made with the spacing indicated by that curve.

TABLE A.
Best Spacing for Solenoid Loops.
(*Center to center between turns.*)

Size loop feet	Spacing inches
4	¼
6	1/8
8	1/16
10	¾
12	15/16
15	1⅛

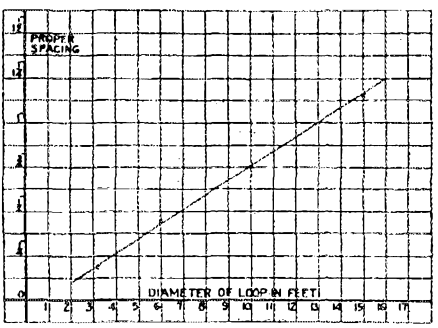


FIG. 5.

Thus far has been determined the criterion for loop reception (i.e. the "Reception Factor) and the best spacing for different sizes. The next problem is to determine the size and number of turns to be used for any given wave length or range of wave lengths. As before, loops of various sizes were made and tested over a large range of wave lengths. From the tests resistance and inductance were found and plotted. The reception factor values were calculated and plotted for each size of loop, the number of turns being gradually increased at each test.

Fig. 6 shows a group of curves for resistances of four foot loops up to 4000 meters. The smallest four foot loop consisted of ten turns (spaced one quarter inch) and the largest 80 turns. The corresponding values of reception factor are plotted in Fig. 7. It is obvious that for any given loop there is some one wave length at which the product of λ^4 and R will have a minimum value. This is clearly indicated by the shape of the curves of Fig. 7. For example, the lower left hand curve shows the reception of a four foot, ten turn loop. The maximum reception factor for that loop (3000) occurs at 800 meters. Below and above 800, the reception is very poor. For the 20 turn loop 1800 is the best wave length. However, at longer waves this loop is much better than the 10 turn loop and, conversely, poorer at the shorter waves. The 60 turn loop is better than any of the others except at short wave lengths; while the 80 turn loop is very poor at any wave length. Two things, then, are apparent: (1) For any given wave length and given size of loop, one number of turns is better than any other, and (2) for any given size of loop, one

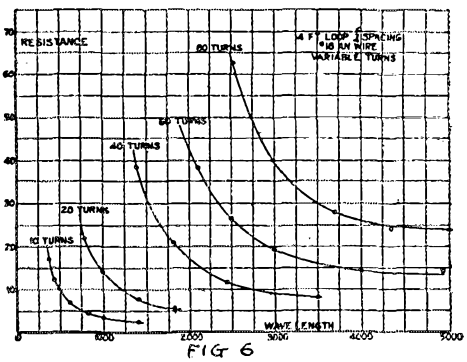


FIG 6

number of turns gives better results over a range of wave lengths than does any other.

Figs. 8 and 9 are respectively the resistances and reception factors for a 6 foot loop. These curves correspond in general character with those for the four foot loop. Curves for all other sizes are substantially the same and tend to confirm the general conclusions of the preceding and of the following paragraph.

Comparing the four and six foot loops it will be seen that for some range one size is better than the other and vice versa. The general conclusions are (1) that for short waves large loops with few turns are

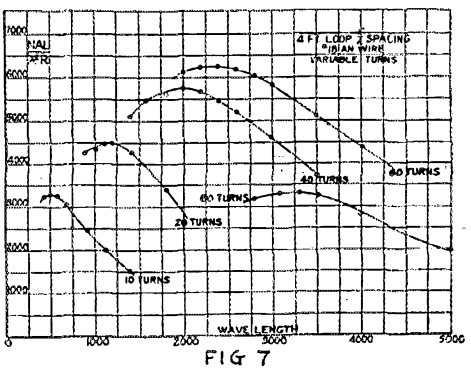


FIG 7

better than small loops with many turns, and (2) that for longer waves large loops are better than small loops. These conclusions may be checked by referring to Fig. 10.

One series of curves of Fig. 10 shows the number of turns (of loops from four to fifteen feet square) plotted against best wave lengths. From these curves may be

obtained directly the dimensions of loops which work best on any given wave length. For example, for 2500 meters, any of the following could be used: (1) fifteen foot, thirteen turn, (2) twelve foot, eighteen turn, (3) ten foot, twenty-three, (4) eight foot, thirty turn, (5) six foot, forty turn

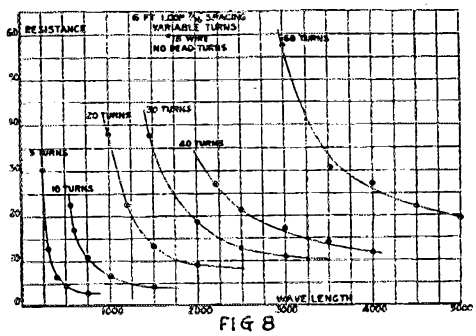


FIG 8

or (6) four foot, fifty-three turn. Numbers of turns for intermediate sizes, (i.e. 5, 7, 9 feet.....etc.) may be got by interpolating between the given curves.

The second series of curves of Fig. 10 are the maxima of reception factors for each size. From this set may be found which size of loop is best for a given wave length. In the last paragraph were determined a number of loops giving best results for their respective sizes. Now will be determined which of those loops gives the best results for that wave length. Taking the same example, 2500 meters, and tabulating the points obtained from the second series of curves,

Size	Turns	Rec. Factor
15	13	7000
12	18	7900 (approx.)
10	23	8600
8	30	9000 (approx.)
6	40	9300
4	53	6400

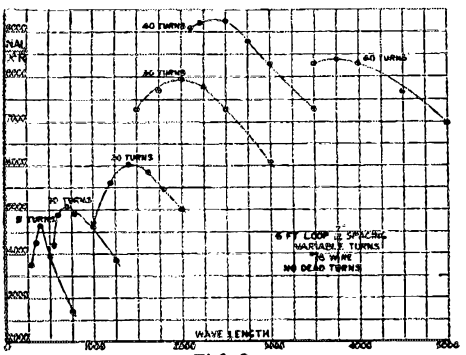


FIG 9

These figures show that of all the possible combinations a six foot loop with forty turns will give the best reception on 2500 meters.

Similar analysis may be made for any other wave length. The following tables summarize results obtained from different sizes and also indicate in order the best sizes for various wave lengths and ranges of wave length.

TABLE B.

Wavelength Range for Four Foot Square Solenoids

Turns	Best Wave Length	Efficient Range
3	250	200-350
4	300	250-400
6	350	300-800
10	600	350-1000
20	1200	900-1800

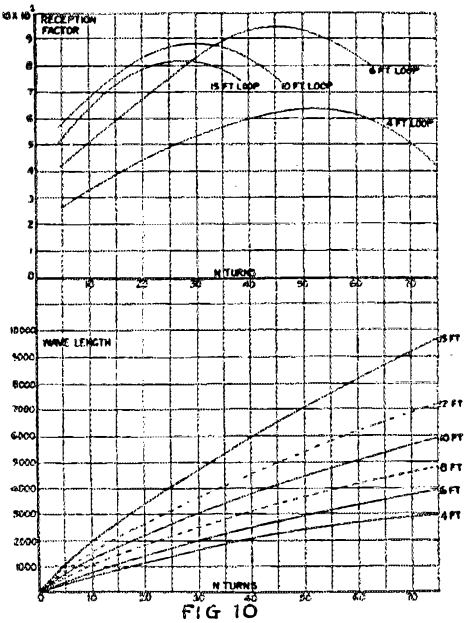


FIG 10

TABLE C.

Wavelength Range for Six Foot Square Solenoids

Turns	Best Wave Length	Efficient Range
3	220	180-400
6	500	400-900
10	700	600-1200
20	1400	1000-2000

TABLE D.

Size of Square Solenoid Loops for Various Wavelengths

Wavelength Meters	Size Feet	Turns N
50 to 100	(4	1
	(3	1

(Concluded on page 44)

EDITORIALS
de AMERICAN RADIO RELAY LEAGUE

Let's Give the Jewelers a Hand

THOSE of you who attended the Chicago Convention will remember an interesting talk by a Mr. Walker, who in the brief time allowed him told you most entertainingly of the efforts and the tribulations of the jeweler who is trying to use radio. It was our good fortune to have a half-hour with Mr. Walker later that week and we learned a lot from him. He is the editor of a monthly magazine that reaches the jewelry trade and he knows his field as well as we think we do our own. We were much impressed with the idea that there is a splendid chance for us A.R.R.L. men to make ourselves useful to the jewelers and at the same time help our own organization.

There are something over twenty-two thousand retail jewelry stores in this country, and they average three able-bodied keen-minded substantial American citizens to each establishment. Many of them already use wireless and the rest are hot prospects. The jeweler has been told for ten years by his trade papers that he needs radio in his business; for the reception of time signals, to act as a distributing station for the market broadcasts of the Department of Agriculture, etc.

But they have an awful time! They don't know what apparatus to buy, or they buy the wrong stuff, or the book says their aerial must be a hundred feet long while the store is only ninety, and what is a loop anyway? What they need, fellows, is a little of the A.R.R.L.'s help. Any radio amateur can tell them in ten minutes what they want to know, and they'll appreciate it mightily. They know they need radio but they lack the confidence to jump into it alone. There is where we come in—we furnish the confidence. The ground is already prepared. A little local missionary work will reap a harvest that will astound you.

It's easy to get time signals. We know that, but it's because we know how. The jeweler has trouble because he doesn't know how, or lacks confidence to tackle it unaided. If an A.R.R.L. man would talk to him a few minutes it would all be changed. We need these men, fellows. They are the class of substantial citizens the A.R.R.L. needs for members. If we'll do a little work in showing them how easy it is to make radio serve them, they'll use it, and sooner or later they'll be actively in the amateur game for its appeal cannot be resisted as we all well know. Local clubs will benefit too, for here will be permanent members who are good fellows and fine mechanics. It will be easy. There are an average of three jewelry stores in a town; after one has secured radio time the other two will not allow him to be the only one to enjoy the benefits and privileges of this wonderful art.

Now! Every member of this big organization ought to consider himself a committee to drop in on his local jewelers and see if they aren't looking for more light on radio, and a hundred to one they are. Give it to them. They're just crazy to find somebody to whom volts and cycles are an open book and you're that man. Tell them what they need to get time signals and show them how easy it is. Get them for members of your local club and of our A.R.R.L.—we *all* want them with us.

You scratch the jeweler's back and he'll scratch yours. And, who knows, maybe he can use that receiving set you'd like to sell.

Our Magazine

ABOUT every so often we get to wondering if all of you fellows are remembering to mention QST when you write to our advertisers. You know, men, this is your magazine and it's up to you to keep it going. Let's go over the story again briefly:

The A.R.R.L. is an organization of amateurs. Its purposes are well known. It has a charter but no capital stock. Its members own it, and elect from their number the directors who look after its affairs. It's non-commercial and devoted to not one solitary thing except the welfare of its members. It owns QST, which is its mouthpiece. That means that QST is yours—not idle talk, it really is, for it belongs to nobody else.

QST is just what you make it. It chronicles your activities. The articles are contributed by the membership for the common good. All we do is paste it up and keep it in the middle of the road. It is supported by its advertising—absolutely. Advertising is necessary to its life, and its

life will always be in proportion to its advertising. The latter will always depend on the results the people get who spend their good money with us. Therefore it's up to us who own this magazine to make them glad they're with us.

What must we do about it? It's simple. Support QST's advertisers, the men who make your magazine possible, buy your equipment from them, and be sure that you tell them that it is their advertising in QST which is bringing them your business. Members of the A.R.R.L. get good service from the advertisers, the advertisers always want to know where the place is that will bring them the most results from their money, and it will help to make your QST bigger and better because it will bring your money back to your organization in the form of advertising.

Please don't forget it.

Listening Hours

LAST spring it was suggested that if we amateurs would be willing to forego our brass-pounding a little, and would co-ordinate our QRX-ing so that all of us in a given part of the country would be standing by at once, we'd have a pretty good chance of hanging up some DX records. So during the summer we asked the bunch thru QST what they thought of the idea—should we do it or was it not worth the trouble? We got quite a few hundred replies endorsing the idea and agreeing with the original proponent that it was a peach of an idea. And we got not one single word of objection.

So the Traffic Manager framed a scheme, and on page 18 of this magazine for August he published a map, showing the country divided into QRX periods, with a time schedule to go by.

So far, so good. But are we observing them? We are not! Really, why not, fellows? It seems to us to be crackerjack idea, with a handle to it, and well worth the trying. It requires every man to stand by an hour on three nights of the week, knowing that at that time his two-thirds of the country is QRX-ing and thereby creating an excellent opportunity to hear some of the fellows over in the far-distant third of the country. "Distance" is one of the chief charms of amateur radio. We want our receiving sets to be able to pick up signals from a great distance, and when they do we are proud of them; and we want our transmitters to reach out, and no man knoweth the pride of a DX amateur in his transmitter! The Listening Hours were designed to help in just this.

Now if we don't want them let's abolish the schedule and stop fooling ourselves. But if we do want them, as we here really believe we do and as so many letters testified, then let's observe them, honorably and sportsmanlike, and get our neighbors to do likewise. Page 18 of August QST—take a look at it.

The Radiophone

THERE has been lots of talk going the rounds about the radiophone—what a wonderful thing it is, or what an infernal nuisance it is, according to the viewpoint of the speaker or according to what kind of radiophone he has listened to.

Right there is the answer! A real radiophone is a wonderful thing, and the high class concerts broadcasted on schedule by stable firms are doing more than any other single factor to bring into this fascinating game of ours the type of people we want. The prime aim of our A R R.L. is the furthering of Citizen Radio and we look forward to that day when every home will have its radio installation—when powerful central stations will broadcast news, concerts, lectures, entertainments, and everyone may get them without stirring from his living room. That day is coming.

Nor have we anything unfavorable to say about the experimenter—more power to him. By his efforts may he continue to improve our art. But the amateur concert fiends! How do they get that way? It looks as tho every bird who assembles a radiophone feels a heaven-sent inspiration to "favor" the community with music, without any regard whatever to the awfulness of the modulation, the ungodly supply ripple, the travesty on music which his alleged phonograph grinds out. Honestly we have seen some of these ginks with one-half of 60-cycles on the plate and a microphone in the ground lead, grinding out their terrible QRM for two hours per night on schedule, and blessed if they didn't think they were doing the community a big favor. With this sort of thing we haven't the least bit of patience, and we think it ought to be handled the same as any other sort of deliberate QRM.

However, there are many amateur installations capable of giving good music and many amateurs who like to listen to it. In a number of communities it has been found desirable to set aside a definite place in the evening's schedule for phone concerts, and this, like the general scheme of dividing working hours, is something for each community to determine according to its sentiment.

For the handling of relay traffic the telephone so far has failed miserably, and it isn't at all likely that it will ever come into any general use for that purpose, mainly for the big reason that any telephone set is capable of covering three or four times its phone range when used

(Concluded on page 51)

With The Radiophone Folks

THIS is the humble beginning of a department which will be devoted to the interests of that constantly-increasing army of Citizen Wireless amateurs who are primarily interested in the reception of radiophone broadcasts.

First and foremost we will endeavor to present here the schedules of the better class of broadcasting stations. The few we list this month by no means cover the field. Suggestions from readers as to where more information on such broadcasts can be obtained will be appreciated.

And then we want to tell in this department of the novel and interesting features of coming affairs and of those of the past month as well, and to present non-technical articles that will be of help in this line of work. Suggestions and ideas will be welcomed.

(A word to the brass-pounding old A.R.R.L. gang: You must know a dozen friends who are interested in receiving radiophones. This is a department for them. Please tell them about it; they will need QST and we want them as members.)

Grand Opera on the West Coast

On Sept. 29th radio stations within a radius of a thousand miles from San Francisco were treated to a wonderful half-hour of grand opera sung by stars of the Scotti company from station 6XG of the Leo J. Meyberg Co., thru the co-operation of the latter company and "The Bulletin", the largest evening paper in San Francisco.

The stars of the evening were Mmes. Queena Mario and Myrtle Schaff, who with Joseph Hislop and Mario Laurenti made up a quartet. The program consisted of three numbers: "La Donne e Mobile", from "Rigoletto", sung by Hislop; the "Toreador Song" from "Carmen", sung by Laurenti; and the quartet from "Rigoletto", probably the most famous of all quartets and a thrilling, inspiring thing, sung by all.

The entire Pacific slope was hushed for this performance. In many cities there were parties of up to fifty listening at a single station, and it is conservatively estimated that at least eight thousand people heard it.

A station similar to the one which sent out this concert has been installed by the Meyberg Co. in Los Angeles, on the roof of Hamburger's Department Store. The Hamburger people are so much enthused over it that they have opened a free school for instruction in radio, with an accomodation of 350 pupils a week.

Electioneering by Radio

For the first time in the history of electioneering, candidates were able to talk to the public without the latter leaving their homes, when arrangements were made in Pittsburgh by the Westinghouse Electric & Manufacturing Company to send broadcast by radio the speeches by the candidates. The nominations for mayor proved a very bitter fight in Pittsburgh recently, and radio was called into play to get the messages of the candidates to the people. In this way thousands of persons were addressed at one time without the inconvenience of leaving their own radio set. Each candidate for mayor was sent to the broadcasting station, where he was allowed five minutes to tell the reasons why he should be elected to the office. This proved to be quite popular, and excited a great deal of interest in Pittsburgh and vicinity.

Miss Dal Buell
—Photo by Bachrach

Miss Buell Plays for New England

The first wireless recital exclusively piano ever given was broadcasted Wed-

nesday evening, November 2, from the high-powered transmitting station of the American Radio and Research Corporation at Medford Hillside, Mass.

Next only to the unique method of entertainment was the prominence of the concert artist, Miss Dai Buell, who ranks among the leading pianists of America, according to the musical experts. Miss Buell interpreted the works of such master composers as Beethoven, Schumann, Chopin, Weber and Schubert, interspersing her selections with explanatory talks. Tetrazzini sang by

Miss Buell playing at Medford Hillside.

wireless for the Navy several months ago, but Miss Buell is the first celebrated artist to give a piano recital for the wireless public.

The concert was given in a specially prepared room in which a very large transmitter was placed directly above the sounding board of the piano. Transmission was on wave length of 350 meters. Reports were received that the music was heard not only by listeners in all parts of New England, but as far away as Canada, Ohio, Pennsylvania, Virginia and ships at sea. A very conservative estimate of the possible wireless audience was 25,000. The call letters of the transmitting station where Miss Buell gave her concert are Amrad 1XE.

A lot of folks have had trouble with their loud-speakers. They amplify telegraphic signals all right but the voice is "distorted" so that it barely can be understood. The following article has been written especially for us by a man intimately connected with the manufacture of these devices.

Making the Most of Your Magnavox

*By Herbert E. Metcalf**

IN common with all new and unique electrical apparatus, the Magnavox electro-dynamic loudspeaker — the receiver with the movable coil—must be used in the proper manner in order to obtain the truly remarkable results of which it is capable. Many thousands are in daily use, giving wonderful results because their owners know how to utilize them to the best advantage. However, there are a few owners who do not fully understand the operation of the Magnavox, and it is for them that this article has been written. But in order that you may be able to determine the proper usage it is necessary for you to understand somewhat of its construction and electrical constants.

None of the features of the Magnavox can be compared to an electro-magnetic receiver. Its construction, like that of a motor in which the armature might be said to be moving up and down instead of turning, gives it the internal characteristics of a motor. Due to the fact that the movable coil floats freely in a magnetic field there are no pole pieces to hit and the freedom of movement of the diaphragm is limited only by its elastic limit. The movable coil is surrounded by the iron field which has the effect of a closed secondary and its impedance is very low, about twenty ohms at 800 cycles. That is the reason for the stepdown coil, and also shows you that the Magnavox is a current-operated device and that the more current which can be passed through the little coil the greater will be the response. This stepdown coil relieves the movable coil of the D.C. component of the output circuit of vacuum tubes. There is no loss in eddy currents in the receiver and its electrical constants are such that a maximum of approximately 2000 milliamperes of voice or modulated current may pass through the little coil. Two thousand milliamperes of current will produce audible signals which can be heard many miles in quiet surroundings. Any less current will produce signals in exact proportion.

In modern radio-telephone reception there are two desired results—volume, and lack of distortion. Volume I need not speak of, for it is well known that practically any volume desired may be easily obtained from the Magnavox by increasing its input. Distortion, then, is the stumbling block over which a few amateurs and experimenters are having trouble.

It must be remembered that when the Magnavox was developed there were no radio telephone stations available for the

*Director of Publicity, The Magnavox Company.

amateur to hear. The Magnavox was primarily developed for public speaking and the reproduction of music from phonograph records. It may be stated on authority of governmental experiments and private researches by individuals in no way connected with the company that the oscillograph will show and prove that the electrodynamic receiver distorts received wave forms to a far less extent than any other receiver or converter ever yet invented or developed, and will reproduce the consonants T, P, and S over wire lines or wireless perfectly, when used correctly. Speech was perfect over an old wire line from Denver to New York with no repeaters, where the Magnavox was used, and the electro-magnetic receiver was unintelligible. Why then do we hear distorted voice and music as reproduced from a receiving set tuned to listen to radio telephone speech and music?

The reasons are many, some of which you can yourself prevent, and some which must be prevented on the transmitting end.

Let us follow the music or speech at the transmitter. The greatest trouble here is that the man at the transmiting end is usually determined to put into aerial every last bit of power he possibly can. He overloads his plate, doesn't dare to brighten his filament for fear of burning it out, and in consequence forces his tube to work on an unfavorable part of his tube's characteristic curve—and the result is "rotten". He may over-modulate his set—a common fault

Schedules of Radiophone Stations

CALL	CITY	OWNER	WAVE	SERVICE	TIME	RANGE
KDKA	E. Pittsburgh	Westinghouse	330 m.	Music	9 p.m. to 10 p.m. exc. Sun.	1000 mi.
				News	9:30 p. m. exc. Sun.	
				Market Reports	8:05 p. m. exc. Sat. and Sun.	
				Organ Recitals	Sat. 8:15 p. m. and Sun. 4 p.m.	
				Sermons	Sun. 7:45 to 9 p.m.	
WBZ	Springfield, Mass.	Westinghouse	375 m.	Concert	Mon., Wed., Fri., 8 to 9 p.m.	150 mi.
				Sermons	Sun. 8 to 9 p.m.	
WJZ	Newark, N. J.	Westinghouse	360 m.	Concert	8:20 - 9:15 p. m. daily	300 mi.
1XE	Medford Hillside, Mass.	Amrad	350 m.	Music	Wed. evenings	
				Sermons	Sun. evenings	
				Police Reports	Daily at 7:45 p.m.	
6XC	California Theatre, San Francisco	Atlantic-Pacific	1250 m.	Concert & News	Daily exc. Sun. for 30 minutes starting 4 p.m., 7:15 p.m., and 9 p.m.	1000 mi.
6XG	San Francisco	Meyberg	350 m.	Press Weather Grain Produce	Daily exc. Sun., 4:30 to 5:30 p.m. and 7:45 to 8 p.m.	1000 mi.
				Concert	Mon., Thurs, Sat., 8 to 9 p.m. Sun. 10 to 11 a.m.	
6XAK	Los Angeles	Meyberg	266 m.	Concert	Daily exc. Sun., 4 to 5 p.m. Mon., Thurs., Sat., 8 to 9 p.m.	500 mi.

—and get plenty of noise but poor music and speech. If he builds his own set the electrical characteristics may be such that they in themselves cause the distortion, and nothing can prevent it except proper design. These operators would be aghast if they could compare the oscillogram of their microphone circuit with the antenna modulation curve and see the enormous distortion between the microphone and antenna.

Let us say, however, that the music and speech gets into the air in a fair manner and sounds good on a crystal and a loose coupler. Why is it so poor when it is loud? Why does one station get it loud and good and the next one loud and poor? In order, there are many things to watch. The receiving set is a great offender. Regeneration absolutely spoils music and speech. Not alone its characteristics but it makes the speech JUMPY. It goes along all right until the speech is loud and then blares out with two or three times the proper volume—the tube slops over and becomes more sensitive to loud impulses than to small—it is set too close to the oscillating point. Besides, voice and music have no business chasing around back and forth through a receiving tube as well as being rectified—they have too many delicate harmonics and overtones the loss of which is fatal to good reproduction. So those of you who attempt to get volume by maximum regeneration should set way off from the oscillating point and make up later in volume. A loose coupler or in fact any receiver with a straight detector will be much more satisfactory for receiving voice and music. That is why the youngster with a small set gets better music and speech than the larger and more complicated regenerators, but of course much weaker.

Next come the amplifiers. How many amplifiers are in use at the present time that were designed with any thought as to distortionless amplification of VOICE or MUSIC? They are for signals and distortion does not show there. When the Magnavox Company wanted a vacuum tube amplifier to amplify the voice for public speaking they had to design it especially for that purpose, and internal circuits, grid potentials and amplifying transformers were entirely different from those of any other amplifiers. One of the big factors in distortion is in the amplifying transformers, and it is to be hoped that they all in the near future will be designed to the end that no voice or music distortion is present. The Magnavox Company after years of experimentation developed a transformer which was most satisfactory for this purpose, and have always obtained excellent results in voice and music amplification. In deference to the many requests the Magnavox Company has designed a power amplifier for the distortionless amplification of music and voice and will soon announce these amplifiers through the advertising columns of this magazine, at a reasonable price. The secret is in the design of the transformer, and it is surprising that more manufacturers have not entered this field.

After the proper design of the amplifier comes the tubes. It is manifestly against good reproduction that many stages be used, and three stages of audio frequency amplification are all that should ever be used for this work. Two stages are usually sufficient. Volume is obtained by the use of high plate voltages and the Magnavox. It must also be noted that tubes MUST NOT be overloaded, as an overloaded tube ALWAYS causes distortion.

How many of us know that any transmitting tube is an excellent amplifier? Transmitting tubes of any make may be used at their rated plate voltages OR UNDER—with very little distortion of any kind. Underload your tube, not overload it, and you will be surprised at the clearness and distinctness of speech, and—if transmitting tubes are used—at the volume. Transmitting tubes, with proper amplifying transformers, will make up an amplifier which will not distort what it gets, within the limits of possibility.

To sum up the way to get maximum results from the Magnavox—be sure that good music and speech is coming in; receive it and rectify it without regeneration, or at least very little; amplify it in a few stages, using proper transformer coils with tubes not overloaded, transmitting tubes if great volume is wanted, and turn it loose through the Magnavox, which will speak out with what it gets—if it gets good speech and music with undistorted modulated current you will hear good speech and music; if you feed it rotten and badly distorted modulated current it will talk up rotten—as it reproduces what it gets, does not distort in itself, and depends on the auxiliary apparatus to give it good stuff. You mustn't expect your telephone on your desk to talk English to you when Chinese is spoken into the other end, and no more should you expect your Magnavox to give you good music and speech if you pour badly distorted modulated current into it. Use your scientific knowledge and have your set right and you will be more than surprised to find that your Magnavox has followed suit.

NOTICE

On page 60 of QST for August, 1921, in the "Communications" section, there was published a resolution received from the Atlanta Radio Club, Atlanta, Ga., relative to the activities of one R. E. Autrey of that city.

(Concluded on page 66)

The Operating Department

F. H. SCHNELL, Traffic Manager
1045 Main St., Hartford, Conn.

LOOK over the figures in the appended table and see where your division stands. Do you know that you can help your division in the percentage of traffic handled, by reporting *your* traffic? That is what counts and while the above figures show the work of the past month, they are not at all conclusive because many individual reports are missing.

F. B. OSTMAN, 2OM,
Ridgewood, N. J.
512 Messages.
Atlantic Division

Because of pressing school work, Mr. E.

Message Traffic Report by Divisions.

OCTOBER

DIVISION	C.W. Stns.	C.W. Msgs.	C.W. M.P.S.	SPARK Stns.	SPARK Msgs.	SPARK M.P.S.	TOTAL Stns.	TOTAL Msgs.	TOTAL M.P.S.	%TFC
Central	14	507	36	36	2106	59	59*	2866*	49	.332
Atlantic	10	581	58	40	2183	55	50	2764	55	.320
New Eng.	2	105	53	10	1046	105	12	1151	96	.134
W. Gulf	0	0	0	16	621	39	16	621	39	.072
Delta	1	6	6	8	343	42	9	349	38	.040
Northwest.	0	0	0	6	290	48	6	290	48	.034
Ontario	0	0	0	1	202	202	1	202	202	.024
Roanoke	4	100	25	2	100	50	6	200	38	.023
E. Gulf	3	182	61	0	0	0	3	182	61	.021
	34	1481	44	119	6891	58	162*	8625*	53	1.000

*Includes 253 msgs. handled by 9 stations not designated as spark or CW.
M.P.S.—Messages per station. %TFC—Percent of total month's traffic.
Total messages, spark, 6891 82.8%.
Total messages, CW, 1481 17.2%.
Divisions not shown did not send in a traffic report.

Every month we will show the percentages according to this form and it is up to you to raise your percentage. YOU, the individual amateur, are responsible for the position your division holds. Are you a worker or a drone?

Also note that only 17% of the traffic was handled by CW, but that is not discouraging at all. Before the war spark handled 100% of the traffic. We shall see how long it will take CW to pass the 50% mark. And too, consider how many more spark stations are in operation. All that we need right now is a little "push" behind the CW men and get them to report their traffic. Competition will run high as each man, whether he operate spark or CW, will do his best to aid his cause. We say to you both, "come on and show us".

Individual honors belong to the Atlantic Division again. Trube, 2BK, gave 2OM a hard run but could not quite make it.

H. Merritt has resigned as manager of the East Gulf Division. No one can detract from the excellent work done by Mr. Merritt in actually putting the East Gulf Division in the lime-light We will miss you, OM, but you have done your bit and we all wish you well. Mr. B. W. Benning succeeds Mr. Merritt and was elected by popular vote which is somewhat of a departure from the former policy. Heretofore division managers have been appointed but now each and every one of you have had your voice in the matter and since Mr. Benning was the choice of the majority we need not express the wish that you will support him to the utmost, which means 100%. Give him the reports and you will find a report every month in QST. Every little bit of information that he receives is of value.

Next month we will announce the name of the man who succeeds Mr. A. E. Bessey

of the Pacific Division. Mr. Bessey resigned because he feels that any work for the A.R.R.L. should be done well and he cannot give the necessary time to do the work well. "Sunny Jim" is the idol of every amateur who has had the pleasure of meeting him and once met is never forgotten. Whenever we met Mr. Bessey he had a radiating smile that reached our hearts and made us feel that we had gained a real friend and brother. The fact that he has resigned his position as Manager of the Pacific Division does not mean that we will not hear from him. In fact we know that when we need him he will be ready to do his part in any and all A.R.R.L. affairs.

Every division manager seems to be having difficulty is gathering his reports. Why don't YOU relieve your division manager of that worry? Why not get your reports in on time? Why put it off until the last minute and wait for him to send you a special request? Show some signs of life and don't wait to be asked. Take it upon yourself to send your report to him in sufficient time for him to study conditions in his division. When you report your message traffic designate whether messages were handled by spark or CW. You have nothing to be ashamed of when you forward your report. Feel proud of the fact that you are doing your part regardless of what the other fellows do. Get after the fellows who do not make a monthly report. Show them what you are doing and insist that they help increase the percentage of their division.

We have one new report this month, the first one from the Vancouver Division under the acting managership of Mr. R. Anderson, Manager of the Alaskan Division. Without material a report is not interesting, but a new born baby does not use a knife and fork either. All of the divisions were in their kid days a few years ago. Look at them now and feel proud of the fact that the A.R.R.L. has made relay work and amateur radio just what it is today.

NORTHWESTERN DIVISION

J. D. Hertz, Mgr.

Eastern Washington, H. E. Allen: Eastern traffic is somewhat divided at the present time between 7ZS, 7FJ, and 7NL, but is moving much better. Most of the eastern traffic goes via 7YA and 7XD. Southern traffic moves with ease and regularity. Seattle is rather hard to work during the winter. 7YL will open up on 375 meters by the time this report is in print. Total messages for the district—85.

A. A. Thibodo: In general, conditions have been much better. 7KS is back again but is QRM'd from harmonics from NPE. 7HD is using a 5 watt CW set.

Seattle: Traffic is on the increase in these parts. 7IU has been doing good work but is out with a crippled Dubilier. 7BK handled 104 last month. East bound traffic goes via 7NL, 7ZM and 7FI. Traffic to the south goes to 6VX who is doing good work in keeping hooks clear. Canadian 9BD, ex 5BR, is on regularly but he seems to have difficulty in working Seattle stations. Reports come in quite often from Alaskan commercials that 6th district stations are being heard. Alaska needs a good receiver and if one is located we can hook up with what amateurs there are in that part. No report from Tacoma. 7IY handled 17 messages.

7XD is credited with 84 messages. He clears with 7ZM, 9EE, and 6ALE. It is requested that all traffic thru Montana be routed over Trunk "A" via 7XD until further notice. 7EX will use CW in addition to the old spark set. 7DJ reports nil. 7ZG has been forced to move his set because of induction. 7LY is making changes that will put him in the rock crusher class. (More power to you, OM.—T.M.)

ONTARIO DIVISION

A. H. K. Russell, Mgr.

Rogers, 3BP, is the only one who sent in a report for this month. Other stations have been active, but no reports have been received. 3BP reports as follows: A total of 202 messages was handled this month which is by far the greatest number ever handled in a single month at this station. In the N.Y.C. district, traffic was cleared chiefly with 2OM, 2AIM, 2BK and 2FP. 8AWP cleared for Central N.Y. and 8AHV for Western N.Y. To the east most traffic was cleared thru 1ARY, 1GM, 1ZE and 1AW. Most of the southern traffic went thru 8SP or 3IW. Western traffic goes thru 9ZN, 9AAW, and 9FS. The CW here clears traffic with N.Y.C. stations when QRM is bad.

EAST GULF DIVISION

B. W. Benning, Mgr.

In the absence of a division manager, City Manager Hodge of Savannah sent his report direct which follows: 4GL, 4FF, and 4BY have been burning the midnight oil handling traffic. 4GL handled 94 msgs.; 4FF, 73; 4BY, 5. 4BY has been operating only two nights but we promise a real report next month. C. J. White, 4DT, says that the East Gulf Division is going to be the top-notcher in CW. The sparks will be upheld by 4GN, 4DH, 4BQ, and 4FD.

ST. LAWRENCE DIVISION

A. J. Lorimer, Mgr.

CW is progressing very well in spite of

the fact that we have only the high power tubes available. 2BG using a VT-14 has been reported in Burlington, daylight. 2BR and 2DD have installed 75 watt tube sets. 2AK with his spark has worked 8XE quite consistently. 2CI keeps a schedule with 1AZX in Burlington. 2AS is putting up a new cage antenna. 2BF keeps an early-morning watch from 2 to 3 o'clock and has repeatedly worked 1SN, 1TS, 3HJ, 8AWP, 8LX, and 8QV. Efforts to work 3BP failed. 3BP is heard in Montreal but Montreal stations are not heard in Toronto.

MIDWEST DIVISION
L. A. Benson, Mgr.

The only report received this month was from G. S. Turner, Dist. Supt. of Western Missouri. Kansas City is beginning to come to the front for the first time since the war. 9AHZ on spark and 9AQR on CW are doing good work in K. C. Mo., while in K. C. Kas., 9DPE, 9AMD, and 9AVN are holding their own. 9AQR is reported QSA in the 5th and 8th districts while using one 5-watt tube. 9YM and 9MC clear during the daytime to 9AVK, 9AQR or 9ZAD who then clear to the west via 9BT; north via 9YO. In this way traffic moves in the day time thru Illinois, Missouri, Kansas, Iowa, and sometimes Nebraska. The entire Midwest Division is connected up during daylight.

At Ft. Leavenworth, Kas., a 100 watt CW set is in operation with the call AA7.

Efforts are being made to line up 9YN and 9YV in a schedule with all amateurs in the vicinity as soon as 9YV gets settled in the new location.

9EX is doing fair work on CW, as is 9FL. No reports have been received from other stations. A total of 257 messages is reported for this district, with 9YM in the lead credited with 123.

DELTA DIVISION
J. M. Clayton, Mgr.

The Division is rapidly regaining those activities which mark the "on" season in radio. Enthusiasm and "pep" are prevalent characteristics. Traffic is being handled to all points without difficulty despite the fact that more of the stations in the division are not in operation yet.

Tennessee: Hutcheson turns in a very interesting report. 5ER, John E. Cain, Jr., has been appointed City Manager of Nashville and reports several CW stations in operation in that city. 5ER is back on the air on spark and raises quite a rumpus. Glad you are back, ER. 5FV at Nashville is on the air regularly now and is doing splendid work. Both FV and ER have handled considerable traffic. 5EK is heard on the air continually and creates *some* noise. He is one of the most consistent Tennessean stations BUT why not a report once and a while, EK? 5XK at Knoxville is reaching out very well and has been appointed Official Relay Station for his City. Chattanooga has been very quiet all along, lately. However it has begun to come to life, and 5MB, B. F. Painter, has been appointed City Manager. 5DA is dividing his time between spark and his 50 watt tube set. Makes a fine noise on either one down this way. DA has been busy getting the hook cleared off and has handled considerable traffic.

Louisiana: 5ZAB in this territory is raising regular sand with his new Grebe sink gap. ZAB can be heard every night now and is handling a pile of traffic north, south and west, and would capture first place in the "most consistent" column if it wasn't for that little brunette! Chas. P. Johannsen, 5HW, of New Orleans, has been appointed City Manager of New Orleans. 5YL at Thibodaux seems to be a most efficient station. One operator from 5ZAB goes down to 5YL occasionally and works the set. Better have a regular op at YL soon tho. 5ZP our Assistant Division Manager is now 5AA pending the renewal of his special license. Everything at 5AA is back in shape and we can tell you the whole works down here is mighty glad to hear deBen going again. Comes in with his former pep, and already has handled a stack of msgs. FB OM.

5JD, C.M. of Little Rock, reports everything shipshape in his territory. 5JD and 5ZL have a QRM-less schedule whereby one station works one night and the other the next. In addition to cutting down QRM it forces them both to go to bed every other night! Mrs. 5JD is rapidly becoming SOME op. Can copy about 12 w.p.m. now and will soon be on the air along with JD. New station, 5SM, opened up at Little Rock. Owned by Dr. L. M. Hunter and manned by Dr. Hunter and 3-step-Carrington, our local commercial opr. Haven't done much work yet due to the untimely end of a Dubilier, but Doc has a 1 KW, Sink gap, etc. and a fone set. Another new station at L.R., 5RO, doing DX work first night of his operation. A radio-fone set has sprung up at Ryan, Ark., 5SI. Using one 5 watt tube, but comes in fine. 5JD has installed a new Radio Shop 1-24 receiver and is so completely outclassing 5ZL when it comes to receiving that 5ZL will shortly go out of business.(?)

No report received from District Superintendent of Mississippi.

CENTRAL DIVISION
R. H. G. Mathews, Mgr.

During October message traffic has practically equalled average winter records. During the summer months the majority of the traffic was handled by the C.W. stations. Spark stations are coming into their

own again with the approach of favorable operating conditions and a great majority of our messages are going forward by this method of transmission although the CW stations are still getting out as well as ever. A great general improvement is manifest in the co-operation between the District Superintendents and the various City Managers but there are still a number of our City Managers who are not sending in reports and getting message reports from their own and surrounding stations to us in time for inclusion with our division report. It is very important that we have an authentic report of the total messages handled by spark and CW in the division and we again want to urge that all our stations see to it that reports are in the hands of the proper District Superintendents not later than the 20th of each month.

Northern Indiana, M. W. Hutchinson: The district of Fort Wayne is getting the CW fever and many of the fellows are installing small tube sets which are doing good work. Spark, however, has handled all of the traffic so far. Only one report from Ft. Wayne, 9ME, who still reports fellows do not turn in their reports to him. You fellows in Fort Wayne—why can't you turn in reports to your city manager—what is the use of your handling messages at all if you can't turn in some sort of report? Please try to help us out in this. 9FS, Goshen, reports weather very poor the last month. 9FG has gone to Purdue where he is one of the operators at 9YB. 9ALY is getting in shape for the season. Several new stations have been erected; one in particular, 9DBW, at Nappanee, Ind., should be doing good work in a short time. Old 9DF at Angola promises to be back on the job this winter. No trouble has been experienced in working over all routes in the district and messages have gone through in great shape.

Toledo District, K. E. Duerk: Efforts are being made to ascertain which of the old stations can be relied on this season and what new stations can be used. Several new appointments have been made. 8BET, E. E. Alden, Toledo, has been appointed to take care of Toledo He has a 50 watt CW set, and has been handling traffic with other 8 stations. 8BOZ, J. Milton Moran, Sandusky, will take care of traffic through that city. He has a 20 watt CW set, 8VJ has a 50 watt which puts out 5.5 amperes and is QSA over the eastern half of the country. He is working regularly with 9AMB, Denver, Colo. 8ZN states that he is getting traffic into Detroit OK through 8ZZ, both using CW. He is now equipped to QSY to 375 meters on CW when stations request same. There has been some difficulty in getting traffic off to the western part of the state, but I am putting 8ZY in trim again, so that difficulty is remedied. Several of the stations are already arranging schedules, to facilitate prompt handling of traffic.

Mr. Vickery, C.M. of Bellevue, (Radio 8KF) advises that things are on the upgrade in that city. A schedule of working hours is to be arranged for Bellevue with the surrounding stations.

C. C. Endly, C.M. of Mansfield (Radio 8ZR), says that conditions are rapidly assuming relay manners. Mr. Kemble of 8AFB has left recently for college, which leaves 8ZR the bulk of the work.

Toledo District, J. P. Turner: It seems that there is still lack of real co-operation between this office and some of our City Managers. I am forced at this time to advise that unless reports are received on time, and more interest shown, it will be necessary to make some changes in the staff of this section of the Toledo District. New let's avoid changes. I request that men who can handle City Manager appointments and traffic appointments in this section write me at 681 George St., Clyde, Ohio. I am badly in need of men in several of our best towns and I want to get in touch with some live ones.

Miami Valley Dist., Mr. & Mrs. Chas. Candler: A number of stations have not yet gotten into their full swing and are delayed in getting their apparatus in first class shape by lack of minor apparatus, blowing down of antenna poles, theft of instruments and one thing and another. Reports from Cincinnati are better every month, showing more enthusiasm and more activity. This is probably partly due to the opening of a route into the southern states via Cincinnati. These stations seem to be able to work south very well and therefore we solicit a share of the southbound traffic for them. Although traffic this month was reported from fewer stations than last, there is a decided increase in messages handled.

No report has been received in regard to the progress in police broadcasts. The District Supervisor of Police Broadcasts has submitted no statement as to whether or not any organization has been carried out. An effort will be made to speed up this phase of radio and bring it into greater prominence.

Star station for the Miami Valley District is 8AIB, Dayton with 118 messages.

Kentucky, J. A. Kolb: After two months of idleness Kentucky is again on the air and messages numbering 385 have been handled. Seven of the above messages were handled by a CW station. 9UH-9VZ-9OX-9GX are in operation. Mr. Green, formerly of 8ANK, Pittsburgh, has moved to Louisville. We welcome Mr. Green and wish to thank him for the assistance promised the A.R.R.L. of Ky. Lieutenant Eugene Link stationed at Camp Knox, has a privately owned CW set in operation and

is breaking through. The call is WUBC.

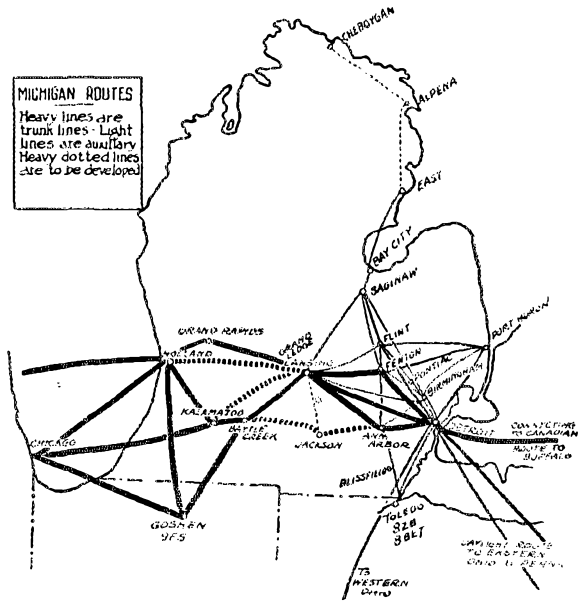
Dist. of Wisconsin, B. A. Ott: The number of messages handled this month by stations in Wisconsin were 32 by CW and 58 by spark. This is not a very good showing but it is believed that it is not a complete report of all stations handling traffic. In the future all relay stations on the Lake Shore route will kindly turn over their reports on messages handled to Melvin Herman, (9FN), Sheboygan, Wisc., who has complete charge of this route in Wisconsin. Stations in Sheboygan, Kenosha, Superior and Milwaukee, should turn these reports in to their respective city managers. All other stations not included in the above should send their reports direct to the Dist. Supt. These reports should all be in by the 10th of the month.

The officials of the District of Wisconsin are at present as follows, Supt., B. A. Ott, (9ZY); Asst. Supt., Melvin Herman (9FN), Sheboygan, Wisc.; Asst. Supt., N. U. Bishop, (9DV), Neenah, Wisc.; City Managers: Milwaukee, C. N. Crapo, (9VD); Sheboygan, J. G. Kraus, (9ACM); Kenosha, Ralph Martin, (9GP); and Superior, E. J. Krusel, (9YAC).

Some of our last seasons excellent DX stations will not be heard this year due to departure from the state or attendance at school. Among these are 9ZL, 9DBT, 9FQ. We have however some new ones on the list that are at present doing good work: 9YAC, 9AZA, 9DMO, and 9DHG. Radio 9XM, U. of W. under the supervision of Mr. Hansen, will soon be going in full swing again. A new type "sink" gap has been installed in their 1 k.w. set and they have at present under construction eight 100 watt power tubes which will be built into their tube set. Relay traffic, however, will be carried on with their spark set. Three nights a week will be devoted to traffic, Monday, Wednesday, and Thursday after 10:00 P.M. 9YAC, Superior State Normal School, has been doing excellent work. They have three operators on the job and the station is working every night but Sunday. 9BM of Wausau is coming back into the game again, with CW this time.

Conditions in Milwaukee in general are improving very rapidly and traffic is moving in all directions except north. Stations to the north of Milwaukee on the Lake Shore Route seem to be at a standstill. This is due probably to Mr. Burhops departure. Also the Sunday morning clearing schedule is not very well organized at present. Milwaukee stations are ready to clear traffic Sunday A.M. starting at 9:00 and finishing at 11:30. Operation in Milwaukee is controlled by the Milwaukee Radio Executive Council, an organization in which all the radio clubs in the Milwaukee District are represented. Milwaukee operates under the Chicago Plan and all relay stations should strictly observe the traffic regulations when forwarding traffic through any part of the Milwaukee district.

Michigan, Mr. C. E. Darr: H. M. Pancost, A.D.S., and myself have developed a sure fire daylight route through this



district. We have several trans-state routes and we feel that we are now in a better position to handle the traffic through Michigan. The writer made visits to several out of town clubs and talked co-operation and general club affairs. Find that a great deal of interest is being created in the smaller cities through being in touch with the outside via radiophone. The western part of the state uses spark more than CW but the eastern section uses CW exclusively and it seems to answer our problem very nicely. Several Michigan CW stations are doing remarkable work on relaying traffic.

We now have a thru line to the East via Canada, a thing we have been looking forward to for a long time. This will materially aid us in getting traffic through to the east.

8ZZ is now using a 50 watt CW set and is handling DX traffic much better than on spark. 8QY, 8EA, 8LV, 8ZZ, 8VY, 8FI,

8XS, 8ZF, 8CP and 8II are all doing good work in the relay work. Also 8YN on spark.

The Flint Radio Association is doing big things in a big way trying to popularize radio throughout the small cities. They are giving concerts via radiophone in all the towns near Flint and assisting the people in putting in receivers. It is working out fine.

Mr. Darr has drawn up a map of Michigan routes which we are publishing herewith and want to call the attention of the other District Superintendents to this excellent method of presenting their routes for the information of their entire personnel. We have always been confronted with the difficulty of keeping in mind just where our routes ran while operating our stations.

Ohio is planning a big social get-together to be held annually. A committee composed of the various district superintendents has been appointed to take charge of the handling of this function with Mr. J. P. Turner, of Clyde, Ohio, as Chairman. No definite plans have been made and suggestions are in order as to what form the meeting should take, where it should be held, what special stunts can be arranged, etc., and Mr. Turner will be glad to hear from anyone interested.

ATLANTIC DIVISION

Chas. H. Stewart, Mgr.

NORTHERN SECTION

C. J. Goette, Asst. Div. Mgr.

Western N. Y., Benzee Bros: 326 messages were handled this month with the majority from 8AWP of Syracuse, with 211. 8BIN, 8BSS, and 8BUM are new stations with two of them CW and QSO Albany consistently. 8AWP is bidding farewell to the old spark. He was known as the big man with the big noise. (He makes more noise on CW—T.M.) Young, City Mgr. of Elmira, reports some traffic. Waverly, Owego, and Binghamton have not been heard from since last summer. City Manager Graham of Rochester has resigned and returned to school. The vacancy still exists. Bissel, 8TY, reports a new station, 8BQA. Since 8AGK has gone back to work he will not be on until later in the evening. He has been in the habit of coming on at 4:00 P.M. No reports have been received from Lancaster, Lockport, or Niagara Falls. (Everyone had a good time at the 8th District convention. Reported elsewhere—T.M.)

Northern N. J., F. B. Ostman: With the good weather, traffic is being handled consistently over longer jumps. Congestion is being experienced in Atlantic City and Philadelphia. 3XM and 2JZ prove good outlets for traffic. The Shore Route still maintains its good reputation. Asst. Dist. Supt. Johnson reports traffic as follows: CW—2AWL, 92; Spark—2ASL, 19; 2ARS, 8; 2MN, 12. Regular schedules are maintained with 8DE and 4GL. City Mgr. Erhard of Hoboken reports following messages: 2UE, 30; 2AX, 15; 2JZ, 10; 2AUN, 10; 2IJ, 5; 2IA, 20. 2IA is the only CW station. City Mgr. Canfield reports: 2ALY, 27; 2AQU, 14. 2OM leads with 512; 2SQ, 32 and 2AJF 80. Total spark—770; CW—202.

Hudson Valley, C. E. Trube: The real radio season has brought in more QRM in place of QRN. The Hudson River Route to Albany is clear, as 2BM is back helping 2DA and 2FG. A. H. Winn, 2DA, of Poughkeepsie and R. W. E. Decker, 2UA, of White Plains have been appointed City Managers of their respective places. 2DA has arranged schedules with 2RM. 2ARB and 2BK assist in keeping this route open. 2UA has moved and is organizing the amateurs in Westchester County. 2DA handled 65 messages. City Mgr. Decker of White Plains says that 2HJ, 2OA and 2DK are in commission. 2AID handled 46 msgs., and 2DK, 12. Yonkers is doing good work. 2DN, 150; 2AJE, 90 messages while 2BK tried to cop first prize this month with 442. Total messages for the district—766.

Brooklyn, F. A. Maher: Traffic and QRM are picking up at a terrific rate. 50% of the stations are now using CW. Messages reported, 2PF, 24; 2AMZ, 18; 2KE, 8; 2RQ, 52; 2BRE, 4; 2WB, 45; 2RM, 76. No other reports received. 2RM has fallen for CW. On October 11th 2BO took upon himself a wife. (OM, when you support both a wife and a radio station you are going some.—T.M.) This report appears extremely poor for a city the size of Brooklyn and it's a fact that more traffic has been handled than has been reported, but if you felows do not report it no credit can be given. Let us have your reports and put Brooklyn on top for once.

Capitol District, F. H. Myers: 2AWF is reaching out very well, 15 msgs. 8TB will be open every Saturday and Sunday night. 8AOT is also doing good work. 8HP is installing CW. 2ABQ is using CW and holds up his end.

New York City, E. A. Cyriax: Total messages, 233, with 2DI, 58; 2LM, 30; 2CT, 84; 2TC, 61; 2LM is going to break out with CW.

Southern N. J., M. Frye: No report. (Second time, OM. What is the matter? —T.M.)

SOUTHERN SECTION

E. B. Duvall, Asst. Div. Mgr.

District of Columbia, F. M. Baer: Not much traffic has been handled this month. 3ZY has been away and the general adverse condition of spark stations has been

the cause of inactivity. 3AFU handled 14 msgs.; 3XF, 6; total 20.

Eastern Maryland, G. Deichmann: 3SQ, 3BJA, 3AHK, and 3XAA are recent new CW stations. Messages reported: 3AC, 21; 3HG, 20; 3EM, 12; Total 53. It is evident that CW is the solution for DX for this district. 3DW has followed 3AHK with a CW set and has junked his spark.

Central Penn., H. M. Walleze: Old 8XE is back as good as ever. 8BQ is rigging up a new antenna 80 feet high. A regular schedule between 8BQ and 8XE is being established between 4 and 5:30 P.M. and 8PQ and 8HR will act as alternates. 8XE wants a daylight schedule west, preferably with Pittsburg, and 8BQ wants one east.

Eastern Penn., S. W. Place: Many new CW stations under construction now will be in operation very shortly. 8ADQ has been appointed official station on Trunk Line #1.

Philly and Delaware Counties, P. C. Peterson: 3HX and 3BG are the only official stations that are on regularly. Messages reported as follows: 3BG, 8; 3CC, 30; 3HJ, 116 spark, 11 CW. Others handling traffic are 3QV, 3AGN, and 3FS. 3HJ handles traffic on schedule with 3AIC. 3ZO 41 msgs. 3AIC works on schedule with 3HJ, 3DM and 3ZO. F. DeLong has been appointed Traffic Asst. in charge of Lancaster, as T. A. Aston is out of the game.

Western Penn. District, W. K. Thomas: Efforts are being made to establish new relay routes in addition to bringing the old ones to their own. 8WY with his CW is reaching out in all directions. 8DV—CW has handled 36 messages bridging the gap from Pittsburg to Erie. Traffic is handled in daylight with 8FD at Cleveland. Other good stations are 8BJX, 8BHA, and 8ASB. 8AIO reports 15 msgs. for the month. 8LX works 4GL consistently during the week ends. Good work is being done by 8DR, 8CI, 8LF, and 8EW. 8RQ is installing CW. During the past month 8RQ worked 3DU, 8TJ, 8JU, and 8BCI during daylight. 94 messages were handled working 2OM, 2WB, 2BK, 3HJ, 2AQI, 8AFS, and 9UU. 8ACF and 8JQ are doing the same good work. Pittsburgh has adopted the Chicago Plan and traffic will go thru much better in the future.

ALASKAN DIVISION

Roy Anderson, Mgr.

As yet nothing has been heard from any of the Alaskan amateurs as to power of set and their willingness to co-operate in getting thru to the States. As to the latter there seems little doubt of receiving a negative reply.

As said in last month's report, Mr. McCue of Craig, will be installing a CW set and it may be that he will be communicating with British Columbia or Washington stations before a very great length of time.

Most of the stations are located in small places, and the mails are subject to a great deal of delay. This prevents a sudden formation of plans, and there seems very little prospect of doing much this winter.

NEW ENGLAND DIVISION

G. R. Entwistle, Mgr.

Amateur radio activities in New England are beginning to open up and club activities are also on the increase.

1DY heads the list this month with 372 messages; 1ZE, 184 messages; 1ASF, 144; 1SN, 131; 1CK, 108; 1ANQ, 74; 1AW, 43; 1QP, 31; 1AZK, 26; 1BGF, 19; 1BES, 10; 1BRW, 9. Other DX stations failed to send a report.

A. D. M. Robinson (1CK), reports: Canadian 3BP is getting to be so common around Boston that no one listens to him much any more; he starts coming in every night around 6 P.M. and sticks right on the job, no QSS. Cumming (ex 1FB, now 1BV) has just bought a new ½ kw 500-cycle motor generator for a pair of 50-watt tubes and uses the 500-cycles to modulate his output. The spark coil with a large condenser across it, hooked to a tube, is fast gaining favor and merely takes your head off at a distance of ten or fifteen miles when you happen on their wave (usually 300 to 350 meters). E. B. Dallin, 1FD, has been doing some very interesting work with a small spark coil CW set which he carries around in his automobile. He has worked distances upward of 20 miles with this set using a small antenna with a total length of wire not exceeding 29 ft. and using the frame of the car as a counterpoise. The tube used is a VT-14 (5-watt). 1CK has had four different antennae up this month but has returned to the old inverted L type. He now has 1FB's coffin and sink gap but can't use it much because it makes such an explosion when the key is pressed that the whole town thinks the fireworks factory is blowing up again.

1DY has completely overhauled his station and is all ready for the winter rush of traffic.

D.S. Vermilya (1ZE), reports: 1AZK is the only spark station left in Fall River since 1AK has gone in for phone work. 1DT has also changed to CW and 1GZ has not been heard from since last fall. 1AZW is taking Rhode Island traffic now and is always on the job. 1XX and 1BES keep very irregular watch. 1BYS has been taking the New Bedford traffic in fine shape. 1AMD, 1OJ, and 1AXD are doing fine work. 1XAD has communicated by phone with Cleveland, Ohio.

D.S. Randall (1ANQ) reports: Among the stations coming into the DX game we

find 1BRW equipped with a 1 kw Thor. 1BGF has been on the air as usual and has cleared some traffic between 1ZE and New Jersey. He has installed a CW set with 1—50-watt tube. 1AW has not been on very much but has succeeded in collecting and delivering some traffic. 1ALP is on once in a while and takes care of Western Connecticut traffic. 1QP is back on the job at Manchester with CW and is clearing fine from there. 1ANQ is now using 2—50-watt tubes and is clearing traffic from as far as 9AW Canadian to 9AJA, Chicago.

A.D.M. Castner reports Northern New England District in good shape but station reports lacking.

VANCOUVER DIVISION
Roy Anderson, Acting Mgr.

At the time of this writing nothing definite has been heard from any of the B. C. amateurs. It seems evident, however, that all will be willing to co-operate, and the writer believes that there are many who have sets the power of which will aid in getting reliable routes established south and east.

Wm. D. Wood, 5BR, advises that he has "installed an efficient and up-to-date amateur set in the Barron Hotel and has worked a few sevens to date." He is using three bulbs and a regenerative for receiving. He expects to put a 20 watt 'phone in in about a month.

DAKOTA DIVISION
Boyd Phelps, Mgr.

Stations in this Division are on the air in greater numbers than ever before. It was predicted by some that by this time spark would be almost entirely out of the game. Such is not the case, however, as the CW has not superseded the spark in all of the stations. There are many five and ten watt stations scattered in all parts of the Division.

9XI has been on the job quite regularly this fall handling traffic and broadcasting football scores. Weather reports and closing prices of wheat are broadcasted every evening at 8:30 on spark. In order to get an idea on the reliability of the communication and the value of the broadcasts Prof. C. M. Jansky wishes those copying the reports to address him at the Dept. of E. E., University of Minnesota, Minneapolis.

9ZT has been out of the game since last spring due to remodeling of the municipal building but is now in operation in room 402 Courthouse, Minneapolis. A spark set is now in operation and a two 50 watt tube set nearly completed.

Mr. Hector Skifter, 9YAJ, of St. Olaf College, Northfield, Minn., has been appointed District Superintendent of Southern Minnesota to succeed H. R. Hall who lacked time to carry on the work. Mr. Skifter already has quite a line on the stations in his district but wishes all others would write him as he has some good dope on branch routes and broadcasts. On September 1st there were 108 licensed stations in the Twin Cities.

We greatly regret the loss of W. Cecil Bridges, 9YAC, A.D.S. of Northern Minnesota. Mr. Bridges has been transferred from the Naval Radio Station at Duluth to the west coast, but the memory of him as an ardent relayer and A.R.R.L. man will linger long. (CUL?)

E. S. Leavenworth, 9WU, reports 9LW, 9DOC at Minot, 9YAF at Pembina, and 9FX at Jamestown are the best DX stations in North Dakota. The best outlets west are thru 7EX, 7LO, 7ZU, 7ZW, and 7ZO, all of whom are QRA at Ellendale, N. D. 9WU has worked quite regularly with 5ZO, ZB1, and to 7FQ on the west coast. The new 9ZX will be operated by both 9WU and 9EE, this winter.

N. H. Jensen, D.S., Box 894, Sioux Falls, S.D., reports that 9YAK, Yankton College Radio Club, is getting out good which is too late notice to many of us who have spoiled several sets of oilcloth diaframs.

WEST GULF DIVISION
Frank M. Corlett, Mgr.

The good old radio weather is with us. Traffic is moving in fine shape all over the division. Traffic appointments made during the last month:

Asst. Div Mgr. L. B. Henson, WRR, has appointed 5ZX, A. P. Daniel, Houston, Texas, and 5ZAF, Wm. P. Clark, Waco, Texas, official Police Broadcast stations to work in connection with their local police and to form a part of the division police broadcast system being worked out.

District Supt. Ed. Nettleton, 5ZN, Eagle Pass, Texas, announces the appointment of L. D. Wall, 216 Pereida St., San Antonio, Texas, Asst. Dist. Supt., Southwest Texas District, San Antonio Territory; and the appointment of G. D. Rayburn, 1134 W. Agarita Ave., San Antonio, Texas, as City Manager of San Antonio.

Reports of the various Sections follow:—

NORTHERN TEXAS SECTION
H. P. Heafer, Asst. Div. Mgr.

No Report. Report of Dist. Supt. Guy Neel, 5XJ, North Central Texas District, found its way to the D.M. somehow. Dublin wants to know what's the chance of a good relay station at Ft. Worth and Dallas? Traffic for these points is now handled thru 5NS and 5QQ. 5AO is making some improvements in station. 5RP, the spark coil station, is doing real good work. 5YN, Simmons College, is now in operation. 5LY at Eastland is coming to the front. 5SD handled 12 msgs. 5GF

has moved to Abilene and is putting in a 100 watt C.W. set. Howard-Payne College at Brownwood will be in commission before long. Comanche stations are evidently not doing very much lately. 5JX has moved to Ft. Worth. 5XJ, Dublin, has worked 6WV, 9WT, 5ZA. Messages handled, 85. 5QS lost one of his 100 foot masts in a storm but will have it on end again soon, is working with one mast at present. 5IR has worked 4BQ. Total messages North Central District, 446.

OKLAHOMA SECTION

No Asst. Div. Mgr. at present

Meager reports reaching the D.M. as follows. 5MF is remodeling. 5LO of Miami is doing fine work, has copied stations in seven of the nine districts. Exchanged calls with 8FT and 6WV, also 9ZC. Handled 8 messages during the two weeks of operation. 5BR, Burle Jones, and 5BM. C. M. Selby, have consolidated stations and will operate under 5BR's call, giving this station two operators and almost a continuous watch till midnight.

NEW MEXICO SECTION

Louis Falconi, 5ZA, Asst. Div. Mgr.

No Report.

SOUTHERN TEXAS SECTION

A. P. Daniel, 5ZX, Asst. Div Mgr.

Weather conditions are favorable for the first time in months, and traffic is moving in this section with a bang, and but for the many break-downs reported from almost every part, the work is progressing nicely. Among the interesting news obtained is that the three radio clubs of San Antonio and vicinity have banded themselves together into a "Bexar County Radio Association" with the one purpose in view of giving to the A.R.R.L. the proper cooperation and recognition of the aid given that city by our organization.

Mr. Nettleton, District Supt. for South West Texas, has been unable to do much organization work via radio because of repeated kick-back troubles. He is anxious to have communications from all stations in his district which includes all of West Texas (excepting El Paso and vicinity) and extends east to and including Bexar County and Nueces County. Address, Ed Nettleton, 5ZN, Eagle Pass.

Mr. Tilley, District Supt. for South Central Texas, reports that at Austin two new stations have opened up—5QA and 5QY.. 5XU is the University station and is doing some splendid work on 325 meters, using a 240 cycle set. New Braunfels High School, 5YK, is the most dependable station in his district at present, with thanks to Mr. Sahm for such good work. 5ZU is as busy as usual. 5RA at Cuero and 5TG at Victoria give promise of good southwest relays; but fellows please be on oftener and have longer watches.

Mr. Worthington, District Supt. for South East Texas with headquarters at Houston, has been spending most of his energy in trying to get assistants to turn in traffic reports. This seems to be a chronic trouble in all parts of the Section. We must have complete reports fellows or else "QST won't come south", as you have been hollering. The opening of college brought an end to several of Houston's most reliable stations. 5YI profited, however, by gaining five new operators. 5XB is back on the job, and even more consistent than usual; it is still the most dependable relay north.

Messages; 5JI, 24; 5ZX, 16; 5ZT, 36; 5AE, 6; total reported, 82.

ROANOKE DIVISION

W. T. Gravely, Mgr.

A wonderful increase in traffic has taken place during the last month and the coming winter months will surpass all previous seasons. Already traffic is moving with greatest ease, via the CW routes, and nowhere does it appear that messages are being held on the hooks by the CW stations.

3RF at Salem, Va., is making his debut with a tube set, and is working nightly, which means that the South West Virginia District is open for Traffic. 3MO, a CW station of Richmond, is clearing nightly for the Central Virginia and Richmond District. 4EN, another CW station located at Winston, N. C., is making his appearance this month with a 15 watt tube set, and is performing most satisfactorily. This station clears traffic with 3BZ daily at 2.30 P.M. 3BZ with a 15 watt set is clearing to all points within range with comparative ease.

Normally, the CW stations in the Division are using 3ZY at Washington as the hub for northern traffic, and occasional western traffic, though much of the northern traffic is handled with New York stations. 4GL is acting as the hub for southern traffic, and with these arrangements there is no trouble clearing north and south with greatest ease. We refer now entirely to tube lines, as these have been working regularly and almost like clock-work.

4EY at Elizabeth City, N. C., has done spendidly, together with 4BE at Wilmington and 4EA at New Bern. These stations have opened up the Eastern North Carolina line. 4AL, 4CK and 4CX take care of the Western Carolina operations in the spark line.

D.S. Heck has appointed E. C. Jones, Jr., as City Manager for Fairmont, and Asst. Dist. Supt. of Northern W. Va. 8SP and 8FD (spark stations) continue to lead in the activities in their section.

The Virginia Seaboard has not yet taken

up its normal activities, and a report is lacking.

The Manager announces the following appointments: For District Superintendent of Eastern North Carolina, Mr. K. K. Kramer of Elizabeth City. For District Superintendent of Western North Carolina, Mr. Taylor M. Simpson of Winston.

No report from D.S. Bunker of Central Carolina. Condensed reports from the District Supts. follow:

D.S. Blair reports real progress for Richmond, stating that 3MO is handling traffic regularly, and that 3ZL will soon be operating with one of the best tube stations in the state. Blair has had the misfortune to break an arm through the misuse (?) of a classy racing automobile, for which he has our sympathy, but we did think that he had better use for his members than to wear them out in such a manner.

3AOV at Stonega is now about ready for traffic.

3CA is getting out with his tube set, but failed to report number of messages handled in the District.

No formal reports will be included this month from the North Carolina Districts, as this field is just being re-organized, but operations will be covered in the next report.

D.S. Heck of W. Va. reports the combination of 8SP and 8JE, who will operate as 8SP, maintaining a steady watch.

8EF is on as often as his duties permit. 8AFD is doing good work with his spark, so with 8EF, 8SP and 8AFD, this neck of the woods is well cared for.

Charleston, Morgantown, and other points in W. Va. are taking on real life.

3BZ at Danville is handling all the traffic, at present, at this point, until 3AEV can get back, and relieve the situation.

3BID! Get the Call!! Is no one but our old friend A. L. Groves, the Division Technical Expert, at Brooke, Va. He is out with a 5 watt tube set, and with batteries and a step up coil furnishing his power. He is laboring under difficulties with which few have to contend, but those of you who know of Groves will be content with the final outcome.

Msgs.: Sparks 100, CW 100. 3BZ leads with approximately 60 msgs. CW, with 8SP, spark, next, with 43.

In conclusion, the Roanoke Division is in better shape to-day than ever before, and the District Superintendents tell the Manager that they mean to place it on top. If there is any constructive criticism to be made by any station in the Division, please let the Manager have it. We are here for the proper kind of criticisms.

DESIGN OF LOOP ANTENNAE

(Concluded from page 28)

Wavelength Meters	Size Feet	Turns N
200	8	1
	6	2
300	8	2
	6	4
	8	4
600	6	7
	4	10
	8	7
800	6	10
	4	15
	8	12
1200	6	14
	4	20
	8	16
1600	6	20
	4	30
	8	30
2500	6	40
	4	60
3500	8	45
	6	65

ROTTEN BUNK

(Continued from page 16)

calling 9AF. Radical yelled, "There's Miller over in Hammond, Indiana." 8BM shoved his head up and said something like, "Send card OM nil hr msg SK."

Radical hollered, "That's Dunlap over in Niagara Falls, asking somebody to send in a card about his signals and that he has no messages for him to-night." Then he gave a mighty jerk. "LISTEN!" he bawled out. He tuned carefully, and closed his eyes as though he was going off into a trance. He was trying to read in between the QRM. He got it. He snapped around and bawled into the face of the fidgety lady, "There's 4EY calling 5ZW." This was something startling, and listening intently and meanwhile staring straight into the face of the embarrassed lady for what seemed five minutes, he howled, "That's Kramer in Elizabeth City, N. C., working Graham at House, Texas. Hot dog, eh what!"

The lady moved back out of range and said something about it being "fascinating". Radical was fast getting overheated. He snapped around in his seat again, held up a warning finger, and everybody hushed. Pointing his finger straight at the fidgety lady with an accusing air, he shouted at the top of his lungs, "There's 3BP up in Toronto calling 1BIR down in New England. He says QRV GA." The lady with the fidgets looked guilty and indicated symptoms of the jitters.

"LISTEN!—That's 8AMZ in Oakfield, N. Y."

Grabbing his pencil he copied feverishly. It worked out on paper like this: "SORRI OM BUT UR CW GASTY GOB BIT FRISHICKEY ON MONKEY BIZNESS MY B BATTS ON THE BUM QRL TONITE K."

Glancing over this hog-wash hastily, Radical interpreted it as to the effect that somebody's gasty gob bit somebody else's frishickey on the monkey business and put his B batteries on the bum. Radical shook his head at this and muttered, "Bad business". What in timenation these folks thought was going on I give up. The idea of passing out such bunk! Suppose somebody's gasty gob did bite somebody's frishickey on it's monkey business, why for gawdsake talk about it in public! There is a time and a place for all thngs, and the public air is no place to quarrel about these stricly private matters. It may be that I am old fashioned, but it sounds nasty to me.

"GEE WHIZ! HARK!—That's 8BEP—says 8XE's MODULATION GRUBSTRETCHER FELL INTO SPITCHSLOP!—Gosh, but that's fierce!" Glaring at the fidgety lady, who by this time was getting beyond control, Radical conveyed the idea that something dreadful had happened over at the Pennsylvania State College.

What good, I ask you, does it do to give the public such news as this? What is a "grubstretcher" anyhow? If it stretches out a man's grub, I can see how it might be a good thing in these hard times, but what good would a grubstretcher be after it had fallen into the spitchslop! Certainly no one would want to eat the grub after it had been stretched with a grubstretcher which had got into the spitchslop. And what has it got to do with radio? What useful purpose is served by explaining to a fidgety lady, who is bordering upon hysterics, that the Pennsylvania State College grubstretcher has got mixed up with the college spitchslop? None at all, and to talk about these back stairs matters in the air is not uplifting. The fidgety lady did not think so either, for she got red in the face and wondered if it were proper to listen to such language.

"HEAR THAT ONE?—that's 8LGJ—he's calling 9AF in Hammond, Indiana—says 9DKV's HIGSPITTER IS PARALYZED."

The fidgety lady exclaimed, "Dear me, how awful!" The stout gentlemon looked serious. Sounded like a railroad accident to him. What rot! I do not believe 9DKV has a higspitter, and anyway, it's not decent to drag it into the public gaze if he has one. (But, between us, what in blazes do you imagine a "higspitter" to be? I have a cat at home and I'm interested.)

"HELLO!—there's 9AGR over in Indiana. He says that 3CC in Philadelphia —For the love of Mike!—says HIS MODULATOR MUGRAT IS LOOSE AND CHASING HIS BILLYGUP AROUND THE CELLAR!" "Hot dog—some night, this!"

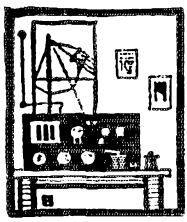
"How terrible!", from the lady with the fidgets.

"LISTEN TO THAT ONE!—that's 3HJ in Haverford, Pennsylvania. Listen to him roar! He's working 9UH in Louisville, Kentucky. Telling him something about 2FP—says HE KILLED 9ZN LAST NIGHT."

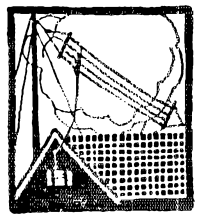
This began to look like murder. I was wondering what best be done before amateur wireless were completely discredited, when Radical's mother called a halt. She feared the party would stay the night. She politely let it be known that that would be all for to-night, and the party put down the phones and broke up. Their eyes were popping out of their heads. The fat man told Radical's father he had no idea that these young men were doing such wonderful things. The fidgety lady nearly wept on Radical's mother and said she would be around again when her nerves got better, and would send a lot of messages to her friend on the Atlantic.

The little wife and I went home and I hunted up kitty, and greased up Old Betsy preparatory to making a night of it. After all the bunk I had been listening to, I wanted to get some of the early morning real wireless stuff. What the poor folks

(Concluded on page 66)



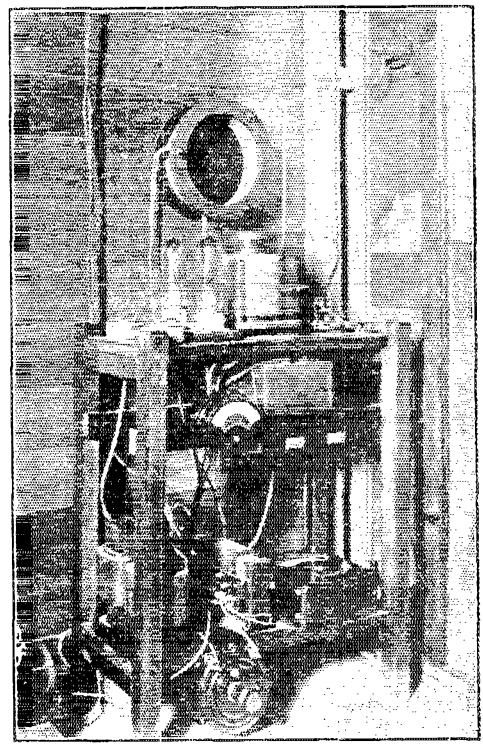
Amateur Radio Stations

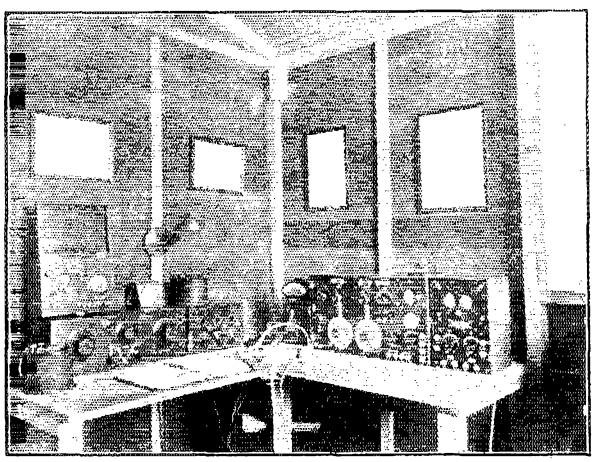


6ALE, Reedley, Cal.

The station of Mr. W. W. Lindsay, Jr., 6ALE, is one of the West Coast's premier C.W. sets and has done much to show the California fellows what the bottles can do.

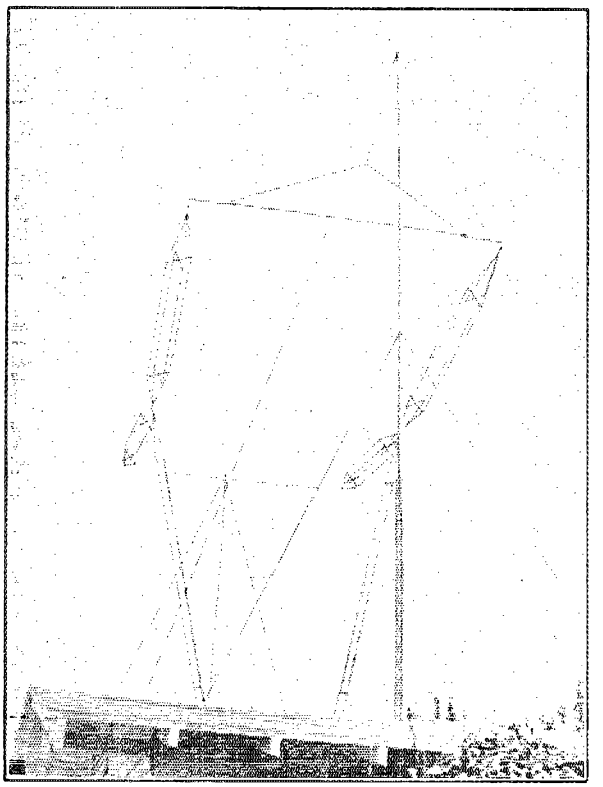
Mr. Lindsay has done so much experimenting that his equipment has not remained very long in any one arrangement. At last accounts it was in the form shown in the present photograph, comprising two 50-watt Radiotrons in a self-rectifying circuit with A.C. supply, a tube working on "each side of the cycle" in the hook-up illustrated. On the bottom shelf are the transformers for filament and anode supply, filament resistance, A.C. voltmeter, and Dubilier protective device. Next come the condensers and the 2000-ohm grid leak, which is behind the 0-500 milliammeter. Just below the tube sockets are the filament r.f. by-passing condensers of .0024 mfds. each. The other condensers are Murdock sections of .0017 mfd. each. On top are the two tubes, with their r.f. chokes in the foreground. Then comes the oscillation transformer. The antenna inductance is the outer one, of edgewise-wound strip, 7¼ in. diameter, inside which the anode and grid coils are wound of No. 14 copper wire on a 4¼ in. threaded tube, 14 turns in the grid coil and 30 in the anode circuit. The transmitter is distant-controlled, and





the relay to the right of the inductances is a magnetic antenna switch, with the antenna lead running up above it to the entrance bushing. In the ground lead a Weston thermo-heating element is inserted, which registers on an ammeter above the operating table in the recieving room—a very nice arrangement in a distant-controlled set. The wiring diagram will make clear the connection for all these parts.

The receiving equipment consists of a Wireless Specialty Apparatus Co. IP-501 and two-step amplifier, and a Grebe CR-3 and detector-two-step. A Magnavox and one step of power amplification have been added since the photo was taken. Signals and received music from 6XAC have been



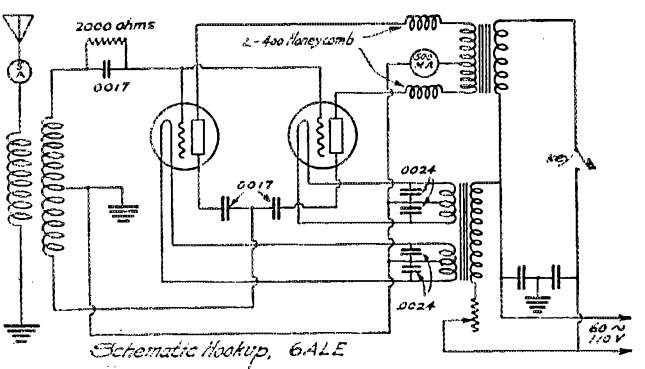
reported half a mile from the shack. This is the receiving equipment on which 2FP, Brooklyn, was copied on Oct. 6th, and is the second time that Mr. Lindsay has copied across the continent.

The antenna arrangement photographed is a very novel one, consisting of two 4-wire cages on 2-ft. crosses, flat-top length 50 ft. and height 60 ft., the two cages spaced 21 ft. apart and arranged as a T aerial with the two center down-leads each consisting of 4-wire cages on 1-ft. crosses. The ground consists of a network of No. 6 copper wire under the antenna, with 6 wires lengthwise and 3 crosswise, embracing an area 50 ft. by 80 ft., with the lead from the center. The capacity is .00054 mfd. and the natural wave length 180 meters. The transmitter put 2.7 amps. in this antenna system on a wave length of 195 meters and was reported by 7th district stations as the loudest "6" heard. 6ALE is now using a single cage, we understand, and also is doing most of its work with a single tube on "one side of the cycle", obtaining an antenna current of 2 amps. (thermo meter) with 160 watts anode input and 110 watts filament input. Regular schedules are maintained with 7XD in Billings, Mont., and 6AEZ in Ogden, Utah, and a good deal of traffic is being handled. The best reports on its signals are from 9AHC, Ellendale, N.D.; 9RY, Topeka, Kan.; 9ALG, Wichita; 5ZO, Houston; and 9AMB and 9ZAF, Denver.

8IB, Columbus, Ohio

8IB is the station of Robert C. Higgy who will be remembered by pre-war amateurs as the operator of that record-breaker, old 6DM at Phoenix, Ariz. He is now devoting himself to experimental C.W. work and a number of sets have been built and operated at 8IB.

The general photograph shows a small self-rectifying A.C. set on the right, using two UV-201's (amplifiers) with a Colpitts circuit as shown in Fig. 1. Note the chokes, RFC, comprised of small coils shunted by an air variable. When such a combination is tuned to the wave length being used it forms an infinite impedance for that frequency and has been found greatly superior to other kinds of chokes. The adjustment of the shunt condensers is very critical. Filaments are lighted by A.C. Condensers C. are glass plates, capacity about .003 mfd. each. The inductance



Schematic Hookup, 6ALE

is a coil of No. 14 D.C.C. magnet wire 4" diameter, good antenna current being obtained when as few as 10 turns are used. This set was only a temporary one for experimental work but was consistently heard at 9ZN and worked 100 miles daylight

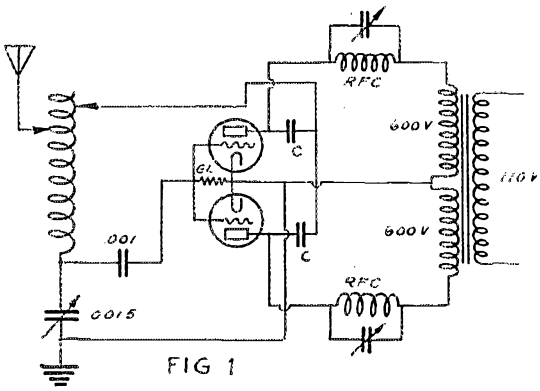


FIG 1

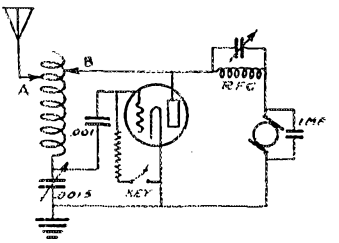


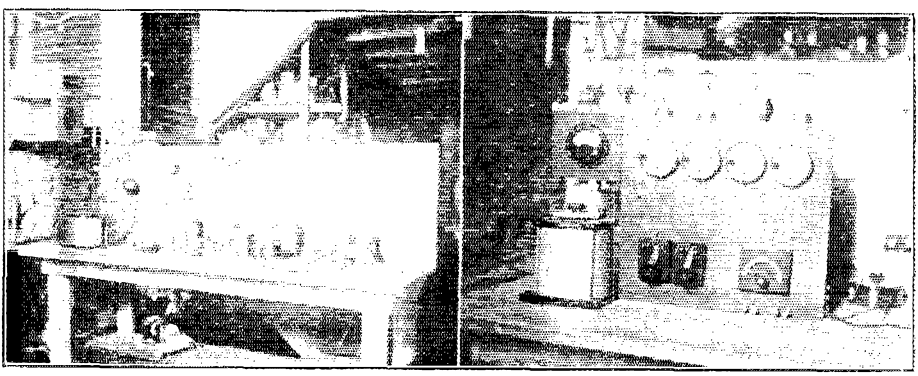
FIG 2

easily, with an antenna current of .8 to .9.

On the left end of the table is the D.C. set, since rebuilt into a panel as shown in the separate photograph. Power is supplied by an old 500-volt motor driven as a generator, giving up to 800 volts. Four 5-watt Radiotrons are used in a Colpitts circuit as per Fig. 2. A tuned r.f. choke, RFC, is again used. The two switches control the inductance taps A and B. The carbon potentiometer is used in series as a grid leak.

If we understand Mr. Higgy correctly he has now forsaken the Colpitts circuit for that British Aircraft hook-up which was first described in QST by 1DH on page 28 of July QST, and again on page 24 of the September issue by 1MO. The Colpitts circuit wouldn't give decent output on a legal wave. That is the experience of most folks. We can unhesitatingly recommend the British circuit as the best we know at this time for short-wave work.

8IB's aerial is a 3-wire inverted L, 65 ft. long and 45 ft. high, with a 60-ft. lead-in. The receiver consists of a Grebe AGP-102 regenerator, and detector-two-step. Signalling on the C.W. sets is accomplished by breaking the grid-leak circuit by means of a relay so that either the A.C. or the D.C. set may be controlled from the receiving table.

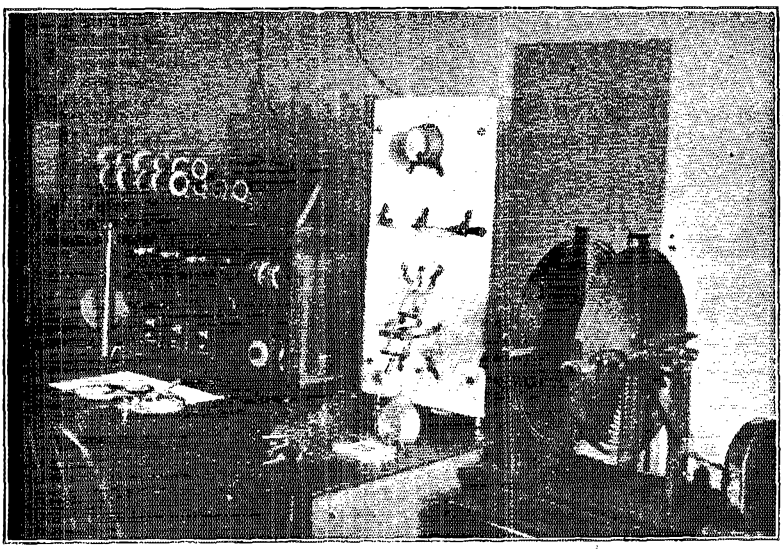


9YK, St. Louis

9YK is the station of St. Louis University at St. Louis, Mo. The receiver is made of deForest units—honeycombs and two step amplifier—with Baldwin phones. The transmitter has a 1 k.w. Thor, Dubilier condenser, a rotary concerning which we have no details, and a large pancake O.T. The antenna current on 1000 meters is

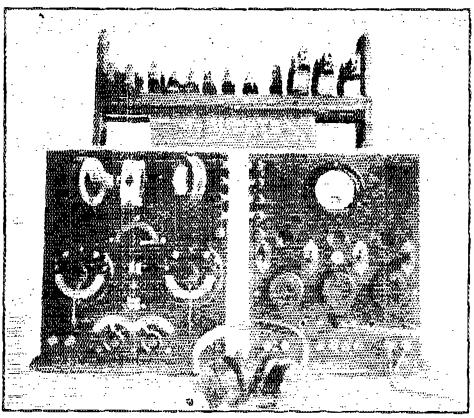
5 amps. with 8-inch coupling between the pancakes, and the daylight range 600 miles.

9YK was kindly loaned by the University to the U.S. Government for use in the Aerial Mail Service, and the call KDEN was used until recently, when the new Government station in St. Louis was erected for that work.



An Amateur in Porto Rico

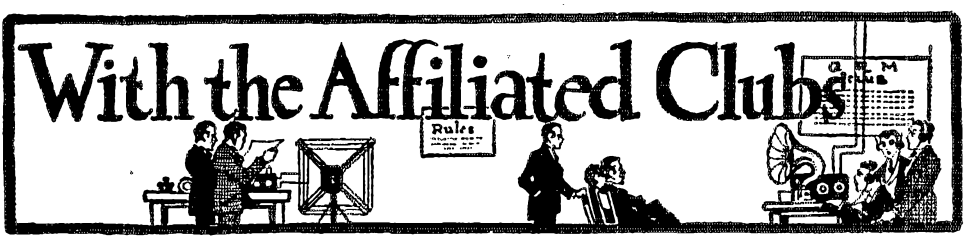
The following description is of the home-made receiving equipment of Mr. Joaquin Agusty, long a member of the A.R.R.L., at San Juan, P. R. This is his fourth set and he labors under many inconveniences, as there are no supply houses in Porto Rico and everything must come from the States.



The right-hand panel controls the tubes, which are Marconis, while the left-hand one is a universal-wave tuner using honeycomb coils. A large percentage of the small parts are hand-made: the switches, the coupling system which is controlled by the knobs at the bottom of the panel thru gears, the coil rack, loud speaker, loop, and particularly the amplifying transformers. Mr. Agusty says that he tried several makes

(Concluded on page 66)

Mr. Agusty at his set.



Help! Help! This department is being conducted by F. H. Schnell. Affiliated Clubs are urgently requested to send in a report of activities. Particularly, we want information regarding activities that have increased your attendance, brought you new members, etc. We want everything that we can get that you think will help the other club. If you publish a club organ, send us a copy every month so that we may tell our radio friends about it.

Nola Radio Club is publishing a bi-monthly paper known as "The Foney Tron." In it we find some good reading matter and a few good "Dont's", among which are "Don't transmit through time and weather reports; don't exceed the legal wave length of 200 meters; don't transmit during the Quiet Hours."

Y. M. C. A. Radio Club of Sioux Falls will hold its first get-together meeting of amateurs in South Dakota on December 28th and 29th at Sioux Falls under the name of the South Dakota Radio Convention. Speakers of considerable prominence in the radio field will be engaged and radio apparatus will be exhibited. There will be some novel stunts, and a banquet will close the convention. Amateurs from Minnesota, Iowa, and Nebraska have signified their intentions of attending. (Wish I could be with you too.—T. M.)

South Jersey Radio Association opened its 1921-1922 radio season with a smoker and a feed. Mr. E. L. Norncross addressed the members. Meetings will be held every Thursday night in the Fire House, Collingwood, N. J., and a cordial invitation is extended to all amateurs to attend.

Brooklyn Tech Radio Club conducts code instruction classes four days a week. Regular meetings are held every Friday noon at 85 Livingston St.

Bay Counties Radio Club—An unusual program greeted about 300 radio amateurs on October 15th. The gang was entertained by wrestlers, boxers, dancers, singers, dramatic readers and speakers, while a 30-piece band furnished the music. Major Dillon, U. S. Radio Inspector for the district, addressed the gathering. In addition to speaking, Sunny Jim Bessey refereed the wrestling and boxing contests. We wager that there was no back talk to Bessey. Mr. Dickow spoke on topics of general interest. A watermelon eating contest was won by 6OC. Mr. Bessey caused much merriment with his weird after-dinner stories.

Akron Executive Radio Council is being represented by "The Radio Voice," a little sectional paper which is edited by 8UX our cartoonist. "The Radio Voice" is published every other Saturday and contains news concerning the 8th district stations and clubs. $1.25 brings the paper to your door for one year, 25 issues.

QRV Radio Association, (Uniontown, Pa.) has started a code class, offering a prize for the members making the best showing. The speed one must reach to win a prize is 15 words per minute. Considerable interest is being shown in this stunt and the membership at each meeting is decidedly on the increase.

Iowa Radio Relay League publishes "The Wouff Hong." We have handled the real Wouff Hong but this is the first time we have seen it in print. The purpose of "The Wouff Hong" is to urge co-operation among the amateurs who are members of the I. R.R.L.

Maryland Radio Association (Baltimore) has started a series of interesting meetings at which radio educational lectures will be given. At recent meetings papers were read by Mr. Steger on a loud talker of unique design, on radio phone construction by Mr. E. C. Densten, and on the operation of power tubes by Mr. E. B. Duvall. A cordial invitation is extended to all amateurs to attend the big smoker in December.

Central Illinois Radio Club (Springfield) recently put over an affair which made a great hit with the members and netted the treasury nearly $30. Every member donated all the junk he had, which was auctioned off to other members. We are informed that there were spark coils, keys, coils of wire, odd fones, and the aggregate scrapings of some thirty hell-boxes. Much interest was manifested, since every piece of junk was sold.

Dallas Radio Club furnished a means of communication between citizens of the U. S. and Mexico City at the State fair which was held in Dallas. One relay between Dallas and Mexico was necessary and this was handled by the Houston Radio

Club members. All messages were handled with dispatch, even though great distances of 500 miles had to be bridged between stations.

Rocky Mountain Radio Association has adopted a schedule of working hours. Copies may be secured from Mr. G. W. Maler, secretary of the club, by addressing him at 3914 W. 29th St., Denver, Colo. Practically the Chicago Plan has been adopted with certain modifications to suit the members located in this territory.

The Buffalo Convention—A very splendid meeting of amateurs from the Eighth U. S. District and the adjoining Canadian districts was held at the Hotel Iroquois, Buffalo, Oct. 28th and 29th, under the auspices of the Radio Association of Western New York, affiliated, with something over a hundred and fifty amateurs in attendance.

The main business of the convention was the formation of an executive council to co-ordinate amateur activity in the territory, and the main business session at 2 p. m. on the 28th immediately buckled down to that problem, with Mr. John G. Rieger, president of the R. A. W. N. Y., presiding. A very interesting talk was made by Mr. A. F. Parkhurst, assistant radio inspector, representing Inspector Edwards, who offered the hearty co-operation of his office. Incidentally Mr. Parkhurst called attention to a point worth knowing in the renewal of station licenses. Station licenses cannot simply be renewed upon expiration; the entire procedure must be gone thru again. Form 762 must be filled out in duplicate, the same as in the original application, and the expired license returned with the new forms, if the same call letters are to be reissued. Otherwise it will be handled as a new application and a new call assigned. If you want to avoid trouble, fellows, ask for two copies of form 762 and voluntarily send them in for a renewal just before the expiration of your station license, and be sure to send back the old license too. Getting back to the meeting's program, addresses were then made by F. H. Schnell and K. B. Warner, respectively traffic manager and secretary of the A. R. R. L., by Mr. Neubauer representing Cleveland Radio Assn. Prof. W. C. Ballard, jr., of 8XU, and others, by which the general sentiment as to the nature of the contemplated organization was determined. At an adjourned session in the evening a temporary name was chosen, "Lower Lakes Executive Radio Council," and Mr. J. ("Jack") Alexander of Buffalo, editor of "QTC", chosen as temporary chairman and instructed to surround himself with a temporary personnel in a scheme that would embrace participation by the various clubs in the district in a plan following in general principles those of the 2d and 3d district councils.

A technical session was held in the hotel that night, with excellent talks by G. Kenneth Thompson of the Amrad company and W. C. White of the research laboratories of the General Electric Co. The next morning Prof. Ballard spoke on "Transmission on Harmonics," with notes on a simple and efficient recorder also used at 8XU. The gang inhaled a four-bit lunch en masse at Wilcox's Restaurant that noon, and returned in the afternoon for addresses by L. C. F. Horle on "Methods of Modulation", and M. C. Batsel, of the Westinghouse Company, on receivers and amplifiers. All of the technical papers were excellent and thoroly enjoyed.

Inspector Parkhurst held operator's examinations on the morning of the 29th, many taking advantage of the opportunity. Little spare time remained but the fellows managed to sneak out to visit various amateur stations in Buffalo and vicinity. (One good thing accomplished by the meeting was the conversion of 8AGK to the use of a real receiving tuner. Hi!)

The banquet was a peach, Brother Rieger doing the honors. An interesting address was made by James W. Higgins, Chief of Police of Buffalo, who incidentally is the man who originated the idea of amateur broadcasts in such police work as the recovery of stolen cars, etc. The Chief's right-hand man, Chief Desk Sergeant Schmitt, told some police yarns, and brief remarks were made by Messrs. Schnell, Horle, R. H. McMann, Parkhurst, Alexander, the two radio Benzees, Warner, Batsel, B. C. Belden, W. C. C. Duncan, past president of the Wireless Assn. of Ontario, and H. C. Coyer. A Buffalo chapter of the Radio Club of America was decided upon and a committee appointed to look after it. Then Mr. McMann exhibited Bray animated movies of what goes on in a radio set, particularly within a vacuum tube. This concluded the formal doings but of course it took the gang four hours thereafter to break up.

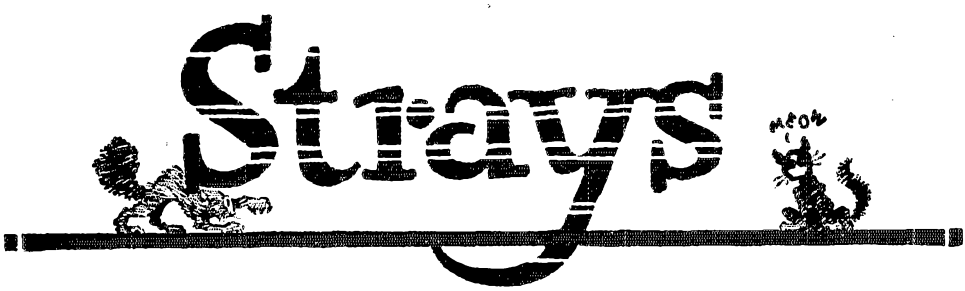
Two good radio days, many real good friends made, another job started in amateur co-operation, and Buffalo always a pleasant memory—that sums it up.

THE RADIOPHONE

(Concluded from page 30)

for straight telegraphy.

On the big question of phone concerts, more success to the folks who are putting out real stuff for us! Let communities decide for themselves on the matter of local concerts of good quality; but for the "I-will-now-favor-you" artist with his gargle-modulation, the Wouff-Hong!



F. Clifford Estey, president and secretary of the Essex County County Radio Association, affiliated with the American Radio Relay League, has become associated with the Clapp-Eastham Company, Cambridge, Mass., as Sales Manager. Mr. Estey will direct all sales and advertising work for the well-known C-E line of radio equipment. New England radio men among whom Mr. Estey has so long been a prominent and popular figure join in congratulating him on his new connection and extend heartiest wishes for success.

In the October issue of QST the wave length range of the receiver described in the Standard Assembling Co.'s advertisement was given as 150 to 170 meters. This was an error, the correct range being 150 to 700 meters.

We learn with deep regret of the death of the father of Harvey Mitchell Anthony, A.R.R.L. Director, of Muncie, Ind., and we all join in an expression of sincere sympathy to Mr. Anthony.

Understand there are a lot of left-handed operators down in Texas.

Clarence Adams, 4413 Fulton St., Chicago, radio amateur, was killed on Oct. 9th when an iron-pipe mast he was erecting came in contact with an 18,000-volt transmission line in the alley behind his home. Roy Bierman, a neighbor who was assisting him, was badly burned.

Call books list the call of V. W. Hurst, Jr., of 9 Fairview Heights, Rochester, N. Y., as 8AHU. This is an error, Mr. Hurst's correct call being 8AGU.

The Formica Insulation Co., of Cincinnati, have scored three victories in patent litigation brought against them by the Westinghouse company and the Continental Fiber Co. In one case the court held that the Westinghouse's claim was outlawed by delay, in another that there was no infringement, and in the case of the Continental Fibre Co. the suit was ordered dismissed, the patent itself being held invalid for want of novelty.

In the report of the Chicago Convention, talking about power factor, mention was made of an unknown man "Simpson". We have learned that the gentleman in question is Prof. Hector R. Skifter, of the Department of Physics and 9YAJ, of St. Olaf College, Northfield, Minn.

"Will the party who has a CW set and is either using the call 3ZL or sends his own call so rotten it sounds like 3ZL write to C. D. Blair, Box 859, Richmond, Va., (lawfully licensed as 3ZL by the radio inspector) and get 57 cards and letters reporting his signals in nearly every state and tell these birds what he is using, and get busy and lay off my call? I have not used this call since April, and the last time it was reported was a Sunday night when I had a date with my girl so howinel could it have been me?" —*C. D. Blair.*

We have received a glowing prospectus advertising the merits of a battery-charging fluid described as "liquid electricity", which merely has to be introduced into a discharged battery and it will immediately be charged again. The pamphlet states that the old idea that when a battery goes dead it has to be put on a line and recharged is a mistaken one, and that rectifiers are of no real use. "Let us explain that a rectifier is simply a current reducer, being capable of reducing a current of 110 volts to less than 1 ampere. The purpose of using a rectifier is to merely heat the plates to a certain temperature. The voltage is thus created thru the positive plate and the gravity thru the negative plates." Funny, but that doesn't seem to be the way it was taught to us.

New records: 6KA reports 2FP, CW, on Oct. 18th, 11:10 p.m. P.S.T. 6BF, Santa Paula, Cal., reports 8BOX, Tippecanoe City, Ohio, calling 8YZ and 8CVT on the night of Oct. 29th. 8QM, Elmira, N. Y., using two 5-watt tubes, has been heard in Lincoln, N. B., 1008 miles. 4GL, Savannah, using three 5-watt tubes, has been reported 2450 miles at sea. Old man C. W. Duzzit!

Canadian Briefs

Glace Bay has been using tube transmission recently with great success. The

installation will be 50 k.w. when completed. Clifden already has been converted over. The tubes are the same as available to amateurs—type MT-2, rated 1000 watts and can be worked to 3½ k.w., price $210, operating potential 10,000 volts, estimated life 3000 hours.

Work has been started on a new Marconi station at LaPrairie, 20 miles from Montreal, which will use a 15 k.w. tube transmitter on 2800 meters. The power will be 3-phase A.C. passed thru tube rectifiers, giving 10,000 volts for the anodes.

The government station VCA, formerly at Tarte Pier, has been moved to a new location on the back river well out of the city of Montreal. The equipment is the same, with little hope of improvement in the decrement.

Say, wouldn't it be perfectly ripping—if 2AWL would learn to make figures right, particularly 1's and 9's????

Earl Jay Dickerson, old time operator from the Philadelphia district, died in the hospital in Falmouth, England, on July 13th as the result of burns received in a fire occurring on the S. S. "Storm King" on which he was serving. The body was returned to the States and on Aug. 5th was interred at West Chester, Pa., with Masonic ceremonies. With the passing of Earl Dickerson the radio art lost a master operator.

The Trial of Ananias.

A riot broke in Hell's engine room,
  The yells were fierce and loud;
The Devil's cops charged quickly in
  And dragged from 'mongst the crowd
A bent old man all ragged and torn;
  Whose breath came quick in fits and jerks,
They rushed him up to the Devil's throne
  And cast him to his knees
To have a sentence passed on him—
  To offer up his pleas.
"Your name, old man, and make it quick"
  Barked the Devil with a frown;
"Has Bolshevism come at last
  To my once peaceful town?"
The old man proudly raised his head,
  His voice rang loud and clear.
"All men have heard of me, O King,
  And know why I am here,
For I am Ananias,
  My time here has been long
And now I would to heaven go
  And join the angel throng.
I told a lie, long long ago—
  'Twas only one indeed—
And now so many are told on earth
  I think I should be freed."
"What mean you, man", the Devil asked,
  "Speak no riddles here,
For if you cannot clear yourself
  You'll shovel coal for years."
"Listen, O King", the old man cried,
  'Till I read a page or two
From my radio log, for I've copied here
  These things Hams said were true:

A pair of phones so finely made
  That sounds came loud and clear
From two microbes in duel to death
  In the southern hemisphere.
And a bulb that once upon a time
  (The witness has left town)
Would oscillate on just six volts.
  'Twas heard for miles around.
And the lad who heard P O Z
  With his thumb in the galena cup.
And here's another bird who says
  NAM is tuned right up.

An amplifier made so swell
  The B batteries cut the buck
And it runs a year on all six steps
  Ere he charge the storage up.
An indoor aerial—it's the goods—
  A thousand miles or so
With a chunk of galena in the cup—
  It's merely play you know"

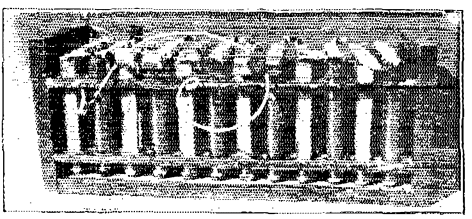
"Enough, enough", the Devil moaned
  And softly dropped a tear.
"You're freed, old man, go hasten on
  And climb the golden stair.
Your place will soon be taken
  (I know your reports are true)
And I'll soon have so many stokers
  I won't know what to do.

—By Geo. M. Phillips,
dedicated to R. Burleson.

A BATTERY-OPERATED RADIOPHONE

(Concluded from page 23)

The modulation loop idea described by 5AL in November QST is used in this set, and 5ZX has found by experiment that there is an optimum number of turns in the loop. This set uses exactly 1¼ turns



with a microphone originally designed for a 6-volt circuit, but a microphone designed for 12 volts works best with 3 turns in the modulation circuit.

The beauty of this set is its absolute quietness—no commutator noise or supply ripple—and its modulation is pronounced perfect.

Calls Heard

HEARD DURING OCTOBER

Unless Otherwise Specified

Amateurs reporting lists are requested to see instructions appearing at the head of this department in previous issues, and to observe following additional instruction:

(4) In order to distinguish between spark and C.W. stations, list **spark** stations from 1 to 9 in the usual manner, and then make a second paragraph in identical form listing the **C.W. stations.**

Can. 3BP, Newmarket, Ont.

Spark: (1ADL), 1AJU, 1AKO, 1ANV, 1AOL, (1ARY), 1AZD, (1AZK), (1AW), 1BDC, -BDT, (1BGF), (1BIR), 1BU, (1GM), 1HK, 1OE, (1QP), (1SN), 2AHU, (2AIM), (2AJE), 2AJZ, 2AKU, (2AQI), (2ARB), 2ARN, 2ASL, (2AW), (2AWF), (2BK), 2DA, (2DI), (2DN), (2EL), (2FP), 2JG, (2JZ), 2OE, (2OM), (2PV), (2RM), 2SS, (2WB), (2XQ), 3ABB, (3AC), 3AIC, 3AN, (3AQR), (3CC), 3CG, 3CN, 3DW, 3EH, (3HJ), (3IW), 3OU, (3PB), 3QW, 3UQ, 3US, 3VW, (3XM), (3YO), 3ZA, 3ZE, 3ZO, (4AS), (4BE), 4BQ, (4BY), 4CX, 4DH, 4EN, 4FD, 4FJ, 4GM, 4GN, 4GX, 5DA, 5EK, 5ER, 5FJ, (5FV), 5XB, 5XU, 5ZAB, (5ZL), 8AAV, 8ADQ, 8AFB, (8AFD), (8AFG), 8AFS, (8AHV), 8AJP, 8AJT, 8AJV, 8AKV, 8AKW, (8AMB), 8ANO, (8AQT), 8AQV, 8AWU, 8AXC, 8AYN, 8AYX, 8BA, 8BDY, 8BEP, 8BKA, 8BLW, 8BRL, 8BSY, 8BP, 8CV, (8CG), (8DY), 8EO, (8FT), (8GW), (8HU), 8IL, 8JP, (8JQ), 8LW, (8MM), (8MZ), (8NZ), (8RQ), 8RU, (8SP), 8TK, 8TN, 8UC, 8VQ, 8VJ, 8VY, (8XE), (8XEQ, (8YN), (8ZB), (9AAP), (9AAW), (9AAY), 9ABH, 9ABU, 9ACA, 9ADI, 9AER, 9AFX, 9AGT, 9AIO, (9AIR), (9AJA), 9AJH, 9AIW, 9AKW, 9AMK, 9AMS, 9AMT, 9AMV, 9ANC, 9AO, (9AOU), 9AP, 9APQ, 9AQE, 9AQM, (9ARG), 9ARI, 9ASJ, 9AV, 9AWU, 9AWX, (9AYW), 9BDE, 9BDS, 9CP, 9DBW, 9DEV, 9DHG, (9DQQ), 9DV, 9DWM, 9DWP, 9DWZ, 9EE, (9ET), 9EZ, 9FM, (9FS), (9GC), 9GX, 9HE, 9HI, 9HK, (9HM), 9HT, 9IY, 9JQ, 9KR, 9LQ, 9MC, 9MK, (9PD), 9PS, 9QH, 9TL, 9UA, 9UH, 9OU, 9VK, 9WT, 9XM, 9YA, 9YAC, 9YAE, 9YB, 9YO, 9ZB, 9ZN, 9ZY,

C.W.: 1ANQ, 1AYL (fone), 1BAI, 1BDX, 1NQ, 1UN, 2ABQ, (2ADL), 2AFP, (AHL), 2AJF, (2AWL), 2BAK, 2BEA, 2BM, (2BRC) ICW, 2BYS, (2DN), (2FP), (2ZE), (2ZV) fone, (2ZL), 3AAE, 3AHK, 3BC, 3BZ, (3FM), 3GR, (3HG), (3HJ), (3HX), (3PB), 3RF, 3ZO fone, 4BY, 4CO, 4FF, (4GL), 4LE, 4NQ, 5LE, 8ABO, 8AQF, (8AQZ), 8ARK, (8AWP), 8BCL, 8BRC, 8FB, (8HJ), (8JQ), 8RQ, 8VV, 8XK fone, 8ZG, (8ZZ), (9AAS), (9AJA), (9ARK), 9AYN, (9EK), (9GL), (9HD), 9HM, 9LQ, 9OL, 9RT, 9ZY.

Can. 2BF, Montreal, Que.

C.W.: 1ABY, 1AKG, 1BAI, 1BYQ, 1BYX, 1IDR, 1PT, (1TS), 2ABF, 2AFP, 2AJF, 2AJW, 2ARP, 2AWL, 2BRB, 2FD, 2FP, 2KL, 2OE, 2ZV, 3AAN, 3AHK, 3AMH, 3EM, 3FM, 3HG, (3HJ), 3HM, 3HX, 3MO, 3ZY, 3ZZ, 4GL, 8AAZ, 8ACF, 8AIO, 8ARY, (9AWP), 8BDE, 8BQ, 8DV, 8DX, 8II, 8JL, 8LF, (8LX), 8QY, 8RQ, 8RU, 8UK, 8UJ, 8VJ, 8VY, 8XM, 9AJA, 9AWZ, 9HY, 9ZB, 9XAH, 3BP.

Spark: 1AMZ, 1BDC, 1BDT, 1IDC, 1OE, (1SN), 2ARY, 2AQI, 2BK, 2DN, 2FP, 2JK, 2OM, 3BFU, (3HJ), 3US, 3UQ, 3XM, 3ZA, 3ZO, 4EY, 8AGB, 8AGK, 8AWP, 8ANO, 8BRL, 8FT, 8HG, 8RU, 8RQ, 8TD, 8YN, 8XE, 9AAW, 9AGR, 8AIU, 9ARI, 9AWZ, 9BDE, 9CP, 9DQY, 9DR, 9GP, 9ZN, 9ZJ, 3BP-3EI.

Can. 3IM, Toronto, Ont.

September—October

1AW, 1BT, 1BG, 1BJ, 1BL, 1CF, 1CK, 1CM, 1MR, 1PM, 1TS, 1ARY, 1BIR, 1CAK, 2AB, 2AJ, 2BF, 2BK, 2FP, 2FZ, 2DN, 2OM, 2NF, 2NR, 2QR, 2XA, 2XQ, 2QV, 2UA, 2ZL, 2AWF, 2AWL, 2AJW, 2AFP, 3CC, 3BG, 3FJ, 3IW, 3KM, 3HJ, 3NB, 3RQ, 3XM, 3ZO, 3ZY, 4DH, 4FD, 4GL, 4GN, 4YB, 5EK, 5FV, 5DA, 5ID, 5XJ, 5ZA, 5AP, 8AY, 8BK, 8BH, 8CG, 8DE, 8DR, 8EV, 8EZ, 8FA, 8FE, 8FI, 8FP, 8FT, 8HA, 8HU, 8HV, 8II, 8IN, 8IQ, 8JQ, 8KI, 8LD, 8LJ, 8LQ, 8LQ, 8LX, 8MZ, 8QJ, 8RU, 8SP, 8TK, 8TN, 8TT, 2TY, 8QX, 8UK, 8VY, 8XE, 8XK, 8YN, 8ZA, 8ZD, 8ZG, 8ZL, 8ZN, 8ZZ, 8DX, 8ZR, 8HG, 8RQ, 8ACF, 8ACS, 8AFD, 8AHH, 8AHV, 8AIM, 8AIO, 8AMT, 8ALO, 8ANK, 8ANY, 8AOT, 8AOU, 8AQR, 8AXC, 8AYN, 8AZF, 8BOX, 8BRC, 9AF, 9AW, 9CF, 9EK, 9FI, 9FS, 9FW, 9GP, 9HM, 9HR, 9IC, 9IR, 9MC, 9ME, 9OI, 9TL, 9UF, 9UU, 9XM, 9YA, 9ZA, 9ZD, 9ZJ, 9ZN, 9ZV, 9ZW, 9AAJ, 9AAW 9AGU, 9AIU, 9AIR, 9AJH, 9AKU, 9AMQ, 9ASJ, 9ARZ, 9AWU, 9AXU, 9AYW, 9AZE, 9DBO, 9DBU, 9DWM, 9YAC, Canadians:—2BF, 2PE, 3BA, 3BP, 3KG, 3KS, 3QJ.

Can. 3GN, Ingersoll, Ont.

Spark: 1FF, 1GM, 1ZE, 1ADL, 1BFZ, 1BGF, 1BLE, 2EL, 2FP, 2JU, 2OM, 2TF, 2AQI, 2ARB, 3CC, 3EZ, 3HJ, 3HX, 3IW, 3OU, 3RF, 3RW, 3XM, 3YK, 3ZA, 3ZO, 3ACM, 3AQR, 3ARM, 3AWF, 3BFU, 4BW, 5DA, 5EK, 5FJ, 8BK, 8BP, 8DY, 8EC, 8EF, 8FD, 8FT, 8GW, 8HG, 8HY, 8IN, 8JQ, 8LM, 8NQ, 8MY, 8MZ, 8OI, 8OW, 8PQ, 8QQ, 8QY, 8RQ, 8RU, 8SP, 8TT, 8XE, 8YN, 8ZA, 8ZD, 8ZN, 8ZR, 8ABO, 8ACF, 8AFB, 8AFD, 8AFG, 8AHH, 8AKE, 8ALV, 8ARD, 8AXC, 8AXN, 8AXU, 8AYN, 8BCL, 8BFP, 8BKN, 8BRC, 8BRL, 8BSY, 8DKK, 9AP, 9AV, 9CP, 9CS, 9ET, 9FS, 9GO, 9HI, 9HM, 8HR, 9HS, 9JQ, 9KO, 9LW, 9MC, 9UU, 9UW, 9WT, 9YB, 9ZB, 9ZJ, 9ZN, 9AAP, 9AAW, 9ABH, 9ABU, 9ADS, 9ANK, 9ARG, 9ARI, 9AWU, 9BDE, 9DBS, 9DPH, 9DWP.

C.W.: 1AJP, 1AKB, 2DN, 2FD, 2FP, 2ZL, 2AFP, 2AWL, 2BCN, 2BGM, 3EM, 3ZY, 4FF, 4GL, 8SO, 8DE, 8GE, 8KM, 8LF, 8OI, 8TG, 8TN, 8UK, 8VJ, 8VY, 8WY, 8XK, 8ZB, 8ZG, 8ZZ, 8ABP, 8ACF, 8AMF, 8AQZ, 8AWP, 8AWX, 8BCI, 8BEF, 8BDU, 8BOX, 9ZB, 9ZY, 9AAV, 9AMA.

Canadian: (3AX), 3BP, (3DL), 3DU, 3FM, 3KS, 3LI, (3JF), (3MN), 3NZ, (3OV), (3QH), (3QJ), 3QM.

1TS, Bristol, Conn.

Spark: 1AA, 1ABB, 1ACO, 1AD, 1ADC, 1ADL, 1ADP, 1AHF, 1AHK, 1AJR, 1AKA, 1ALP, 1AMD, (1ANT), 1APO, 1ARY, (1ASF), (1AW), (1AXW), 1AYQ, 1AZK, 1BCF, 1BDC, 1BDL, 1BDT, 1BFE, 1BFZ, 1BGF, 1BIR, 1BJE, 1BJN, (1BLE), 1BNF, 1BQL, (1BRW), 1BU, 1BVB, 1BWY, (1BYM), 1BYS, 1CEO, 1CHW, 1CHX, 1CK, 1CP, 1CY, (1DY), 1DZ, 1EZ, 1FU, 1FV, 1GM, 1GV, 1HK, 1IA, 1JX, (1MA), 1OE, 1OJ, 1OT, 1PU, 1PY, (1QP), 1RV, 1SN, 1SZ, 1UJ, 1WP, 1WQ, 1XZ, (1ZE), 2ABM, 2AFR, 2AHU, 2AIM, 2AJA, 2AJE, 2ANH, 2ANM, 2AQI, 2AQL, 2ARB, 2ARY, 2ASL, 2AWF, 2BCC, 2BDG, 2BGR, 2BJF, 2BK, 2BM, 2BSC, 2DA, 2DB, 2DI, 2DK, 2DN, 2DO, 2DX, 2EL, 2FP, 2JU, 2JZ, 2OA, 2OM, 2OX, 2PF, 2PK, 2QR, 2RM, 2SQ, 2TC, 2TF, 2TJ, 2TS, 2UA, 2WB, 2WM, 2XQ, 3AC, 3ACE, 3ACM, 3AFE, 3AHF, 3AIC, 3ALN, 3AUW, 3BFU, 3BGT, 3CC, 3CG, 3CN, 3DW, 3EH, 3EZ, 3FM, 3GM, 3HJ, 3HX, 3IW, 3KM, 3LP, 3OB, 3OU, 3PB, 3PU, 3QN, 3RW, 3TH, 3TJ, 3UC, (3UQ), (3US), 3UX, 3VW, 3XM, 3ZA, 3ZO, 4BE, 4BY, 4DQ, 4EA, 4FD, 4SC, 5FJ, 5FV, 5XU, 5ZL, 8AAV, 8ACF, 8ADE, 8ADQ, 8ADR, 8AFA,

8AFB, 8AFD, 8AFM, 8AFS, 8AGB, 8AGK, 2AHH, 8AHV, 8AIB, 8AIM, 8AIO, 8AJT, 8AJV, 8AJW, 8AKW, 8AMB, 8AMZ, 8ANW, 8AOT, 8APB, 8APP, 8AQD, 8AQV, 8ARD, 8ARK, 8ASF, 8ASV, 8ASZ, 8AWP, 8AXC, 8AXO, 8AYM, 8AYN, 8AYS, 8AYT, 8BA, 8BBU, 8BBW, 8BCO, 8BDY, 8BEP, 8BFT, 8BFV, 8BIW, 8BJA, 8BO, 8BP, 8BPU, 8BRL, 8BSY, 8BUN, (8BVA), 8CG, 8CI, 8CV, 8DR, 8DY, 8EA, 8EB, 8EW, 8EZ, 8FA, 8FE, 8FI, 8FT, 8GI, 8GO, 8GW, 8HA, 8HG, 8HP, 8HU, 8HY, 8IL, 8IN, 8JJ, 8JP, 8JQ, 8JU, 8LW, 8MR, 8MZ, 8NZ, 8OI, 8PX, 8QC, 8QH, 8QM, 8RB, 8RQ, 8RU, 8SP, 8TJ, 8TK, 8TT, 8TY, 8TZ, 8UC, 8UP, 8VL, 8VQ, 8XE, 8XS, 8XU, 8YN, 8ZA, 8ZN, 8ZW, 8ZY, 9AAP, 9AAW, 9ABH, 9AF, 9AGR, 9AIR, 9AIU, 9AJH, 9AJI, 9AKH,9AMT,9ARG,9ASJ,9AV,9AWU,9AWX,9AWZ, 9AXU, 9AZE, 9BDE, 9BDS, 9CP, 9DAX, 9DBW, 9DLX, 9DWM, 9DXM, 9EE, 9ET, 9FS, 9GX, 9HM, 9HR, 9HT, 9KO, 9LQ, 9MC, 9ME, 9OX, 9PC, 9TL, 9TV, 9UH, 9UU, 9VG, 9WT, 9XI, 9XJ, 9XM, 9YA, 9YAE, 9YB, 9YM, 9YO, 9ZH, 9ZJ, 9ZN, Canadian: 2CI, 3BP, 3EI, 3EP, 3GE, (3JL), 3KG.

C. W. Stations: 1ABY, 1AFV, 1AGI, 1AJP, 1AJS, 1AJU, 1AKA, 1AKB, 1AKG, 1ALY, (1ANQ), 1AOK, 1AOL, 1AR, 1ARX, 1ARY, 1AWB, (1AYL) fone, 1AZD, 1AZW, 1BAI, 1BCB fone, 1BCF, 1BCY, 1BDI, 1BDS, 1BDT, 1BEA, (1BEP) fone, 1BES, 1BGH, 1BGF, 1BJN, (1BQE), 1BUA, 1BWJ, (1BYM) fone, 1BYX, 1CAK, 1CDR, 1CF, 1CGG, 1CGO, 1CHW, 1DH, 1ES, 1FF, 1ID, 1II, 1IN, 1MB, 1OE fone, 1PE, 1PT, 1PY, 1QG, 1QN, 1QP, 1RD, 1RH, (1RU), 1RZ, 1UN, (1UQ), 1XAD fone, 1XE fone, 1XM, 2AB, 2ADB, 2ABR, 2ABQ, (2ACT), 2ADL fone, 2AFP, 2AHL, 2AJF, 2AJW, 2AKO, 2ALG, 2ANZ, 2AQJ, 2AWK, 2AWL, 2AXR, 2AYZ, fone, 2BAK, 2BEA, 2BEB, 2BFZ, 2BGH, 2BGM, 2BIV, 2BML, 2BQH, 2BRB, 2BW, 2BUA, 2BYS, 2BZY, 2CAK, 2CT, 2DA, 2DN, 2EL, 2FD, 2FP, 2FQ, 2FZ, 2HI, 2JO, 2KL, 2KP, 2KV, 2MW, 2NN, 2OB, 2OE, 2QB, 2RU, 2UD, 2VH, 2WP, 2XA, 2XK, 2XQ, 2ZE, 2ZL, 2ZV fone, 3AAE, 3AAN, 3AAY, (3ABI), 3ACZ, 3ADT, 3AFU, 3AHF, 3AHK, 3ANU, 3APQ, 3BG, (3BIY), 3BJA, 3BJP, 3BZ, 3CC, 3DH, (3EM), 3FM, 3FS, 3G,B 3GR, 3HG, 3HJ, 3HX, 3MO, 3PN, 3QV, 3RF, 3SQ, 3XAA, 3XM, 3ZN, 3ZO fone, (3ZY), 3ZZ, 4BK, 4BQ, (4BY), 4CO, 4EL, 4EN, 4FF, (4GL), 4ZE, 5DA, 5ZA, 8AAZ, 8ABO, 8AC, 8ACF, 8ADG, 8ADR, 8ADY, 8AEG, 8AGZ, 8AIO, 8AJP, 8AKE, 8AKP, 8AKS, 8AMQ fone, 8AMZ, (8AND), 8AOA, 8AOG, 8APT, 8AQF, 8AQZ, 8AVH, 8AVL, 8AWF, 9AWP, 8AYW, 8BA, 8BCI, 8BDU, 8BCF, 8BFG, 8BFX, 8BFZ, 8BHJ, 8BJC, 8BJX, 8BK, 8BLT, 8BMA, 8BNJ, 8BO, 8BOX, 8BPL, 8BQL, 8BRC, 8BRL, 8BUM, 8CI, 8DE, 8DR, 8DZ, 8EA, 8FB, 8FQ, 8GE, 8GV, 8HJ, 8IA, 8IB, 8II fone, 8IQ, 8IV, 8JL, 8JQ, 8JS, 8KM, 8LF, 8LJ, 8LV, 8LX, 8NQ, 8OH, 8PC, 8PU, 8QM, 8QQ, 8QY, 8RQ, 8RU, 8SE, 8TB, 8TG, 8TN, 8UJ, 8UK, 8VJ, 8VY, 8WR, 8WY, 8XB, 8XK, 8XS, 8XU, 8YJ, 8ZD, 8ZG, 8ZL, 8ZN, 8ZZ, 9AAS, 9AAV, 9ACO, 9AJA, (9ANE), 9ARK, 9ASB, 9AVN, 9AWZ, 9AXE, 9DAB, 9EK, 9FM, (9HD), 9HY, 9IO, 9JD, 9RT, 9VD, 9XI, 9XM, 9ZAE, 9ZAF, 9ZB fone, 9ZQ, 9ZY. Canadian: 2BF, 3BP, 3NB, 9AW.

1DY, Lynn, Mass.

Spark: 1ADL, 1ADP, (1AMD), 1AJP, (1AW), 1AWD, (1ARY), (1AZK), (1BUC), 1BGF, (1BIR), (1BLE), 1BPI, (1BWY), 1BVB, 1BU, 1BVS, 1CAC, (1OE), (1OJ), 1JW, (1ZE), 1TS, 2AHU, 2AIM, (2AJE), 2ASL, (2AWF), 2AQI, 2AQL, (2BK), 2BM, 2CY, 2DA, (2DN), 2EL, 2DI, (2FP), (2JU), (2OA), (2OM), 2OW, (OX), 2PE, (2RM), 2RQ, (2SP), (2IG), (2SQ), 2TF, (2TS), 2UA, 2WB, (2WZ), 3ACE, 2ACM, 3AHF, 3AIC, (3AQR), 3AQV, 3ARM, 3BCU, 3BFU, 3BG, 3CC, (3CN), 3EH, (3HJ), 3HX, 3IW, 3LP, 3OD, 3PU, 3RW, 3TA, 3TH, 3US, (3UQ), (3VW), 3WX, 3XF, 3XM, 3YM, (3ZA), 3ZE, 4BY, 4EY, 4FD, 8AFD, 8AGK, 8AHH, 8AIG, 8AJV, 8ANW, 8AOT, 8APB, 8AQR, 8AQV, 8ARD, 8AXC, 8AYN, 8AYS, 8BCO, 8BG, 8BGF, 8BGV, 8BRL, 8BSY, 8CG, 8CGJ, 8CI, 8DY, 8DZ, 8EL, 8HG, 8HU, 8IL, 8OE, 8OI, 8RQ, 8RU, 8SP, 8TT, 8UV, 8XE, 8ZN, 8ZO, 8ZR, 9AY, 9ACY, 9AWU, 9BDE, 9MC, 9OX, 9UL, 9ZJ. Can. 2JZ, 3BP.

C.W.: (1BAI), 1BQE, 1CAK, 1RZ, (1TS), 1XAD mus. & phone, 2ABD, 2AFP, 2AJW, 2AJE, 2AWL, 2BEA, 2BIK, 2BND, 2BRC, 2CT, 2DN, 2EL, 2DEV. 2KL, 3ALT, 3BZ, 3CC, 3EM, 2HJ, 3MO, 3RF, 3SQ, 3ZO phone & music, 4FF, 4GL, 8ADA, 8AIO, 8AOA, 8AWP, 8AWW, 8DE, 8DR, 8EZ, 8ICF, 8IQ, 8NQ, 8XM, 8WY, 8ZG, 8ZZ, 9AH, 9AJA, 9AWV, 9IO.

1CEB, Bridgeport, Conn.

C.W.: 2AHA, 2AJA, 2AJF, 2AJR, 2AJW, 2AWK, 2AWL,2AXB,2BAK,2BDG,2BDU,2BEA,2BEB,2BQH, fone,2BRB,2BRC,2BUM,2BYC fone,2BYS,2BZL fone, 2DN, 2EL, 2FP, 2FZ, 2HZ, 2KL, 2MW, 2RA fone, 2RU, 2SB fone, 2XNA, 2ZD, 2ZL, 3BIY, 3BZ, 3FS, 3IH, 3ZO, 3ZY, 3ZZ, 4BY, 4CO, 4GL, 4FF, 4NX, 8AAZ, 8ACF, 8AKJ, 8AOF, 8AQZ, 8AWP, 8BCI, 8BO, 8DE, 8DR, 8II, 8JM, 8KM, 8SZ, 8TB, 8UJ, 8XK, 8XV, 8ZG, KDKA, WJZ, XF1.

Spark: 2ABM, 2ACY, 2AHU, 2AID, 2AIS, 2ASL, 2ASR, 2AWF, 2AZD, 2BCF, 2BSC, 2DA, 2DI, 2DO, 2EL, 2FP, 2IF, 2OM, 2OX, 2JU, 2TS, 2TU, 2UA, 2WM, 3ACE, 3ACM, 3AGS, 3AIC, 3AQR, 3BP Can., 3DW, 3HJ, 3HX, 3IW, 3KM, 3UC, 3XM, 4BQ, 4DH, 5FV, 8ACF, 8ACR, 8AFB, 8AFD, 8AFS, 8AHH, 8ARD, 8AYN, 8BDK, 8BO, 8CH, 8EA, 8EW, 8FE, 8GW, 8HF, 8HY, 8KE, 8OA, 8RU, 8SP, 8TJ, 8TY, 8XE, 9AAW, 9CP, 9HR, 9MC, 9ZN.

1MO, Hartford, All C.W.

1AGI, 1AJS, 1AJU, 1AWB, 1ARY, 1BAI, 1FF, 1II, 1IN, 1QP, 1RZ, 2AJW, 2AWK, 2AWL, 2AXB, 2BRC, 2CC, 2FZ, 2IA, 3ACE, 3BIY, 3BZ, 3EM, 3FS, 3MO, 3RF, 4BY, 4FF, 4GL, 8AAZ, 8ACF, 8ADS, 8AKJ, 8AQF, 8AWP, 8AZF, 8BMA, 8DE, 8FQ, 8HJ, 8OH, 8UJ, 8VJ, 9AAS, 9AAZ, 9AJA, 9FS, 9ZB, Can. 3BP.

1NY, Belmont, Mass.

Spark: 1AA, 1AD, 1AW, 1AWS, 1ACB, 1AIZ, (1AJL), 1ARY, 1AMT, 1ASF, 1ASP, 1AYD, 1BDS, 1BDT, 1BFZ, 1BGG, 1BJE, (1BJI), 1BNT, 1BNX, (1BXW), 1BV, 1CEV, 1CGH, 1CHC, 1CHX, 1CK, 1CY, (1DP), 1DY, 1EW, 1FU, 1GM, 1GV, 1KJ, 1KM, 1MA, 2EL, 2JU, 2OM, 2RM, 3ACM, 3BP, 3EM, 3HJ, 3IW, 3TH, 3ZE, 8AHH, 8AQV, 8MZ, 8NAE, 8RQ, 8SP, 8XE, 8VQ, 8UK, 9ZJ.

C.W.: 1ADB, 1AKB, 1AKG, 1ALY, 1AOK, 1BAI, 1BCX, 1BDS, 1BES, 1BHE, 1BQE, 1BYX, 1BZE, 1CAK, 1ES, 1FF, 1DM, 1PT, 1SF, 2AJW, 2AWL, 2BEA, 2FD, 2FP, 2DN, 2ZE, 3AHK, 3APQ, 3JH, 4GL, 8AIO, 8AWP, 8BEF, 8DE, 8LF, 8LX, 8OW, 8VJ, 8XK.

2TS, Staten Island, N. Y.

1ADL, 1AMD, 1ARY, 1AZK, 1BDC, 1BFB, 1BVB, 1CK, 1CP, (1DY), (1GM), 1HK, 1IA, 1OJ, (1SN), 1XM, 1ZE, 2QE, 2DA, 3ACE, 3ARN, 3CC, 3DM, 3DW, (3HG), (3HJ), (3HS), (3IW), 3OU, 3RW, (3UQ), 3TH, 4BQ, 4FD, 4GL, 4GN, 5DA, 5FV, 5XK, 8ACF, 8AFD, 8AGK, 8AIB, (8AJW), 8AMB, 8AOT, 8APB, 8AXC, 8AYN, 8BO, 8BRB, 8BRL, 8CI, 8DR, 8EA, 8EZ, (8FT), 8HG, 8HU, 8IN, 8MZ, 8OE, 8OI, 8RQ, 8RU, 8SP, (8TJ), (8TZ), 8UP, 8VQ, 8XD, 8YN, 9AAW, 9AGR, 9AJH, 9ARG, 9AWZ, 9AXU, 9MC, 9TL, 9TW, (9UH), (9UU), 9ZN, Can. 3BP.

2AWF, Albany, N. Y.

Spark: (1ADL), 1AMD, 1ARY, 1AW, (1AZK), 1BDC, 1BFZ, (1BIR), 1BRW, 1CHJ, 1CK, (1CP), (1DY), 1FV, 1GM, 1HK, (1IA), (1OE), (1QP), (1SN), (1UL), 1UV, 1XE, (1ZE), 2AIM, 2AJE, 2AJR, 2ASL, 2BCF, (2BK), (2BM), 2BRC, 2DI, 2DN, 2EL, 2FP, (2JU), 2OA, 2OM, 2OX, 2RM, 2TJ, 2TS, 2WB, 2ZV, 3AAN, 3ABB, 3ACE, 3ACR, 3AHF, 3AIC, (3AQR), 3BG, 3CC, 3CG, 3CN, 3DM, 3FJ, 3HJ, (3IW), 3OU, 3PU, 3QW, 3TH, 3UC, 3UQ, (3VW), (3XM), (3ZO), 4BC, 4BE, 4BQ, 4CX, (4EA), 4EY, 4GN, 5DA, 5EK, 5FJ, 5FV, 5XK, (8ACF), (8ADR), 8AFB, 8AFD, (8AHH), (8AHV), 8AJC, 8AJK, 8AJV, 8AJW, 8AMB, 8AMP, 8ANM, (8AOT), 8APB, (8AQV), 8ARD, 8ASV, 8AVO, (8AWU), (8AXC), 8AXN, 8AYN, 8BK, 8BO, 8BP, 8BRL, 8BSY, 8CG, 8DR, 8DZ, 8EO, 8EZ, 8GE, 8GW, 8HG, (8HU), 8HY, 8JJ, 8JP, 8JU, 8MM, (8MZ), 8OI, (8QC), (8RQ), (8RU), (8SP), 8TT, (8TY), 8UI, (8XE), 8YN, 8ZA, 8ZD, 8ZZ, 9AAW, 9AGR, 9AIR, 9AP, 9ASJ, 9AWU, (9AWZ), 9AZE, 9BDE, 9CP, 9ET, (9FS), 9FU, 9GP, 9GX, 9IR 9MC, 9ME, 9PC, 9PD, 9TL, 9UH, 9UU, 9VG, 9YR, 9ZJ, Can. (3BP), (8FQ).

C.W.: 1II, 2AWK, 2AWL, 2FD, 2ZV, 3BZ, 3CC, 3ZY, 4BY, 4GL, 8AWP, 8DE, 8II, 9AAS, 9ZY.

2AFP, Paterson, N. J.

C.W.: (1ADL), 1AFV, 1AJP, (1AKB), (1AKG), 1ANQ, 1ANY, 1AOK, 1AWB, 1BAI, 1BDI, 1BYX, (1CAK), (1CGG), 1DH, (1ES), 1FF, 1QN, 1UN, 1VAA, 3AAE, 3AAY, 3ABI, 3ADT, (3AFU), 3AHD, (3AHK), (3ANU), 3BED, 3BIY, 3BZ, 3EM, 3FS, (3GR), 3HG, (3HJ), 3JH, (3MO), 3PB, 3QV, 3RF, 3SQ, (3ZN), (3ZO fone), 3ZY, 3ZZ, 4BK, (4BY), (4EL), 4EN, 4FD, (4FF), 4GL, 4RL, 4XQ, 4ZE, 5DA, (8AAZ), 8AB, (8ABO), 8ADG, (8AIO), (8AIX), (8AJP), 8AKE, 8AMF, 8AND, 8AOA, 8APT, (8AQF), (8AQZ), (8ARV), 8AVH, (8AWP), 8AWX, (8BCI),8BA, 8BFG, 8BFX, (8BK), (8BO), (8BOX), (8BPL), 8BQ, (8BRC), (8BRL), 8BUM, (8DE), 8DR, 8DV, 8DX, 8FD, 8FQ, 8HA, 8HD, (8HM), 8HY, (8IB), (8II), (8IQ), 8JL, 8JU, 8KH, (8KM), 8LF, (8LJ), 8LU, (8LV), 8LX, 8NQ, (8NV), 8OW, 8PW, 8PX, (8QM), (8QU), 8QY, 8SE, (8TG), 8TN, 8UJ, (8UK), 8VY, (8WY), 8XB, 8XK, 8XM, (8ZG), 8ZV, (8ZZ), 9AAS, (9AAV), (9ACO), (9AJA), (9ANE), (9ARK), 9DAB, (9HD), 9HY, (9LQ), 9RT, (9XI), (9VG), 9XM, 9ZY, Canadian 3JL, (3BP), (9AW).

Spark: 4AG, 4BE, 4BY, 4CX, 4EA, 4FD, 5FV.

2BK, Yonkers, N. Y.

(1ADL), 1AW, 1CK, (1DY), 1ES, 1FV, 1IA, 1QP, (1SN), 1UN, 1XX, (1ZE), 1BFZ, (1BDC), (8AC), 8AHK, (3AQR), (3ARN), 3CC, 3HJ, 3HX C.W., (3IW), (3OU), 4CX, (4EA), (4EY), 4FD, 4GM, 4GN, 5DA, (5FV), 5HK, 5XA, 5ZL, 7XD, (8AL), (8AY), 8BA, (8BK), 8BM (8BQ C.W.), (8CV), (8DY), (8EA), (8EV), (8FE), (8FT), 8HP, (8IN), 8JQ, (8JU), (8KH), 8KS, 8LX, 8MM, (8MR), 8OA, (8OJ), 8OZ, 8QM, (8RQ), (8SP), (8TJ), (8TY), (8UC), (8UP), 8VQ, (8WA), (8WO), (8WY), (8WZ), (8ZD), (8ZN), (8ZR), (8ZZ), (8ACF), 8AEZ, (8AFD), (8AFS), (8AGK), (8AHH), (8AIB), (8APB), (8AOT), (8AWP), (8AVO), (8BBU), (8BEP), (8BRL), (9BP), (9CP), 9FS, 9HT, (9ME), 9NQ, 9TO, (9PS), (9OX), (9UH), (9UU), (9VZ), 9WU, 9ZJ, (9ZN), (9AAW), (9AGR), 9AJB, (9AJH), (9ALH), (9AIR), 9AIU, (9AMA), 9ASJ, (9AWZ), (9AZE), 9DAX, 9DIH, Canadian 3CG, 3JL, 3KG, (3BP).

2OM, Ridgewood, N. J.

Spark: 1ADC, (1ADL), 1ADM, 1AMB, (1AMD), (1ARY), (1ASF), (1AW), 1AXC, (1AZK), (1BCF), (1BDC), (1BDT), (1BIR), (1BJE), 1BKP, 1BLE, 1BRJ, (1BVB), 1BWY, 1CHX, (1CK), 1DF, (1DY), (1DZ), 1FB, (1FD), 1FV, (1GM), (1HK), (1IA), (1MA), (1DE), (1OJ), 1OT, (1QP), 1RV, (1SN), 1XM, (1ZE), 3AAN, 3AC, (3ACE), 3ACM, 3ACR, 3AGL, 3AIC, (3AL), (3ALN), (3AQR), 3ARM, (3ARN), (3ATZ), 3BC, (3BFU), (3BGT), 3BX, (8CC), (3CN), (3DM), 3DN, (3EZ), 3FM, 3GM, 3GX, 3HG, (3HJ), (3HS), 3HX, (3IW), (5KM), (8LP), (3OU), 3PB, (3QN), (3RW), (3TH), 3TT, 3UC, (8UQ), 3UX, (3VW), 3WX, 3XF, (3XM), 3ZA, 3ZE, 3ZO, 3ZZ, Canadian (3BP), (3EI), (3JL), 4AG, 4AS, (4BE), 4BQ, (4BX), (4BY), (4CX)4DH, 4DQ(4EA)(4FD) 4GN, 4XC, 5DA, 5EA, 5ER, (5FV), 5HK, 5XA, 5XK, 5ZK, 5ZL, 7XD, (8ACF), (8ADE), 8AFA, (8AFD), (8AFS), (8AGK), 8AGT, (8AHH), (8AHS), (8AIB), 8AIO, 8AJK, 8AJL, 8AJT, (8AJW), 8ALW, (8AMB), (8AMZ), (8ANO), 8ANY, 8AOT, 8APB, 8AQV, 8ARD, 8AVO, 8AVT, (8AMP), 8AXC, (8AYN), 8AYS, 8BBU, (8BCO), 8BDO, (8BDY), (8BO), (8BRL), (8CG), 8CI, (8CV) 8DR 8DZ, (8EA), 8ER, 8EQ 8EZ 8FI, (8FT), 8FW, 8GO, 8HA, 8HG, 8HP, 8HU, (8HV), 8ID, 8IL, (8IN), 8IQ, 8JS, 8JU, 8KH, 8LH 8LW (8MZ), (8NZ) 8OI 8PX, 8PM, 8PT, 8OE, (8RQ), (8RU), (8SP), (8TJ), 8TK, 8TT, 8TV 8TZ 8UC, 8UK, 8UP, 8VQ, 8WA, 8WZ, 8XE, 8YN 8ZAA, (8ZD), 8ZN, 8ZR 8ZW, (9AAW), 9ARV 9AFX, (9AGR), (9AIR), (9AIU), (9AJH), 9AMG, 9AMR 9ANC 9APK, 9AQE, 9AQN, (9ARG), 9ARI 9ASJ, 9ASN 9AW, (9AWZ), 9AXU, (9BDE), (9CP) 9DMJ, 9DWP, 9DZY, 9EA, 9EE, 9ET, (9GC), 9HM, (9HR), 9KH, 9LF, 9LQ, 9MC, (9ME), (9OX), 9PC, 9PS, 9TL, 9TO, (9UH), (9UU), 9UW, 9VZ, 9WK, (9WT), 9YM, 9ZJ, 9ZN,

C.W.: 1AJS, 1AKG, 1ANQ, 1BAI, 1CAK, (1OE cw & voice), 1PT, (1PE), 1QN, (1RZ cw & voice), 3ABI, 3AHK, (3EM), 3FF, 3FS, 3HG, (3HJ), 3MO, 3ZY, 3ZZ, Canadian (3BP), 4CO, 4FF, 4GL, 8AAZ, 8ALE, 8ARV,(8AWP), 8BPL, 8DE, 8GE, 8HK, 8LF, 8TY, (8UJ), 8UK, 8VJ, 9AA, 9ANE, 9AOJ, 9HY, 9IO.

XF1, Langley Field, Va.

1BAP, 1BDI, 1BDT, 1BFL, (1CGG), 1CHX, 1GM, 2ADL, 2AFP, (2AKO), 2ARP, 2BAK, 2BGH, 2BR, 2DA, 2FD, 2FP, 2GN, 2JD, 2MO, 2OM, 2TF, 2TS, (2XA), (2ZE), (2ZL), 2ZN, (3AAE), 3AAV, 3ABI, 3AC, 3AGR, 3AQR, 3BDQ, 3BFB, 3BGH, (3BZ), 3EF, 3FJ, (3FM), 3HJ, 3MK, 3PJ, 3PV, 3ZL, (3ZO), (3ZZ), (4BK), 4CX, 4DH, 4EB, (EL), 4KU, 4TQ, (5DA), (5XB), 5XK, 8AFD, 8AGN, 8AHB, 8AHH, 8AJB, (8AKE), 8AKS, 8AMQ, 8APD, 8AQ, 8AQZ, 8AR, 8AVP, 8AWK, 8AYN, 8AZQ, 8BBU, 8BJC, 8BO, 8BRC, 8BRF, 8BUA, 8EA, 8FT, 8GE, (8JS), 8KM, (8LF), 8LW, 8QU, 8RQ, 8TG, 8VY, 8WY, 8XB, 8XE, 8XF, 8XK, 8XM, 8XU, (8XY), 8YN, 8ZA, 8ZD, (8ZG), (8ZN), (8ZZ), 9AJA, 9AP, 9BDE, 9CP, 9DAB, (9HD), (9LQ), 9LZ, 9RT, 9XAH, 9XI, 9XM, 9ZA, (9ZAC), 9ZAE, 9ZJ, 9ZN, 9ZY.

3RF, Roanoke, Va.

C.W.: 1BQ, 1CF, 1PY, (1QN), 1UN, 1BYS, 1CAK, 2DN, (2EL), 2FD, 2FQ, 2OE, 2QN, 2UD, 2XA, 2ZL, 2ZN, 2ZV, 2AFP, 2AJW, 2AKO, 2AOL, 2AWL,2BAD, 2BAK, 2BEA, 2BGH, 3BY, (8BZ), 3CC, 3EM, 3FQ, 3HB, 3HX, 3ZL, 3ZV, (3ZY), 3AAE, 3AAN, 3ASK, 3AQR, 4AJ, 4BQ, (4BT), 4BY, 4CO, 4EB, 4EF, 4EH, (4EL), 4EN, (4FF), 4FJ, (4GL), 4HW, 4II, (5DA), 8BC, (8BK), 8DE, 8DR, (8FQ), 8GE, 8GO, (8HA), 8HG, 8II, 8IO, (8IQ), 8JU, 8JM, 8JQ, (8KM), (8LJ), 8LU, (8LX), 8MK, 8NQ, 8OW, (8PN), 8PU, (8QY), 8QK, 8RQ, (8TN), 8JU, (8UK)(8VJ)8VQ(8VY)(8WY)8XE, 8XK, 8XS,8YN, 8ZB, 8ZG, 8ZL, 8ZJ, 8ZR, 8ZZ, 8AAQ, 8AAZ, 8ABK, (8ABO), (8ACF), 8ADG, 8ADY, 8AFD, 8AFP, 8AJT, (8AKS), 8AMZ, 8ALE, 8AMQ, (8AOA), 8AQF, (8AQZ), 8AWF, (8AWP), 8AWX, 8AYF, (8BCI), 8BET, 8BDP, 8BDU, 8BIX, 8BOX, 8BRF, 8BSY, 9AU, 9AW, 9IQ, 9QY, 9RT, 9ZA, 9ZJ, 9ZY, 9AAS, 9ARK, 9AWT, 9BDE.

Spark: 3BP, 3MS, 3XF, 3XM, 3YK, 3YL, 3AQR, 4AS, 4BX, 4BY, 4CK, 4FJ, 4YA, 4YB, 4YZ, 5DA, 5ER, 5XB, 5XK, 5ZL, 8IN, 8SP, 8RQ, (8XE), 8YN, 8ZN, 8ACF, 8AFB, 8AFD, 8AHH, 8AJG, 8AJV, 8ARN, 8AWR, 8AXC, 8AYN, 9AC, 9FS, 9MC, 9TL, 9UU, 9YM, 9ZJ, 9AWG.

3BEC, Radnor, Pa.

Spark: 1AW, 1BL, 1CK, 1DY, 1GM, 1HO, 1IA, 1OE, 1PB, 1RU, 1TS, 1ACO, 1ADL, 1AMD, 1AOL, 1AQK, 1ARY, 1AZD, 1AZK, 1BDC, 1BFZ, 1BGF, 1BIR, 2BK, 2DM, 2CT, 2CY, 2DA, 2DB, 2DN, 2FP, 2JU, 2OM, 2RM, 2TF, 2TS, 2VT, 2UP, 2XA, 2ACR, 2AFP, 2AID, 2AIM, 2AJE, 2AKB, 2AJR 2ASL, 2AWF, 2AZL, 2BCU, 2BRC, 4CX, 4EA, 4FD, 5DA, 5FC, 5XA, 5ZA, 8AG, 8BA, 8BO, 8DJ, 8DR, 8DY, 8EA, 8EW, 8FI, 8FT, 8FX, 8HD, 8HG, 8IL, 8HP, 8HU, 8ID, 8IF, 8II, 8IN, 8JL, 8JQ, 8JU, 8NV, 8OI, 8OU, 8QC, 8QR, 8RQ, 8RB, 8SL, 8SP, 8TG, 8TZ, 8UN, 8VW, 8WA, 8XD, 8XE, 8XM, 8ZN, 8ZR, 8ZZ, 8AAO, 8ABO, 8ACF, 8ACM, 8AFD, 8AFM, 8AFS, 8AFZ, 8AGK, 8AGN, 8AHH, 8AHK, 8AHU, 8AIB, 8AID, 8AIO, 8AJT, 8AJV, 8AMB, 8AOJ, 8APB, 8ARD, 8ARW, 8AVN, 8AWX, 8AWZ, 8AXC, 8AZQ, 8BCI, 8BEN, 8BFH, 8BKO, 8BON, 8BTO, 8BRC, 8BRD, 8BRF, 9CP, 9ET, 9FH, 9GV, 9HG, 9HM, 9HS, 9MC, 9ME, 9TL, 9TO, 9UH, 9UU, 9ZJ, 9ZN, 9AAW, 9AGR, 9AJH, 9APK, 9ARG, 9ARW 9ASJ 9AWU, 9AWZ, 9AXM, 9BDE, 3BP Canadian.

C.W.: 1AQ, 1AR, 1CK, 1RQ, 1UN, 1AGI, 1AJU, 1AKG, 1ANQ, 1AWB 1AZN, 1BAI, 1BES 1CAK, 2CT, 2FD, 2IQ, 2RU, 2AIV, 2AIW, 2AWL, 3BC, 3BZ, 3DC, 3EM, 3HG, 3QV, 3AFQ, 3AGL, 3APQ, 4EL, 4FF, 4GL, 8AW, 8BK, 8DE, 8FB, 8IQ, 8MK, 8NQ, 8TF, 8TV, 8UK, 8WY, 8XA, 8XK, 8AAZ, 8ADQ, 8AMZ, 8AWD, 8AWP, 8BEF, 8BJX, 9IO, 9RT, 9AGG, 9ARK.

Phone: 3AR, 3FM, 3FS, 3MI, 3NO, 3YQ, 3ZY, 3AAE, 3AND, 3ANO, 3ANU, 3ARV, 3II.

3ARN-3HS, Washington, D. C.

Spark: (1ARY), (1AW), (1BGF), (1IA), (1ADL), 1ADW, 1AHU, 1ALK, 1ALQ, 1AQK, 1ASF, 1AZK, 1AZY, 1BDC, 1BFZ, 1BRW, 1BVB, 1DY, 1FM, 1FV, 1GM, 1HO, 1OH, (1QP), 1RV,

1SN, (1TS), 1WR, 1XM, 1ZE, 2ABR, 2AHU, 2AID, 2AIM, (2AJE), 2AQE, 2ARB, 2ARD, 2ARY, 2ASL, 2AZ, (2BK), 2BM, 2BSC, (2DA), (2DN), 2EL, 2FM, 2FP, 2JU, (2JZ), (2OM), 2PV, 2RM, 2TF, (2TS), 2UE, 2WB, 2WM, 2XZ, 3ABC, 3AC, 3ACE, 3ACM, 3AVS, 3BFU, 3CC, 3CG, 3DW, 3EZ, 3HG, 3HJ, 3HX, 3KN, 3MV, 3OU, 3PB, (3PU), 3QC, 3QN, 3RA, 3UC, 3UQ, 3US, 3VW, 3ZA, 3ZO, 4AG, 4AS, 4BQ, 4BY, 4CG, 4CX, 4DH, 4DQ, 4EY, 4FD, 4FJ, 4GN, 4XK, 5CHJ, 5DA, 5EK, 5ER, 5FJ, 5FV, 5HK, 5RZ, 5XA, 6XI, 6XK, 6ZL, 5ZO, 8AAV, (8ACF), 8AEZ, 8AFA, 8AFB, 8AFD, (8AFS), 8AGK, 8AHH, 8AHV, 8AHS, 8AIA, 8AIB, 8AIG, 8AIM, 8AIO, 8AJE, 8AJF, 8AJT, 8AJV, 8AJW, 8AK, 8AL, 8AMB, 8AMF, 8AMG, 8AMU, 8AMZ, 8ANC, 8ANF, 8ANO, 8ANY, 8AOT, 8APB, 8AQV, 8ARD, 8ARK, 8ARS, 8ASO, 8ASV, 8ASZ, 8AU, 8AVO, 8AVT, 8AVX, 8AWU, (8AXC), 8AXS, 8AYN, 8AYT, 8AYZ, 8AZK, 8BBU, 8BCQ, 8BDP, 8BEN, 8BFH, 8BFN, 8BGJ, 8BH, 8BHV, 8BN, 8BO, 8BOX, 8BPU, 8BR, (8BRL), 8BRO, 8BRU, 8BSY, 8BU, 8BVA, 8CI, 8CV, 8DO, 8DR, 8DV, (8DY), 8DZ, 8EA, 8EB, 8EF, 8EW, 8EZ, 8FA, 8FC, (8FT), 8GE, 8GV, 3GW, 8HJ, 8HU, 8HY, 8IK, 8IL, (8IN), 8JQ, (8MD), 8ML, 8OI, 8PJ, 8PX, 8QC, 8RG, (8RQ), 8RV, 9RZ, 8SP, 8TJ, 8TK, 8TT, 8TY, 8TZ, 8UC, 8VY, 8WA, 8WZ, 8XE, 8YE, 8YN, 8ZA, 8ZAA, 8ZD, 8ZN, 8ZR, 9AAP, 9AAS, (9AAW), 9ABH, 9AC, 9ACS, 9ADX, 9AFK, 9AGG, 9AGR, 9AGV, 9AIH, 9AIO, 9AIR, 9AIW, 9AMT, 9ANC, 9AOJ, 9AOU, 9AOX, 9APK, 9APS, 9APT, 9AQR, 9ARG, 9ARI, 9ARK, 9ARP, 9ASJ, 9ASV, 9AV, 9AWU, 9AWZ, 9AXU, 9AY, 9AZE, 9BDE, 9BDR, 9BDS, 9CP, 9DEU, 9DMM, 9DP, 9DWM, 9DY, 9DYU, 9DZ, 9EK, 9ET, 9FS, 9FZ, 9HM, 9HO, 9HR, 9HS, 9HT, 9IJS, 9JF, 9KO, 9KR, 9LF, 9LQ, 9MC, 9ME, 9MGG, 9MR, 9MS, 9MX, 9NQ, 9NR, 9OX, 9PC, 9PS, 9PX, 9QR, 9TL, 9TO, 9TY, 9UH, 9UQ, 9UU, 9VI, 9VN, 9VO, 9VZ, 9WX, 9WZ, 9YA, 9YAC, 9YB, 9YN, 9ZAC, 9ZJ, 9ZN, Canadian 2AA, 3BP, 3JL, 3KG, (3PL).

C.W.: 1AE, 1AGI, 1AOL, 1APX, 1AWB, 1CAE, 1FF, 1HGS, 1IN, 1PE, 1QN, 1RN, 1RU, 1RZ, 1TAV, 1TBY, 1UN 2AFP, 2AJF, 2AJL, 2AJW, 2AKO, 2AWL, 2AWP, 2BAK, 2BDM, 2BEA, 2BG, 2BGH, 2BGM, 2BRB, 2BRZ, 2DN, 2EL, 2FD, 2FF, 2FP, 2KL, 2KP, 2RU, 2XA, 2XT, 2ZL, 3AWI fone, 2BL, 3BZ, 3CA, 3CC, (3EM), 3FS, 3PB, 3QV, 3RF, 3ZO, 4BY, 4FF, 4GL, 4NX, 8ABO, 8ACF, (8ADY, 8AEU, 8AIO, 8AIX, 8AJP, 8AOA, 8APF, 8AQF, 8AQR, 8AQZ, 8AWL, 8AWP, 8BCI, 8BEF, 8BK, 8BO, 8BOX, 8BPL, 8BQ, 8BRF, 8DE, 8DR, 8DX, 8DZ, 8FQ, 8GE, 8GO, 8GV, 8HA, 8HJ, 8HM, 8II, 8IQ, 8JL, 8JM, 8JU, 8KM, 8LJ, 8LW, 8LX, 8NM, 8NQ, 8PU, 8PW, 8QY, 8RQ, 8RU, 8SE, 8TN, 8UJ fone, 8UK, 8VJ, 8VY, 8WY, 8ZB, 8ZG, 8ZR, 8ZV, 8ZZ, 9AAS, 9AAV, 9AJA, 9ARK, 9HD, 9HY, 9IO, 9UC.

3ZO, Parkesburg, Pa.

Spark: 1BE, 1BK, 1CK, 1CY, 1DV, 1GV, 1HK, 1IA, 1MA, 1OE, 1PQ, 1RV, 1RX, 1RZ, 1SW, 1UA, 1UN, 1ZE, 1ADC, 1ADK, 1ADL, 1ADP, 1AFZ, 1AHF, 1AMD, 1AML, 1ANY, 1APO, 1ARY, 1ASF, 1AZK, 1BCF, (1BDC), 1BDT, (1BFZ), 1BGF, 1BIR, 1BJE, 1BKP, 1BLE, 1BYX, 2BK, (2BM), 2CI, 2CY, 2DA, 2DN, 2DV, 2EL, 2GM, 2KM, 2OA, 2OM, 2PK, 2PV, 2RB, 2RM, 2RP, 2RQ, 2SS, 2TF, 2TJ, 2TS, 2UE, 2WB, 2AID, 2AIM, 2AQI, 2AQL, 2ARB, 2ASL, (2AWF), 3AS, 3BF, 3BJ, 3CG, 3CN, (3DM), 3DW, 3EI, (3GX), (3HJ), (3MB), 3OB, 3OU, 3PU, 3QN, 3QU, (3QW), 3TH, 3UQ, 3VA, 3WX, 3XF, 3XM, 3YK, 3YM, (3YP), (3ZS), (3ZVI, (3ABB), 3ABP, 3ACM, (3ACS), 3ADB, 3ADT, (3AEB), 3AHF, 3AHU, 3AHT, (3AIC), (3AIS), (3AQL), (3AQR), 3AQS, 3ARY, (3ASK), 3AWF, 3BIR, 4EL, 5FJ, 8BA, 8BP, 8BQ, 8DY, 8FI, 8FS, 8FW, 8HJ, 8HP, 8IL, 8IQ, 8RQ, 8SG, 8SP, 8TB, 8TK, 8TT, 8TZ, 8UK, 8VF, 8WO, 8WY, 8XE, (8ZA), 8ADQ, 8ADV, 8AFA, 8AFB, 8AFD, 8AGK, 8AHV, 8ALV, 8AMB, 8ANW, 8AOT, 8APB, 8BFH, 8BSY, 9FS, 9MC, 9TL, 9UU, 9XM, 9YA, 9ZJ, 9AAW, 9ASJ. Canadian 3BP, 3GN, 3JL, 2Lw.

C.W.: 1BY, 1CF, 1DH, (1DY), 1FD, 1FF, 1GM, 1IN 1QN, 1QP, 1RH, 1RU, 1XE fone, 1XF, 1XM, 1AJP, 1AJU, 1ANQ, 1AOL, (1BAI), 1BDI, 1BQE, (1CGG), 1HCS, 1UNQ, 1XAD fone, 2CT, 2FD, 2FP, 2RU, 2WL, 2XA, 2XK, 2ZL, (2ZV), 2ABN, (2ADL), (2AFP), 2AHL, 2AJW, 2AKD, 2ATS, 2AWL, 2AYK, 2AYZ fone, 2BAK, 2BEA, 2BRZ, 2BGH, 2BYS, 3BZ, 3CC, 3FF, 3FS, 3GR, (3HJ), 3HX, 3LK, 3QV, 3XG, 3XZ, 3ZY, (3AAE), (3ANU), 3ASW, (3APQ), 3BAK, 3FBL, (XF-1), 4EB, 4FF, 4GL, (4NX), 8BO, 8CG, 8DE, 8DR, 8DZ, 8GE, 8GV, 8HA, 8IL 8JQ, 8KM, 8LJ, 8LV, 8TG, 8TN, 8UJ, 8VK, 8VY, (8XB), 8XE, 8ZG, 8ZZ, 8ACF, 8AHR, 8AKJ, (8AQZ), (8AWP), 8BCI, 8BOX, 8RUM, 9AW, 9HD, 9IQ, 9UC, 9XI, 9YB, 9ZY, 9AAS, 9AAV.

4XC, Atlanta, Ga.

Spark: 2BK, 2DN, 2FP, 2MB, 3ACE, 3AHK, 3AQR, 3ALN, 3HJ, 3XF, 3YK, 3LP, 4AS, 4BY, 4FD, 4GN, 4DH, 4RE, 4DQ, 4ZC, 5AA, 5DA, 5EK, 5FJ, 5FO, 5FV, 5HJ, 5LA, 5LO, 5MR, 5QA, 5JD, 5SM, 5XA, 5XB, 5XJ, 5XQ, 5XU, 5YE, 5YL, 5XI, 5ZAB, 5ZAG, 5ZAK, 5ZL, 5ZX, 5ZS, 8AFD, 8AFB, 8ACF, 8AJV, 8AXC, 8AIB, 8AAB, 8AHY, 8ANY, 8ADE, 8ANO, 8AIO, 8AQV, 8AGK, 8AYN, 8AFK, 8ARD, 8BBU, 8REN, 8BDO, 8BRL, 8BVA, 8BSY, 8BYT, 8DR, 8AOI, 8EA, 8EB, 8FG, 8FI, 8FT, 8HY, 8JQ, 8OI, 8RQ, 8RU, 8SP, 8TT, 8TK, 8TZ, 8UC, 8VQ, 8XE, 8YN, 8ZD, 8ZAA, 8ZN, 8ZW, 8IN, 9AAG, 9AAW, 9AAP, 9AWZ, 9ANC, 9AMT, 9AIR, 9ARI, 9AMA, 9AUO, 9ATN, 9AQE, 9AZE, 9ARX, 9ABH, 9AAU, 9BDE, 9CP, 9DQQ, 9DSN, 9FZ, 9ET, 9FU, 9FS, 9ASJ, 9GX, 9DMQ, 9HM, 9GO, 9KO, 9ME, 9MC, 9DWM, 9LF, 9MG, 9LR, 9LQ, 9PS, 9NR, 9PC, 9PB, 9AV, 9RY, 9UU, 9UH, 9QH, 9OX, 9VZ, 9VV, 9VG, 9WU, 9UW, 9ZJ, 9ZN, 9WT, 9YB, 9YAE, 9ZB, Can. 3BP.

C.W.: 1BAI, 2AWL, 2AJF, 2AFP, 2BAD, 2BCI, 2FD, 2FP, 2EJ, 2EQ, 2KL, 2ZL, 3BZ, 3BFS, 3BIY, 3AFU, 3CC, 3FM, 3GB, 3HG, 3MO, 3RF, 3ZY, 4BY, 4NX, 4EN, 4EL, 4FF, 4GL, 4BK, 4II, 4XN, 4XB, 4ZE, 5LA, 8ACF, 8AQZ, 8AHZ, 8AWP, 8AQA, 8AIO, 8AOF, 8AZF, 8AAZ, 8BPL, 8BOX, 8REF, 8BK, 8DE, 8DR, 8EA, 8II, 8IQ, 8KM, 8HM, 8JL, 8KI, 8OI, 8LF, 8RI, 8PD, 8UK, 8UJ, 8TA, 8XK, 8VJ, 8WY, 8XM, 8ZD, 8ZG, 9ARK, 9AAS, 9AVN, 9AJA, 9AWN, 9AAV, 9AQR, 9YM, 9RT, 9IO, 9ZJ, 9XM, 9DCP, 9ZY, 9ZB, Can. 3BP,

4GL, Savannah, Ga.

Spark: (2DN), (2EL), (2FP), 2JZ, 2XA, (3HX), (3HJ),3OU, 3UQ,4BC,4BI,4BQ,(4FD),(4FR),(5DA), 5FV, 5HK, 5LO, 5XB, 5XU, 5YM, 5YZ, (5ZAB), (9OX), 9XT, 9YM, 9ZAC, (9ZJ), (9ZN).

C.W.: 1BQE,, (1CAK), (1PT), 1QP, 1RZ, (1TS), (1UN), 1XM, 2ADL, (2AKO), 2AJE, (2AJF), (2AWL), (2BAD), (2BYS), (2DN), (2EL), 2FD, (2FP), 2MW, (2BU), (2ZE), (2ZV), (3AAE), (3BIY), (3BZ), 3DH, (3FM), 3MO, (3RF), (3SQ), 3ZO, (3ZY), (3ZZ), (4BK), 4BQ, (4CO), (4EN), (4II), (4ZE), (5DA), 5LA, 5ZA, 8ACF, 8AFB, 8AKE, 8AWQ), (8AQF), (8AQZ), 8ARS, 8BCI, 8RCO, 8BK, 8BOX, 8BPL, 8CI, (8DE), 8DX, 8DZ, 8FT, (8GE), 8II fone and C.W.), 8IQ, (8JM), (8JS), (8KM), (8IF), (8LU), (8LX), (8NQ), (8OH), (8RQ), 8RM, 8UJ fone and C.W.), 8VJ, 8VY), 8WR, (8WY), 8XB, 8ZN, (8ZZ), (9AAS), (9AJA), 9AVN, (9EK), (9HD), (9IO), (9ZB fone and C.W.), 9ZY.

4FD, Midville, Ga.

Spark: 1AMD, 1BGF, XF1, 2BK, (2EL), 2FP, (2OM), 2XM, 2AJE, 3BF, (3BP can.), 3BU, 3CC, 3EZ, 3HG, 3HJ, 3HX, (3IW) 3KM, 3XF, 2XM, (3ACE), 3ACM, 4AS, 4AG, 4BE, 4BI, 4BY, 4CG, 4CP, 4CX, (4DH), 4DQ, 4DZ, 4EA, (4FR), 4FP, (4GM), 4HS, 4HW, 4ZC, 5AA, 5AF, (5DA), 5EK, (5ER), (5FV), 5HK, 5JD, 5JI, 5MA, 5MM, 5NK, 5RZ, 5SM 5UK, 5XA, 5XK, 5YL, 5ZA, 5ZK, 5ZL, 5ZP, 5ZX (5ZZ), 5ZAB, 8BO, 8CG, 8DZ, 8EB, 8EF, 8EZ, 8GV, (8HG), 8HU, 8HI, 8IN, 8JU, 8NZ, 8OI, 8RU, (8SP), 8UC, 8UH, 8UN, 8UP, 8VZ, 8WZ, (8XE), 8ZA, 8ZD, 8ZN, 8ZR, (8ACF), 8ACY, 8ADE 8ADO, 8AEG, 8AEU, 8AFB, (8AFD), 8AHH, 8AJE, (8AJT), 8AJV, 8ANO, (8ARD), (8AXC), 8AYN, 8AYS, 8BCO, 8BEN, 8BOY, 8BRL, (8RVA), 8DYZ, 8ZAA, 9AP, 9CP, 9EL, 9ET, 9FS, 9GX, 9HM, 9KO, 9LF, (9ME), 9MC, 9OC, 9OU, (9OX), 9PC, 9PS, 9RY, 9TK, (9UH), 9UQ, 9UU, 9WP, 9ZD, 9ZJ, 9ZN, 9AAP, 9AAW, 9ABS, 9AEG, (9AGG), 9AGT, (9AIR), 9AMK, 9AMT, 9AMV, 9AOU, 9AOW, (9APS), 9AQM, 9ARG, (9AJT), 9ASJ, 9ASZ, 9AWZ, 9BCX, 9BDE, 9DQQ, 9DWN, 9DYU, 9TYW.

C.W.: 2EL, 2AWL, 3BZ, 3MO, 3RF, 4BY, 4CO, 4EN, 4GL, 4II, 4ZE. 5DA, 8DE, 8II, 8IQ, 8UK, 8VJ, 8ACF, 9AWP, 9ZJ music.

4HJ, South Jacksonville, Fla.

Spark: 2DN, 2EL, 2ZH, 3BFU, 3ZO, 3ZY, 4AS, 4BC, 4BL, 4BQ, 4BY, 4BZ, 4CX, 4DH, 4DQ, 4DT, 4FD, 4FF, 4ZC, 4ZH, 4ZY, 5DA, 5EK, 5FV, 5JL, 5XA, 5XJ, 5YK, 5YL, 5ZA, 5ZL, 5ZP, 5ZX, 8BEP, 8XA, 8XJ, 8ZN, 9ASJ, 9BDE, 9MC, 9UU, 9ZJ.

C.W.: 2ABD, 3EM, 3ZH, 3RF, 4ED, 4EL, 4GL, 4HW, 8II, 9AAS, 9AJA, 9AL, 9LV, KDKA fone.

4II, Box 467, Orlando, Fla.

Spark: 4AG, 4AS, 4BC, 4YB, 5JD, 5FJ, 5XB, 5XI, 5XQ, 5XU, 5ZA, 5ZL, 5ZO, 5ZAB, 5ZAK, 8JQ, 8ZA, 8ACF, 8AJP, 8BEP, 8BSY, 8BVA, 9MC, 9YA, 9YM, 9ZJ, 9AQM.

C.W.: 1UN, 1AGI, 1ANQ, 1AFV, 1CAK, 2FD, 2ABD, 2ABR, 2BAK, 2XA, 2ZL, 3BA, 3BZ, 3CC, 3FD, 3FS, 3HJ, 3PB, 3RF, 3MO, 3ZN, 3ZY, (3AFU), 3AHK, 3BIY, 4BD, 4BK, 4BQ, 4BT, (4BY), 4CO, (4EL), 4FF, (4GL), (4HW), 4ZE, 4ZF, 5LA, 8BA, 8BK, 8BO, 8DE, 8GV, 8IB, 8JQ, 8KM, 8LF, 8OI, 8QM, 8TN, 8VY, 8XK, 8ZD, 8ZZ, 8APT, 8AKJ, 8AQZ, 8AWP, 8BCI, 8BFX, 8BOX, 9HD, 9LQ, 9RT, 9ZB, 9AAS, 9ARK, 9AJA, 9XAH, Canadian 3BP.

5FO, Norman, Okla.

5AL, 4DW, (5EK), 4EW, 5FI, 5FV, (5HK), (5HZ), 5HQ, 5HY, 5HX, (5IB), 5IC, (5IF), 5IQ, (5IR), (5IS). 5JD, 5JI, 5JM, (5JR), (5JP), 5KH, 5KJ, 5KP, 5KW, 5LA, (5LB), 5LC, 5LK, (5LO), 5NI, (5NK), (5NS), 5NW, (5OF), (5OG), 5OH, (5PU), 5QA, (5QH), 5QK, (5QP), (5QS), 5QU, 5QX, (5QY), (5RA), (5TA), (5TG), 5TK, 5XB, 5XG. (6XI), (5XJ), 5XL, 5XQ, (6XT), (5XU), 5YE. 5YL, (5YN), 5YS, (5ZA), (5ZC), (5ZL), (5ZO), 5ZS, (5ZT), 5ZX, (5ZZ), (5ZAB), (5ZAF), (5ZAG), 5ZAK, 7MO, (7ZO), (8VJ), 9AC, 9BD, 9BP, 9CP, 9DE, 9DH, 9DM, 9DU, (9EL), (9ET), (9FZ), 9HI, 9HM, (9HT), (9IY), 9JQ, (9KA), (9KO), 9LR, (9LW), (9MC), (9PI), (9PS), (9RW), 9TL, 9TV, 9UU, (9WI), (9WL), (9WU), (9XJ), (9XM), (9YA), (9YM), (9YO), (9ZB), (9ZH), (9ZJ), (9ZM), 9ZN, (9ZY), 9AAW, (9AEG), 9ABU, 9ABV, 9ABZ, 9AFW, 9AFX, 9AIF, 9AIG, 9AJN, 9AKC, 9ALO, (9AMA), 9AMB, (9AMD), 9AMK, 9AMV, 9ANO, 9AOU, 9AQE, 9ARZ, 9ATU, 9AWU, 9AWZ, 9AYU, 9AYV, 9AYW, 9AXU, 9DAB, (9DAY), 9DEH, (9DFL), (9DOC), (9DUG), 9DUL, 9DQQ, 9DSD, 9DZJ, (9YAE), (9YAC), (9YAK), 9XAE, 9ZAC, (9ZAF), 9ZMC.

5HK, Oklahoma City, Okla.

Spark: 5BM, (5DH), (5EK), (5EU), (5FV), (5FO), (5HA), (5HZ), 5IR, (5IB), (5IF), (5SD), (5SR), 5LO, (5LB), 5NH, (5PU),(5QQ), 5QY, 5QN, 5RM, (5TA), (5XB), (5XT), (5XU), (5XJ), 5XA, 5XI, 5YK, (5YN), (5ZA), 5ZC, (5ZL), 5ZO, 5ZR, (6ZS), 5ZT, (5ZU), (5ZX), (5ZAB), (5ZAD), 5ZAK, (6WV), 6ZZ, 7XD, 8EA, 8YN, (9CP), 9EE, (9EL), (9ET), (9FZ), (9HT), (9HI), (9HM), 9IY, 9JQ, (9KA), (9KO), (9LQ), 9LF, (9MC), (9NQ, 9NR, (9OR), 9OX, 9PH, (9PS), (9RY), (9TL), (9TV), 9UK, (9UU), (9WI), 9WT, (9WS), 9WV, 9XM, (9YA), 9YK, (9YM), 9YT, (9YO), (9YAE), 9YAL, (9YAK), (9ZB), 9ZC, (9ZH), 9ZJ, 9ZN, (9ZAC), (9ABV), 9ACN, 9AEX, (9AEG), (9AEY), 9AFO, (9AFX), (9AFF), (9AFW), (9AHZ), 9AIF, 9AJA, (9AJN), (9AKC), 9ALO, (9AMA), 9AMK, (9ANO), (9AOV), (9AOU), 9AQE, 9AQA, (9ARG), 9ARK, (9ARI), (9ASN), (9AUO), 9AUW, 9AUN, 9AVN, 9AWX, 9AWZ, 9AXU, (9AYW), 9DEH, 9DFL, 9DMJ, (9DQQ), (9DSD), (9DUG), (9DVA).

5ME, Dallas, Texas

Spark: 5AL, 5AO, 5BM, 5EH, 5EK, 5ER, 5FI, 5FO, 5FV, 5HK, 5IC, 5IF, 5IK, 5IR, 5JD, 5JI, 5JR, 5KI, 5LC, 5LX, 5MF, 5MK, 5MX, 5NF, 5NK, 5NS, 5OK, 5OI, 5QA, 5QI, 5QY, 5RA, 5RM, 5SM, 5TG, 5TP, 5XA, 5XB, 5XI, 5XJ, 5XL, 5XU, 5YL, 5ZA, 5ZL, 5ZO, 5ZT, 5ZU, 5ZX, 5ZZ, 5ZAB, 5ZAG, 5ZN, 5ZAK, 5ZAM, 5ZAN, 5ZAR, 8FT, 8ACF, 8ARD, 9ET, 9FZ, 9HM, 9HT, 9IO, 9KA, 9LF, 9MC, 9MR, 9NQ, 9NR, 9OR, 9PS, 9TL, 9TN, 9UU, 9WI, 9WN, 9WU, 9ZB, 9ZJ, 9ZM, 9ZN, 9YA, 9ACL, 9AEG, 9AEY, 9AFX, 9AHZ, 9ALU, 9AMA, 9AMS, 9AQU, 9AQE, 9AQM, 9ASN, 9AUO, 9AYW, 9AWX, 9BDS, 9DEH, 9DFL, 9DPH, 9DQQ, 9DSD, 9DUG, 9DZI, 9YAE, 9YAK, 9ZAB, 9ZAC.

C.W.: 2FD, 2FP, 4BY, 4DH, 5DA, 5LA, 5ZA, 8DE, 8DR, 9GK, 8II, 8IQ, 9JL, 8KM, 8LY, 8OI, 8TN, 8UJ, 8VJ, 8VY, 8AQF, 8BFX, 8BOX, 9AA, 9AB, 9EK, 9MR, 9RJ, 9RQ, 9RT, 9RV, 9VE, 9AAS, 9AJA, 9AKD, 9AMB, 9ANE, 9AQR, 9ARK, 9XI, 9XAC, 9ZB, 9ZY.

5NH, Rockdale, Texas.

1AE, 5AI, 5EK, (5FA), (5FO), 5HK, 5HZ, (5IQ), 5JR, (5KP), (5LM), 5LX, 5MR, (5MX), 5NK, (5PP), (5PR), (5QA), 5QI, (5QY), (5SA), (5XB), 5XI, 5XJ, (5XU), 5YI, 5YK, 5ZA, (5ZF), 5ZJ, 5ZO, 5ZS, 5ZT, (6ZU), (5ZX), 5ZAB, (5ZAF), (5ZAG), 5ZAK, 5ZAM, 5ZAR, 5ZAY, 9AC, 9AP, 9FZ, 9MC, 9RY, 9WS, 9AEG, 9AEY, 9YAE, 9ZAC.

5ZAB, Houma, La.

2AFP, 2DK, 2FP, 2ZL, 3OU, 4AS, 4BK,(4BQ), 4BY, 4BZ, (4DH), 4FD, 4FF, 4GN, 4GL, 4LE, (5AF), 5AO, 5EK, 5ER, 5EW, (5FO), (5FV), 5HK, (5HR), 5JD, 5JI, 5KP, (5LA), (5LO), 5ND, 5NK, 5SM, 5TG, (5XB), 5XI, 5XJ, 5XU, 5YI, 5YK, 5YL, (5ZA), 5ZC, 5ZE, 5ZJ, (5ZL), 5ZO, (5ZS), 5ZT, (6ZU), (6ZW), 5ZX, 5ZAF, (5ZAG), 5ZAI, 6ZAM, 5ZAN, 6WV, 6ZZ, 7ZO, 8DE, 8DR, 9JQ, 8AYN, 8KM, 8VY, 8XI, 8KK, 8YN, 8ZA, 8ZD, 8ZL, 8ZR, 8ZY 9AAN, 9AAW, 9ABY, 9ADY, 9AEG, 9AEY, 9AMA, 8AMK, 8ANF, 8AON, 9AOU, 9ARG, 9ASN, 9AUO, 9AXU, 9DUG, 9DYA, 9EL, 9FZ, 9HR, 9HS, 9HM, 9IY, 9LQ, 9MC, 9NQ, (9OX), 9PS, 9TV, 9UU, 9WI, (9WT), 9XM, 9YA, 9YB, 9YI, 9YM, 9YAK, (9ZAC), (9ZB), 9ZJ, 9ZN, 9ZY.

5AA (ex-5ZP), New Orleans.

2EL, 3BZ, 3MO, 4AN, 4AT, 4BQ, 4BY, 4CP, 4DH, 4FD, 4FF, 4GL, 4GN, 5EK, 5ER, 5FA, 5FO, 5FV, 5HK, 5HZ, 5IC, 5ID, 5IR, 5JD, 5JI, 5KP, 5LX, 5MT, 5NK, 5NS, 5RM, 5RZ, 5UJ, 5XA, 5XB, 5XJ, 5XK, 5XU, 5YB, 5YL, 5YN, 5ZA, 5ZC, 5ZI, 5ZL, 5ZO, 5ZR, 5ZS, 5ZT, 5ZU, 5ZW, 5ZX, 5ZAB, 5ZAF, 5ZAG, 5AM, 5ZAN, 8BO, 8DE, 8DR, 8EZ, 8II, 8IQ, 8JM, 8JQ, 8OI, 8SP, 8TN, 8UJ, 8VJ, 8XK, 8ZN, 8ZR, 8ZY, 8ACF, 8ACL, 8AFB, 8AFD, 8ZG, 8AFS, 8AKS, 8ARD, 8AUH, 8BPL, 8BRL, 9DW, 9EL, 9FS, 9FU, 9FZ, 9GX, 9HD, 9HI, 9HM, 9HR, 9HS, 9IY, 9JQ, 9KO, 9MC, 9MN, 9NH, 9NQ, 9NR, 9OR, 9PS, 9TV, 9UU, 9VV, 9WI, 9WT, 9XI, 9XJ, 9YA, 9YB, 9YM, 9YT, 9YAE, 9YAK, 9ZB, 9ZJ, 9ZAC, 9AAY, 9AEG, 9AEY, 9AFX, 9AIO, 9AIR, 9AJH, 9AMA, 9AMT, 9AMV, 9ANO, 9API, 9AQA, 9AQM, 9ATI, 9ATN, 9AVN, 9AXU, 9AYW, 9BDS, 9DQQ, 9DYU, 9DZJ.

5ZL, Little Rock, Ark.

2FP spk. C.W, I.C.W., 2ZL I.C.W. 3BP Canadian, 3HG C.W., 3XM, 4AS, 4BQ, 4DH, 4EB C.W., 4FD, 4FF C.W., 4FJ, 4GL C.W., 4GN, 4ZF, 5AA, 5AF, 5AL, 5AO, 5DA C.W. spk., 5EH, 5EK, 5ER, 5EW, 5FA, 5FO, 5FV, 5HJ, 5HK, 5HZ, 5IC, 5IE, 5IF, 5IR, 5IX, 5JI, 5JL, 5KP, 5LA C.W. spk., 5LB, 5LC, 5LO, 5LX, 5NK, 5NS, 5PE, 5PX, 5QA, 5QH, 5QI, 5QQ, 5QS, 5RA, 5RB, 5RZ, 5SI, 5TG, 5XA, 5XB, 5XI, 5XJ, 5XU, 5YL, 5ZA, 5ZAB, 5ZAF, 5ZAG, 5ZAM, 5ZC, 5ZO, 5ZS, 5ZT, 5ZU, 6ZV, 5ZW, 5ZX, 6WV, 8ABO, 8ACF, 8ACY, 8AEL, 8AEZ, 8AFD, 8AFS, 8AGK, 8AJV, 8AKE, 8AKS, 8AMK, 8AND, 8ANO, 8ANY, 8AOA, 8AQZ, 8ASD, 8AWX, 8AXC, 8AYN, 8AZF, 8BP, 8BBU, 8BDY, 8BGF, 8BOX, 8CI, 8DE, 8DR, 8EA, 8EZ, 8FA, 8FI, 8FT, 8GW, 8HA, 8IBO, 8IC, 8II, 8IN, 8JJ, 8MR, 8OI, 8RQ, 8RU, 8SP, 8TK, 8TN, 8TT, 8UC, 8UJ C.W., 8VJ, 8VY, 8XM, 8YN, 8ZA, 8ZD, 8ZN, 8ZR, 8ZZ, 9AR, 9AV, 9AAP, 9AAS C.W., 9AAW, 9ABU, 9ACB, 9ACL, 9ACN, 9ACP, 9ADH, 9AEG, 9AEY, 9AFF, 9AFK, 9AFW, 9AFX, 9AGR, 9AHV, 9HZ, 9AIF, 9AIR, 9AJA, 9AJN, 9AKC, 9AMA, 9AMD, 9AIU, 9MK, 9MV, 9ANF, 9ANV, 9AOF, 9AOO, 9AOU, 9APW, 9AQE, 9AQM, 9ARG, 9ARI, 9ASJ, 9ARZ, 9ASN, 9AUL, 9AVR, 9AWZ, 9AXU, 9AZA, 9BP, 9BDS, 9CP, 9DBU, 9DCX, 9DEH, 9DFL, 9DHG, 9DII, 9DQQ, 9DUG, 9DYE, 9DYU, 9DWM, 9EE, 9ED, 9EL, 9ET, 9FS, 9FZ, 9GC, 9GN, 9GX, 9HD, 9HI, 9HM, 9HR, 9HT, 9IY, 9JQ, 9KA, 9KO, 9KR, 9LF, 9LW, 9LQ C.W., 9MC, 9NR, 9OX, 9PN, 9PS, 9QM, 9RV C.W., 9RY, 9TL, 9TV, 9UU, 9VZ, 9WI, 9WT, 9WZ, 9XI C.W., 9XM,

9YA, 9YAK, 9YM, 9YO, 9ZAC, 9ZB, 9ZH, 9ZJ spk. C.W., 9ZN, 9ZX, 9ZY.

6TV at Tucson, Ariz.

5HK, 5QQ, 5IR, 5IF, 5DF, 5ZA, 6AK, 6BW, 6DP, 6FH, 6GR, 6GF, 6GP, 6HY, 6IS, 6IV, 6KC, 6OC, 6OD, 6PJ, 6TU, 6TF, 6VX, 6SK, 6QR, 6XG, 6XAC, 6ZU, 6ZZ, 6ZB, 6AAT, 6AAH, 6AAU, 6ABP, 6AEZ, 6ACY, 6AFN, 6AHV, 6AHP, (6AJH), (6ALE), 6AMT, 7MO, 7XD, 9AOU, 9DSD.

WJK, Taft, California, Ex-6BU, opr.

5OF, 5ZU, 5ZA, 6AH, 6AN, 6AW, 6AS, 6AV, 6BW, 6CV, 6CP, 6DA, 6EX, 6FH, 6GB, 6GR, 6GT, 6II, 6KC, 6KM, 6LU, 6MH, 6MK, 6JE, 6RW, 6SK, 6TU, 6TV, 6UX, 6VK, 6VM, 6WV (voice), 6ZA, 6ZB, 6ZU, 6AAT, 6AAW, 6ABW, 6AEI, 6AEZ, 6AFN, 6AFY, 6AIV, 6AJT, 6ALE (voice & C.W.), 6API, 6ARO, 6ARW, 6ATQ, 6ATV, 6XAC (voice & C.W.), 6XAD (C.W.), 6ZAD, 7ATQ, 7LY, 7MF, 7MP, 7WH, 7XD, 7XF, 7YA, 7YG, 7YS, 7ZU, 7ZT, 9AJA, 9AMB, 9PS, 9ZN, 9ZAF, 9BD.

6OL, Glendale, Calif.

(5ZA), (6AK), (6AS), 6EP, 6FH, 6FN, 6GF, 6GR, 6GX, 6HC, (6IC), 6IM, 6JE, (6KC), 6KM, 6LU, (6OC), 6OH, (6PJ), (6QR), (6QT), (6SK), 6UQ, (6VX), (6XH), (6ZB), (6ZU), (6ZX), (6ZZ), 6AAH, 6AAU, 6ABX, (6AEI), 6AFN, 6AGF, (6AHP), 6AHV, 6AID, (6AJH), 6ALV, 6ANG, 6APE, 6ATQ, 6ATV, 6AVB, 6AVV, 6AWP, 7BP, 7ED, 7IN, (7MF).

6JD, Los Angeles, Cal.

2FP C.W., 5IF, 5ZA, 6ZZ, 7YJ, 7ZT, 7XD, 9BD.

6BF, Santa Paula, Cal.

Spark: 5IF, 5ZA, 6AG, 6AK, 6AS, 6BR, 6CZ, 6DA, 6FH, 6FN, 6GF, 6GR, 6HC, 6KC, 6KM, 6LU, 6OC, 6PJ, 6PO, 6PR, 6QR, 6QY, 6TF, 6UO, 6VX, 6VZ, 6WZ, 6ZU, 6ZX, 6AAH, 6AAU, 6ABX, 6ACX, 6ADL, 6AEH, 6AEV, 6AEW, 6AFN, 6AGF, 6AHP, 6AID, 6AKL, 6AME, 6APH, 6AOZ, 6ASK, 6ASZ, 6ATQ, 6ATV, 6ATY, 6AVV, 6AWP, 6AXP, 7GJ, 7HN, 7IN, 7IY, 7MF, 7ZO.

C.W.: 6EN, 6FZ, 6XG, 6XH, 6XAC, 6XAK, 6ZB, 6ZN, 6AAT, 6ALE, 6ARK, 8BOX., 9AMB, 9ZAP.

6AWP, (Ex-8GX) Santa Ana, Calif.

Spark: 5HK, 5IF, 5ZA, 6AE, 6AK, 6AR, 6AS, 6CH, (6DA), 6EA, 6EB, (6EC), (6EN), 6ER, 6EV, 6EY, 6FH, 6FK, (6FT), 6GE, 6GF, 6GI, 6GN, 6GP, 6GT, 6GX, 6HM, (6HY), 6IC, (6IF), 6IK, 6IM, 6IV, 6JE, 6JY, (6KA), 6KC, 6KP, 6KS, 6KV, 6KY, 6LC, 6LU, 6MD, 6MH, 6MM, 6OC, 6OD, 6OH, 6OL, 6OM, 6PJ, (6PQ), 6QR, (6SK), 6TF, 8UH, 8UL, 6UO, 6VH, 6VV, 6VX, 6WI, 6WZ, 6ZB, 6ZE, 6ZM, 6ZN, 6ZU, 6ZR, 6ZX, 6ZZ, 6AAH, 6AAU, 6AAW, 6ABM, (6ABP), 6ABX, 6ABZ, 6ACR, 6ACY, 6ADF, 6ADL, 6ADP, 6AEH, 6AEZ, 6AFN, 6AFO, 6AGF, (6AGN), 6AGP, 6AHK, 6AHO, 6AHP, 6AHQ, (6AHU), (6AHV), (6AIB), 6AID, 6AIO, (6AIU), (6AJH), 6AKL, 6AKR, (6ALK), 6ALJ, (6ALP), (6ALU), 6AMN, 6AMQ, 6AMW, 6APE, 6APH, 6ARK, 6ARW, 6ASQ, 6ATQ, 6ATV, 6AUS, 6AVD, (6AVR), 6AVT, 6AWF, 6AWH, 6AZU, (6BAC), 6BAF, 6BAU, 7BP, 7CB, 7CW, 7ED, 7FI, 7IN, 7KB, 7LY, 7MF, 7MO, 7MP, 7TJ, 7XD, 7ZA, 7ZL, 7ZP, 7ZS, 7ZM, 7ZU, 7ZY, 9BD, 9OP, 9AEG, 9AEY, 9AYU.

C.W.: (6EN), 6JE, (6KA), 6KH, 6MK, 6RR, 6XD, 6XG, 6ZN, (6AAG), 6ABG, 6ALE, 6ALJ, (6AQT), 6AVY, 6AWT, (6XAD), 6XAK, 6ZAD, 9AMB, 9ZAF.

6AS, San Francisco, Cal.

(6AK), 6ABX, 6ACY, 6ADL, (6AEW), 6AEZ, (6AGF), 6AHP, (6AID), 6AIB, 6AIO, 6AJH, 6ALU, (6ALE), 6AMN, (6AVB), 6AVD, 6AVV, 6AWH, 6AWV, (6EA), (6EB), 6EN, 6ER, 6FK, 6FS, (6GF), 6GI, 6GP, (6GR), 6GX, 6HY, (6IC), (6ID), 6IS, 6IV, (6JE), (6KA), 6KC, 6KE, 6KS, (6KY), (6MH), 6MK, 6MN, 6NK, 6OH, (6OL), (6QR), 6SA, 6SK, (6TU), 6UO, (6VX), 6ZA, 6ZB, 6ZU, (6ZX), (7BP), 7ED, 7GJ, (7HF), 7IN, 7IU, 7JW, 7KJ, 7LU, (7MF), 7MW, 7MP, 7NL, 7TJ, 7YA, 7LJ, (7ZJ), 7ZM, 7ZT, (7ZU), 9BD Canadian.

6ALE, Reedley, Calif.

Worked: 6AS, 6BM, 6EA, 6EB, 6ER, 6EX, 6FK, 6FT, 6GF, 6GR, 6IC, 6JD, 6KA, 6KP, 6KY, 6KX, 6LC, 6MH, 6OC, 6SK, 6TV, 6VX, 6ABM, 6ACY, 6AEZ, 6AGF, 6AHU, 6ALV, 6ANP, 6ASK, 6ATV, 6AVB, 6AVV, 6AVY, 6AWH, 6ZB, 6ZX, 7BP, 7ED, 7GA, 7IU, 7KB, 7KG, 7KM, 7LU, 7LY, 7MF, 7MP, 7MY, 7OZ, 7XD, 7ZJ, 7ZM, 7ZT, 7ZU.

Heard: 2FB I.C.W., 5BR, 5ZA, (6GR C.W.), 6JE, (6IF C.W.), (6ZN), 6AAT C.W., (6ABY C.W.), (6ABX C.W.), (6ALA C.W.), (6ASJ C.W.), (6AWT C.W.), (6AWV C.W.), (7XF C.W.), 9AQ, 9BD Canadian, 9CP, 9RY, 9AMB C.W., 9ZAC, 9ZAF C.W.

7KP, Seattle, Washington.

4CB, 5ZA, 6AE, 6AK, 6CO, 6CP, 6EA, 6FH, 6GF, 6GT, 6GX, 6IC, 6IM, 6KA, 6KM, 6LU, 6OC, 6OH, 6OW, 6PJ, 6QR, 6QT, 6TC, 6VX, 6WL, 6ZU, 6ZX, 6AAT, 6AAU, 6ABX, 6AEZ, 6AFN, 6AGF, 6AIU, 6AID, 6ALE, 6ATQ, 6AUL, 6AWH, 6AWT, 6AWV, 7AW, 7BA, 7BC, 7BG, 7BH, 7BP, 7BR, 7CC, 7CE, 7ED, 7FI, 7GA, 7GS, 7HI, 7IN, 7JF, 7JU, 7KA, 7KB, 7KG, 7LU, 7LW, 7MF, 7MO, 7MU, 7MW, 7NJ, 7NL, 7NC, 7TM, 7TO, 7XF, 7XD, 7ZS, 7ZU, Canadian XEQ, XEV, 5BR, 9BD.

7PO, Seattle, Wash.

6AAN, 6AAV, 6ABX, 6AEZ, 6AID, 6AIR, 6AKT, 6APH, 6ARK, 6ATV, 6CH, 6CJ, 6EB, 6FH, 6FN, 6GF, 6GR, 6HC, 6IC, 6ICM, 6IM, 6ITJ, 6KA, 6KC, 6MF, 6MP, 6OC, 6PO, 6QR, 6QT, 6SK, 6UO, 6VK, 6VX, 6WZ, 6XH, 6ZS, 6ZU, 6ZX, 7BA, (7BG), 7BP, 7ED, 7FN, 7GA, 7HF, 7IC, (7IN), 7KJ, 7MF, 7MJ, 7MP, 7YS, 7ZJ, 7ZS, 7ZT, 7ZU, Canadian 9AX and 9BD.

7ED, Portland, Ore.

4CB Canadian-C.W., 5XU, (6AK), (6BB), (6CH), (6CP), 6CV, (6EA), (6EB), 6EN C.W., (6FH), 6FN, 6GI, 6GP, (6GR), (6GX), 6HC, 6HY, (6IC), 6IM, (6IS), 6JE C.W., 6KA, 6KC, 6KM, 6LU, (6OC), 6PJ, 6PR, (6QR), 6QT, 6SK, 2TU, 6VM, (6VX), (6WZ Spk. & C.W.), 6XH C.W., 6ZE, 6ZN C.W., (6ZU), 6ZX, 6AAT C.W., (6ABX), 6ACY, 6AEI, 6AFN, (6AFO), (6AGF), (6AID), 6AJH, (6ALE C.W.), 6ALU, 6AMX C.W., 6ANG, 6APE, 6ATV, 6AVV, 6AWH, 6AWT, 6XAF C.W., 7AY, (7BA), 7BH, (7BK), 7EX C.W., (7IN), (7IW), (7IY), 7JF, 7KG, (7KJ), (7LU), (7MF), 7MO, 7MP, 7NJ, (7NL), 7NN, 7NW, 7OZ, 7PO, (7TJ), (7YA), (7YL), 7ZP, (7ZU), 9AX Canadian, (9BD Canadian), 9AMB C.W., 9ZAC.

7LO, Boise, Idaho

5ZA, 6AAN, 6AAW, 6ABW, 6ABX, 6AEI, 6AEZ, 6AFN, 6AGC, 6AGF, 6AGV, 6AID, 6AIV, 6AK, 6ALE, 6ALW, 6APH, 6ARK, 6ASA, 6ATQ, 6AUL C.W., 6AVB, 6AWH, 6CV, 6EN, 6FN, 6FK, 6GX, 6HC, 6IC, 6IM, 6IW, 6JR, 6KA, 6LU, 6MO, 6NK, 6OC, 6QR, 6ATV, 6UO, 6VY, 6WZ, 6XH, 6ZU, 6ZX, 7BA, 7BH, 7CP, 7DI, 7ED, 7FG, 7FI, 7FY, 7HW C.W., 7IN, 7KB, 7KG, 7LK, 7LN, 7LU, 7LW, 7LY, 7MF, 7MP, 7NW, (7OK), (7OT), 7XD, 7XF C.W., (7YA), 7YS, 7ZU.

7LU Greybull, Wyoming.

Spark: 5DM, 5FO, 5HK, 5IF, 5JR, 5LB, 5OF, 5QI, 5ZA, 5ZAM, 6AT, 6CV, 6GR, 6IC, 6IF, 6KA, 6KC, 6KM, 6LU, 6OC, (6QR), 6SJ, 6UO, 6VM, 6VX, 6WZ, 6ZU, 6ZX, 6ZZ, 6AAU, 6ABX, (6AEZ), 6AFN, 6AKL, 6ATH, 6ATQ, 6AWS, (7BH), (7DH), (7ED), 7EX, 7GA, (7IN), (7JF), (7JQ), (7KB), (7LY), 7MF, (7MO), (7MP), (7NL), (7NW), 7XD, 7YJ, 7ZE, 7ZJ, (7ZM), (7ZO), 7ZU, 9EE, 9EL, 9ET, 9FX, 9FZ, 9HM, 9HT, 9IF, 9IY, 9MF, 9NR, 9PN, 9PS, (9TI), 9TL, 9UU, 9WI, 9XI, 9YA, 9YM, 9ZC, 9ZN, 9ABV, 9AEG, (9AEY), 9AFX, (9AIF), (9ALU), 9AMV, (9ANF), (9AOU), 9AQE, 9AQM, 9ARZ, (9ASN), 9ATN, 9ATU, 9AUO, 9AVK, 9AXU, 9AYU, (9AYV), 9DBS, 9DJX, 9DOC, (9DSD), 9DUG, 9DUU, 9DYH, 9DZR, (9ZAC), 9YAC, (9YAK), Canadian (9BD).

C.W.: (6WV), 6XS, 6AAT, (6ALE), 6XAC, 6XAD, 7HW, 7XF, 9VE, 9ZY, 9AJA, 9AMB, Canadian 4CB.

8BBU, Columbus, Ohio.

Spark: (1AW), 1DJ, (1SN), 1TS, 1AKG, 1AWZ,

(Continued on page 66)

Radio Communications by the Amateurs

Honeycombs on 200 Meters

93 California St.,
Ridgewood, N. J.

Editor, QST:

I have read with great interest the various articles on honeycomb coils. However, very little has been said about *two hundred* meter reception. The average relay operator cares more about 200 meter work than all the rest of the waves put together. Mr. Kinyon in the July QST classes "short waves" as 200 to 1000 meters. According to that, 150 meters must be microscopic. What applies to a 1000 meter station certainly does not apply to 200 meters. He also states that a Paragon-type receiver has a quicker arrangement and a greater range than honeycombs.

The reverse is true at this station. The position of the three coils remains fixed. The primary condenser stays at one spot and all the tuning is done on the secondary condenser. Hence the secondary condenser is the only adjustment. The primary and tickler may be set in such a position that the oscillating point is at 203 meters, for example. Tuning the secondary condenser from 190 to 203 not only tunes in the required station but brings the tube up close to the oscillating point where it is most sensitive. It is then super-sensitive from 200 to 203 meters, very sensitive from 190 to 200 meters, and moderately so on lower waves. This adjustment permits sharp tuning and maximum regeneration. If you use a 2-plate vernier condenser across the secondary condenser, you can set the secondary condenser at 200 meters and have extremely sharp tuning from 200 to 203 m. with the bulb just on the oscillating point. This adjustment can be made to tune from 260 to about 273 m. or from 230 to 243 m. or anywhere you please on amateur waves. You have very sharp tuning and maximum regeneration over 3 m., sharp tuning and sensitiveness over the next 10 m., and fairly broad tuning on lower waves.

To get these adjustments I use L-25 primary, L-50 secondary, and L-35 tickler. If you have a good tube you can use a small tickler; if not you will have to use L-75 or 100. The oscillating point can be set at any wave between 150 and 300 m. by adjustment of the primary and tickler. If the primary is pulled away from the secondary and the tickler shoved in, louder signals result, as there seems to be more regeneration and sharper tuning is had. Doing this will cut out nearby stations to some extent and bring long distance ones roaring in. Many times last winter I cut out a lot of QRM from 2d district stations and was able to copy 9's all night by doing that.

Some folks have advised junking the amateur size honeycombs. What ignorance! From November, 1920, to June, 1921, I logged over 800 amateurs, including 230 eights, 110 nines, and 10 fives. Those include 5ZA, two in Texas, two in N. D., one in S. D., three in Nebraska, and five in Kansas, all of whom are considerably removed from Ridgewood, N. J. That reception was done on honeycomb coils, two-steps, and an indoor aerial. How come they are no good? It only takes a little skill to use them.

They are especially good for tuning amateur C.W. stations. Using the same coils mentioned above the bulb will oscillate on all amateur waves if all three coils are kept close together. Here again all the tuning is done on the secondary or vernier condenser. Honeycombs may not get quite as loud sigs as other sets but the sharp tuning gets greater distance. So far I have got better distance than any of the variometer sets in town and have often heard locals spend time, energy and watts trying to get a QSL which I could copy easily with sharp tuning. When a tuned-plate set has to ask for QTA time after time because of QRM and a honeycomb set can copy thru the QRM, why "use the honeycombs as a ground"?

The leads in such a set should be as short as possible, especially the one from secondary to condenser to the grid.

NM, 73 and CUL.

Paschall Jessup, 2AUG.

9TI Reassigned

Office of Radio Inspector,
Chicago, Ill.,
October 21, 1921.

Editor, QST:

Will you kindly inform your subscribers that call letters 9TI are now held by Irving Patridge, Milbank, South Dakota. This call was formerly held by Kenneth Rein-

king, of Minneapolis, Minnesota, who died July 7th. Cards addressed to Mr. Reinking have added fresh grief to the stricken family and I have taken this means to alleviate this, as much as possible.

Respectfully,
L. R. Schmitt.

Amateur Radio in Finland

Abo, 46 it. Rantakatu.
Finland (Europe),
26/9/21.

Editor, QST:

I have the pleasure to inform you that our radio enthusiasts here in Finland have recently got a permit for amateur radio communication, wave length maximum 300 meters, high frequency energy from 50 to 100 watts for spark transmission and from 5 to 20 watts for C.W. and telephony.

We have at this time existing only four radio clubs, but we hope that after a short time the number of clubs will be increased. I wish therefore that you would kindly send to me specimen copies of your magazine if it is possible.

Awaiting the favour of your answer, I am, sir,

Yours truly,
Leo Lindell, N.V.L.T.T.,
President of Finnish Amateur Radio Assn.

Home-Made Dials

2102 San Jacinto St.,
Houston, Tex.

Editor, QST:

While constructing a duplicate radiophone set I found I needed a dial. Trying to purchase same I found there were none on the market suited to the purpose for which I wished to use it, and I then hit upon the following scheme:

Being a draftsman I had ink, tracing cloth, instruments and other material handy, so I proceeded to draw a dial of the proper size and calibration on tracing cloth. I then made a print of it on photographic paper and the result was a good looking black dial with the letters and calibration in white.

If a white dial is desired the tracing should be printed as before except that the ink side of the tracing cloth is placed against the sensitive side of the photographic paper, producing a "negative"; i.e., a print with the figures reversed but with the dial still black and figures white. It is then necessary to make a print from the negative, which is done by placing a piece of photographic paper with its sensitive side to the sensitive side of the negative, exposing and developing as before.

These prints can be backed with cardboard, metal or celluloid, or pasted to a panel, and used to good advantage. Dials can be made for all uses by this method at a cost of only a few cents apiece.

Yours truly,
Elmer F. Hard, 5PO.

Fluctuating Antenna Fundamentals

544 Jefferson St.,
Corvallis, Oregon.

Editor, QST:

I thought it might be of interest to you to know of the results of measurements of fundamental wave length of our antenna at various hours of the day for four days.

The reason for making the test was that students were getting different fundamental wave lengths on different days. Their results varied from 240 to 290 meters. As they were using three different ways of obtaining the wave length and as all three ways gave practically the same results I concluded the difference was not entirely due to experimental error, especially since different sections the same day would get the same results. It was suggested that relative humidity might be a factor, so the following table was obtained by use of a vacuum tube generator to find the fundamental wave length. As this method is exceedingly accurate there must be a change in the fundamental, but so far as this experiment goes the cause is not apparent.

Date	Hour	Atmosphere	Rel. Humidity	Wave Length
May 18	2:00 p.m.	Cloudy	65%	262 m.
	5:25 p.m.	"	80%	250 m.
	11:24 p.m.	"	82%	250 m.
May 19	8:00 a.m.	"	70%	258 m.
	9:05 a.m.	"	64%	262 m.
	10:25 a.m.	"	60%	258 m.
	1:15 p.m.	"	55%	258 m.
	1:45 p.m.	"	50%	257 m.
	6:15 p.m.	"	70%	262 m.
May 20	8:00 a.m.	Rain	60%	262 m.
	11:30 a.m.	Cloudy	50%	262 m.
	2:45 p.m.	Pt. Cloudy	38%	258 m.
	8:00 p.m.	Clear	74%	258 m.
May 21	9:15 a.m.	"	50%	260 m.
	4:15 p.m.	"	39%	262 m.
	2:30 p.m.	"	52%	270 m.

I realize that a great deal more data would be required to be of any value in indicating the cause. If this is of any interest to you, you may use it as you see fit.

Very truly yours,
Jacob Jordan,
Physics & Radio Instructor.

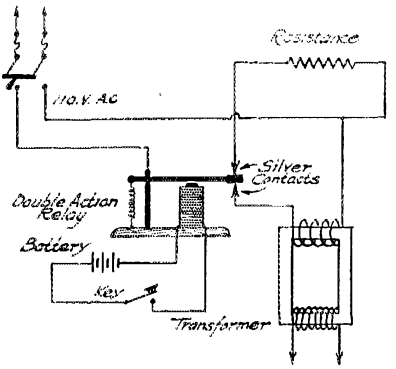
Flickering Lights

Francesville, Ind.

Dear Eddie:

I am enclosing a circuit which I have found very successful in preventing flickering of the lights when transmitting. I realize that many amateurs are confronted with this problem and therefore offer this suggestion if it will help any.

The double action relay is easily constructed by any wide-awake amateur from an old telegraph sounder. The silver contacts should be sufficiently large to carry the current. I believe the circuit is self-explanatory in the drawing.



The resistance noted at "R" should be so constructed that it can be varied to correspond with any variation in power to the transformer, such as half-power step, etc. It may be in the form of a wire rheostat or it may be any water resistance jar that may be at hand. Above all it must draw the same load as the primary of the transformer. This system will be more appreciated by those who use remote control for they need only add another set of contacts to the relay that they already use.

I hope that this little suggestion may be of help to some brother ham who has the light flickering problem to contend with. I tested this circuit here at my station, and it worked fine. One might be led to think that the lights would still "duck" between breaks in the relay, but this did not prove to be so in the test gave it. The mechanical action of the relay is so quick that the brightness of the lights is not affected. I will be glad to hear from anyone who uses this circuit and gets good results.

Herbert Ames, 9DTJ.

Milk By Radio

Bloomington, Ill.

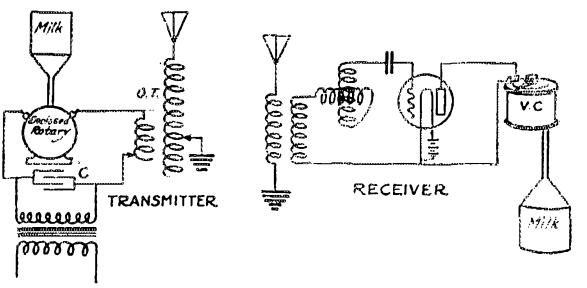
Editor, QST:

Enclosed is a rude drawing to illustrate an idea which I have originated after much study and research. I trust you will see the practicability of this device. I shall endeavor to give you a brief description.

It is a well known fact that farmers experience difficulty in bringing their milk to the creameries, both because of the time wasted in transporting, and the difficulty of obtaining satisfactory transportation facilities. Now this invention is designed to totally eliminate both troubles.

As is to be seen by the diagram a regular spark transmitter is used for transmitting the milk. The type and make of apparatus is optional with the exception of the spark gap. This must be of the enclosed rotary type. A small hole is drilled in the top of the case, and this is threaded. A pipe line is fitted into this, and connected to a tank which contains the fresh milk. No control valve need be put in this line as the milk will feed down automatically as it is sent out. Now the action as nearly as I can figure it out is as follows: The milk is evaporated in the gap and then transmitted out on the emitted waves. To comply with the pure food laws the coupling must be very loose, so that the emitted wave is pure.

Now the receiving set is the biggest mystery to me. If any of you have any theory as to its operation I wish you would let me know it. A simple regenerative circuit is used with the exception that in the plate circuit the variometer and "B" batt. are omitted. Instead a variable condenser is put in the circuit. This condenser is of the 43 plate variety with a tight case. This case has a small hole drilled in the bottom of it into which is fitted a small pipe. This pipe should have a tank or some other kind of container under it to catch the milk which will flow from it. To tune this set it is only necessary to tune with the grid variometer until the milk wave



is found. This can be found by watching the vacuum tube. When it becomes slightly milky you will know that your grid variometer is set right. *Do not touch this adjustment again.* Now to get the plate circuit in resonance with the grid circuit it is only necessary to vary the variable condenser. Watch the outlet of the pipe line connected to the variable condenser, and when the milk begins to trickle from the pipe you will know that the tube is oscillating. Adjust the variable condenser until a maximum flow of milk comes from the pipe.

Obviously the milk received will be condensed, as it must pass thru the condenser.

Very truly yours,
9SA.

Simplified vs. Three Circuit Regenerative Receivers

East Pittsburgh, Pa.

Editor, QST:

In the September issue of QST there was an article by Mr. Paul F. Godley under the heading "Simplified vs. Three Circuit Regenerative Receivers". In that article Mr. Godley shows considerable animosity towards the "simplified" receivers and in his arguments, in support of his contention, he has made some statements that are misleading, if not actually incorrect.

For the purpose of allowing the reader, not familiar with the underlying principles of receiver operation, to judge of the merit of Mr. Godley's criticism, the following preliminary statements are made.

Any radio receiving circuit increases in its selectivity as its decrement is reduced. In other words, its selectivity increases as the resistance to an oscillating current in it is reduced. As this resistance is reduced, the greater becomes the effect of the inductance and capacity in determining the current that will result from a certain impressed voltage. It is thus apparent that, if the resistance could be made zero, the resulting current, at that particular frequency at which the inductive reactance neutralizes the capacitive reactance, would become infinitely large, while at all other frequencies the inductive, or capacitive reactance would limit the current as the frequency was above or below the resonant value.

The effective resistance that determines the decrement of a circuit, is made up not only of the ohmic resistance of the conductors of that circuit, but includes, in addition, all circuits, devices and everything that withdraws energy from that circuit. Thus the detector associated with an oscillation circuit withdraws energy from it and produces an effect on it the same as would be produced by adding resistance in the circuit. As the draft of energy increases, the effect of an apparent increase of resistance, and hence decrement, is manifested by a falling off in selectivity.

Another important factor that influences the selectivity of a circuit is the ratio that the inductance bears to the capacitance when it is adjusted for resonance. In general, the larger the inductance the more selective the circuit. Such a circuit is commonly spoken of as a "stiff" circuit, owing to its tendency to resist excitation from other frequencies than the one to which it is resonant.

Failure to appreciate the importance of this principle in the design of the antenna, or primary, circuit of many receivers, causes them to be much less selective than they would be if provision had been made to secure a proper compliance with it.

For instance, receivers which are not provided with condensers in their primary circuit are subject to this criticism as they may be used with antennas of considerable capacitance and hence, when no series condenser is used to reduce the effective capacitance of the circuit, the inductance required, for resonance, is small. This results in a low ratio of inductance to capacitance and a circuit readily influenced by frequencies somewhat different from the one to which it is resonant.

All of the above refers to a single circuit (and is equally true with or without the Armstrong regenerative connection.) If instead of a single circuit, two circuits are employed, inductively connected, then the following conditions exist. The first circuit, generally made up of an antenna, a tuning inductance and a tuning condenser in series, has its decrement determined by (a) its ohmic resistance, (b) its radiation resistance, and (c) its equivalent resistance, due to energy lost in actuating the detector. This same circuit must exist in both instances whether a simplified single circuit is used or a two circuit arrangement is employed in which energy is withdrawn from the first circuit to actuate the detector. The ohmic resistance of the antenna, or first circuit is the same in both instances. So is the radiation resistance the same. Such difference as exists between the single circuit and the two circuit arrangements in supplying the detector with actuating energy is in favor of the single circuit, as the detector requires the same amount of energy in both instances and the energy can be delivered to it more efficiently in the case of the single circuit than in the other which latter requires the establishment of a current in a second circuit and the overcoming of its resistance losses. The second circuit must of course be tuned to the same frequency as the first and then, by changing the coupling, it becomes possible to determine the rate at which energy is drawn from the first circuit. This function is one of determining the rate of energy draft on the first circuit and thus makes it possible to control, within the limits of the detector energy draft requirements, the decrement of the first circuit.

The above deals with the influences which affect the primary circuit in determining its selectivity. These same factors determine the selectivity of the secondary circuits as influenced by the oscillating currents existing in the primary.

The advent of the Armstrong regenerative circuit connections brought about a new order of things in securing selectivity, as by means of this arrangement the resistance of the circuit could be nullified

and thus the decrement made to vanish. Mr. Godley's discussion of this is misleading as one is apt to reach the conclusion from his article, that the Armstrong regenerative arrangement is not used or is available for use with the simplified, or single circuit. Such is not the case, however, as the use of the Armstrong arrangement makes the single, or simplified circuit, a thoroughly efficient and effective receiver and differentiates it from the old "single slide tuner", referred to Mr. Godley, employed in the early days of the art with inefficient detectors.

The question then that is before us for a decision is what are the relative advantages and disadvantages of a good single circuit arrangement and a good two circuit arrangement, both provided with Armstrong regeneration, or feed-back connections, in the reception of radio signals.

This question is answered best by considering what the receiver is to do in use and what are the difficulties in their use that raise these questions.

In the practical use of a receiver one has three kinds of signals with which to deal; (a) desired signals on one wave length, (b) interfering signals on a different wave length, and (c) very powerful interfering signals which shook the aerial system and set up oscillations of the same frequency as those to which it is tuned.

Should the interfering signal be on the same wave length as the desired one, the receiver cannot, of itself, offer any relief. There are other methods by means of which relief sometimes can be secured.

For conditions (a) and (c) above there is substantially no difference between the single circuit and the two circuit arrangements. For condition (b) there is possible, some difference in favor of the two circuit arrangement, when skillfully employed. Condition (b), i.e., interfering signals on a different wave length, results from signals from nearby stations which force oscillating currents, of the frequency of the transmitted, to be set up in the receiving aerial.

In a single circuit receiver these forced oscillations produce effects directly on the detector while with the two circuit receiver there is the possibility, if the operator is sufficiently skillful, of reducing the intensity of such interference.

This one possibility of securing an improved result is the only advantage the two circuit receiver has over the single circuit. In a very large majority of instances this possibility is not realized, but the set is operated in a manner which gives no improvement in results and with much more effort on the part of the user. The great advantage of the single circuit receiver is the ease with which even a novice can pick up a signal any place within its range. There is but one knob to move to cover the entire range and the adjustment is made in the shortest possible time. To one engaged in listening to a number of stations, working without any schedule arrangement, and on different wave lengths, the importance of this feature needs no further comment.

To one listening to only one wave length and with proper skill of adjustment of the set, the two circuit receiver will give somewhat better selection.

The single circuit receiver with which the writer is most familiar was designed for the reception of radio telephony and spark or modulated C.W. telegraphy. In none of these applications is the receiver used in an oscillating state, so Mr. Godley's contention that the single circuit receiver, when operated in this manner, produces serious interference due to the radiation of its locally produced oscillations, is not pertinent to this specific single circuit receiver.

However, the writer's experience with heterodyne reception indicates that there is, in fact, little to choose between a single circuit receiver and a two circuit receiver in this respect.

On short wave operation the amount of detuning needed to get the local oscillations of the required difference in frequency is so slight that the oscillation transformer which efficiently brings the incoming signal to the secondary circuit also takes the local oscillation, of practically the same frequency so far as resonance adjustment is concerned, with equal facility and efficiency over to the antenna circuit and hence makes it nearly, if not quite, as efficient a source of radiation.

That these conditions exist in practice with two circuit receivers is manifest to anyone reading the English technical papers which of late have dwelt at length with this trouble and with remedies for overcoming it. Most of the English sets are of the two circuit type and so ample proof of their having this characteristic is supplied by these publications.

Some recent tests of good single and good two circuit receivers, made for the purpose of determining what, if any, differences existed between them in their radiating propensities, disclosed the fact that for equal strength of received signal there was no difference in their radiation effects.

It appears then that, contrary to Mr. Godley's opinion of the single circuit receiver as a producer of interference by heterodyne radiation effects, it is less apt to cause trouble of that kind than the two circuit receiver.

This is so because the user of a single circuit receiver can find the desired station more quickly and hence does not spend a lot of time "sweeping" over the bands of wave lengths hunting for some particular

station with which it is desired to establish connections.

Advances in the development of appliances in all arts are marked by a simplification of the means employed for securing the result. Radio is no exception to this rule and the single circuit receiver is but one of the evidences of such development in that art.

A proper weighing of the relative importance of the features of these two kinds of receivers has resulted in favor of the single circuit for the service in which they are being used.

Yours truly,
S. M. Kintner, *Gen. Engineer*,
Westinghouse Elec. & Mfg. Co.

Fifth District O.W.'s

Houston, Tex.

Editor, QST:

Sa, OM, whadayu mean, publishing an announcement of "a" first district O.W. The Houston Radio Club has *four* of them as members, and I can name at least *ten more* that are actually operating in the fifth district. Everything that is published is about how far ahead of the game those northern birds are. Let's see you put this in and see what they say to it.

Best 73's.

Ingham S. Roberts, 5ZT.

Pipes for Aerials

Washington Apts.,
Detroit, Mich.

Editor, QST:

The following may be helpful to those who are unable to put up a receiving aerial.

Using the gas pipes of the apartment as an aerial and the radiator for a ground connection, with my hook-up which was published on page 28 of QST for December, 1919, I hear practically all of the east coast and gulf coast and ship stations, as well as the amateurs. Following are a few of the C.W. amateurs heard: 2XK, 3VV, 2AJF, 2ACT, 4GL, 2RR, 2BFZ, 3ZY, and numerous 8's and 9's. I might add that C-4 in diagram can be dispensed with and a straight connection from primary to A-battery side of secondary is all that is necessary.

Respectfully,
H. V. Simmons.

Spark Coil Work

167 Savin Hill Ave.,
Dorchester, Mass.

Editor, QST:

Little has been said about Spark Coils in QST, perhaps from lack of activity or because nobody has the nerve to start something going about them. The following is a report of some of my work:

I have been heard by 1OE, 70 miles; 1ADL, 50 mi.; 1ZE, 50 mi.; 1BYS, 54 mi.; and 1UN, 30 mi., and a few other equally distant stations. Work stations up to 25 miles in the summer months when QRN is in full swing.

My transmitter consists of ½" spark coil (not radio coil), 6-volt storage battery, home-made glass plate condenser consisting of 10 sheets of copper foil 3½" x 4½"; helix; all connections including lead-in and ground lead of ½" copper ribbon; longest lead in transmitter is 5". Antenna current is 0.3 amp. but do most of my DX with 0.2 amp. using a 60-cycle note. Aerial is 50 ft. 4-wire flat-top on top of two-family house, which gives me no room for a counterpoise.

I am sure that surprising results can be obtained with any spark coil if a little time is taken and the set carefully tuned. Of course it is a well known fact that a spark coil when properly tuned is much more efficient than a transformer is, considering the input used. I would like to see more about spark coils and their activities in QST, and am sure that the other spark coil ops would too. There ought to be a column in QST devoted exclusively to spark coils. The fellows could send in their ideas, etc., so that other coil ops would benefit from this section.

Hoping this reaches to the bottom of T.O.M.'s heart, I remain

Yours for the spark coil,
George Forant, 1AWF,
Vice-Pres., Greater Boston Spark Coil Club.

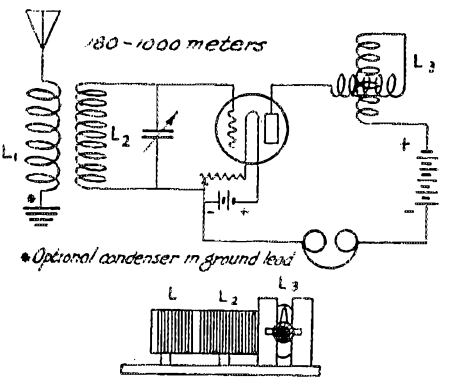
(Well, fellows, send in your spark coil ideas and if enough material can be secured we will start a regular department for the boxes.—Ed.)

Another Simple Circuit for C.W.

Radio 8AVX, Camp Dudley,
Westport, N. Y.

Editor, QST:

We are enclosing diagram of a short-wave regenerative circuit designed by 2XK



which has been used at this station this summer with great success. This circuit

brings in C.W. stations much better than anything else we have tried, and is also very efficient for spark signals.

The only tuning control is a variable condenser across the secondary. The diagram is self-explanatory and no one should experience any difficulty in obtaining good results from this set.

Yours truly,
William S. Halstead, "DC".

LEGEND

L_1—Primary coil, 20 turns No. 18 bell wire on 3" tube.

L_2—Secondary coil, 50 turns of same size wire on same tube, with ⅛" space between. Both coils must be wound in same direction as stator of the variometer.

L_3—Variometer plated next to coil so that axes coincide.

Note—If set will not oscillate at all points on the variable condenser, reverse the secondary leads to the condenser.

AN AMATEUR IN PORTO RICO

(Concluded from page 48)

of transformers and they all burned out, but at last his home-made ones with No. 40 enameled wire work fine, using a leak across the primaries and grounded.

The antenna is inverted L in type, 65 ft. long, between two bamboo poles 35 ft. high, well insulated with electrose. The loop gives good results as a direction finder and signals from WSO, WII, WGG, etc., are easily readable on it. Very good results are had on all wave lengths above 600 meters but Mr. Agusty makes no mention of hearing shorter waves. He is building a ½ k.w. spark set, a 15-watt C.W. set, and a short-wave regenerator, in order that he may connect up with amateurs of the 4th district in the States. Porto Rico, it should be remembered, is also part of the Fourth U.S. District, altho Cuba is not. The distance to Savannah is about 1200 miles, not at all unsurmountable. If Mr. Augusty will get a good C.W. set and receiver it looks like we might soon be able to accept Porto Rican traffic via 4GL.

ROTTEN BUNK

(Concluded from page 45)

thought about the evening, I give up. Between the arsi ishibigs, the spitchslops and the paralyzed higspitters, I will bet they never slept a wink. I hate to think of the Day of Judgment, when Radical presents his ticket at the Golden Gates, and St. Peter takes a slant at him, and asks about all that rotten radio bunk he has been guilty of on Earth. Radical's ticket will be refused at the gate and he will have to take a train going in the other direction. And by Heck, he will find a lot of others on the same train, according to my way of thinking.

Well, that will be all for to-night, Son. Seems like old times to be unloading my troubles again onto you. GN and best 73's to the gang.

T.O.M.

NOTICE—*(Concluded from page 34)*

The Atlanta Radio Club has not been able to substantiate their statements that Mr. Autrey used the name of the National Radio Insitute other than as an authorized agent of that firm and that he made use of the title "Radio Superintendent", as made in the resolution in question. QST therefore wishes to retract these statements and to make public apology for their publication.

CALLS HEARD

(Continued from page 59)

1AZK, 1BDT, 1BGF, (2BK), 2BQ, (2DA), 2DN, 2EL, (2FP), (2OM), 2RU, 2TS, 2WB, 2AJE, 2AJW, 2AQI, 2ARY, 2CAP, 3AC, 3BS, 3DM, 3EL, 3HD, (3HJ), (3IW), 3JJ, 3KM, 3LP, 3MS, 3QN, (3RW), 3SQ, 3UC, 3WC, 3XF, 3ZO, 3ZV, 3ACE, 3AOV, (3AQR), 3ASE (3BFU), 4AG, 4AW, 4BE, (4BQ), 4BY, 4CG, 4CX, 4DQ, (4DH), 4DR, 4FD, 4GN, 5BM, 5DA, 5DJ, (5EK), (5ER), 5FO, (5FV), 5HK, 5HY, 5JD, 5JO, 5JR, 5LO, 5QI, 5QQ, 5SO, 5SW, 5XA, 5XK, 5XU, 5YI, 5ZL, 5ZX, 6WV, 7XD, 7ZU, 8AC, (8BO), 8BP, 8CF, 8CI, (8CV), 8DH, 8DR (8DZ), (8EA), (8EB), 8EF, (8EZ), 8FI, 8FN, 8FQ, 8FS, (8FT), 8GO, 8GX, 8HB, 8HM, 8HU, 8HY, 8ID, 8IN, 8JJ, 8JU, 8ML, 8MM, 8MR, 8NZ, 8OI, 8QF, (8RQ), (8RU), 8SP, 8TN, (8TK), (8TY), 8TZ, (8UC), 8UG, 8UP, 8VQ (8WA), 8WE, (8WZ), 8XE, (8YK), (8YM), 8YN, 8ZD, 8ZN, 8ZR, 8AAV, 8ACF, 8ACN, (8ACY), (8ADE), 8ADO, 8AER, 8AEY, 8AFB, 8AFD, 8AFG, (8AFS), 8AGK, 8AGO, 8AHH, 8AHV, 8AHY, 8AIA, (8AIB), 8AIM), 8AIO, 8AJB, (8AJE), 8AJQ, (8AJV), 8AJT, 8AJW, (8AJX), (8AMJ), (8ANO), 8ANQ, (8ANY), 8AQV, 8ARB 8ARD, (8ARS), 8AWP, 8AXC, 8AYN, 8AVP, 8BCC 8BCO 8DBO, 8BDP, 8BDY, 8BEF, (8BEN), 8BEP, (8BGF), 8BHO, 8BHR, 8BIA, (8BIS), (8BKT), 8BKT, (8BKN), 8BMR, (8BMW), (8BNA), 8BOG, 8BOV, (8BRL), 8BTV, 8BUK 8BUN (8ZAA), (9AF), 9AP, 9AU, 9AV, 9AW, 9BE, 9BF, (9CP), (9CS), (9EG), 9EL, 9ET, 9FS 9FZ, 9GP, (9GX), 9HD, 9HM, 9HN, 9HR, 9HT, 9KM 9KO 9KR, 9KS, 9LF, 9MC, (9ME), 9MK (9MS), (9NQ), 9OV, (9OX) 9PC, 9PD, 9PS 9QB, 9QV 9RY 9TI, 9TV (9UH), 9US, (9UU), 9VG, 9VK (9VL), 9VV 9WI 9WT, 9WU, 9XI, 9XM 9XR 9YA, 9YB 9YH, 9YM, 9YO, 9ZB, 9ZC, (9ZJ), (9ZN), 9ZR, 9AAE, 9AAP, 9AAV, (9AAW), 9ABA, 9ABH, 9ACN, 9AEG, 9AEQ, 9AEY 9AFC 9AFF, 9AFK, 9AGG, 9AGR, 9AIC, 9AIO 9AIR (9AIU), 9AIY, (9AJA), 9AJE, (9AJH), 9AKD, 9AKT, (9ALH), (9AMA), 9AMK, 9AMS, 9AMT 9AMV 9ANC 9ANK, 9ANP 9AOJ, 9AOU, (9APK), 9APQ, 9APS, 9AQE, (9AQM), (9ARG), 9ARI, 9ARX, (9ASJ), 9ASN, 9AUG, 9AUO, 9AUU 9AVP 9AWU (9AWZ), (9AXU), (9AYH), 9AYK 9AYY, 9AZC (9AZE), 9BCX, 9BDE, 9BDS, 9BDU 9BED, 9DBU, 9DDU, 9DEF, 9DKV, 9DMJ, 9DMW, 9DPH, 9DQQ, 9DQY, (9DRJ), 9DUD, 9DUG, (9DWM), 9DXM, 9DYA, 9YAE (9ZAC).

C.W.: 1BM, 1RU, 1RZ, 1XF 1XM 1ANO 1CAE, 2DN, 2EL, 2EM, (2FP), (2KL), 2KP, 2OE, 2RU, 2ZI, 2ZZ, 2AHL, (2AWJ), 2AWZ 2AYZ 2BQH, 3BZ, 3EM, 3HD, 3HG, 3HJ, 3MO, 3RF, 3SQ 3ZO, 3AHK, 3AJD, 3AWL, 4BK, 4BQ, 4BY, 4CD, 4CO, 4FF, 4GL, (5DA), 5BK, 5BO, 5CI, 5DR 5DX, 5FB, 5HJ, 5HM, 5II, 5IQ 5IV, 5JQ, 5LE, 5LF, 5LX, 5NQ, 5RQ, 5RU, 5SE, 5SP, 5TN, (5UJ), 5UK, 5UX, 5UQ 5VQ, 5XK, 5XM, 5ZD, 5ZL, 5ZR, 5AIO (5AJX) 5AKS 5AIE, 5AOA, 5APT, 5AQZ, (5AVH), 5AWP 5AZE 5BDU, 8BEF, 8BJV, 8BOX, 8BPL, 9IO 9RV, 9XI, 9ZB, 9ZJ, 9ZL, 9ZY, (9AJA), (9AWZ).

8BPP, Wooster, Ohio.

1AAP, 1ABY, 1AGI, 1AW, 1AWB, 1BDC, 1BKA, 1CAK, 1CG, 1CGG, 1FF, 1GV, 1IT, 1MB, 1QN, 1RU, 1UN, 1XM, 1YK, 2ABD, 2ADL, 2AFP, 2AJF, 2AJW, 2AKO, 2AQL, 2AWL, 2AYZ, 2BA, 2BAK, 2BGH, 2BGM, 2BK, 2BM, 2BYS, 2CI, 2DA, 2DN, 2FP, 2FS, 2KL, 2OE, 2PZ, 2UN, 2WP, 2XA, 2XO, 2XQ, 2ZL, 2ZV, 3AAE, 3ABI, 3ABP, 3ADT, 3AFU, 3AHK, 3AQR, 2AZP, 3BIY, 3BZ, 3CA, 3CC, 3JH, 3JL, 3MO, 3PB, 3RF, 3XA, 3XM, 3ZA, 3ZN, 3ZO, 3ZY, 3ZZ, 4AS, 4BQ, 4BY, 4CO, 4DH, 4DR, 4EH, 4FD, 4FF, 4GL, 4LE, 5DA, 5ER, 5FJ, 5LA, 5XA, 5XB, 5XK, 5ZAB, 5ZL, 5ZR, 5ZZ, 8AAV, 8AAZ, 8ABO, 8ACF, 8ADO, 8ADS, 8AFB, 8AFD, 8AFG, 8AFO, 8AFV, 8AGB, 8AGK, 8AHH, 8AHR, 8AHV, 8AIO, 8AJW, 8AKE, 8AKJ, 8AKS, 8AKW, 8ALB, 8AMB, 8AMK, 8AMZ, 8ANO, 8ANW, 8AOZ, 8APB, 8APP, 8AQF, 8AQL, 8AQV, 8AQZ, 8ARD, 8ASH, 8AWF, 8AWK, 8AWP, 8AWU, 8AXC, 8AXN, 8AY, 8AYN, 8AYS, 8BA, 8BAH, 8BCH, 8BCL, 8BCO, 8BDU, 8BEF, 8BEP, 8BFH, 8BFM, 8BGF, 8BK, 8BMF, 8BNZ, 8BO, 8BOW, 8BOX, 8BP, 8BQ, 8BQF, 8BRC, 8BSY, 8BUM, 8BWC, 8CI, 8DE, 8DR, 8DV, 8DY, 8DZ, 8EA, 8EZ, 8FB, 8FI, 9FO, 8GE, 8GO, 8HA, 8HJ, 8HY, 8II, 8IN, 8IP, 8IQ, 8JL, 8JM, 8JP, 8JQ, 8IU, 8KM, 8LF, 8LI, 8LJ, 8LX, 8MM, 8MK, 8MZ, 8NQ, 8OH, 8OI, 8PD, 8PN, 8QM, 8QP, 8QY, 8RQ, 8RU, 8SP, 8TG, 8TJ, 8TK, 8TR, 8TZ, 8UC, 8UI, 8UJ, 8UK, 8UX, 8VJ, 8VY, 8WO, 8WY, 8XE, 8XK, 8XM, 8XU, 8YA, 8YN, 8ZA, 8ZB, 8ZG, 8ZN, 8ZR, 8ZZ, 9AAP, 9AAS, 9AAW, 9ABS, 9ACL, 9AGR, 9AIR, 9AIU, 9AJA, 9AKK, 9ANC, 9ANK, 9AOU, 9APK, 9ARG, 9ARK, 9ARX, 9ARZ, 9ASJ, 9ATN, 9AUL, 9AV, 9AWU, 9AWZ, 9AYN, 9AYW, 9BDE, 9BEH, 9CP, 9DBJ, 9DJX, 9DZG, 9ET, 9FA, 9FN, 9FS, 9GL, 9HD, 9HI, 9HM, 9HR, 9IO, 9KR, 9LF, 9MC, 9ME, 9MO, 9MP, 9OX, 9PC, 9PN 9RM, 9RT, 9TL, 9TO, 9UH, 9UN, 9VD, 9VZ, 9WO, 9XAE 9XAH, 9XAK, 9XI, 9XM, 9YB, 9YO, 9ZB, 9ZJ, 9ZN, 9ZY, Can. 3BP, 3KG.

8DE, Akron, Ohio

Spark: (1ADL), 1AW, 1BFZ, (1BGF), 1BIR, 1CK, 2ARM, 2AJE, 2AQI, 2AWF, 2BK, 2CAP, 2DN, (2EL), 2FP, 2JU, 2LR 2OM, 2WB, 3ACM, 3AIC, 3AOV, 3AQR, 3CC, 3CN, 3HJ, 3HS, 3HX, 3IW, 3LW, 3MC, 3OU, 3PU, 3XF, 3XM, 3ZO, 4AS, (4BE), 4BQ, 4CX, 4FD, 4GN, 5DA, 5EK, 5ER, 5FJ, 5FV, (5JD), 5XA, 5XK, (5ZAB), (5ZL), (8AAV), (8AFB), 8AFD, (8AFG), 8AIM, 8AJT, (8ALL), 8AMB, 8ANO, 8AQV, (8AXC), (8AXR), 8BBW, 8BCL, 8BEP, 8BFV, 8BRL, 8BSY, 8DV, (8GW), 8FI, 8HG, 8HP, (8HU), 8IN, (8III), (8MM), 8MZ, 8NZ, 8OI, 8QH 8TT, 8VC, (8XE), 8YN (8ZA), 8ZD (8ZN), 9AAW, 9AGR, 9AIJ, (9AIR), 9ALP, 9AQM 9ASJ, 9AWZ, 9AV 9AYW, 9AYY, 9BDS 9CP, (9DRW) 9DMM, 9DYU, 9FS, 9GX, 9JQ 9LK 9LQ 9MC 9ME 9TL, 9TV, 9UH, 9UU, 9UW, 9WU, 9ZJ, 9ZN, Can. 3BP, 3JL.

C.W.: (1AGI), 1BEP, 1QN, 1RZ, 1UN, (2AFP), (2AWL) 2BAD 2BGH (2BYS), (2DN), (2EL), 2FD 2MO (2WP), 2ZV 3ADT, 3AFU, 3AHK, 3APU 3ASK 3BIY, (3BZ) 3CC, (3FS), (3HJ), 3MO, 3RF 3ZY, 4BL, 4BT, 4BY, 4EH, 4EN, (4FF), (4GL), 4ZE 5LA 5ABO, 8ACF, 8ADY, 8AFO, 8AJP 8AKE, (8AKJ), 8AKS, 8ALY, 8AQF, (8AQZ), 8ARK, 8AWF 8AWP, (8AWX), (8BCI), 8BDP, (8BDII), 8BEF 8BOW, 8BOX 8BUM, 8DR, (8GW), 8IM, 8JQ (8JS) (8III), 8KM, 8LV, 8NX, (8NQ), 8OH, (8OI), 8PN, 8QM 8QY, 8TN 8WY, 8XM, 8ZG (8ZN), 8ZV, 9ARK, 9AS, 9DAR, (9GL), (9HD), 9HY, (9LQ), 9XAH, 9ZY, Can. 3BP.

8AYM, Jamestown, N. Y.

Spark: 1AW 1ARV, 1ASE, 1GM, 1HK, 1BDC, 1BVB, 1OE, 1ZE, 1ZV, 2AIM 2AQI 2AJE, 2BK, 2BM, 2DA, 2EI, 2FP 2EL, 2IH, 2JU, 2IZ, 2OM, 2RM, 2SQ, 2TS, 3ACE, 3AIC, 3AQR, 3ARN 3BDU, 3CC, 3CG 3CP, 3DW, 3HI 3IW, 3KM, 3LP, 3OU, 3PU, 3UK, 3ZF, 3XM, 3ZV, 4EY, 4FD, 4GN, 4YA, 5DA, 5AE, 8AAV 8AFD, 8AGK, 8AFA, 8AHH, 8AHU 8AHV, (8AIS), 8AFS, 8ACF, 8AJV, 8AKY, 8AMB, 8ANW, 8AOI, 8AQT, 8AJT, 8AGY, 8APB, 8AOL, 8AOV, 8ARK, 8ASV, 8ASZ, 8AWT, 8AWU, 8AWX, 8AXC, 8AXN 8AYN 8AYS (8ASL), 8AWP, 8AVT, 8BBU 8BCO, 8BDV, 8BDI, 8BGI 8BIW, 8BMA, 8BCK, 8BUN 8BRL, 8BO, 8CN, 8DY, (8CH), 8EZ, 8EW 8EA, 8FI, 8GW 8HP, 8HU, 8ID, 8IN, 8JU, 8LW, 8MM, 8OI, 8RU, 8SP, 8SH, (8TJ), 8TT, 8NZ, 8RQ, 8UP, 8TK, 8VH, 8XE, 8XM, 8YN, 8ZA, 9AIR 9AJH, 9ANC, 9AOU, 9ARI, 9ASJ, 9ASN, 9AZF, 9DWM, 9CP, 9FN, 9FS, 9FW, 9HR, 9OR, 9OX, 9MC, 9UH, (9UU), 9YAE, 9ZJ, 9ZN, Canadians 3BP, 3BR, 3EI, (3JL), 3KG, 8KS.

C.W.: 1AZD, 1CAK, 1RZ, 2AJF, 2AJW, 2FP, 2KL, 2AWL, 3AFU, 3AJT, 3HJ, 3XZ, 4GL, 8AFD, 8ACF, 8AIO, 8AWP, 8AQF, 8BMA, 8CI, 8DE, 8DR, 8HJ, 8PU, 8WY, 8XM, NZO.

8BUM, Syracuse, N. Y.

Spark: 2OM, 3AC, 3AQR, 3HJ, 3IW, 3KN, 3OU, 4GN, 5HJ, 5ZL, 8ACF, 8ADQ, 8AFA, 8AFD, 8AFT, 8AHH, 8AHX, 8AJV, 8AL, 8AMP, 8APB, 8AUC, 8AVT, 8AXC, 8AXF, (8AXI), 8AYN, 8BAH, 8BBU, 8BEP, 8BGJ, 8BIN 8BR, (8BRA), 8BRL, 8BTX, 8BUZ, 8BVA, (8BWH), 8CI, 8EW 8FI, 8HI, 8HP, 8HU, 8HY, 8IL, 8IN, 8ML, 8MZ, 8OI, 8PEC (QRA PSE), 8RI, 8RQ, 8SP, 8TK, 8TT, 8UC, 8XE, 8YN 8ZD, 8ZY, 8ZZ, 9AAW, 9AAY, 9AF, 9AJH, 9ASJ, 9AV, 9AWU, 9AWZ, 9AXC, 9CP, 9HM, 9HR, 9IQ, 9MC, 9ME, 9MGG, 9MQM, 9PC, 9UU, 9VL, 9XM, 9YB, 9YM, 9ZJ, 9ZL, Can. 3BP.

C.W.: 1AWB, 1AZD, 1BDI, 1CAK, 1CK, 1DY, 1FP, 1OE, 1RU, 1RZ, 1TS, 1UN, 1XB, 1XE, 2AAE, 2AFP, 2AKY, 2AWL, 2BGH 2BQH, 2BYS, 2DN, 2EL, 2FB, 2FD, 2FP, 2GV, 2HI, 2KL, 2OE, 2QR, 2WP, 2ZE, 2ZG, 2ZJ, 2ZL, 2ZR 3AAY, 3ABI, 3AFU, 3AHK, 3BA, 3BIY, 3BZ, 3CC, 3EM, 3FM, (3HJ), 3IN, 3IW, 3MO, 3RF, 3XM, 3ZN, 3ZO, 3ZY, 3ZZ, 4BY, 4CO, 4GL, 4FF, 4II, 5DA, 5ZA, 8AAZ, (8ARO), 8ABP, (8ACF), 8ADD, (8ADG), 8ADN, 8AEG, 8AGG 8AGZ, (8AIO), 8AJU 8AJV 8AKE, 8AKA, 8ALE, 8AMQ, 8AND, (8ANO), (8AOA), 8AOG, 8AOJ, 8APP, 8AQF, 8AQV, (8AQZ), 8ARD, 8ARK, 8AUO, 8AWO, (8AWP), 8AWX, 8AYW, (8BCI), 8BD, (8BDP), 8BDU, (8BEF), 8BFG, (8BFX), 8BFZ, (8BIN), (8BIP), 8BJC, 8BJV, 8BK), 8BNE, 8BNJ, (8BNY), (8BO), 8BOW, (8BOX), 8BPD, 8BRC, 8BRI, 8BSS, (8BWL), 8BWT, 8BXA, 8DE, 8DR, 8DX, 8EA, 8FB, 9FD, 8FG, 9FN, 8FQ, 8GE, 8GV, 8HJ, 8HY, (8IB), (8II), 8IQ, 8IV, 8JL, 8JM, 8JQ, 8JU, 8KM, 8LF, 8LJ, 8LV, 8LX, 8ML, 8NQ, 8OH, 8PD, 8PX, 8QM, 8QQ, 8QY, 8RA, (8RQ), 8SE 8TD, STG, 8TN, 8TO, 8UJ, (8UK), 8UY, 8VJ, 8VY, (8WY), 8XK, 8XM, 8XV, 8YG, 8YN, 8YX, (8ZD), 8ZG, 8ZV, 8ZZ, 9AAP, 9AAS, 9AAV, 9ABU, 9ACO (9AJA), 9AMB, 9ANE, 9AQR, (9ARK), 9ASB (9CA), 9CR, 9DAB, 9DVA, 9EK, 9GL, (9HD), 9IO, 9LQ, 9LV, 9OA, 9RM, 9RT, 9RV, 9WS, 9XAH, 9XI, 9XM, 9ZAE, 9ZB, (9ZJ), 9ZY, Can. 3BP, 9AW.

8AFD, Clarksburg, W. Va.

Spark: (1GM), (1ZE) (1AMN) (1AVV), (1BDC), (2BK), (2BM), (2EL), (2IW), (2OM), (2AIM), 2AJE), (2AQI), (3AC), (3BP Canadian), (3BG), (3CN), (3EZ), (3HJ), (3HX), (3IW), (3JL Canadian), (3OU), (3PU), (3QW), (3US), (3XF), (3AQR), (3BFU), (4CX), (4GX), (5EK), (5FV), 5ZA, (8AY), (8BA), (8BK), (8BO), (8DV), (8CC), (8EA), (8EB), (8EF), (8EZ), (8FA), (8FI), (8HU), (8JJ), (8JU), (8MM), (8OI), (8OQ), (8RQ), (8SP), (8TK), (8TZ), (8TT), (8WO), (8XE), (8YN), (8ZA), (8ZD), (8ADE), (8ADO), (8AIB), (8AIK), (8AIM), (8AJV), (8AMB), (8ANO), (8APB), (8ARD), (8ARS), (8ASV) (8AVO), (8BBA) (8BBU), (8BCO), (8BDO), (8BHV), (8BKN), (8BMU), (8BPU), (9AP), (9ET), (9FS), (9GC), (9HP), (9IO), (9ME), (9OX), (9PC), (9QH), (9TV), (9UH), (9UU), (9VV), (9ZJ), (9ZN), (9AAP), (9AGR), (9AGG), (9AIR), (9AMT), (9APS), (9AQA), (9ASJ), (9AWU), (9AWZ), (9BDE), (9DQQ), (9MRG).

C.W.: (1CAK), (3BZ), (3CC), (4GL), (8BK), (8II), (8SE), (8VJ), (8VY), (8XY), (8AJP), (8AQF), (8AWP), (8BRV), (8BUL), (9UC), (9ZB).

8QY, Mt. Clemens, Mich.

All C.W.: (1PT), 1PY, 1ON 1RZ, 1TS, 1UN, 1XM, 1AGI, 1AKB, (1ANQ), 1BES, 1BWJ, (1BYX), 1CAK, 2EL, 2FD, 2FP 2KL, 2PE, (2MW), 2ZE, 2ZL, 2ZV, 2ABP, 2ABQ 2AFP 2AWK, 2AWL, 2BAK, 2BGH, 2BGM 2BYS 3BZ, 3CC, (3MO), (3RF), 3ZN, 3ZO 3ZT (3ZY), 3AEE, (3AFU), 3AHK, 3ARJ, 3ARQ, 4RT, 4BY, 4FF, 4GL, 4LE, 5IA, (8DE), 8DR 8DV, 8DZ, 8FO, 8GE, 8IQ, 8JS, 8LJ, 8LX, 8NQ, 8OA, (8OI), 8OW, 8PN,

8PU, (8VJ), 8VY, 8WY, 8XK, 8ZG, 8ZN, 8AAZ, 8ACF, 8ADG, 8ALE, 8AMW, 8AMQ, 8AMF, (8AQF), 8AWP. (8BEF), 8BCI, 9AA, 9AW, 9HD, 9HY, 9RT, 9UC, 9XI, 9ZY, (9AAS), 9AAV, (9AJA), 9AMB, 9ARK, 9AVN, 9XAH. (2BF) Can.

9OX, Louisville, Ky.

(1AW), (2BK), (2DN), 2FP, (2OM), (3HJ), (3IW), 3AS, (4BQ), 4CX, (4DH), (4DZ), (4FD), (4GL C.W.), (4GM), 5EK, 5ER, 5FJ, 5FV, (5HK), (5QI), (5XA), (5ZAB), 5ZL, 6KA, 7XD, (8AL), (8AFD), 8AGK, (8ANO), 8AOI, (8AQV), 8BCO, (8BO), 8BOX C.W., (8BBU), (8BDY), (8BRL), 8CI I.C.W., (8CP), 8DE, (8EA), (8EZ), (8FI), (8FT), 8II, (8IN), (8JP), (8MR), 8OL (8SP), (8TT), (8UJ), (8WA), 8XE, (9AAE), (9AAW), 9AEG, (9ARK), (9AGG), 9AIR (9AJH), (9ALH), (9ALU), (9AMA), (9ANO), (9ARG), (9ARI), (9ASJ), (9ASN), (9AUO), (9AWZ), (9AZE), 9EE, (9CP), (9DEH), (9DRJ), (9DUG), (9ET), (9HT), (9LQ), 9MC, (9ME), (9NQ), 9PS, (9UU), (9VV), (9WT), (9YM), (9ZN), Can. 3BP. All districts.

9DMA, Caledonia, Minnesota.

3BP (Can.) 1XM, 2BK, 2FD, 2FP, 2KL, 2RP, 2ZL, 2ARP, 2AWL, 2BIY, 3ZO, 3ZY, 4BQ, 4CB, 4CD, 4CO, 4FF, 4FJ, 4GL, 5BM, 5BQ, 5DA, 5EB, 5EK, 5ER, 5FO, 5FV, 5HK, 5IR, 5JD, 5LA, 5LD, 5MF, 5PM, 5QQ, 5SM, 5XA, 5XB, 5XJ, 5XU, 5YL, 5YZ, 5ZA, 5ZL, 5ZO, 5ZU, 5ZX, 5ZZ, 5ZAG, 5ZAM, 6WV, 7EX, 7LK, 7ME, 7YA, 7ZU, 7ZO, 8BA, 8BO, 8BP, 8BR, 8CI, 8DE, 8DR,8DZ 8EZ,8GV, 8FI, 8FS, 8FT, 8II, 8IQ, 8IV, 8JL, 8KM, 8LF, 8LU, 8LX, 8MD, 8NQ, 8RQ, 8RU, 8SF, 8TK, 8TN, 8TZ, 8UC, 8UK, 8UJ, 8VJ, 8VY, 8WY, 8XK, 8XM, 8YA, 8YJ, 8YN, 8ZD, 8ZG, 8ZN, 8ZW, 8AAZ, 8ACF, 8AFD, 8AFS, 8AIO, 8AIM, 8AKE, 8AKF, 8AKS, 8ANY, 8AOA, 8APB, 8APN, 8AQF, 8ARZ, 8AWP, 8AYN, 8BAF, 8BCI, 8BDU, 8BFX, 8BJC, 8BLI, 8BOU, 8BOX, 8BRC.

9AGR, Crown Point, Ind.

C.W.: 1CAK, 1AWY, 2AWL, (2FP), 2KL, 3EM, 3GA, 3HG, 3ZZ, 4GL, 8AAZ, 8ACF, 8AIO, 8AOA, 8BEF, 8BOX, 8DE, (8II), (8IQ), 8LU, 8UJ, 8UK, 8XM, 9ZY.

Spark: (2BK), 2BF, (2FP), (2JZ), (2OM), (3AQR), (3CC), (3HJ), 4BQ, 4DR, 5DA, 5EK, 5FO, 5FV, 5FW, 5HK, (5XA), 5ZA, 5ZAB, 8ACD, (8AFB), (8AFD), 8AFS, 8AGK, (8AIB), (8AMB), 8ARS, 8AWS, 8AWO, 8AWU, (8AYN), (8AYS), (8AZG), 8BBU, (8BCO), (8BEP), 8BET, 8BKN, (8BOG), 8BRL, 8BA, (8CP), 8EA, (8EB), 8EF, (8FT), 8FI, 8HG, 8IN, 8JU, 8MZ, (8RQ), 8RU, (8SP), 8TK, 2TZ, 8UC, 8WR, (8XE), 8YN, 9ADU, 9AEG, (9AEY), 9AFF, 8AFW, 9AFX, 9AGG, 9AIF, (9ALU), 9AMK, 9AOJ, (9AOU), 9AQE, (9AQM), 9ARG, 9ARS, (9ASJ), (9ASN), 9ATN, 9AUO, 9AWU, 9AXK, (9AXU), (9AZA), (9AZE), 9BDE, 9DBW, 9DEA, (9DEH), (9DHG), 9DKR, 9DQQ, (9DRJ QRA PSE?), (9DSD), 9DUG, (9DYZ), (9CS), 9ET, 9FS, 9GC, 9GX, 9HI, (9HM), 9HR, (9IY), 9LA, 9LF, (9LQ), 9MC, 9ME, 9MS, 9NQ, (9OX), 9PC, (9PS), (9TO), (9UH), 9VZ, 9WT, 9ZC 9ZJ, (9YAK), (9ZAC), Canadian (3BP), 3JL.

9CP, Hammond, Ind.

1ARY, (1AW), (1AZK), 1BDC, 2AJE, (2BK), (2DN), 2EL, (2FP), (2JU), 2JZ, (2OM), 2TS, 3ACE, 3AQR, (Can. 3BP), (3HJ), 3HX, (3IW), 3KM, 3UC, (4BQ), 4DH, 4GN, 5BM, 5DA, 5ED, 5EK, 5FO, (5FV), (5HK), 5IF, (5JD), 5QI, 5RZ, (5XA), (5ZAB), 5ZAM, (5ZL), 7XD, 8ACF, (8ADE), (8AEZ), (8AFB), (8AFD), (8AFS), 8AGK, (8AIB), (8AJV), (8AKV), (8AL), 8AMP, 8ANO, 8ANY, 8ARD, (8ARS), 8ASV, (8ASZ), (8AWP), (8AWU), (8AYN), (8AYS), 8AZG, (8BBU), (8BCO), 8BDY, (9BEN), 8BEP, (8CH), (8BO), 8CI, 8DZ, 8EA), 8EB, 8EF, (8EW), 8EZ, 8FI, 8BRF, (8FT), 8GW, 8HG, 8HY, (8ID), (8IN), 8JJ, (8MC), (8ML), (8OI), (8PM), (8RQ), (8RU), 8SP), (8BOG), (8TJ), (8TK), (8TT), 8TY, (8TZ), 8UC), (8UP), (8VQ), 8WA, (8YN), 8ZN.

C.W.: (2AWL, (2FP), (2KL), 3EM, (3HG), 3ZY, 4GL, (8AAZ), 8AIO, 8AOA, (9AWP), 8AWX, (8BEF), 8BOX, 8DE, 8DX, 8II, (8IQ), 8LX, 8NQ, 8UJ, 8VJ, 8WY, 9AAS, 9IO, 9ZB, (9ZY).

9UU, Chicago.

Spark: 1AW, 1ARY, 1BDT, (2BK), (2DN), (2FP), (2JZ, (2OM), 2TS, (2UE), (3HJ), (3HX), (3IW), (3AQR), Canadian (3BP), 3JL, 4BQ), (4CX), (4DH), 5EK, (5ER), (5FO), (5FV), 5HK, (5NK), (5XA), 5ZL, 5ZA, 5ZAB, (8AL), (8BO), 8DR, (8EA), (8EZ), (8FI), 8FT, (8GW), (8HG), (8HU), (8ID), 8JH. (8LW). (8JQ), (8NZ), (8OI), (8RQ), (8RU), (8TK), (8TT), (8TZ), (8SP), (8UC), (8UP), (8VQ), (8XE), 8YN, (8ZA), 8ZD), (8ACF), 8ACY, (9ADE), 8AEZ, (8AFB), (8AFD), (8AFS), 8AGK, 8AHH, (8AIB), (8AJE), (8AKV), (8ANO), (8AQV), (8ARS), (8AYN), (8AYM), (8AYS), (8ZAA), (8BBU), (8BCO), (8BDY), (8BEN), (8BRL), 9EL, 9ET, (9FS), (9GX), (9HM), (9HR), 9HT, 9KO, 9MC. (9ME), (9MS), (9NQ), (9OX), 9PC, (9PN), 9PS, 9QJ, (9TL), (9UH), (9VG), (9VZ), (9WT), (9XI), 8ZB, 9ZJ, (9AEG), (9AFF), (9AFX), (9AIF), (9AIR), (9AMT), (9AOU), (9AQE), 9AQM, (9ASJ), 9ASK, (9ASN), 9AUO, 9AXU, 9ZAC, (9DEH), (9DWM).

C.W.: 1TS, 1AKB, 1CAK, 2EL, (2FP), (2KL), 2XA, 2AJF, (2AWL), 2BYS, (3EN), (3HJ), 3ZY, (3AHK), 4BK, (4FF), 4GL, 5DA, 8BK, (8DE), (8II), (8IQ), 8JL, (8LX), (8UJ), (8VJ), (8VY), 8WY, 8ZB, 8ZG, 8ACF, (8AIO), 8AQZ, 8BCI, 8BDU, (8BEF), 8BPL, 9XM, 9ZY.

9AOG, Lawrence, Kansas

Spark: 4BQ, 5AL, 5EK, 5EW, 5FA, 5FO, 5FV, 5HK, 5HL, 5IF, 5IR, 5JD, 5JI, 5JR, 5LB, 5LO, 5NK, 5NS, 5PE, 5PP, 5PU, 5QI, 5QK, 5QQ, 5QS, 5QX, 5QY, 5XB, 5XI, 5XJ, 5XU, 5YL, 5YN, 5ZA, 5ZAB, 5ZAG, 5ZAK, 5ZAM, 5ZC, 5ZJ, 5ZL, 5ZN, 5ZS, 5ZT, 5ZU, 6ZZ, 7EA, 7MO, 7XD, 7ZO, 8ACF, 8AEE, 8AEZ, 8AIB, 8AYN, 8FI, 8GW, 8IN, 8LY, 8SP, 8UC, 8YN, 8ZD, 8ZN, 9AA, 9AAW, 9ABV, 9ACL, 9ACN, 9AEG, 9AFF, 9AFK, 9AFW, 9AFX, 9AHZ, 9AIR, 9AKC, 9AKY, 9AMA, 9AMD, 9AMK, 9AMV, 9ANF, 9ANO, 9ANQ, (9AOD), 9AOU, 9AQE, 9AQM, 9ARG, 9ARI, 9ARX, 9ARZ, 9ASJ, 9ASN, 9AUL, 9AUO, 9AVE, 9AVK, 9AWZ, 9AXU, 9AYL, 9AYW, 9AYY, 9BDS, (9BT), 9CP, 9DBU, 9DEH, 9DEO, 9DFL, 9DJB, 9DP, 9DPE, 9DQQ, 9DSN, (9DTA), 9DTS, 9DTU, 9DVF, 9DWP, 9DZP, 9EL, 9ET, 9FS, 9FU, 9FZ, 9GV, 9HI, 9HM, 9HR, 9HS, 9IY, 9JG, 9JQ, 9KA, 9KO, 9LW, 9MC, 9MS, 9ND, 9NF, 9NQ, 9OX, 9PN, 9PS, 9QJ, (9QO), 9RY, 9TI, 9TL, 9TV, 9UU, 9WI, 9WT, 9XAF, 9XI, 9XM, 9YA, 9YAB, 9YAC, 9YAE, 9YAK, 9YB, 9YM, 9YO, 9YW, 9ZAB, 9ZAC, 9ZAD, 9ZB, 9ZC, 9ZH, 9ZN.

C.W.: 2XA, 4CO, 4GL, 5ZA, 8AAZ, 8ACF, 8AQZ, 8AWP, 8BEF, 8BK, 8BOX, 8DE, 8DR, 8DZ, 8HA, 8II, 8IQ, 8LF, 8PN, 9QU, 8TN, 8VJ, 8VK, 8VY, 8WY, 8XM, 9AAV, 9AJA, 9ANE, 9AQR, 9ARK, 9ASD, 9AVN, 9AXJ, 9DHB, 9DKB, 9DKX, 9DJB, 9DTS, 9DYG, 9DZQ, 9EX, 9RT, 9RV, 9XI, 9XM, 9ZB, 9ZV, 9ZY.

9FK, Clinton, Iowa.

C.W.: 1UN, 2AWL, 3CA, 3ZY, 4FF, 8AAZ, 8ABO, 8ACF, 8AOA, 8AQF, 8ASO, 8AWP, 8BOX, 8DE, 8DX, 8GV, 8LA, 8TN, 8UK, 8UJ, 8VJ, 8VY, 8WR, 8XM, 9AAS, 9AJA, 9AMB, 9AMK fone, 9AQR, 9ARK, 9AVN, 9RV, 9ZY.

Spark: 4DH, 5EK, 5FO, 5HN, 5PP, 5XB, 5XI, 5XJ, 5ZA, 5ZT, 6KA, 7LU, 7XD, 7ZU, 8ACF, 8AFS, 8BRL, 8YN, 8ZAA, 9AAW, 9AEG, 9AFF, 9AHZ, 9AJH, 9ALU, 9AMK, 9ANO, 9AOU, 9APK, 9AQM 9ARY, 9ARZ, 9ASM, 9ASN, 9AUO, 9AUU, 9AYV, 9AYW, 9AWH, 9AWX, 9DQQ, 9DZA, 9DZJ, 9CC, 9HN, 9HT, 9MS, 9OX, 9PS, 9TB, 9UU, 9WU, 9XI, 9YAK, 9ZN.

9ANO, St. Joseph, Mo.

Spark: 5AA, 5AO, 5CO, 5EK, 5FO, 5FV, (5HK), 5HZ, 5IC, 5IF, 5IR, 5IQ, 5JR, 5JL, 5KI, 5LA, 5LB, 5LO, 5LR, 5LU, 5LX, 5LZ, 5MS, 5NK, (5NS), 5OF, 5PU, 5QA, (5QI), 5QM, 5QQ, 5RA, (5TA), 5TO, 5XA, 5XI, 5XJ, 5XU, 5XV, 5ZA, 5ZAB, 5ZAG, 5ZAM, 5ZC, 5ZI, 5ZL, 5ZS, 5ZT, 5ZU, 5ZX, 6ZZ, 6KA, 7ZU, 8AFS, 8AFD, 8AJU, 8ARS, (8AVO), 8AYN, 8AYR, 8EZ, 8FI, 8FN, 8FT, 8HG, 8HR, 8LU, 8TJ, 8WA, 8YN, 8ZU, 9AAW, 9ABU, (9ABV), 9ABW, 9AEG (9AEY), 9AFC, 9AFF, 9AFI, 9AFK, (9AFX), 9AGF, 9AGR, 9AHZ, 9AIF, 9AIJ, 9AIR, (9AJH), 9AKC, 9ALD, 9ALK, (9ALU), 9AMD, 9AMJ, 9AMK, 9AMN, 9AMV, 9ANF, 9ANQ, 9ANS, 9APK, 9AQE, 9AQM, 9ARG, 9ARI, 9ARR, 9ASJ, 9ASM, 9ATN, (9AUO), 9AVK, 9AWZ, 9AXM, 9AXU, 9AYY, (9AZE), 9AE,

9BDI, (9BT), 9DAC, 9DBS, 9DED, 9DEH, 9DFL, 9DFN, 9DHB,(9DJB), 9DPE, 9DPH, 9DPL, 9DQN, 9DQQ, 9DSD, 9DUG, 9DYA, 9DYU, (9DZJ), 9EE, 9EL, 9HI, 9HM, 9HT, 9IY, 9KA, 9KO, 9LF, 9MC, (9MS), 9NQ, (9OX), 9PL, (9PS), (9RY), 9SY, 9TI, 9TL, 9TV, 9WI, 9WN, 9WT, 9WU, 9XI, 9XM, 9YA, (9YAE), 9YM, (9YO), 9ZA, 9ZAC, (9ZAD), 9ZAM, (9ZH), 9ZN, 9ZW, 9ZX.

C.W.: 2ZY, 4GL, 5LA, 5XI, 6WV, 8AKS, 8BDU, 8DE, 8DR, 8DX, 8GL, 8II, 8LQ, 8TN, 8UJ, 8VY, 9ACR, 9AJA, 9ALZ, 9AMA, 9AMB, 9AOU, (9ASD), (9AQR), 9AVN, 9DPB, 9DVA, 9EK, 9FM, 9RV, 9VE, 9XAB, 9ZB, 9ZY.

9AQR, Kansas City, Mo.

Spark: 2OJ, 3KM, 4BQ, 4DH, 4FD, 4GN, 5AF, 5BM, 5EF, (5EK), 5ER, 5FA, 5FO, 5FV, 5HI, 5HK, 5HZ, 5IR, 5JD, 5JI, 5JR, 5KP, 5LB, 5LX, 5NK, 5NS, 5OF, 5QA, 5QI, 5QQ, 5QY, 5XA, 5XB, 5XI, 5XK, 5XU, 5XJ, 5YE, 5YL, 5YN, 5ZA, 5ZAB, 5ZAC, (5ZAG), 5ZAK, 5ZAM, 5ZC, 5ZL, 5ZO, 5ZS, 5ZT, 5ZU, 5ZW, 5ZX, 6GV, 6ZZ, 7MO, 7XD, 7ZO, 7ZU, 8CI, 8DZ, 8EZ, 8FI, 8FT, 8GV, 8HG, 8SP, 8XE, 8YN, 8ZA, 8ZN, 8AIB, 8AYN, 8BEP, 8BRL, Can. 3BP, 5HK.

C.W.: 1ANQ, 2AWL, 2EL, 2FD, 2FK, 2KL, 2QR, 2RF, 2ZL, 2FP, 3BQ, 3BZ, 3EM, 3RF, 3ZY, 3AHK, 3BIY, 4BB, 4BK, 4BY, 4GD, (4CO), 4FF, 4GL, 4XZ, 5DA, 5LA, 5XB, 5ZA, 6WV, 8BK, 8DE, 8DR, 8DX, 8FO, 8GN, 8II, 8IQ, 8IV, 8JQ, 8LF, 8LX, 8MK, 8NK, 8NQ, 8IB, 8QU, 8TA, 8TN, 8UJ, 8VJ, 8VY, 8WY, 8XK, 8XM, 8ZD, 8ZG, 8ZU, 8ZZ, 8ZV, 8AAZ, 8ACF, 8AIO, 8AOA, 8AQF, 8AQZ, 8AWF, 8AWP, (8BOX), 9AW, (9EK), (9EX), 9FA, 9HD, 9HY, (9IO), 9LQ, 9LV, 9RM, 9RT, 9RV, 9UC, 9WD, 9XI, 9XAH, (9YM), 9ZB, (9ZY), 9AAO, (9AAS), 9AAV, (9ABU), (9AJA), (9AMB), 9ANE, 9ARK, 9AWY, 9BAC, 9DAB, 9DTS, 9DVA, 9DYE, 9DYG, 9ZAF, 9VE.

9AHC, Ellendale, N. Dak.

C.W.: 2FP, 2ZV, 3BM, 3RM, 3ZO, 5YI, 6WV, 8AVH, 8AWP, 8BAC, QRA? 8CF, 8DE, 8DX, 8DZ, 8IQ, 8LX, 8NQ, 8OH, 8UJ, 8VJ, 8VY, 9AAV, 9AJA, 9ANR, 9ASD, 9DVA, QRA? 9JD, 9LQ, 9VE, 9ZY, 9AKX, 9PI, 9ZB.

Spark: Canadian 3BP, 5EK, 5ER, 5FO, 5HK, 5IR, 5JD, 5JR, 5LO, 5NS, 5XB, 5XJ, 5XU, 5ZA, 5ZL, 5ZX, 7FI, 7MO, 7XD, 7ZO, 8AGK, 8AYN, 8BO, 8DR, 8FI, 8YN, 8ZN, 9AAW, 9ABV, 9ACL, 9AEG, 9AEY, 9AFX, 9AHZ, 9ALK, 9AMA, 9AMK, 9AMS, 9ANF, 9ANP, 9ANQ, 9AOU, 9AP, 9ARZ, 9AUO, 9AXU, 9AYW, 9DBS, 9DEH, 9DFL, 9DFR, 9DJX, 9DTO, 9DUG, 9DUI, 9DWP, 9DWY, 9DZR, 9FL, 9FZ, 9GC, 9HM, 9HR, 9HT, 9II, 9KA, 9LW, 9MC, 9ME, 9NQ, 9PC, 9PN, 9PS, 9QH, 9TI, 9TV, 9UU, 9VL, 9WI, 9XI, 9XM, 9XO, 9YA, 9YAE, 9YAK, 9YB, 9YM, 9YO, 9ZAB, 9ZC, 9ZN, 9ZU.

9AVZ, Pierre, So. Dak.

C.W.: 4EB, 6WV, 8AAZ, 8ABO, 8ACF, 8AND, 8AQF, 8AQZ, 8AWP, 8BC, 8BEF, 8BO, 8BOX, 8BV, 8BVX, 8DE, 8GV, 8KM, 8OH, 8TN, 8VY, 8XK, 8ZY, 8ZZ, 9AAH, 9ABU, 9AJA, 9AMB, 9ANE, 9AQR, 9ARK, 9AVN, 9AXA, 9DKX, 9DVA, 9DYE, 9EK, 9GL, 9HD, 9RT, 9WH, 9XAC, 9XAH, 9XI, 9XM, 9ZB, 9ZY.

Spark: 5FO, 5FX, 5HJ, 5HV, 5JR, 5JD, 5ZA, 5ZL, 5ZO, 5ZU, 7ZQ, 7ZU, 9AAP, 9AAV, 9AEG, 9AEY, 9AFX, 9AIF, 9ANF, 9AOU, 9AP, 9AQM, 9ARI, 9ARZ, 9ASN, 9AWU, 9AXU, 9AYW, 9DEH, 9DOC, 9DUG, 9DZJ, 9EE, 9FZ, 9HN, 9LW, 9MC, 9NR, 9PI, 9PN, 9PS, 9RN, 9TI, 9VW, 9WI, 9WT, 9WU, 9YAE, 9YAK, 9YM, 9ZAC, 9ZC, 9ZJ, 9ZN.

9DV, Neenah, Wisconsin

Spark: 1XM, 2BK, 2FP, 3PL, 3AIC, 3AQR, 3BFU, 4BQ, 4DH, 5AA, 5BM, 5BQ, 5EK, 5FO, 5FV, 5HK, 5HZ, 5IB, 5IR, 5JR, 5LO, 5QI, 5XB, 5ZAB, 8IC, 8EA, 8FI, 8FT, 8JQ, 8MM, (8NZ), 8RQ, 8TK, 8TT, 8UA, 8YN, 8YT, 8ZZ, 8AAC, 8ARD, 8AYN, 8ZAA, 9AF, 9ET, 9FS, 9GP, (9HM), 9IF, 9MC, 9ME, 9MS, 9NQ, 9NR, 9OX, 9PN, 9RH, 9RY, 9TL, 9TV, 9UU, 9VV, 9XI, 9YM, (9ZB), 9ZC, 9ZH, 9AAP, 9AAW, 9ABU, 9AEG, 9AFF, 9AFK, 9AFW, 9AFX, 9AGN, 9AIR, 9AJH, 9ALO, 9AMK, 9AMS, 9ANF, 9AOU, 9AQE, 9AQM, 9ARZ, 9ASJ, 9UO, 9AWZ, 9AXU, 9AYW, 9AYY, 9AZA, 9AZF, 9BDE, 9DEH, 9DFL, 9DFR, 9DQQ, 9DSD, 9DUG, 9DWC, 9DWM, 9DXM, 3DH Can.

C.W.: 1RU, 1TS, 1XM, 2DN, 2EL, 2FP, 2KL, 2AJW, 2AWL, 3EN, 3ZO, 4EN, 4GL, 5LA, 8DE, 8IU, 8II, 8IQ, 8JL, 8LU, 8NQ, 8OH, 8PX, 8RU, 8UJ, 8VM, 8XM, 8ZG, 8AIO, 8AJP, 8AWF, 8AWX, 8BOX, 9FZ, 9RV, 9UK, 9VE, 9XI, 9ZY, 9ANR, 9XAC.

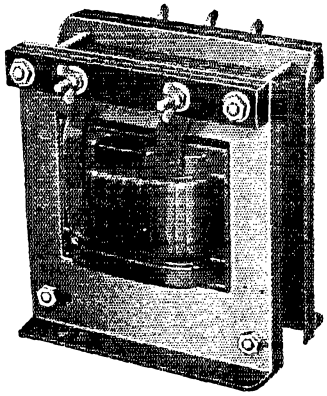
9BGJ, Lincoln, Nebraska

Spark: 5AL, 5BM, 5EK, 5ER, 5EI, 5FO, 5HK, 5HN, 5HY, 5HZ, 5IR, 5JA, 5JD, 5JR, 5KZ, 5LA, 5LB, 5LI, 5LO, 5OT, 5RI, 5RK, 5TI, 5VI, 5VJ, 5XB, 5XJ, 5XU, 5YA, 5ZA, 5ZX, 5ZZ, 7LO, 7XD, 7ZU, 8YN, 9AAP, 9AAW, 9AEG, 9AEU, 9AEY, 9AFX, 9AG, 9AIN, 9AJI, 9ALO, 9ALA, 9AMA, 9AMB, 9AMV, 9AN, 9ANF, 9ANV, 9AOU, 9APA, 9APC, 9APN, 9AQE, 9ARI, 9ARS, 9ARZ, 9ATC, 9AUL, 9AUO, 9AV, 9AWU, 9AYA, 9AYS, 9AYW, 9AZF, 9BBX, 9BBU, 9DA, 9DBS, 9DEH, 9DFA, 9DGS, 9DNC, 9DOC, 9DPF, 9DPH, 9DQE, 9DQS, 9DQQ, 9DSC, 9DTK, 9DTM, 9DTU, 9DUL, 9DUP, 9DUO, 9DUX, 9DWI, 9DZM, 9EE, 9EW, 9FM, 9FZ, 9GM, 9HA, 9HE, 9HI, 9HM, 9HT, 9IC, 9JZ, 9LZ, 9MC, 9NR, 9TH, 9TI, 9TL, 9TO, 9TU, 9UU, 9WI, 9WT, 9XA, 9XM, 9XI, 9YA, 9YAC, 9YAK, 9YAE, 9YB, 9YO, 9YT, 9YW, 9YY, 9ZAA, 9ZAC, 9ZC, 9ZJ, 9ZM, 9ZU.

C.W.: 6CB, 8DE, 8DZ, 8GT, 8IQ, 8TN, 8VJ, 8VP, 8XK, 8ZG, 8ZH, 8ZK, 9AAS, 9AJA, 9AVN, 9HD, 9MM, 9QY, 9TU, 9VE, 9XM, 9ZY, 9ZB.

Shell Type Filament Transformers

PRI. 110 VOLTS



SEC. 10 VOLTS

FOR C.W.

SECONDARY TAPPED AT CENTRE

1 or 2 50 Watt Tubes	Mounted—$10.00
1 or 2 50 Watt Tubes	Unmounted—$ 8.00
4 50 Watt Tubes	Mounted—$15.00
4 50 Watt Tubes	Unmounted—$12.50

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Change over your type "R" or "RS" spark transformers to high voltage C.W. transformers.

We are prepared to furnish two secondary coils to replace the high voltage winding now on your transformer. Each coil 1500 volts.

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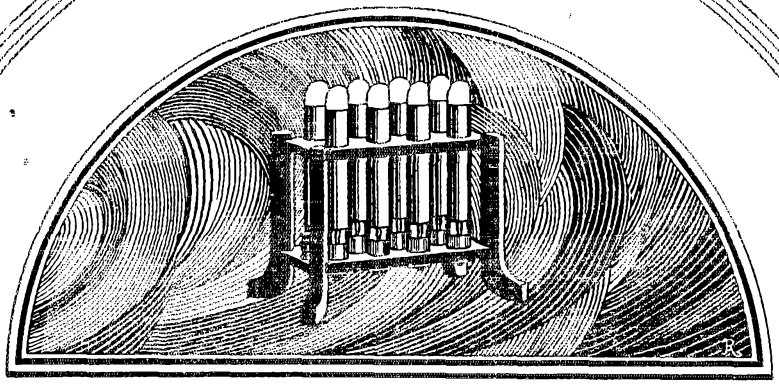

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In the Radio world this seems like a long time ago, and yet ten years before Marconi sent his first message, the Manhattan Electrical Supply Co. was an established electrical supply house.

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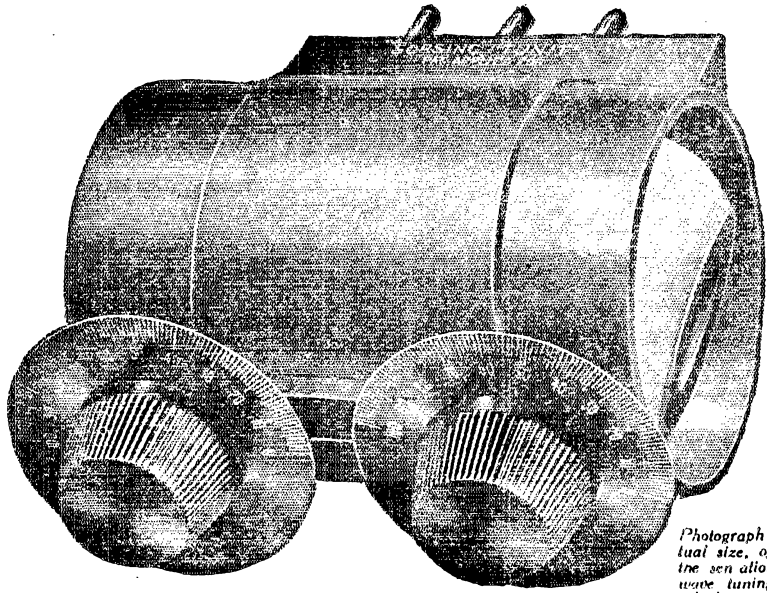

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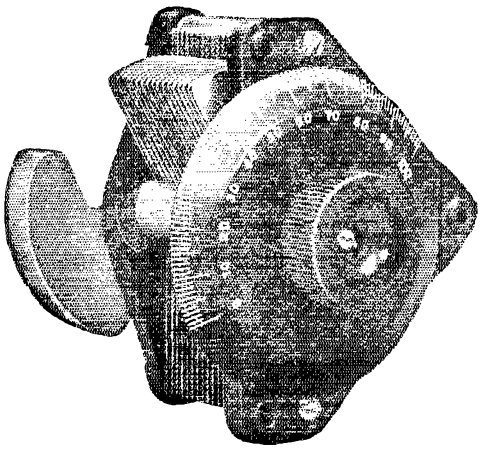


Chelsea Variable Condensers

(*Die Cast Type*)

No.	Capacity	Type	Size	Weight	Price
1	.0011m.f.	Mounted	4⅝x4⅝x3¼	1¾ lbs.	$5.00
2	.0006m.f.	Mounted	4⅝x4⅝x2⅝	1¼ lbs.	4.50
3	.0011m.f.	With Dial	4¼x3x4	2 lbs.	4.75
4	.0011m.f.	Without Dial	4¼x3x4	2 lbs.	4.35
5	.0006m.f.	With Dial	4¼x3x3⅛	1¼ lbs.	4.25
6	.0006m.f.	Without Dial	4¼x3x3½	1¼ lbs.	3.85

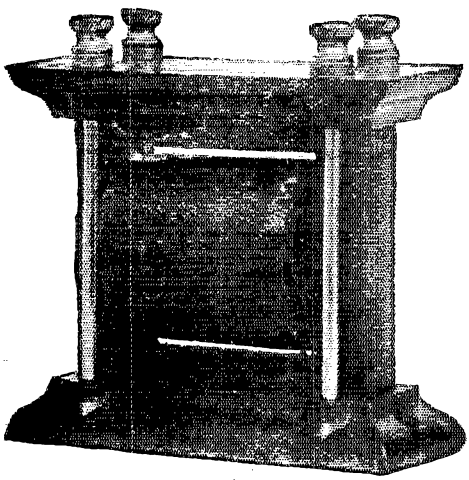
Top, bottom and knob are genuine bakelite, shaft of steel running in bronze bearings, adjustable tension on movable plates, large bakeilte dial reading in hundredths, high capacity, amply separated and accurately spaced plates.

Unmounted types will fit any panel and are equipped with counter-weight.

Purchase from your dealer; if he does not carry it, send to us. Bulletin sent upon request.

The CHELSEA Amplifying Transformer

is a supreme attainment in the design of Audio Frequency Transformers. It embodies the highest grade of materials obtainable and proper design, which reflects the result attained namely high amplification factor. It is unequalled either in electrical characteristics or good appearance. Price as shown $4.50.



$4.50

Chelsea Radio Co., 150 Fifth St., Chelsea, Mass.

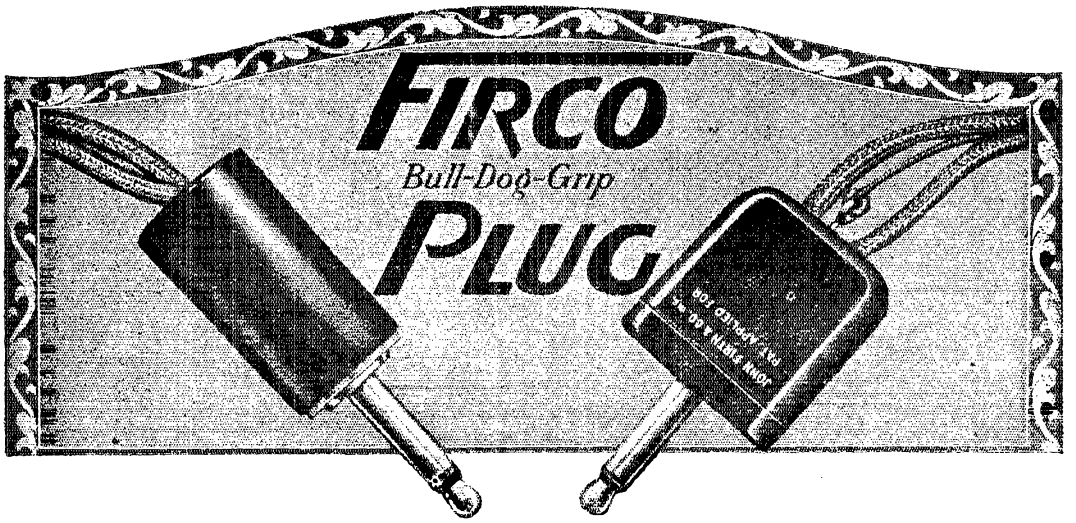
THE-BLANK-RADIO-CALL-BOOK

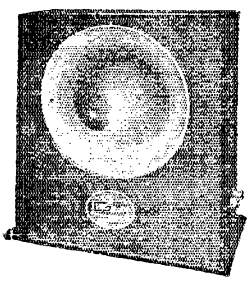
(AMATEUR STATIONS)

A Wonderful Help to All—An Absolute Necessity for C.W. Reception

This NEW station help is printed in brilliant RED to make the call letters and column headings prominent. ON BOND PAPER which will stand repeated erasure. Can be used in connection with ANY RECEIVER. Liberal space provided for DIAL SETTINGS and other data, including notes. INDISPENSABLE—but the cost—only $1.50. Order your copy today from your dealer or the publisher.

F. M. ENDE, **Fort Riley, Kansas**





VOCALOUD

The ideal Christmas gift. This sensational loud speaker needs no batteries, no adjustments, no extras whatever. Just hook on a Vocaloud, and get your signals QSA all over your house! Put it on your Christmas list. $30.00 at all Firco dealers.

Immediate Delivery

Altho' the first lot of Firco Plugs were manufactured in what we considered a liberal quantity, the supply was almost instantly exhausted. If you were among the hundreds who have had to wait for Firco Plugs, you will be glad to learn that your dealer can now supply you without delay.

Just press the chucks slightly outward to instantly insert or release any standard telephone cord tips. The "Bull-Dog-Grip" makes a perfect electrical connection and never lets go!

We suggest Firco "Bull-Dog-Grip" Plugs as an inexpensive, but highly appreciated Christmas remembrance to your radio friends.

Firco Plugs fit all standard jacks and cost no more than other plugs without their exclusive improvements.

Type 34A, flat, $2.00. Type 34B, round, $2.50. (Patent applied for.)

If there is any Firco product your dealer does not carry, send two cents for illustrated leaflet. Ask your radio dealer to show you the new Firco loose-leaf catalogue. Mailed direct for 25 cents.

John Firth & Company, Inc., 18 Broadway, N. Y.

FIRCO RADIO

Firco Audion Detectors and Amplifiers
Radio Frequency Amplifiers
High Voltage Units
Baldwin Phones
Firco Vocaloud
Saco-Clad Transformer
Firco Plug and Accessories
Navy Standard
Leyden Jars
Kolster Decr meter
Eldredge Meters
Seibt Scientific Instruments

FIRCO RADIO EQUIPMENT

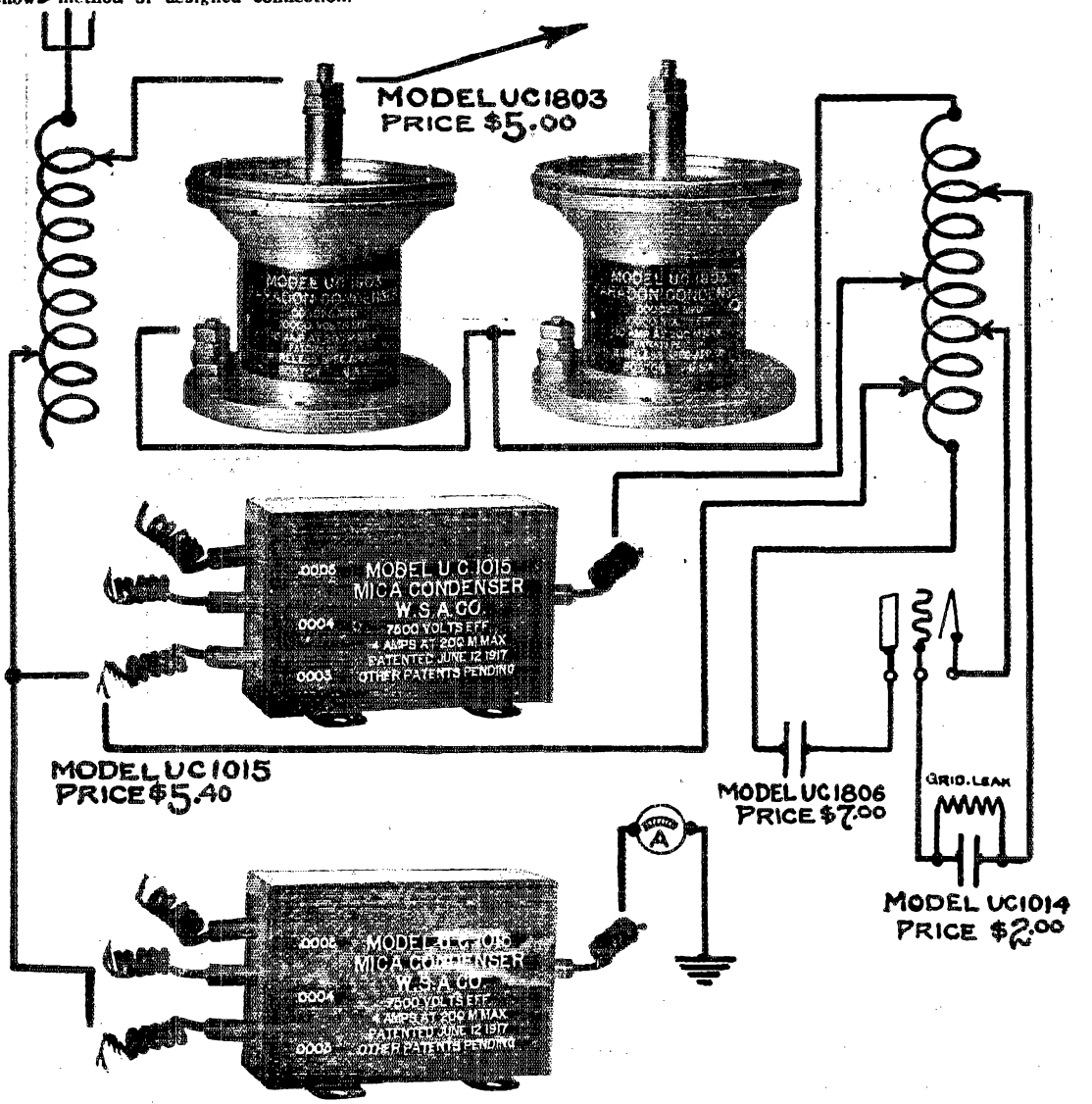
"Pioneers–since 1901"

Faradon

FOR SERVICE

COUPLING CONDENSER, MODEL UC 1803

Great distances can be covered by a continuous wave transmitter, if the transmitter frequency is sufficiently constant for the receiving station to hold the beat note. In the usual antenna circuits, the antenna constants are continuously changing, due to a slight antenna swing; thus, it is impossible for the receiver to hold the beat note, on amateur wavelengths. If the antenna circuit is tuned to the wave of a local tuned "reservoir" circuit, and the antenna and "reservoir" circuit, coupled very loosely by a condenser of small capacity capable of withstanding extremely high voltages, energy can be radiated at the wavelength of the "reservoir" circuit independent of the antenna swing. The Wireless Specialty Apparatus Company has developed for this purpose, a coupling condenser, Model UC 1803. For undamped telegraphy on the normal antenna, one unit will provide proper coupling. Slightly better results can be obtained on telephony, if two Model UC1803 units are parallelly connected, as shown in the below circuit. The surge voltages in a tube circuit rise to enormous values under certain adjustment conditions, but this condenser is so designed that it cannot be broken down by a surge voltage. The circuit below shows method of designed connection.



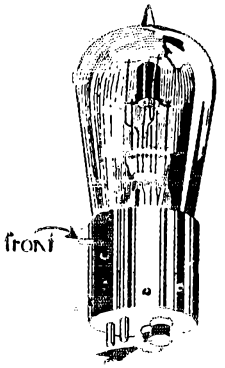
WIRELESS SPECIALITY APPARATUS COMPANY Established 1907 BOSTON, MASS. U. S. A.

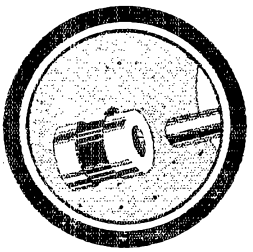
Confucius has said =
"Only two
classes of men
never change -
the wisest of the
wise and the
dullest of the dull."
The owner of a
Grebe Receiver
will never
change it =
he is the
wisest of the wise

Doctor Mu

GREBE RADIO

The Grebe CR-5 Receiver





Let Your Set Know It Is Christmas!

Stop Replacing Burnt-out Bulbs

You can be sure that your new tube will not accidentally burn out if it is protected with the

Carrying Capacity
1, 1¼, 1½, 2, 2½ and 3 amp. Size ¼ inch over all.

RADECO SAFETY FUSE

(Pat. Pending)

Slips directly on filament terminals of any standard bulb, and can be used in any standard socket. This tiny fuse "absorbs" destructive high amperage before it can reach and destroy the delicate filaments. Your new bulb needs RADECO protection.

RADECO Safety Fuses are equally valuable in all CW work preventing injury to meters resulting from shorts. Send today cash, money order or certified check.

4 For **$1**

ORDER BY MAIL

Control For Tubes

Paragon Rheostat
For Back or Front of Panel Mounting. 6 ohms, 1½ amps. 1½" dia. **$1.50**

"VT" Sockets
Heavy moulded base and polished nickel brass shell, with concealed connectors and sure lock contacts **$1.00**

Amplifier Coils
The transformer is of the shell type embodying a minimum of flux leakage, and hence a negligible effect upon the surrounding circuits and apparatus. This feature enables a number of stages of amplification to be arranged in close proximity without the customary noises **$4.50**

44V. Variable "B" Battery $3.60
Include postage on 4 lbs. Complete in handy wooden case and adjustable phosphor bronze "jiffy" connectors. Better than block batteries—if one 4.4V. unit weakens prematurely, it can be removed and replaced—thereby not impairing total voltage **$3.60**

A Few Presents Your Set May Need

Order From Any Standard Catalog

50 CENTS
ALLOWED ON YOUR OLD
VACUUM TUBE

For demonstrating purposes in connection with our famous RADECO Safety Fuse, we need a number of burnt out tubes.

In order to get these tubes immediately we offer for a limited time, a cash allowance of 50 cents on the purchase price of any standard tube you buy from us. Order from price list of any standard catalog.

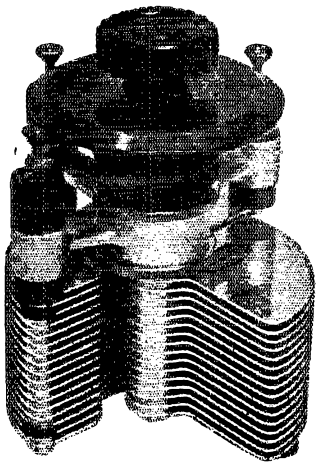
CAUTION! Pack tubes carefully. No allowance made on tubes received with glass broken.

You will have no more useless tubes if your new one is protected with a RADECO Safety Fuse.

RADIO EQUIPMENT CO.

630 Washington Street **Boston, Mass.**

Using An Inefficient Condenser Is Like Carrying Water In A Sieve



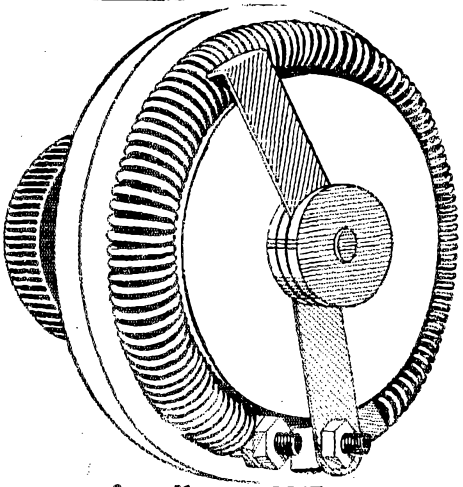
The same judgment used in the purchase of radio equipment that you use unconsciously in everyday affairs will invariably lead you to select COTOCO condensers. Users are unanimous in proclaiming them **"the best."**

This condenser used in conjunction with our inductance units will enable you to build a set that you will be proud to own.

If your dealer cannot supply you with our products, advise us, and send us his name.

COTO-COIL CO.

87 Willard Ave., Providence, R. I.



for all your V Ts--

use Shramco Reos. A type for each tube. Genuine "Nichrome" resistances, mounted on solid asbestos block. It pays to use a GOOD rheostat with your expensive tubes. Ask your dealer for Shramco Reos.

DEALERS:

There's a good profit in handling Shramco Reos because they sell so fast. And they build up good will for you by delivering complete satisfaction. Write for liberal discounts today. Don't put it off, you may lose profits. Write today.

Shotton Radio Mfg. Co., Inc.

8 Market Street, Albany, N.Y.

OMAHA

Now has a good Up-to-Date stock of

WIRELESS

Apparatus and Supplies.

We are AMRAD stock dealers

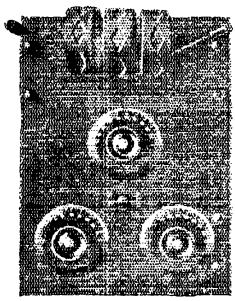
also a good line of Aerial Equipment, A.A. Transformers, Brandes, Baldwin, DeForest, Federal, Firth, G. A., Murdock, Radio Corp., Remler and Thordarson Apparatus and parts.

Genuine Formica panels cut to any size @ $2.50 per lb.

WOLFE ELECTRIC CO.

313-S. 17th St. **Phone Atlantic 1414**

Type "Q" Receiver

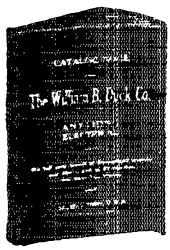


AN IDEAL RECEIVING SET FOR LONG AND SHORT WAVE AND RADIO TELEPHONE RECEPTION

This set is the most flexible receiving set on the market. With the use of the various sizes of Honeycomb Coils everything in the range of radio telegraph and telephone reception from 200 to 25,000 meters is brought into your home. Consists of a three coil mounting, and three Variable Condensers of proper capacity. Tuning extremely sharp. Remler dials.

Price without Detector.....$35.00

Duck's New Radio Catalog No. 16



Send 12c today for copy of the greatest radio catalog ever put between the pages of two covers.

275 Pages--A Catalog DeLuxe

Never in the history of radio was such a catalog printed. The radio data and diagrams embracing upwards of fifty pages, gives the experimenter more valuable and up-to-date information than will be found in many text books selling for $2.00, and $1.00 could be spent for a dozen different radio catalogs before you could gather together the comprehensive listing of worth while radio goods found in this great catalog.

A brief summary of the radio goods listed in this catalog:

The entire radio catalog of the Radio Corporation, with a wealth of scientific and technical data on C.W. transmitting sets, and all the diagrams for the assembling of these sets; the complete Remler catalog, which embraces 25 pages, the Westinghouse, Firth, Murdock, Federal, DeForest, Clapp-Eastham, Brandes, Connecticut Company, Thordarson, Turney, Magnavox Company catalogs, the best products of Adams-Morgan, Signal and countless other manufacturers, including our own complete line of radio apparatus, and many individual items and parts used in radio work today.

Send only 12c for copy of this wonderful catalog. You will need no other when you have Duck's, and you cannot find in all others combined what you will find in Duck's Wonder Catalog.

The William B. Duck Company

243-245 Superior Street **Toledo, Ohio**

FROM COAST TO COAST

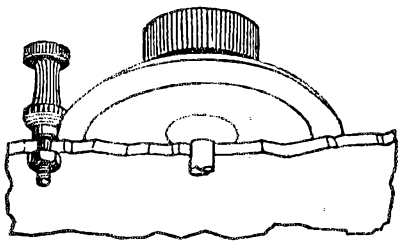
A CHAIN OF CW STATIONS

WILL ULTIMATELY CARRY ON THE RELAY WORK

Efficiency on low wave lengths is what is demanded in relay work. It has been demonstrated that CW works better under adverse conditions than spark transmission. DX C.W. stations are now piling up long distance records that were undreamed of in the days of spark. A new era is here in amateur work,—the C.W. era.

Now is the time to install that new C.W. set. The good operating months are here, everybody is "on the job," and it is up to you to reach out with your signals and make new acquaintances. We will doubtless have another C.W. relay on Washington's birthday;—WILL YOU BE IN ON IT? Our C.W. stock is complete in every detail, and we can supply you with all parts, or complete transmitters from the 5 watt size to the 250 watt, for phone, ICW or CW. We are covering distances up to 1400 miles nightly at 9XAC with an output of only 110 watts. You can cover 200 to 800 with an output of 10 watts.

A complete line of Radio Corporation, DeForest, Murdock, Clapp-Eastham, Acme, Chelsea, and John Firth & Co., products are on our shelves at all times. Our complete catalog will be sent for 5c in stamps, our CW catalog for 4c, or both for 7c.



Pat. Applied For

The newest addition to the K line of wireless instruments is the K Vernier Attachment, a universal type, in that it is adaptable to any style condenser and dial.

In tuning CW and radiophones, a difficulty often experienced with the standard condenser is the impossibility of securing that exact adjustment required to bring in the music clearly, and free of troublesome and disconcerting back-wave screeches. With the standard dial all these troubles are experienced time and time again. The K-35 Vernier Attachment eliminates this. After a coarse adjustment by means of the dial, the little vernier button is pressed forward, and a slight turn either way, as needed, serves to bring in a maximum signal of clearness not obtainable by the first adjustment. Actual measurements show that it will tune 10 to 15 times more accurate than a straight dial adjustment.

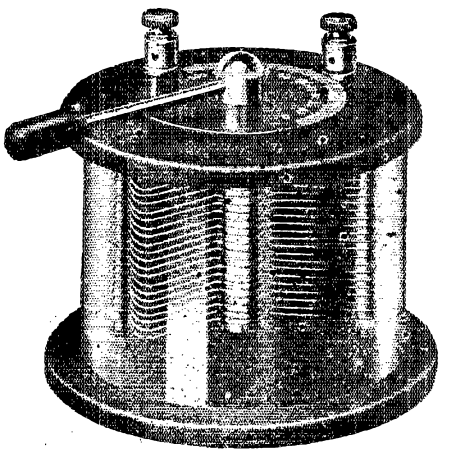
K35 Vernier Attachment .....45c.

UV204 250 watt power utbe	110.00
Perfection Knock-Down Condensers	
11 Plate	$1.80
21 Plate	2.25
41 Plate	3.25
Chelsea Panel Mount-43 pl.	4.75
CV1000	12.40
CV1500	14.00
CV500—90 degree type	5.25
Murdock #366	4.75
Murdock #367	4.50
Murdock #368	4.00
USC1500 DeForest Bridging	5.75
CONDENSER—FIXED	
Murdock Transmitting Sections	3.25
Thordarson Oil Condensers	25.00
UC1631—R C. filter type	1.85
UC1014-3000 volts .002	2.00
UC1806-6000 volts .002	7.00
UC568—Receiving .0005	1.35
UC570—Receiving .0025	2.00
Remler Grid Condensers	.35
RK500 Grid Mica Condensers	.30
TRANSFORMERS—C. W.	
Acme 500 watt	25.00
Acme 200 watt	16.00
Acme 50 watt	12.00
Radio Corporation—750 watt	38.50
Radio Corporation—325 watt	25.00
TRANSFORMERS—SPARK	
Acme 250 watt	16.00
Acme 500 watt	22.00
Acme 1000 watt	33.00
Thordarson Old Type—1 K.V.A.	35.00
Thordarson ½ K.V.A.	14.00
VACUUM VALVES	
UV200 Detector	5.00
UV201 Amplifier	6.50
UV202 5 watt power tube	8.00
UV203 50 watt power tube	30.00
UV204 250 watt power tube	110.00
ER—Detector tube	5.00
APVT—Amplifier tube	6.50
SOCKETS	
R500—DeForest Bakelite	1.25
R300—DeForest VT	1.50
R400—DeForest Gooseneck	1.75
RC Porcelain	1.00
RC Porcelain for 50 watts	2.50
Murdock Moulded	1.00
Amrad VT Sockets	.75

RHEOSTATS	
F500 DeForest	$1.65
Murdock Reversible	1.00
Porcelain Front Mount	1.00
K31 Panel Mount	1.35
PR535 Radio Corp	3.00
PR537 Radio Corp.	10.00
"A" Potentiometer	2.00
AMPLIFYING TRANSFORMERS	
K32 Unmounted	3.75
UV712 Radio Corp.	7.00
Federal 226W	7.00
Acme Unmounted	4 00
Acme Semi Mounted	5.00
Acme Fully Mounted	7.00
Amrad Semi Mounted	5.00
KEYS	
K6 Cootie Key	3.50
#85	3.00
#51	1.80
PHONES	
Baldwin Type C	13.75
Baldwin Type E	15 00
Baldwin Type F	16.25
Brown Non-adjustable	17.00
Brown Adjustable	18.00
Brownlie Adjustable	12.50
Federal Liberties	12.50
Brandes Superior	8.00
Brandes Transatlantic	12.00
Brandes Navy Type	14.00
Murdock 56—3000	6 00
Murdock 56—2000	5.00
Murdock 55—3000	5.50
Murdock 55—2000	4.50
CRYSTAL DETECTORS	
UD101—DeForest	2.60
#324 Detector Stand—Silicon or Galena—pc	.25
REGENERATIVE SETS	
C.E. ZRF	37.50
C. E. Variometers	5.75
Murdock Variometers	7.50
T Imaco Variometers	5.00
K73—Tuner-detector	30.00
DeForest Regenerative	42.50
INDUCTANCES—C.W.	
K75 On Bakelite Tube	9.50
Radio Corporation	11.00

KARLOWA RADIO CO. Rock Island, Illinois

QUALITY CE SERVICE



C. E. Rotary Variable Condenser

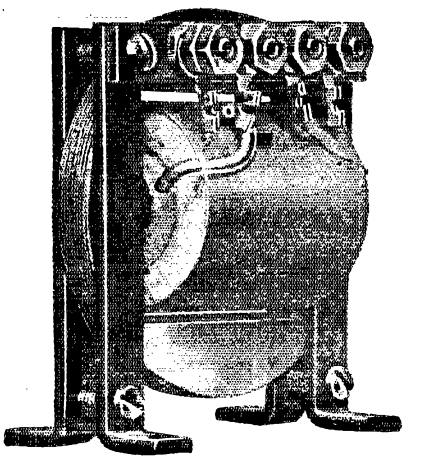
43-Plate size complete	$4.75
Without case, for panel mounting	4.25
17-Plate size complete	4.25
Without case, for panel mounting	3.25
Capacity of 43-Plate size approximates .0008 mf	
Capacity of 17-Plate size approximates .0003 mf	

REDUCED PRICES

We are glad to announce to "QST" readers that lower manufacturing costs have enabled us to make a substantial reduction in the price of our C.E. Types 43 and 17 Rotary Variable Condensers. The new prices are quoted under the illustration at the left. Quality remains exactly the same in every detail of design, materials, workmanship, beauty of finish and dependable, efficient performance. Another example of good value in high grade wireless equipment is this C.E. Type Q.O. Amplifier Coil at $6.50 mounted with panel, or $4.00 without panel. Amplifies weak signals to many times their original strength. Highly efficient with standard vacuum tube detectors. If desired two or more coils may be used with an equal number of tubes to make a multi-stage amplifier.

Remember that C.E. equipment is real, practical wireless equipment, built for the serious work of radio men.

Send 6 cents in stamps for the C.E. Catalog showing our full line of radio equipment—Hytone Transmitting Sets, Oscillation Transformer, Regenerative Receiving Sets, Radio Telephone Receiving Sets, Two Stage Amplifier, Wavemeters, Tesla Coils, Spark Dischargers, Keys, Instruments, etc., etc.



C.E. Type Q. O. Amplifying Coil

Mounted with Panel	$6.50
Without Panel	4.00

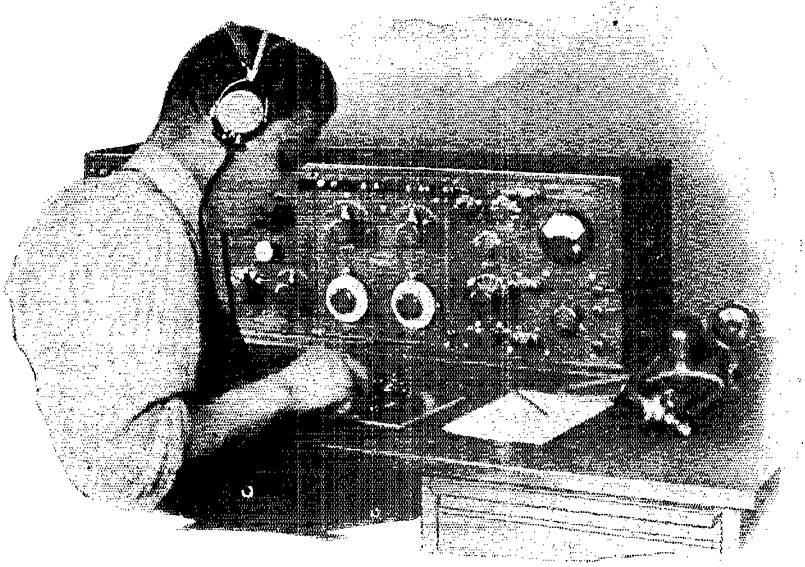
CLAPP-EASTHAM COMPANY

RADIO ENGINEERS *and* MANUFACTURERS

114 MAIN STREET, CAMBRIDGE, MASS.

California Representative: Leo J. Meyberg Co., San Francisco and Los Angeles.

127-11



The New DeForest Interpanel Set is Made of

CONDENSITE

The quality of radio instruments depends essentially upon the insulation of which they are made. A concern like the DeForest Tel. & Tel. Co., who have an enviable reputation in the radio field, would not jeopardize their good will by using an inferior material. They chose Condensite, the substance that possesses all the properties essential to good electrical insulation.

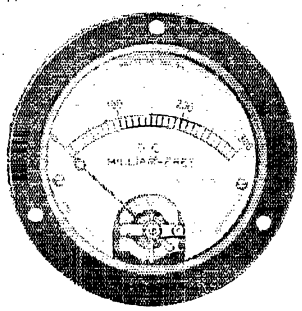
Condensite-Celoron is finding innumerable applications in the radio field where high quality water proof fibre is required. It is manufactured by the Diamond State Fibre Company, Bridgeport, Montgomery County, Pennsylvania.

If you are interested in Condensite or insulation in general, we will gladly send our catalog upon request.

Condensite Company of America

Bloomfield, New Jersey

SPEAKING OF PRICES, HOW ARE THESE?



TYPE X CWM

We have been very fortunate in obtaining a large supply of meters for C-W and radio telephone sets, at a greatly reduced figure. As usual, we give the purchaser a real price.

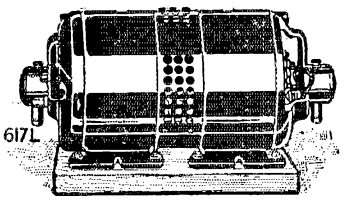
Are manufactured by the Jewell Electrical Inst. Company and are exactly the same as furnished the government during the recent encounter. Finest sapphire bearings, ground to shape with diamond dust, are a feature.

0-100, 0-300, 0-500 Milliamperes DC ...$5.00
0-10, 0-15 Volts AC 7.50
0-1, 0-3, 0-5, 0-10 Radio Frequency 10.75

Although very good results are being obtained from step up transformers and some form of rectifier as a method of obtaining high voltage direct current, it is generally conceded that a motor-generator is more efficient, and less troublesome, in the long run.

The IDEAL MOTOR-GENERATORS are ring oiled and unconditionally guaranteed for a period of one year. Are rated very conservatively.

500 Volt 100 Watt.....$60.00
500 Volt 200 Watt..... 75.00



TYPE HSM

DEALERS WRITE

POWER TUBES

Radiotron 5 Watt	$7.20
Radiotron 50 Watt	27.00
Radiotron 250 Watt	99.00

TUBE ACCESSORIES

Socket for 50 Watt	2.75
Socket for 5 Watt	1.35
Variable Grid Leak 5000 Ohm	2.75
.002 Mfd Grid Condenser	1.80

C-W TRANSFORMERS

Acme 50 Watt	13.50
Acme 200 Watt	18.00
Acme 500 Watt	22.50
Acme 150 Watt Filament Heater	14.40

MODULATING EQUIPMENT

UP-414 Transformer	6.75
UT-1357 Magnetic Modulator	11.25
Federal Hand Microphone	6.25
J-K Hand Microphone	5.50
Radio Frequency Choke	1.50

FILTER EQUIPMENT

Acme 500 MA Choke	$7.20
Acme 150 MA Choke	5.40
IDEAL 1 Mfd Condenser	2.00
IDEAL 2 Mfd Condenser	1.50

WIMCO INDUCTANCES

25 Turn with 5 clips	9.00
50 Turn with 5 clips	10.50

C-W RHEOSTATS

7 Ampere Continuous	1.80
3 Ampere Continuous	1.80

Z-NITH EQUIPMENT

C-W Regenerator	55.00
AGN-2 Det. Two Stage	89.25

MOORHEAD TUBES

Electron Relay	4.50
Amplifier-Oscillator	6.00

FORMICA PANELS

12 x 18 x 3/16	4.00
6 x 18 x 3/16	2.25

CATALOG FREE. LISTEN FOR 9XAH CATALOG FREE

IDEAL APPARATUS CO., EVANSVILLE, INDIANA

SPECIAL PRICES

for the XMAS TRADE

Radio apparatus is a highly appreciated Xmas gift. Place your orders with us and benefit by the saving in cost. Get the same high grade equipment and more for the same money.

Every piece of apparatus we sell is "FIRST TESTED—THEN SOLD." This test by expert radio men assures you of equipment in perfect condition. Make up your list NOW.

Buy these Lines of Apparatus from Us

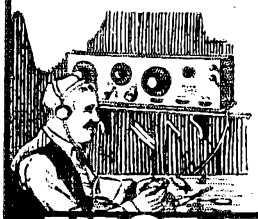
Remler Apparatus
Radio Corporation
Murdock Parts
G ebe CR8 and CR9
Acme Apparatus
Magnavox
Baldwin Phones
Brandes Phones
Chelsea Cond. and Dials
Tuska Apparatus
L. G. S. products
DeForest Sets
Paragon Apparatus
Clapp-Eastham Supplies
Moorhead Tubes
Jewell Meters
Radisco Coils
Esco Motor Generators

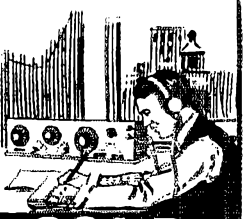
RADIO CITIZENS: We allow 5 per cent. di count on orders of $10.00 or more and pay postage in 1st and 2nd zones. Write for prices.

PEORIA RADIO SALES CO.
Dept. A., Peoria, Ill.

DEALERS: Write for our trade schedules. We represent some large manufacturers exclusively. Get our new lowest prices.

KLAUS RADIO COMPANY
Dept. 100, Eureka, Ill.





FIRST TESTED—THEN SOLD

Send for ABC Catalogue

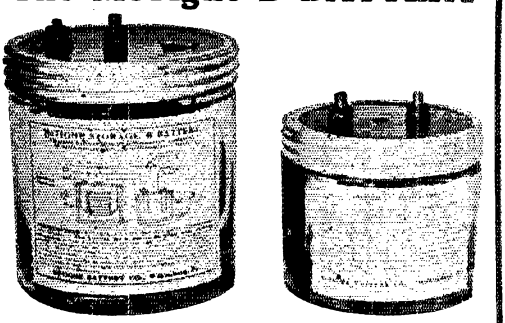
Here is a catalogue you cannot afford to miss because it describes in detail the unusual mechanical and electrical features and simplicity of the complete ABC line.

Sixteen pages, clearly illustrated, in two colors. Every price quoted in this catalog represents a new low level for apparatus of recognized quality.

Send 10c for latest ABC catalog "Professional Radio Equipment at Amateur Prices." Request Catalog 12.

WIRELESS EQUIPMENT CO. Inc
32 Austin Street, Newark, N.J.

The McTighe B BATTERY



Connect one or more units of the McTighe Storage B Battery in your circuit and know the satisfaction of using this wonderful battery. Connect the McTighe Rectifier permanently to the lighting circuit and close the charging switch when necessary.

One Rectifier will charge as many as four battery units in series on a 110 volt a.c. lighting circuit.

The McTighe Rectifier is also useful where a small chemical rectifier is desired for transmission purposes.

SATISFACTION GUARANTEED

Battery Complete 22 volt unit $3.50
Rectifier 1.25

Postage and packing 20c extra

McTIGHE BATTERY CO.
WILKINSBURG, PA.

Boston.
Radio 1ADR—Oct. 25, '21.

Experimenters Information Service,
45 Pinehurst Avenue, New York City.

Gentlemen:—

Have recently finished my 160 to 1000 meter Improved Armstrong Regenerative Receiver built in accordance with your Blue Prints Nos. 30021, 22, 23, 24.

I believe you will be interested in the success which I have experienced in the initial tryout. On Oct. 22nd between 10:25 P.M. and 11:00 P.M. the following 600 meter stations were heard. In all instances the signal strength was remarkable. Most of them were quite easily read with the phones on the table.

GDLR WCC KIJJ WCY WLC WNY MTK MSA WSA NAH PEC GBZW FTS KEKD KXC IEE VBG GCTN WCI NRH KEXM VBH KDHS KDFO KOJR NBD NAJ NGE

On the following evening Oct. 23rd between 11 P.M. and midnight the following amateurs were heard between 200 and 350 meters. Second district amateurs are not listed as there were over 30.

3ZA 3KM 3ACE 3ZY 3CN 3HA 3OU 3BEA 3UQ 3AER 3BP(C) 4GL XF1 NMW 5DL 5XO 8SP 8AGK 8AYN 8AHH 8AFD 8XE 8ZZ 8BAB 8AU 9ZJ 9LQ 9AWU

The only amateurs that I have listed are those that were sufficiently loud to enable continuous reception. There were many others in the fourth and fifth district that could not be distinguished because of local and second district QRM.

The results on 600 meters are infinitely better than any observed while operating for the commercial companies and U.S.A. Transport Service where I had the opportunity for comparison of the best types of American, English and German receivers.

The results on 200 meters speak for themselves. All districts in the U.S. with the exception of 6th and 7th, were heard in one hour. I have never been able to even approximate this with the two variometer form of receiver.

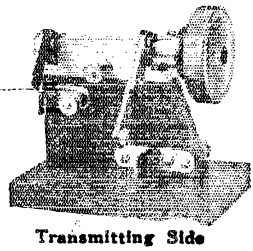
The ability of your receiver to isolate and make readable distant stations through local QRM is proof of its great selectivity. This work was all done on an antenna 40′ high 40′ long, using standard detector and 2 stage amplifier. The receiver parts cost me $32.00 and I feel that I could not have done better at any price.

Yours truly,
(Signed) Edwin E. Turner, Jr.

"SIGNAL" Radio Apparatus Pleases Professional and Amateur —

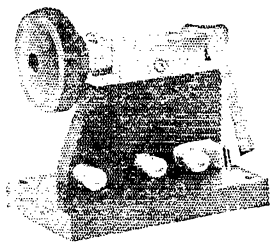
Because it is built to the exacting requirements of the **professional** radio-electrician, SIGNAL wireless products are **bound** to fulfill every requirement of the exacting **amateur.** And the name SIGNAL is the only thing to be certain of in buying!

Aerial Change-over Switch



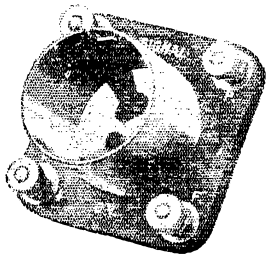
Transmitting Side

Reduced to fewest words, the superiority of this SIGNAL Switch is due to the fact that it has the good features found in highest priced amateur change-over switches, plus all the qualifications of the modern antenna switch. Lack of room prevents recounting these features here; one point alone should suffice, however, as an example: That is the arrangement whereby the aerial is drained of any accumulated charge, before the switch reaches receiving position. Search and you'll find this feature only in the most expensively built commercial aerial switches. And any operator who is "wise" to the nasty kick in telephone receivers, when shifting quickly from send to receive will appreciate this SIGNAL advantage.



Receiving Side

The Signal "V.T." Socket

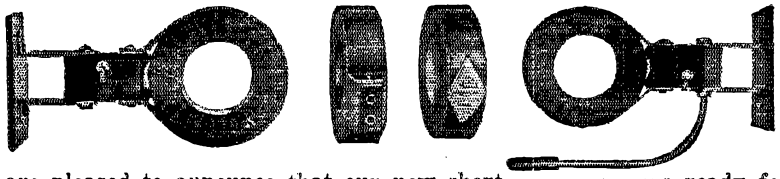


The only vacuum tube socket on the market today that will take any of the standard four-prong tubes, either Detector, Amplifier, or Oscillator, without changing or adjusting. And this is not the only distinguishing mark of this SIGNAL socket—the others are all told in the latest SIGNAL Bulletin of High Class Wireless Apparatus, which is yours for the asking.

Write for the SIGNAL literature now—it is free. Address

SIGNAL ELECTRIC MANUFACTURING COMPANY
Menominee, Michigan

READY FOR CHRISTMAS



We are pleased to announce that our new short-wave coils are ready for distribution. They are not "freak" coils but designed upon the solid fundamentals of radio practice. They are, however, adapted for use with our standard unit mounting fixtures. With a given condenser these coils all have a greater wavelength range, than the honeycomb coils.

But most important,—note the H.F. resistance values and decrement of the three secondary coils compared with three old type honeycombs.

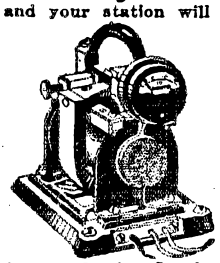
	External Capacity	Wave ngth	H.F. Resist.	Power Factor	Decrement
Old Type 25	.0001mf	147	64	.0820	.257
	.0004mf	244	11	.0340	.107
New Type 1s	.0001mf	147	12	.0154	.048
	.0004mf	273	3	.0083	.026
Old Type 50	.0001mf	283	134	.0891	.280
	.0004mf	475	23	.0364	.114
New Type 2s	.0001mf	305	26	.0160	.050
	.0004mf	588	8	.0102	.032
Old Type 100	.0001mf	540	314	.1091	.343
	.0004mf	900	40	.0334	.105
New Type 3s	.0001mf	623	77	.0212	.067
	.0004mf	1160	11	.0072	.022

Facts are facts. We place them before you to *use* when buying inductances. And will furnish more for the asking.

COTO-COIL CO. 87 WILLARD AVENUE, PROVIDENCE, R. I.

10c. Charges Your Storage Battery AT HOME WITH AN F-F Booster

and your station will never be closed because of a discharged battery.



Is it not gratifying to feel that your filament battery will always be ready when you want it and that you will never have to give up in disgust when working a distant station.

F-F Batttery Boosters are automatic and operate unattended. Screw plug in lamp socket, snap clips on battery terminals and see the gravity come up.

The AMMETER shows you Service Station Service just the amount of current flowing. Both waves of current are rectified thru adjustable and easily renewable carbon electrodes which maintain a constant efficiency and last for thousands of hours. Everything Complete in One Compact, Self-Contained, Portable Charging Unit. F-F Boosters are Magnetic Rectifiers for 105-125 Volt 60 Cycle Alternating Current. PRE-WAR PRICES:

Bantam Type 6 charges 6 Volt Battery at 6 Amperes $15
Bantam Type 12 charges 12 volt Battery at 5 Amperes $15
Type 166 Charges 6 Volt Battery at 12 Amperes $24
Type 1612 Charges 12 Volt Battery at 7 Amperes $24
Type 1626 Charges Both 6 and 12 Volt Batteries $36

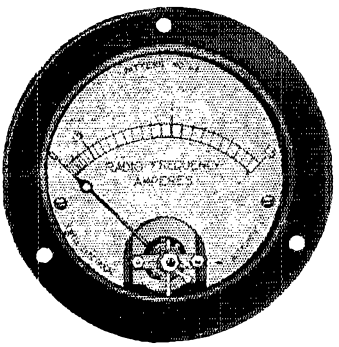
Shipping Weights 12 to 15 Pounds

Order from your Dealer or send check for Prompt Express Shipment. If via Parcel Post have remittance include Postage and Insurance Charges. Or have us ship C.O.D. Other F-F Battery Boosters charge batteries from Farm Lighting Plants, Direct Current Circuits and D.C. Generators. For Group Charging use our Full Wave Automatic F-F Rotary Rectifier of 100 Volt, 36 cell capacity.

Order Now or Write for Free BOOSTER Bulletin No. 31 or ROTARY 31A

The France Mfg. Co. OFFICES & WORKS CLEVELAND, OHIO, U.S.A.

Canadian Representative: Battery Service & Sales Co. Hamilton, Ontario, Can.



THERMO-COUPLE INSTRUMENTS FOR C-W

All long distance C.W. operators use thermo-couple ammeters.

Precise electrical measurements are the basis for the successful operation of any C.W. set.

Unreliable and inaccurate instruments will result in the unreliable operation of any set.

Government Bureau of Standards tests have shown Jewell thermo-couple instruments to be accurate and reliable.

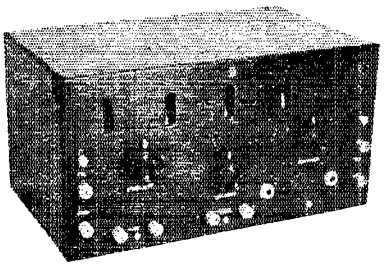
PRICE $12.00

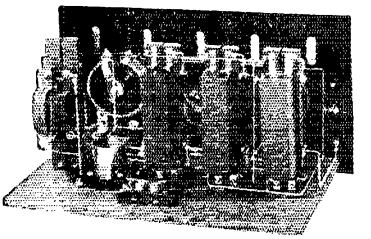
ORDER FROM YOUR DEALER

Jewell Electrical Instrument Co.

CHICAGO

THE SUPRISE OF YOUR LIFE
AWAITS YOU—





WHEN you "listen in" on a Radio Frequency Amplifier USING OUR NEW

DX RADIO FREQUENCY AMPLIFYING TRANSFORMER

WHY?—because the DX Radio Frequency Transformer USES AN IRON CORE and is so designed that losses at low wavelengths, thru capacity effects, are NEGLIGIBLE.

The CLOSE ELECTRO MAGNETIC COUPLING between primary and secondary, made possible by the use of an iron core—together with the UNIQUE DESIGN (patent pending) which eliminates capacity effects—makes this Radio Frequency Amplifying Transformer HIGHLY EFFICIENT on Long *and Short* wavelengths.

Absolutely NO FORM of Radio Frequency Amplification now known, approaches this in—*Amplification combined with Dependable Operation.*

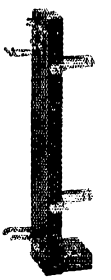
The use of "SOFT" TUBE DETECTOR gives greatest SENSITIVITY and is entirely satisfactory in operation with One, Two, or Three stages of Radio Frequency Amplification. The DX R F Transformer is suitable for use with RAC-3, Radiotron and A-P vacuum tubes.

Standard Mounting for DX Radio Frequency Amplifying Transformer.
PRICE $1.00

DX Radio Frequency Amplifying Transformer.

Wavelength range	PRICE
150-650	$8.00
650-2000	8.00
2000-5000	9.00
5000-12000	9.00

(Sheet of circuit diagrams 25c.)



Combination Mounting for RAC-3 Audion and DX R F Amplifying Transformer.
PRICE $1.50

SEND STAMP FOR BULLETIN NO. 10A

Radio Instrument Co.

Hutchins Bldg., 10th and D, N. W., Washington, D. C.

Get a Real Radio Education And Step Into a Big-Pay Position

You amateurs who have started to study radio. Why not finish it? And you who know nothing of radio yet.— Have you stopped to think what a wonderful career you can have in radio communication? It is the fastest growing field in the world. Twenty years ago, radio was a scientific plaything. What do you think is going to happen within the next ten years? Why not train yourself in a professional way and cash in on some of the opportunities that are presenting themselves in the radio field? Do not let the other fellows beat you to the high-paying jobs that are within your grasp. Many thousand trained radio men will be needed next year. Prepare yourself now and step into a real radio job next spring on land or sea.

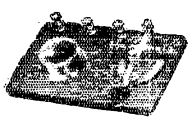
Put the Final Polish to Your Training—Do Not Stop Half Way

Many wireless amateurs do not realize the big opportunities that await them in the commercial radio field. They love the work and yet do not seem to appreciate how badly radio communication needs them. Some of them do, however. We can name twenty-five big radio men, whom you know, who have climbed to their present position by putting the final polish on their radio education. You can do the same thing. America's largest and oldest radio school is holding out its hand to you. It will help you up the last step. It will broaden you out into a professional radio man and put you in a position of a trained radio expert.

New Easy Four-Step Method of Practical Teaching

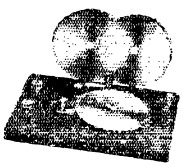
This is the day of learning by doing. That is why we have backed up our wonderful fourteen copyrighted lessons with four wireless instruments that will be sent to you without charge. You learn by actual practice in your own home, or you can come to Washington if you wish and join our resident school. The Natrometer is an almost human machine that teaches you the code. You listen, the Natrometer does the rest. In Step No. 1 you learn to send correctly. In Step No. 2 you start to learn to receive correctly. In Step No. 3 the Natrometer will send to you automatically at any speed. In Step No. 4 you learn to receive from other operators with a real receiving outfit and with this practical training you receive our regular lessons and your work with them will be guided by our trained experts.

Learn By Doing in Your Own Home



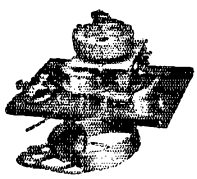
Instrument No. 1

The key and buzzer used in connection with our code lessons for training in transmission.



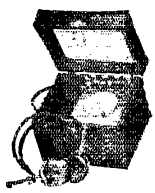
Instrument No. 2

For receiving training, the hand transmitter used in connection with the buzzer.



Instrument No. 3

The wonderful Natrometer sends to you automatically at any speed freeing both hands to copy messages.

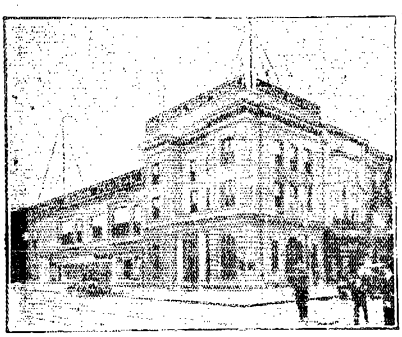


Instrument No. 4

The beautiful portable receiver with 'phones with which you learn to receive other wireless operators.

Big Salary Just Ahead of You

Wireless operators receive upwards from $110 per month and their expenses. Experts receive anywhere from $2400 per year to $10 000 and there is no danger of them losing their jobs, because the radio field is not overcrowded. You can probably save more as a wireless operator than you now earn. Then, think of the beautiful outfit you could have in your own home! An outfit that will be the envy of all your amateur friends. Many amateurs have cashed in on the opportunities in radio. Why don't you do the same?



The Oldest and Best Radio School

We have trained eight thousand men since 1914. Our school is recognized by the United States Department of Commerce and it is located in Washington, the center of all radio development. Our diploma is recognized officially and you will receive extra counts in your license examination. You can have a post graduate course in our big resident school if you wish, absolutely free. There is nothing to prevent you. A few hours each week, and a few cents a day will complete your training within four months. Start now. Send for our beautiful booklet "Wireless, the Opportunity of Today." It is yours for the asking with no obligation attached.

National Radio Institute,
Dept. 2812, Washington, D. C.
Send me your free booklet, "Wireless, the Opportunity of Today." Tell me about the opportunities open in wireless, about your Institute, and about your Special Limited Offer.

Name .....

Address .....

City ..... State .....
I am interested in a sea position
I am interested in a land position.

National Radio Institute
Dept. 2812 Washington, D.C.

The Benwood Wireless Telephone

TWO AMPERES WITH TWO 5 WATT TUBES ON 200 METERS.

A COMPLETE RADIO TELEPHONE AT A REASONABLE PRICE.

SOLD KNOCKED DOWN WITH FULL SET INSTRUCTIONS FOR ASSEMBLING AND WIRING.

We guarantee this set to radiate at least 1½ amperes on average amateur antennae when assembled in accordance with our instructions. We also **Guarantee** this set to radiate 2 to 3 amperes when used with an antenna whose fundamental wave length is 225 to 300 meters.

The complete set of parts needed is listed herewith with prices applying to same. Wiring diagrams and full set of instructions accompany each outfit.

WIRELESS PHONE PARTS

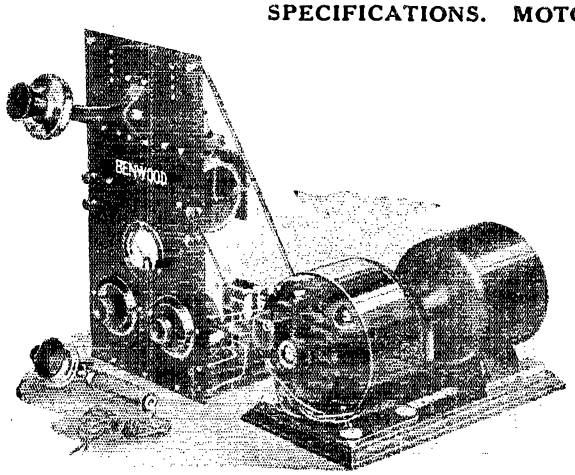
2	UV 202 5 watt tubes, $8.00 each	$ 16.00
1	9x18 Formica panel, ¼-in. thick	3.75
2	brass panel support rods, set	1.50
2	Audion tube bases, Rhamstine, $1.00 each	2.00
1	Filament heating transformer, variable	5.00
1	modulation trans. Acme	5.00
1	BENWOOD CW inductance	7.00
1	Federal hand transmitter	7.50
1	panel type transmitter (one needed)	5.00
1	0-2½ radiofrequency meter, Jewell	6.50
1	0-800 milliammeter. Jewell	6.50
1	21 plate panel type condenser. Chelsea	4.25
1	43 plate panel type condenser. Chelsea	4.75
1	tapped CW condenser. Dubilier	2.00
1	1300 honeycomb coil (choke)	1.00
1	Federal 1000 volt tested condenser	2.00
Total—with panel transmitter		72.25
Total—with hand transmitter		74.75
Total—with both transmitters		79 75

OUTFIT COMPLETE AS LISTED ABOVE WITH ALL HOLES DRILLED IN PANEL, FULL SET OF BLUE PRINTS FOR ASSEMBLING AND WIRING AND OPERATING.

$70.00 with panel tansmitter. **$74.00** with hand transmitter.

Outfit Complete with BENWOOD MOTOR GENERATOR AND TUBES, Boxed for Shipment. $155.00, F. O. B. St. Louis, Mo.

SPECIFICATIONS. MOTOR GENERATOR.



Cut shows the outfit completely assembled with 2 tubes and motor generator.

Motor—Rated at 1-3 hp., 1750 rpm, 110 volts 60 cycle induction type, exceptionally easy running. We can furnish similar motors for any current available either AC or DC.

Generator—The finest ever constructed for CW work. Rated at 200 watt capacity and will stand a 300 watt load for 15 minute intervals.

Has 82 segments in commutator, (an exclusive feature.)

Generator under actual test gives following results.

Running cold, no load	610 volts
With 50 watt load	580 volts
With 100 watt load	550 volts
With 150 watt load	530 volts
With 200 watt load	510 volts
With 250 watt load	506 volts
With 300 watt load	500 volts

We can safely say that the complete unit is in a class by itself, it is of the highest grade workmanship and material throughout.

PRICES. F. O. B. St. Louis, Mo.

Motor Generator Complete as shown, $85.00

Generator only, $48.00
Motor, $35.00

We desire to impress upon the prospective purchaser that this is a very remarkable and attractive price for this high grade equipment as no expense has been spared in design and materials used in its construction and the low price is only due to quantity production.

THE BENWOOD CO., Inc.

ST. LOUIS, MO.

MEYBERG

The Largest Radio Stock on the Pacific Coast

SAN FRANCISCO

Everything the Amateur Wants

LOS ANGELES

Send for 32-page Remler Catalogue—*just off press*

Stocks Guaranteed—Prompt Service From Either Address

VACUUM TUBES

C300 Cunningham Detector	$ 5.00
C301 Cunningham Amplifier	6.50
C302 Cunningham 5 Watt Power	8.00
C303 Cunningham 50 Watt Power	30.00
UV200 Radiotron Detector	5.00
UC201 Radiotron Amplifier	6.50
UV202 Radiotron 5 Watt Power	8.00
UC203 Radiotron 50 Watt Power	30.00
Moorhead Electron Relay	5.00
Moorhead VT Amplifier	6.50
Moorhead VT Transmitter	7.50
Moorhead Rectifier Tube	9.75

All tubes postage postpaid.

AMPLIFYING TRANSFORMERS

231A General Radio	$ 5.00
226W Federal	7.00
A2 Acme-Unmounted	4.50
A2 Acme Semi-mounted	5.00
A2 Acme Fully mounted	7.00
UV712 Radiotron	7.00

EVEREADY BATTERIES

765 Small 22½ Volt B	$ 2.50
766 Large 22½ Volt B	3.50
774 Variable 43 Volt B	5.00
746 Special 108 Volt Amp. B	16.50
6 Volt 40 Amp. hr. Storage	18.20
6 Volt 60 Amp. hr. Storage	20.80
6 Volt 80 Amp. hr. Storage	24.05

REMLER APPARATUS

Moulded Bakelite Variometers	$ 6.00
503 Moulded Bakelite Variocouplers	5.40
100 3" Bakelite Dial and Knob	1.00
330 Detector Panel Moulded Bakelite	8.00
331 Amplifier Panel less Transformer	6.00
333 Amplifier Panel less Transformer (with cam switch)	9.00
810 Jr. Reostat	1.00
94 A Battery Potentiometer Unit	.75
74 Knob and Lever for above	.45
96 Variable Grid Leak	.60
97 Fixed Grid Condenser	.35
400 3 Coil Mounting on base	6.50
3 Coil Mountings for Panel Mtg.	3.60

TELEPHONES

Brandes Superior	$ 8.00
Brandes Trans-Atlantic	12.00
Brandes Navy	14.00
Baldwin Type C Navy	16.50
Baldwin Type E	20.00
Baldwin Type F	21.00
Murdock No. 55 2000 ohm.	4.50
Murdock No. 55 3000 ohm.	5.50

JACKS AND PLUGS

Federal 1421 open Circuit Jack	$ .70
Federal 1422 single Circuit Jack	.85
Federal 1423 double Circuit Jack	1.00
Federal 1435 Automatic Filament Control Jack	1.20
Federal 1438 Automatic Filament Control Jack	1.55
Western Electric Plugs	1.30
Federal Plugs	2.00
Pacent Universal	2.00

SOCKETS

No. 92 Remler Socket	$ 1.50
No. 156 General Radio	1.50
No. 550 Murdock	1.00
No. R300 DeForest	1.60
De Forest Moulded Bakelite	1.40

VARIABLE CONDENSERS

No. 230 Wireless Shop Panel Mtg. .0005	$ 3.60
No. 430 Wireless Shop Panel Mtg. .001	5.25
No. 630 Wireless Shop Panel Mtg. .0015	7.50
No. 1 Chelsea Mtd. .0011	5.00
No. 2 Chelsea Mtd. .0006	4.50
No. 3 Chelsea Unmtd. .0011	4.50
No. 4 Chelsea Unmtd. .0006	4.00

REGENERATIVE RECEIVERS

Myco D12 175 to 25000 meters Detector 2-step Amp. less Coils and Tubes	$165.00
CR3 Grebe Relay Special	68.00
CR3A Grebe Tube Control self-contained	47.50
CR5 Grebe 175-3000 meters tube control	85.00
CR6 Grebe 175-680 meters Det. 2-step	210.00
CR7 Grebe 5000-20000 Long wave Special	220.00

C. W. APPARATUS
JEWELL METERS

O-100 Milliamps Flush Mtg.	$ 8.00
O-250 Milliamps Flush Mtg.	8.00
O-500 Milliamps Flush Mtg.	8.00
O-15 Volts Panel Mtg. back-con.	10.00
O-500 Volt Meter	16.00
O-1000 Volt Meter	23.00
O-1500 Volt Meter	29.00
O-1, O-2, O-2½, O-5, Thermo coupled Radiation Meter Flush Mtd.	12.00

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Westinghouse 100 Watt 110 Volt 60 cycle AC 500 Volt DC	$ 80.00
Westinghouse 250 Watt 110 Volt 60 cycle AC 1000 Volt DC with 87 Volt Grid Bias Tap	142.50
Pacent Universal CW Condensers, any capacity	2.00
CW Tuning Inductance	8.00
Variable Grid Leak 8000 ohm	3.00
Wireless Shop Condenser .0008	9.00
231M Modulation Transformer	5.00
Kellogg Transmitter	3.50
Kellogg Transmitter, adjustable arm	4.75
IMF-2IAA Western Electric Filter Condenser	2.75
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Send For Your Copy of New 32-Page Remler Catalogue Just off Press. DEALERS: Our Stock Guarantees Service. Send For Special Co-operative Plan.

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C-W C-W C-W C-W C-W C-W C-W C-W

CW Filters

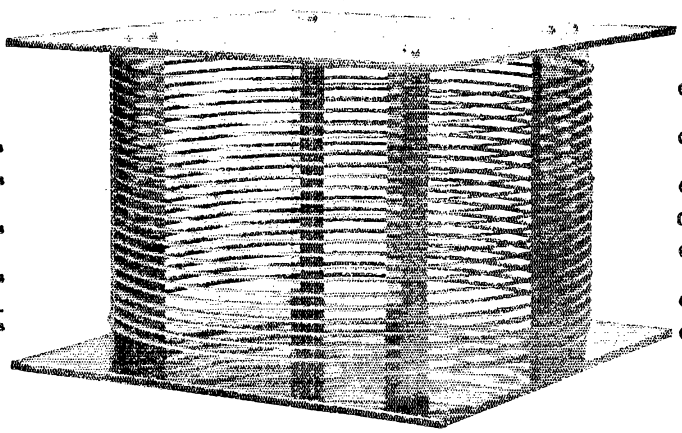
CW Plate Transformers

CW Condensers

CW Filament Transformers

CW Iron Core Chokes

CW Radio Frequency Chokes



CW Power Tubes

CW Rectifier Tubes

CW Sockets

CW Rheostats

CW Microphones

CW Tone Arms

CW Modulation Transformers

WIMCO CW 100 INDUCTANCE

Get the BEST CW Inductance. Real connection clips provided, no uncertain switches which short circuit turns. Entirely insulated on Formica, high conductivity copper, very efficient. Made in 25 and 50 turn sizes, priced at $10.00 and $13.50 respectively. Also sold in parts ready to assemble.

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Big line of high voltage generators and motor-generators reasonably priced—just what you have been looking for.

SPECIAL NOTICE

Grid coils for the above CW Inductance are now supplied so that the circuit described in July QST can be employed—and take it from us it is the REAL amateur circuit. Grid coil for the CW 100 Inductance priced at $2.00. Ask for our new bulletin containing full dope on this circuit—try it on your own set, it's a winner.

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Now is the time to remodel your antenna and we are especially prepared to supply your needs in solid copper, stranded copper and copper-weld aerial wire.

Ask about the New Air Gap Type

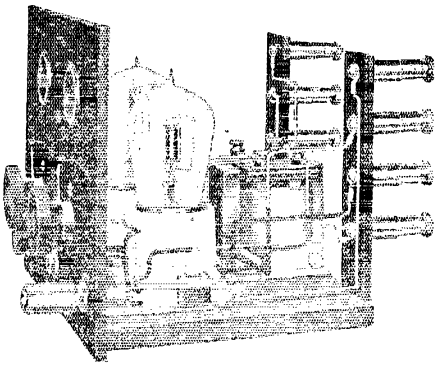
Antenna Insulators—wonderful for CW—priced right—positively superior to present forms and materials.

Send for special Antenna Material Bulletin or send 15c in stamps for catalog and complete literature.

8ZV WIRELESS MANUFACTURING CO. 8ZV

CANTON, OHIO

WIMCO apparatus is distributed in Canada by Ontario Radio Laboratory, Sault Ste. Marie, Ont.



TELMACO

Vacuum Tube Detectors and Amplifiers

The very best that skill and experience can produce

THE CABINETS are constructed of selected quarter sawed oak; stained inside and out; waxed and hand rubbed. PANELS are of grade M ⅜ in. Formica, 6½ in. high, grained finish. They are attached to draw shelf, permitting complete assembly to be instantly removed and used without cabinet, if desired. FILAMENT CONTROL RHEOSTATS are of approved type.

TELMACO SPECIAL BINDING POST CONSTRUCTION is used throughout, entirely eliminating all wiring from the front of the panel. AMPLIFYING TRANSFORMERS are of new type, designed to operate with maximum efficiency with the n w type tubes. We furnish them FULLY MOUNTED.

The GRID CONDENSER and VARIABLE LEAK are wired in the detector circuit, the latter on the front panel. SOCKETS are of high grade construction to fit tubes having standard four prong bases. LETTERING on panel is pantograph machine engraved and filled with best grade of white enamel.

FULL AUTOMATIC CONTROL JACKS are wired into these amplifiers. RADIO PLUG is furnished with the above.

TELMACO VARIOMETERS and VARIO-COUPLERS

VARIOMETER—Price without dial $5.00
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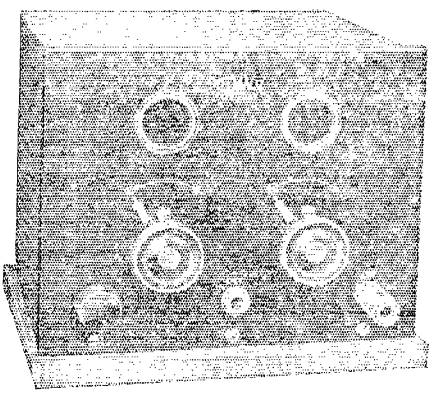
Telmaco beginner's complete receiving outfit includes 2000 ohm double phones, detector, mineral, cond nser, double slide tuner 150 ft aerial wire, insulators, and book of instructions. A first class outfit. Very popular. Price $12.00.



PRICES

Type TD-1 Telmaco Vacuum Tube Detector Unit $15.00

Type TDA-1 Telmaco Detector and Single Stage Amplifier Unit 35.00

Type TA-2 Telmaco Two-Stage Amplifier .. 40.00

Type TDA-2 Telmaco Detector and Two-Stage Amplifiers 45.00

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Your panels engraved with our GORTON ENGRAVER. Price 5 cents per letter. Minimum charge $2.00.

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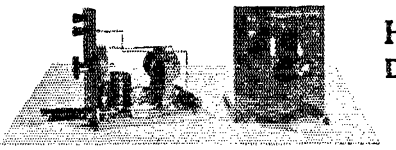
RADIO DIVISION

Telephone Maintenance Co.

17 N. LaSalle St., Chicago, Ill.

HORATIO A P 1

1 Step Amplifier, assembled from nationally advertised parts.



SPECIFICATIONS: 5" high, 4" wide. Bakelite socket, Standard size jack, fit any plug, Condensite Celoron panel, the best insulation obtainable, High quality amplifying transformer specially tested, Hard Rubber Binding Posts, Back connection for Batteries, Bus-bar wiring 3 ply maple base stained Mission style, Gorton machine engraved lettering. Price including blue print and directions, $16.50. Add PP on 3 lbs. Plug 75c extra.

HORATIO D P 1

Detector panel, nationally advertised parts.

SPECIFICATIONS: 5" high, 4" wide, Bakelite socket, Standard size jack to fit any plug, Condensite Celoron panel, Fixed mica grid condenser, correct capacity for all detector tubes, grid leak .5 megohm Back connection for batteries, Bus-bar wiring 3 ply maple base Mission finish, Hard Rubber binding posts, All connections designated plainly in Gorton engraved letters. Price including blue print and directions $6.50. Add PP on 2 lbs. Plug extra 75c

These panels are made so that no apparatus need be discarded. Just add another step when ready for it. We employ no agents. We make our price as low as consistent with the HIGH QUALITY and give you the benefit of buying direct from manufacturer to consumer. HORATIO control panel DP1 and 1 step audio frequency amplifier panel AP1 are the embodiment of 9 years of experience in radio experimentation. They have every refinement necessary for precision control of vacuum tubes. They are the only panels on the market that use plug and jack system for changing from step to step at a medium price. They are strictly quality and guaranteed to give satisfaction. Your money will be refunded without question if HORATIO panels do not please you.

We are dealers in radio equipment and carry the best products of other manufacturers. If it's QUALITY, HORATIO has it.

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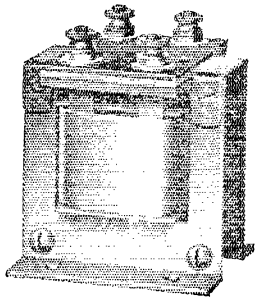
NEW THORDARSON AMPLIFYING TRANSFORMER



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Add PP on 1 lb.

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4—Considering the high standing of the maker and the very moderate price this is unquestionably the best transformer "buy" on the market.

In stock for immediate delivery—orders filled in rotation—send yours today. DEALERS:—Get our special discount on the Thordarson Amplifying Transformer—be the first in your locality to give your customers what they want. The demand will be heavy, place your order early.

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Our Rotary Amplifier Control Switch with Automatic Filament Control. Changes from detector to any desired stage by slight turn of knob. For detector and 1, 2 or 3 stage amplifier complete, knob with pointer and diagram. For panel mounting, size 1⅝ x 1⅝ x 2½.

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1¾" Navy Type Knob 10-32 threaded bushing.

With pointer....35c. Without pointer....15c.

We will quote lowest possible prices on any raw materials, parts or apparatus you may require.

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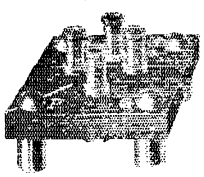

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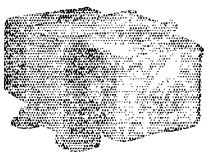

750-Watt C. W.
Power Transformer
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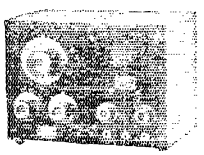

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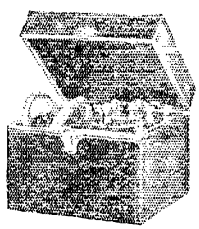

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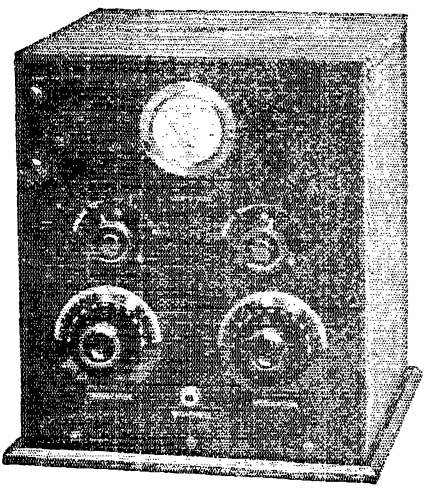

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Complete satisfaction was expressed by the entire field during the Chicago Show, bringing to Marshall-Gerken engineers the satisfaction that comes only with real accomplishment.

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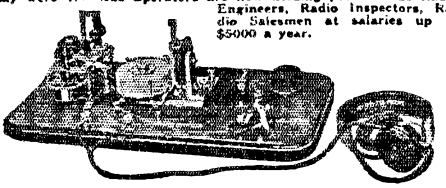

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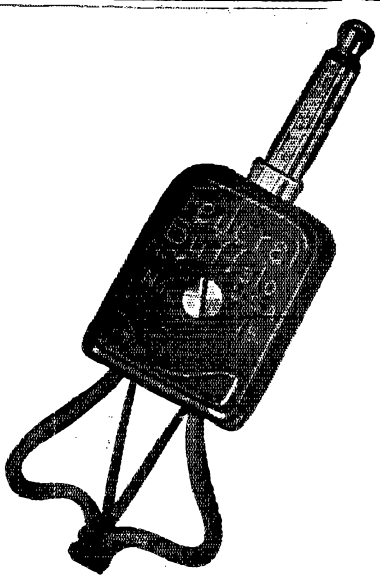

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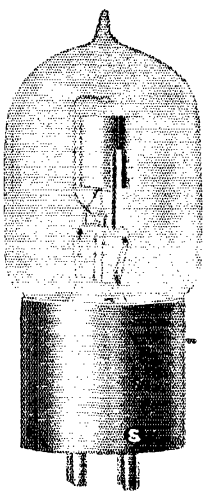

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AMPLIFIER OSCILLATOR
—the Amplifier used by the U. S. Navy. "Use the tube the Navy uses."
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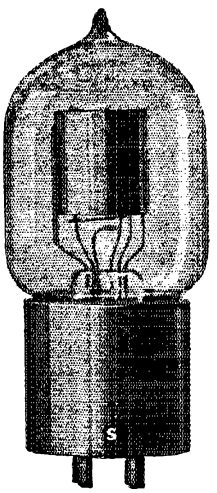

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—the most sensitive detector of spark signals known to the radio art.
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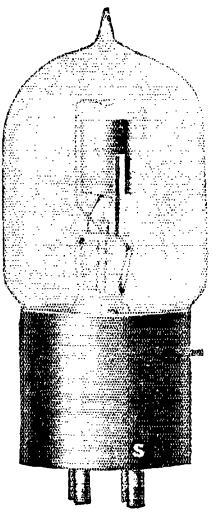

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—an efficient undamped wave transmitter for use in radio-telephony.
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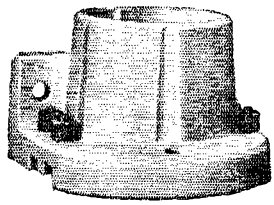


The reason for its tremendous success is not low price, but because it is BETTER. The bayonet catch is now imbedded in a much heavier wall instead of being cut clear through. This eliminates the possibility of breakage through careless handling. The whole socket has been greatly reinforced. It is now practically unbreakable. Dropping it on the floor will not break it. The springs are phosphor bronze, nickel-plated; screws and nuts brass nickel-plated.

It is built for base or panel mounting, an exclusive feature. It is the prettiest thing you ever saw assembled in a set. Now used by several manufacturers as standard equipment. Made of one piece porcelain: no metal shell, hence no ground hum. Better for power tube work, as it withstands heat and will not melt. Patent pending.

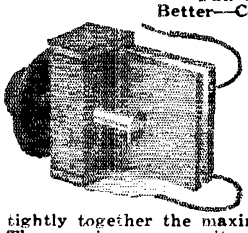
Every progressive dealer now handles the CROSLEY VT SOCKET or will obtain them for you. If your dealer can't supply you, send us his name and order direct. We will ship prepaid.

Every socket is GUARANTEED to give satisfaction or money refunded. Patent pending.

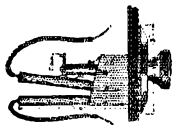
The Crosley Variable Condenser

Pat. Pend.

Better—Costs Less



This Condenser works on an entirely new principle. The two plates are hinged and are opened and closed like a book by means of a specially designed cam. The plates are surfaced with copper. One copper sheet is covered with mica so that when the two plates are clamped tightly together the maximum capacity is obtained. The maximum capacity of this Condenser will average about .0008. We rate it conservatively, however at .0005.

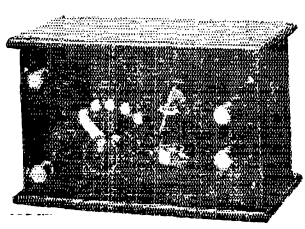


This Condenser has several advantages over the ordinary type of air condenser. Will stand 1000 volts without breaking down. It can therefore be used for CW work. Has no body or hand capacity effect. Has much greater signal strength due to the fact that mica is a much more efficient dielectric than air, due to less resistance. The calibration curve of this Condenser is almost a straight line. Has unusually low zero capacity—.00006.

Price without knob and dial $1.25
With knob and dial 1.75
Mounted in cabinet with knob and dial 2.50

Sold on a GUARANTEE of absolute satisfaction or money refunded. Ask your dealer.

HARKO RADIO RECEIVER

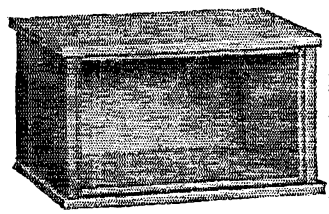


The most compact and complete efficient crystal receiving outfit on the market. Designed for the amateur who wishes to get started in this wonderful game. The illustration shows complete outfit ready to hook to aerial, fones and ground wire.

Will tune from 200 to 600 meters, bringing in spark, voice and music with average amateur antenna. NAM, Norfolk, Va. and ships at sea copied in Cincinnati.

A wonderful little instrument. Price complete with battery, interrupter for testing crystal, instructions, etc. $9.00. One thousand ohm single head set. 125 ft. antenna wire, insulators, etc. $6.00 extra. Complete outfit $15.00.

Crosley Cabinets



The tendency in the radio field today is to put apparatus in cabinets not only for appearance's sake, but as a protection from dust, dirt, atmospheric conditions etc. Realizing the demand for attractive stock cabinets of various sizes, we are building them in quantities in our large wood working plant. These cabinets are all uniform in style. The panels are rabbated in to the front. As the outside dimensions and inside dimensions are either larger or smaller than the panel itself, we show panel size and also inside dimensions. Prices quoted do not include the panels. Wood used is either gum or mahogany in dark antique or red mahogany finish or in quartered oak in natural or antique finished. Specify type of wood and finish in ordering. Lids or tops are hinged. Sizes and prices are:

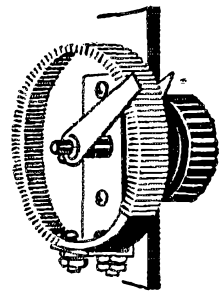
For Panel Size	CABINETS Inside Dimensions High	Wide	Deep	Mahogany or Quartered Gum	Oak
6x7	6½"	6½"	7"	$2.50	$3.85
6x10½	6½"	10"	7"	2.75	4.40
6x14	6½"	13½"	7"	3.30	5.55
6x21	6½"	20½"	7"	3.90	7.30
9x14	8½"	13½"	10"	3.70	6.80
12x24	11½"	13½"	10"	4.40	6.80
12x21	11½"	20½"	10"	5.25	10.60

Cash must accompany order. No C.O.D.'s. We pay transportation charges. Ask your dealer.

FORMICA PANELS

We can furnish genuine formica panels ⅜" thick, cut to the following dimensions: 6x7; 6x10½; 7x9; 6x14; 7x12; 6x21; 7x18; 9x14; 12x14; 14x18; 18x21. Price of panels—2½c per square inch. For odd sizes order the next largest size: we will trim. We pay postage.

CROSLEY RHEOSTATS

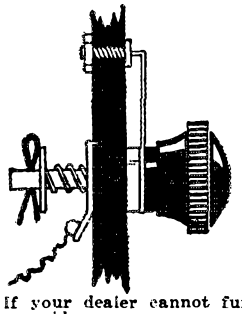


Complete with knob, pointers, etc. as shown in illustration. Our unique construction permits mounting on panel of any thickness up to and including ⅜": non-corrosive resistance wire.

Model "A"—overall diameter 1⅝". Resistance 7 ohms, one ampere without heating. Suitable for detector or amplifier tubes. Price 60c each.

Model "B"—Resistance 4 ohms: will carry 3 amperes without heating. Suitable for detector, where very accurate adjustment is required and for 5 watt power tubes. Price $1.25.

CROSLEY TAP SWITCHES



Note unique construction assuring constant tension. Composition knob, nickel-plated switch arm and bushing. Note stationary washer with soldering lug, making possible buss wire connection. Price 40c each. Better—Costs Less.

SWITCH TAPS for above, brass nickel-plated, complete with brass nut 3c each, 30c per dozen or $2.50 per hundred.

If your dealer cannot furnish, we will ship direct prepaid.

CROSLEY MFG. CO.
Radio Dept. Q-6, Cincinnati, Ohio.

CLASSIFIED ADVERTISEMENTS

Five cents per word per insertion, in advance. Name and address must be counted. Copy must be received by the 10th of month for succeeding month's issue.

LOG BOOKS and Postal Cards. Tell the other fellow how and when you heard him. Your name and call on 100 postals giving information about signals heard and your own equipment, dollar fifty. Eighty page Log Book, special pages, abbreviations, calls, other information, postpaid, dollar. Call and name printed on book cover free if order both. Commercial Press, Everett, Washington.

HONEYCOMB RECEIVER, detector and 2 step with B battery, Brandes phones and 5 coils less tubes and ampliformers. Mahogany finish cabinet $50. R. Woodbury, Manchester Rd., Winchester, Mass.

CASH SNAPS—Two Step Amplifier, Tubes and Phone Plug $20; Murdock Rotary $7, two original Audiotrons unused each $5.50—1AE.

BARGAIN: Clapp-Eastham half KW Hytone Transmitter. This set cost $250, new, but is going cheap, as the owner is hard up for cash. James Mott Hallowell, Jr., Chestnut Hill, Mass.

40-45 VOLT GENERATORS, Guaranteed $8.00 each R. Flora—8DN—Sylvania, O.

OLD TYPE Benwood with special plate glass front $15. Vacuum Cleaner motor suitable to drive the same, directly coupled, $4. R. E. Stoughton, Central Garage, Portland, Me.

STORAGE BATTERIES 6V. 100 amp. 12V. 60 amp. These batteries are of standard make, slightly used. Rebuilt and reinsulated by expert workmen. Special price $15. Limited supply at that price. The Storage Battery Service Co., Box 53, Danville, Indiana.

EDISON B Battery elements. Make you own. Can be recharged and lasts for years. Harry Morrell, 52 Goffe St., New Haven, Conn.

FOR SALE: 1 KW Clapp-Eastham type E transformer used about twelve hours, $37.50; ½ KW .007 Dublier condenser, $20.00; 1 KW Amrad gap, $20.00; ½ KW Amrad gap, $10.00; Murdock O.T., $2.00; 1 KW Mesco key, $2.50; Brandes Superiors, $4.00; Baldwin Navies, $9.00; Western-Electric V.T. 1's, $5.00; H. C. coils ½ price; General Radio 0-10 amps. H.W. meter, $5.00; 2 step amplifier, bakelite panel and cabinet, Acme transformers, $17.50 with W. E. bulbs, $25.00; Illinois and Murdock .001 and .0005 condensers, ½ price; H.C. coil receiver on Bakelite and in cabinet, A. L. Grove's circuit complete $20.00, with Marconi V.T., $22.50. All the above in good condition. All letters answered. M. L. Goldstein, 1225 Washington St., Waco, Texas.

CLAPP-EASTHAM regenerative receive in cabinet. $21 gets it. Merle Coulter, Rockwell City, Iowa.

FOR SALE: New Exide 6V. 35 amp. $12.50; 6V. 60 amp. Drew $16. Special Radio Batteries. Radio Battery Service Station, 1KM, 44 Bryant St., Malden, Mass.

FOR SALE: A five cell, No. A6 large type Edison Battery, $40. F.O.B. Shelton. Howard Reffelt, 11 Orchard St., Shelton, Conn.

EXCEPTIONAL BARGAIN Special Model Grebe C.R.7 Longwave Regenerative Receiver, complete, without detector, will sell $110.00 cash. Write L. Room 201 120 Liberty Street, New York.

WIRELESS SETS for sale: 2" induction coil, glass plate condensers, Murdock oscillation transformer—hinge type, Duck open spark gap, aerial and ground switches, Arlington receiving transformer 150 to 3800 meters, Murdock variable condenser, audion control cabinet with bulb, Murdock 3000 ohm phones. Sending range 50 miles or more. Set practically new. First M. O. for $45.00 takes it. 4000-20000 meter tuner with 3 condensers in good condition $35.00. P. P. Roy Anderson, Box 206 Ketchikan, Alaska.

500V. MOTOR Generator, $40.00; 500V. Esco Generator, New, $40.00; Variometer Regenerative Set, $15.00; 2 Acme Amplifying Transformers, $3.00 ea.; Modulation Transformer, $4.00; C.W. Inductance, 32 turns, No. 7, $4.00; Murdock Antenna Switch, $2.00; Federal Jacks, etc.; Federal Hand Microphone, $4.00. A. Hengelbrok, 922 Washington, Newport, Ky.

FOR SALE: Acme oil-immersed condenser—brand new. Transformer 220 to 110V. or 110V. to 220V. 1KW, new. F. E. Cannings, 4249 Russell St., St. Louis, Mo.

PARAGON, $20.00; Murdock fones, $4.00; Acme Transformer, $3.50. Gail Wade, 1308 Hamilton St., Manitowoc, Wis.

FOR SALE: ¼ KW Thordarson Transformer, $10.00. Ray Farwell, 502 Knickerbocker Ave., Brooklyn, N. Y.

CHRISTMAS BARGAINS: Private laboratory stock for immediate disposal. Following are new and in perfect condition. Six complete sets Honeycomb Coils $25.00 set. Six Triple Coil Mountings $4.00 each. One Triple Crystal Detector Stand $10.00. Four pairs Western Electric Receivers $8.00 pair. Two Western Electric Loud Speakers complete with current amplifying transformers $35.00 each. Two Westinghouse ¼ H.P. A.C. Motors $20.00 each. Six Western Electric Microfones $2.00 each. Ten Moorhead Amplifying Tubes $3.00 each. Six Western Electric VT-1's $5.50 each. Six Western Electric VT-2's $8.00 each. Following have been used only in test work and are in excellent condition. Ten sections Murdock Moulded Condensers $1.00 section. Twenty Western Electric 1000 volt filter condensers $1.00 each. One Complete Transmitting Set consisting of Clapp-Eastham Type E 1KW Transformer, Six sections Murdock condensers, Murdock Rotary Gap for A.C. with Rheostat, Telefunken type Oscillation Transformer, Radiation Meter, Large Key. Price complete $50.00 Parts of above set will be sold separately if desired. Send your money order early. Or send stamp for inquiry or reservation at once. All apparatus guaranteed as represented. P. J. Stockwell, Box 157, Reading, Mass.

FOR SALE: Grebe CR3 and Grebe RORD detector and two step, like new, both for $88.00 or sell separate; Thordarson 8 point rotor, $2.00; Bunnell straight line key, new, $6.00; Saco amplifying transformer, $3.50; 3.000 ohm Murdock fones, $3.50; Murdock 0-10 H.W.A. $5.00; Weston 0-200 milliammeter, new, $6.00; Weston model 280, new, $15.00; Paragon rheostat, $1.00; Dubiller 20,000 Volt, .004 M.F. condenser, $20.00. S. A. Waite, 49 Benefit St., Worcester, Mass.

CW-MEN: Get our 32T CW Inductance with grid coil 3 clips—Bakelite insulation—Walnut finish. Real Value, $9.00. Specialists in CW equipment, 500 M.A. 1000V. Chemical Rectifiers in Cabinet, $9.50. Jones Electric and Radio Mfg. Co., 120 East Lexington St., Baltimore, Md.

LOOK 'EM OVER: For sale—Fine Navy type Coupler, $12.00; Connecticut V.C., $4.50; DeForest Panels: U200 $2.00, US100 $2.00. Carter McCormick, Box 200, Chesaning, Michigan.

STOP! LOOK! and ACT! We supply free of charge with each 50 watt Radiotron power tube UV-203, price $30.00, the standard General Electric V.T. Socket, price $2.50, and with each UV-202 five watt power tube price $8.00, your choice of a 4 ampere C. E. rheostat, porcelain or improved Murdock V.T. Socket. Unsatisfactory or damaged tubes replaced at once. No risk. Immediate delivery. Shipped postpaid and insured. The Kehler Radio Laboratories, Dept. Q, Abilene, Kansas.

YOU WANT A SYNCHRONOUS GAP! We have a few synchronous motors of prices you can afford. ⅛, 1-5 and ¼ H.P.—220 and 110 volts. Price and full information on request. Stahl Rectifier Company, 1401 W. Jackson Blvd., Chicago, Ill.

BARGAIN One K.W. Transformer Close core type. Very Efficient, $25.00. M. Glindemann, 834 Market St., San Francisco, Cal.

FOR SALE: DeForest detector and three step amplifier, mounted in cabinet, complete with four "B" batteries and fifteen coils. First class condition. First check for $90.00 gets it. Earl Swickard, Newman, Ill.

A .007 DUBILIER 14,000 volt Condenser. Perfect condition, reasonable price. M. Liedeker, 1516 53St., Brooklyn, N. Y.

SELL—Short wave regenerative receiver $25.00. Colt's .45 automatic $30.00. Want .32 automatic. H. Robinson, 44 East Patterson, Columbus, Ohio.

BARGAIN 500 Volt International M-G with field rheostat. 110 A.C. Motor. Jurian Van Riper, 117 Lafayette Ave., Passaic, N. J.

NAVY STANDARD 2 step, DeForest Guaranteed, brand new, never used, Cost over $70.00, sell for $45.00 with B Bats. Need money for C.W. B. Jones, 1658 Beacon St., Brookline, Mass.

STAMPED POSTALS: For reporting reception. Blanks for how and when, printed description of your receiver and call in large red letters. Hundred, $2.00. Radiogram blanks with your call in large red letters. Hundred, 40cts. Radio printing. Howard Frazier, 5714 Hazel Avenue, Philadelphia.

FOR SALE: Several Radio Frequency choke coils, unmounted 3 Milhenry; $1.35 Postpaid. Elmo Lindberg, 816 Puget St., Olympia, Washington.

BLUE PRINTS—Have the wiring diagram of your hookup made in a blue print and hang it on the wall of your radio room. .Three blue prints 8½"x11" for 60 cents. Tracing of the same 50 cents extra. Palmer and Freund, 1261 Octavia St., San Francisco, Calif.

FOR SALE: Federal Amplifying Transformers, $6.00. General Radio Milliammeter, $6.00. Honeycomb Tuner and full set of coils $40.00. J. A. Baker, 45 Prospect St., Claremont, N. H.

DUBILIER—25,000 Volts —0.01 M.F.D. Practically new. Trade for 25.000 Volt—0.007 MFD. and $5.00 or $35.00 cash. 2DB—R. D. Zucker, 46 Clinton Place, Mt. Vernon, N. Y.

QRK- Hawaiian and German Stations Read With a Single Bulb. Are you satisfied with your receiving set? Would you like to build one that will receive over 6000 miles on a single bulb and quit experimenting? One that will be the equal of any regardless of claims or price? Using the instruments you now have, you will be able to duplicate the long distance records you read about every day. Get our simple diagram of a complete short and long wave receiver, 175 to 20,000 meters, with which we read Honolulu, California, German, South American, French and English stations, and practically all the high powered foreign and domestic stations, amateurs as far west as New Mexico and numerous telephone and musical concerts come in good. Diagram and complete instructions, leaving nothing to guess about, will be promptly mailed for 50 cents in coin or stamps. Wire a set up and quit wasting good money. Virginia Novelty Co., Martinsburg, West Va.

GOVERNMENT GOODS CHEAP—Insulators, $0.60. 1 KW Keys, $1.25; Leyden Jars, $2.25; ½ KW Quenched Gaps, $4.50; Protective device, $4.25; .0035 French Dubiliers, $8.50; Sperry arc transmitter, $9.50; 6V. 400V. Dynamotor, $22.50; ½ KW 600 cyc. French Portable, $45; ¼ KW 500 cycle motor generator, $46; ½ KW Marconi 500 cycle Complete. Description on request. Eaton, 1915 South Twelfth, Pa.

AGENTS WANTED in every community to sell "WorkRite Receiving Sets" at $6.00 complete. Every boy wants one. Works perfectly. Chance to earn good money. WorkRite Mfg. Co., Cleveland, Ohio.

SELL: 425 volt 100 watt generator, $20. 0-1, 0-2½ General Radio ammeters, $5 each. Himmer tone arm, $8. General Radio modulation transformer, $4.50; new| A Bachtel, 151 Garman Rd., Akron, Ohio.

$12 takes my new 6 volt-8 amp. Storage Battery. Postpaid, E. Davault, 1052 William St., Baltimore, Md.

BARGAINS: ¾ KW Thordarson never used. $17.95; Clapp-Eastham Boston Key, $3.95; Murdock Aerial Switch, $1.95; Murdock .005 Variable, $2.95; Clapp-Eastham Precision Hotwire Ammeter, $6.95; Audiotron, never used, $4.95; Adams-Morgan 3 Slide Tuner, $0.95; 3000 meter Loosecoupler $4.95; Pancake O.T., $2.95; ¼ Spark coil, $0.95; Stationary Gap, $0.95; Tresco Tuner, $7.95; Hamilton-Beach Aluminum case Variable Speed Motor, used very little. $9.95; Fan Motor, $2.95; Perfection 23 plate Variable, $1.95; Crystaloi, $0.95; Transmitting series Condenser, $1.95; Harley Motorcycle, $49.00. Everything prepaid. Robt. C. Bishop, Locust St., Lockport, N. Y.

FOR SALE: Half KW 13200 volt Packard excellent rotary, oscillation transformer, condenser plates, Overland key. Write for low prices. O. R. Wimpy, 116 Sheetz, LaFayette, Ind.

ASSEMBLED ANTENNAE: Cage type. Copper wire, wooden hoops and moulded insulators. T and L types, leads all soldered. 25'x20' size, $5.00. Jolawmac Radio, Wollaston, 70, Mass.

FOR SALE or trade: Smith Motor wheel and Junior car parts. Want Radio apparatus only. Lloyd Bjornstad, Ellendale, N. Dak.

RARE OPPORTUNITY to secure brand new ½ KW DeForest latest type OT 101 Radio-Telephone complete. Voice record 1500 miles summer. Cost $1750 —Will sacrifice. Particulars on request. J. Edw. Brown, Box 107, Glenbrook, Conn.

HR QSL: Induction Motor 110V. A.C. ⅛ H.P.| Holtzer-Cabot $10.00. Filter System 1000 Volt. $6.50; One Baldwin Fone, $5.00; Microphone, $0.50—Electrical Experimenter's 40 volumes 1915 to 1920, $3.00 F.O.B. E. G. Baier, 253 9th St., Brooklyn, N. Y.

DON'T READ THIS—If you are a millionaire. We want a real, live amateur in every community to represent us in sales of all standard radio apparatus. Attractive discounts allowed. We still have a few territories open. Write us immediately if you want to get the Xmas business. Wilmington Electrical Specialty Company, 705 Adams Street, Wilmington, Delaware.

8JL FOR SALE: Special 1KW rotary quenched set record 1900 miles complete $110.00. Regenerative and 2 step $110.00. Write for price on any part. L. N. Chatterton, 12320 Woodside, Cleveland, O.

RADIO APPARATUS made to order. I do repairing, rebuilding and assembling. Special inductances wound to order. Send for estimate. R. Pringle, 1096 Ryde St., St. Paul, Minn.

FIVE DIAL Omnigraph, $12. Single pole, double throw, Relay $5. James Mott Hallowell, Jr., Chestnut Hill, Mass.

BARGAIN, ½ KW Clapp-Eastham transformer, oscillation transformer, stationary spark-gap, 2-60 glass plate condensers, in oil, aerial switch, Mesco key, $35. 1-15 H.P. Emerson, 110 volt, 60 cycle, A.C. motor. $22, cost new, $36. Dust-proof DeForest detector, $2. Navy Recieving transformer, new $18. R. W. Pratt, 15 Kilby St., Sanford, Maine.

BARGAIN: Complete short wave regenerative set and 2 step amp. Mounted on Bakelite minus phones. First $80.00 takes it. Geo. B. James, 1414 S. Vermont, Sedalia, Mo.

FOR SALE: Three federal amplifying transformers, $4.00 and two Acme's $3.00 each. Honeycomb coils and other accessories. Dr. E. Cyriax, 219 East 71 Street, New York City.

SAVE AND HAVE—Radiotron 5 watt tubes $7.25 each; Crystaloi Detector each, $2.85 were $3.50; Complete 5 watt C-W set for $62.50. Send 4c. in stamps for photo and description of set. Mack's Radio Shop, Ansonia, Conn.

REGENERATIVE RECEIVER $10. Navarrette, 196 Wallace Street, New Haven, Conn.

FOR SALE: Two only, 1KW Darling 30,000 volt transformers in welded steel tanks oil immersed each $50.00 F.O.B. Russell Huckstep. Lebanon, Indiana, 9DGX.

1KW United Wireless Transformer $60. Heavy glass oil condenser in ten gallon container with oil $30. George Hamilton, Millville, N. J.

FOR SALE: Paragon RA 10. First money order for $35 takes it. J. F. Furey, P. O. Box 629, Hartford, Ct.

—FOR YOUR CONVENIENCE—

QST'S INDEX OF ADVERTISERS

IN THIS ISSUE

ALWAYS MENTION Q S T WHEN WRITING TO ADVERTISERS

CONTINENTAL NEWS

December, 1921

PUBLISHED OCCASIONALLY IN QST BY THE CONTINENTAL RADIO AND ELECTRIC CORPORATION

PARAGON - reduced !

Was $85.00, now only $69.50

IN AN EFFORT to reduce the H. C. of Radio, we announce this important price reduction. It is based on present day replacement costs for raw materials; on increased production; and on our willingness to sacrifice profits to start things moving in the right direction.

The famous R.A. Ten—now $15.50 lower than ever before. The identical instrument that hundreds of amateurs have endorsed so heartily!

All the famous Paragon features are still the same: the remarkable amplification that has astonished all hearers, the wide range to which Paragon Engineers have applied this amplification, the 24% greater sensitiveness and selectivity than even the noted R.A. 6 and all the little niceties of design that have made Paragon the most admired receiver in the world.

Now is your opportunity to make your station the pride of your district Buy a genuine Paragon at this revised price, and save enough for a V Detector outfit.

Continental stands back of every Paragon to see that you get full value out of its years of service. Ask your radio dealer to show you the splendid construction of a Paragon receiver. If he hasn't one in stock, he will gladly get it if you ask him.

Or, send for Free bulletin, direct to
Continental Radio and Electric Corp.
Dept. B11, 6 Warren St.,
New York City

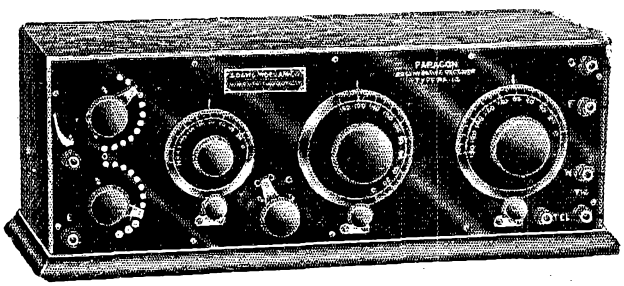
Western amateurs:
Examine Paragons at these enterprising dealers:

RAY-DI-CO
1547 North Wells Street,
Chicago, Illinois
and

THE BENWOOD COMPANY
13th and Olive Streets,
St. Louis, Missouri

2ZL Says:

The Paragon has proved especially satisfactory in C.W. work, because of the entire absence of any capacity effect.



2ZM Says:

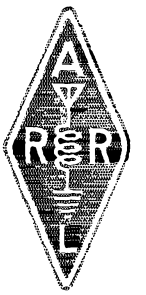
Heard a number of DX stations that were never heard before, even in the winter time, with my other receivers

Licensed Under Armstrong and Marconi Patents

QST ALL A.R.R.L. MEMBERS !

Do you wear the Emblem of your League?

Every A.R.R.L. man should display the gold and black diamond of his organization.



Radio has taken a firm grip on public interest.

Daily hundreds are seeking more light on Citizen Wireless.

As a member of the A.R.R.L. you can be a power in amateur radio in your community. Wear your emblem and proclaim yourself to the world as a part of the greatest association of Radio Amateurs in existence, the AMERICAN RADIO RELAY LEAGUE, Of the Amateur, By the Amateur and For the Amateur!

The official A. R. R. L. badge may be worn by League Members only.

It is of extra heavy 14K rolled gold and black enamel, and may be had in either pin or lapel button style.

Write to A. R. R. L. Headquarters, Hartford, Conn., specifying type of emblem desired, and enclose only $1. Your badge will then be mailed you promptly, postpaid. WEAR YOUR EMBLEM!

THE A.R.R.L. NEEDS YOU!

IF you have a genuine interest in Citizen Wireless you are eligible for membership.

The A. R. R. L. is a National, Non-Commercial Association of Wireless Amateurs, and is the leader in amateur thought and activities. Its field extends from the Wireless 'Phone to the Long Distance Relay Station; its membership comprises the listener and the operator, its aim is to further the orderly and lawful work of Citizen Wireless in all its branches.

Write to the American Radio Relay League Headquarters at Hartford, Conn., enclosing your yearly dues of $2. You will then be formally entered as a member of the A. R. R. L. and a Certificate of Membership, good for one year, will be mailed you. You will also receive 12 issues of QST, the League's official publication.

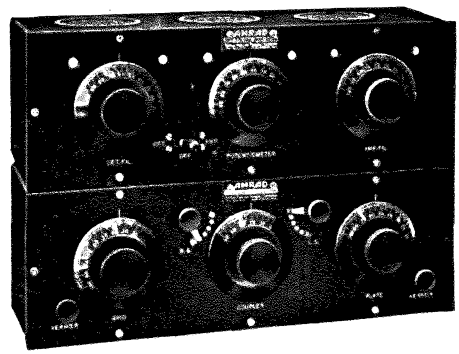
QST will keep you in touch with the manifold forms of amateur activity. Its advertising pages show the best apparatus in the country, backed by reliable manufacturers and dealers. Patronize the advertisers and benefit yourself; mention QST when writing them and benefit your magazine.

JOIN THE A.R.R.L., READ QST, AND MAKE YOUR RADIO LIFE COMPLETE!

AMRAD

The Recognized Symbol of Superior Performance

Ideal for Radiophone Reception



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