Blueprint Section Every Month

RADIO AGE

The Magazine of the Hour

May 1926

Short Wave Transmitter in Blueprint Form ¶ Twin Loop Receiver ¶ Radio on the Farm ¶ Simplifying Battery Charging

25¢

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In Each Issue

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RADIO AGE

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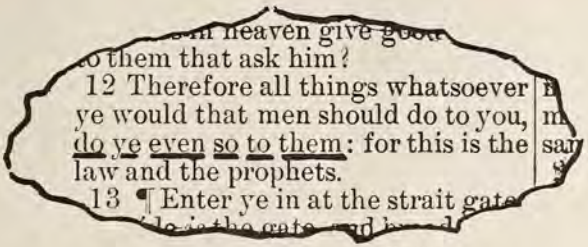

Matt. 7:12

Radio Age's Golden Rule Receiver

Blooping receivers are on the wane, regardless of whether they are regenerative or the tuned r. f. type in which the first tube can be thrown into oscillation. The recent international tests crystallized sentiment against the radiating receiver to a phenomenal degree. So we believe RADIO AGE is setting forth a worth while contribution to experimenters' work in announcing the Golden Rule receiver which will not bloop nor disturb your next door neighbor, at the same time allowing good selectivity and good volume on two stages of audio amplification when signal audibility is at a normal level. (Naturally no receiver will bring in signals when the audibility level is low.)

Three months of tests under nearly all conditions have confirmed our opinion that the Golden Rule receiver is a good receiver for anyone to build who has any regard for his own feelings or those of his radio neighbor. The set has been operated under normal conditions and no radiation could be picked up on another receiver in the laboratory, nor by a neighbor hardly a hundred feet distant. Tests of the plate current of the first tube while in operation also show the r. f. stage was not thrown into oscillation by the detector circuit. Hence we believe every radio fan who likes to make his own set cannot go wrong by building the RADIO AGE Golden Rule receiver.

Order Your June Copy Now

RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 5 *May, 1926* *Number 5*

CONTENTS

Cover insert by A. P. Mehlum

Radio Age is published monthly by RADIO AGE, Inc.
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A Chat With the Editor

OUR associate editor has been experimenting for the past three months with a circuit arrangement which, after being successfully tried out over a considerable period, RADIO AGE is announcing as the Golden Rule receiver. It will be shown in blueprint form in the June issue.

The arrangement is an adaptation of the old Weagant circuit to double regeneration, but so controlled that the detector circuit even though in an oscillatory state, cannot emit energy into the antenna circuit. Several tests have been made at the laboratory, all under different conditions, and so far the receiver has proved a non-radiator. This feature of the set leads us to believe it is aptly named the Golden Rule receiver.

Sensing the attitude of the radio fans towards a simplification in receivers the set has been designed with the idea in mind of reducing to a minimum not only the units necessary in its make up, but the controls as well. There is only one tuning control for the wave, and one regeneration control for increasing the volume of signals. For the benefit of the city dweller who must work beneath the shadow of a high power broadcaster there has been incorporated a wave filter. A glimpse at the log of the Golden Rule receiver which appears in the June issue should convince any set builder that such a receiver is highly desirable from more than one standpoint.

In this month's issue the novel twin-loop experiments performed by Friis are detailed by S. R. Winters. Brainard Foote has a good story on simplifying battery charging which should appeal to every radio user who has had to shift battery connections when getting ready to give the battery its required charging. Truly low loss coils are discussed by H. M. Bishop and data given so you can make up your own inductances. The blueprint section is devoted to construction of an amateur transmitter and should be welcomed by every radio fan who contemplates the transition from the broadcast class to that of the transmitting amateur.

All in all we feel quite proud of our May number while we can hardly restrain our enthusiasm for the June number.

Frederick Smith

Editor of RADIO AGE.

"The *little wrinkle that makes my* 'B' *batteries last longer is using the right size Eveready with a* 'C' *battery*"

"I USED to think that because the Eveready 'B' Battery No. 772 cost less than either of the larger Heavy Duty Evereadys that I was saving money. As a matter of fact, on four or five tube sets, that was false economy.

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To get the maximum of "B" battery life and satisfaction, follow these simple rules:

On 1 *to* 3 *tubes—Use Eveready No.* 772.
On 4 *or more tubes — Use the Heavy Duty "B" Batteries, either No.* 770, *or the even longer-lived Eveready Layerbilt No.* 486.
On all but single tube sets—Use a "C" battery.*

Follow these rules, and No. 772, on 1 to 3 tube sets, will last a year or more; Heavy Duties, on sets of 4 or more tubes, eight months or longer.

The average year-round use of a set is two hours a day. If you listen longer, your "B" batteries will have a some what shorter life. If you listen less they will last longer.

Our new booklet, "Choosing and Using the Right Radio Batteries," is free for the asking. It also tells about the proper battery equipment for the new power tubes.

LEFT — *No.* 486, *for* 4, 5 *or more tubes.* $5.50.

RIGHT—*Eveready Dry Cell Radio "A" Battery,* 1½ *volts.*

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Radio Batteries
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*NOTE: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

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WEAF–*New York* WGR–*Buffalo* WGN–*Chicago*
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WTAG–*Worcester* WEAR–*Cleveland*
WFI–*Philadelphia* WWJ–*Detroit* KSD–*St. Louis*

RADIO EDITORIALS

MEMBERS of the United States Senate and the House of Representatives were holding joint meetings of their patent committees as this issue was going to press. An important section of the radio public will be keenly interested in watching the result.

The main topic at these conferences is a proposed new copyright law which will provide an equitable and uniform price which broadcasters shall pay for the use of copyrighted music. Opposed to the contentions of the broadcasters is the American Society of Authors, Composers and Publishers. That organization has been bearing down pretty heavily with its demands for money from the broadcasters and the station owners have no means of knowing, under the present obsolete law passed in 1909, how much the Society may demand of them from one year to another. Under the present conditions the broadcaster appears to be rather at the mercy of arbitrary demands.

We are pleased to publish herewith a statement on the situation issued by the National Association of Broadcasters.

Statement

THE following summary of the broadcasting position in regard to the copyright music situation as regards radio broadcasting covers high lights in this important problem that threatens the music of America in no uncertain manner.

When broadcasters started to use copyright music, none of them had any idea of its ramifications. In those days broadcasters considered themselves in the light of public benefactors, inasmuch as they were all rendering a public service with no visible means of income. It seemed impossible to collect from the listeners, and money for the upkeep of stations was hard to find.

It was at this particular period when the American Society came down so heavily for license fees, and there is little wonder that broadcasters rebelled.

Now that at least seventy percent of the regular broadcasters of the country are charging for the use of their facilities, by advertisers, and now that a partial solution of the troublesome matter of income has been developed, broadcasters have come to the conclusion that they should pay for the use of copyrighted music. While court decisions have been upon both sides of the controversy, broadcasters feel that when the Supreme Court refused to review this matter, they had gone far enough along that road.

Radio programs are ninety percent music, and nine-tenths of this music is controlled by the American Society, through its pooling arrangement with copyright owners. A broadcasting station cannot successfully operate without the music of this Society. It is as necessary as raw material to the manufacturer. Supposing a furniture manufacturer finds that ninety percent of his raw material consists of lumber, and ten percent of casters, hinges, hardware and mirrors. Then supposing he finds that his lumber is controlled by an organization who pool their interests and charge what their fancy dictates. Would that be a sound position for the furniture manufacturer? Broadcasters are in no different position with respect to music.

If broadcasters wanted to obtain music without payment, or at a low payment, then there would be some basis for the opposition which comes from the American Society. We cannot, however, discover one valid argument which can be advanced against a proposal to pay fairly and liberally for the use of copyrighted music to every copyright owner, whenever copyrighted music is used, whether he be a member of the American Society or not. We have no desire to secure this music upon a low basis, but on the contrary are willing to pay fully and fairly for its use. What we do desire is permanency, so that a broadcaster may know whether he will be in business next year or the year after.

FURTHERMORE, any arrangement made with the American Society does not take into consideration those writers outside of the American Society, who oftimes are more in need of payments than the established members of the Society. Therefore, we believe our proposal is fair from every standpoint. Then there is the public interest to consider. As matters stand at the present time, the American Society withdraws musical numbers from their licensed users at will. This was done in the cases of Rose Marie, Nanette, and others. As far as the public interest is concerned, it is made up of a desire to hear the music it wants to hear. If the public knows that the broadcaster pays for the use of his music, then he sees no reason why certain popular numbers should be withdrawn at the height of their popularity.

In 1909 a Copyright Law was passed. It contains a so-called mechanical paragraph covering the use of copyright music by mechanical reproducers such as phonograph records, player piano rolls, and others. If radio had been known at that time, it would undoubtedly have been included, because radio is a mechanical reproduction.

Broadcasters are trying to have this mechanical paragraph enlarged so that it includes radio. We have no interest in the rate paid by phonograph record manufacturers. All we wish is the principle applied to radio and a new rate set for the use by radio, which may be as high as Congress or any other constituted authority may, in its judgment, determine as being fair and equitable. The career of radio has been one of chaos extending in a long line from the producer of supplies of manufacturing down to the ultimate listener. It is time that at least one portion of this chaos be removed and that a fair and just settlement be made of a matter which has been acutely controversial ever since broadcasting started.

WE venture the prediction that the United States Senate will not pass any radio legislation to regulate broadcasting at this session.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

Twin Loop Divorces Static *from* Signals

STATIC is reduced to a minimum and other forms of interference are appreciably curtailed by means of a novel directional radio receiving system developed by the Bell Telephone laboratories. The directional properties of a coil of wire or loop antenna in the reception of radio signals are known to radio fans, and from this elemental principle H. T. Friis, a radio engineer, has perfected the more complicated two-loop antenna system whereby atmospheric disturbances may be divorced from the orderly radio signals.

By S. R. WINTERS

Unfortunately, this double antenna in its exercise of discrimination between static and signals is limited in application to the super-heterodyne type of radio receiver. That is to say, a radio receiving set employing two detectors is necessary since the beat oscillating circuit at long wave lengths, a feature of the super-heterodyne receiver, is employed in neutralizing the output voltages from the two loop or coil antennae. The proper control of the current output from the double antenna system is made possible by taking advantage of the beating oscillating current of the super-heterodyne circuit.

The two coil antennae are identical in construction and in the number of turns of wire which they contain—thus making sure that they are Siamese twins with respect to their natural periods or frequencies and time constants. This is highly essential because in reducing static the effects from the two coils are made to

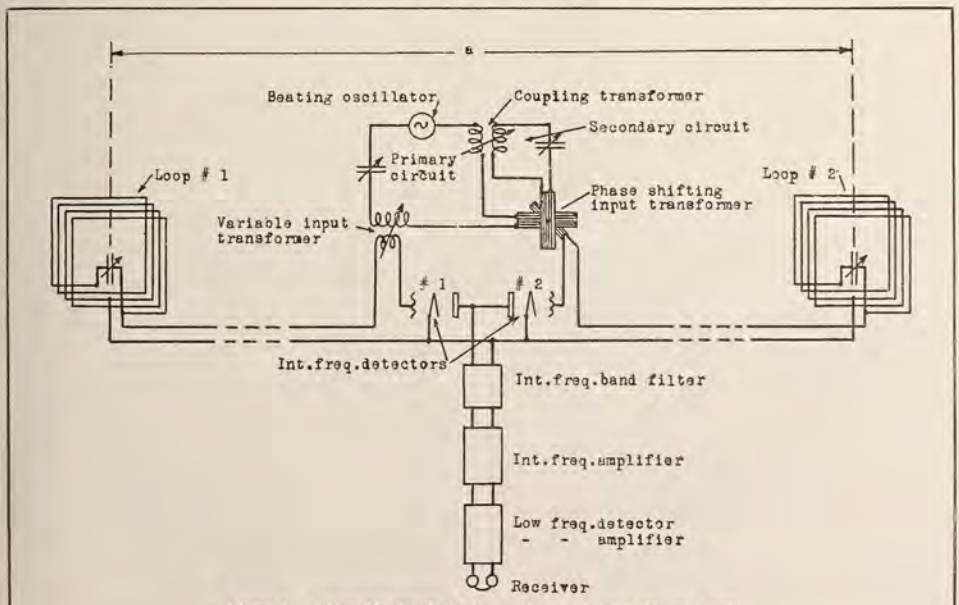


Figure 1. Schematic circuit of the two loop system is shown above

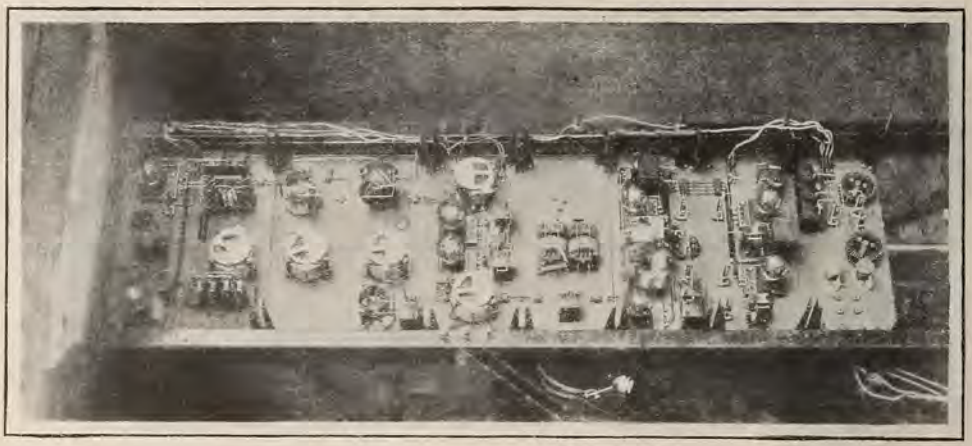


Figure 2. Rear view of receiver for short wave two loop system

neutralize each other. Previous directional antenna systems designed to balance out atmospheric disturbances have aimed to accomplish this purpose by including phase and amplitude control apparatus in the antenna circuits, which has made difficult the equalizing of the properties of the two loop antennae. This latest directional antenna system inserts the instruments for controlling the output voltages in the beating current circuit of the super-heterodyne receiver which is more or less independent of the antenna circuits.

Details of Connection

DESCRIBING in detail the arrangement of this novel receiving system designed to ostracize static, the midpoints of two loop antennae are connected to the ground in order to avoid open-antenna effects. The planes of the loops are both, and at the same time, perpendicular to the ground and to the broadcasting station from which the incoming signals originate. An intermediate-frequency vacuum-tube detector is employed with each coil antenna, the plate elements being connected in parallel to the intermediate-frequency filter. The secondary winding of a variable coupling transformer is inserted in series with the end of loop No. 1 to the grid element of the vacuum-tube detector with which it is identified. This transformer affords the beating oscillator current to this antenna circuit. On the other hand, the beating oscillating current for loop No. 2 is supplied by means of a phase-shifting transformer.

The latter transformer consists of two fixed coils, whose planes or positions are mutually perpendicular, and a third coil which is rotatable between the two fixed coils. One of the latter units, the primary windings of the beating oscillator current input transformer to loop No. 1 and of a coupling transformer, and a tuning condenser constitute a primary circuit in resonance with the beating current frequency. The other fixed inductance coil is part of a secondary tuned circuit which is loosely coupled to the primary circuit. At the point of resonance, the currents in the primary and secondary circuits are 90 degrees out of phase. Any desired phase angle of the beating current input to the circuit of loop No. 2 is effected by rotating the so-called phase coil. The other integral parts of this directional receiving system —namely; intermediate-frequency filter, intermediate - frequency amplifier, the long-wave-length detector and the long-wave-length amplifier—are conventional equipment, familiar to owners of super-heterodyne radio receiving sets.

Turn Table Mounting

FOR experimental purposes, the Bell Telephone laboratories mounted the two-loop radio receiving system on a platform similar to a turn-table, thus facilitating the rotation of the coils of wire in taking advantage of their directional characteristics. The receiving set proper was installed in a house six feet square. The complete equipment, including the antenna system and the house, rotates around a bolt in the center of the house. The latter is mounted on four 8-inch truck casters and the outside ends of the bridges carrying the antenna system are supported by wheel-barrow wheels, as illustrated in one of the photographs. The distance between the two loops is 34 meters, thus affording the opportunity of receiving radio-telephone signals over the broadcast band up to about 600 meters. Each loop is comprised of 6 turns of bare copper wire, No. 16, and one of the loops may be turned a few degrees. This is essential, since both loops should point in the same direction.

"It may be pointed out that the tuning of the system to a signal is quite simple," suggests the Bell Telephone laboratories in explaining its operation. "First," continues Mr. Friis, the inventor, "one of the loops is short circuited and the other loop tuned and the beating oscillator frequency adjusted as for an ordinary double detection receiver. Then the beating oscillator circuits are tuned up and finally the previously short circuited loop is tuned. The set is now ready for the two adjustments of beating oscillator inputs giving a minimum of interference. It is quite convenient especially at long wave lengths, to tune the set on a local oscillator, the frequency of which is adjusted to zero beat with the desired signal.

"This short-wave system was tested during the summer months at Cliffwood, New Jersey, and found to verify all conclusions derived from the shape of its directional characteristic. The reduction in spark interference when receiving signals from broadcast stations in Philadelphia was especially noticeable. The spark interference at Cliffwood is mainly due to stations along the shore and on ships around New York Harbor and the New Jersey coast, so that the interfering waves are coming from 'behind' when the system is adjusted for receiving signals from Philadelphia stations.

"On many occasions it was possible to reduce the summer static interference so much that talk from broadcasting stations which was absolutely unintelligible when received on one loop alone, was made clearly intelligible by the two-loop system. It may here be pointed out that static interference at broadcast frequencies, in the summer, is mainly due to local thunderstorms and it is, therefore, generally directive, but the direction is quite arbitrary. A gain in regard to reduction of static interference can, therefore, not always be expected since the static may come from the same direction as the signal wave. At long waves the direction from which static waves arrive is generally southwest, so a considerable reduction in static may be expected when receiving signals from Europe."

Static Directional

HAVING demonstrated the value of this new directional receiving system in effecting a large reduction of static

at broadcast frequencies, the Bell Telephone laboratories constructed a similar two-loop antenna for experimental reception of signals on long wave lengths—5,000 to 6,000 meters. One of the limiting factors in this instance was that the loops were built stationary, since it was impractical to rotate a system 400 meters long like a turn-table. This limitation dwindles in significance when we are told that long-wave receivers are used primarily for reception of signals from one point of the compass. In these experiments, for instance, the two loops are fixed in a vertical plane at an angle of 60 degrees east of north and 400 meters apart; this arrangement being quite effective in the reception of signals from Europe. This arbitrary location, however, is subject to variations in contemplation of the direction from which the interfering waves arrive. These tests indicated that during the winter months static originated in the southwest during the night and shifted to the south-southeast during the day. This variable static factor suggested the advisability of using two sets of the two-loop systems, switching from one to the other in deference to the direction of atmospheric disturbances.

The antenna circuits of the long-wave two-loop system differed from that employed in receiving signals at the broadcast range of frequencies. Double tuned circuits were used, due to the fact that a low resistance single loop circuit is too selective for speech signal reception. The loop antenna circuit and the secondary circuit were coupled together electromagnetically by means of a variable coupling coil. The two loops were installed in 10 by 10-foot wood houses, thus offering protection from adverse weather conditions. Each loop was 8 feet square, containing 40 turns of bare copper wire, No. 14, each turn spaced three-fourths of an inch apart. The loops were rotatable. The loop tuning condenser was mounted in the loop, but the loop circuit resonance could be varied slightly in the building where the receiving set proper was installed. This variation in tuning was accomplished by use of two variable inductance units inserted in series with the two wires that connected the loop with the coil coupled to the secondary circuit. A pair of twisted wires, weatherproof, was placed on the ground as a 200-meter connecting link between the two loop antennae and the radio receiver. This arrangement did not sacrifice much loss in the antenna circuits because of the low resistance of the variable inductance units and the coupling coils terminating the line.

Not Very Portable

ONE of the loops and the quarters in which it was housed approximated a ton in weight; obviously too heavy and cumbersome for a radio fan to classify as portable! However, we are told that the radio engineers of the Bell Telephone laboratories transported the loop and house to desired points by means of a team of horses. Such flexibility, indicated Mr. Friis, is very desirable in a long wave two-loop system which is still in its experimental stage. By placing the two loops close together it can be determined whether the constants of the two antenna circuits are sufficiently alike. For a small distance between the loops, it should be possible to balance out signals from all directions because the electromotive-forces in the loops are then always in phase. The balance, that is, the decrease in interference when receiving with the combined loops, as compared to the interference when receiving on one loop alone, depends only upon the constants of the two antenna circuits, and it ought to be at least 40 times. The full length of twisted wire is naturally used when experimenting with the loops close together, and while the loops must point in the same direction, this direction is chosen so that the coefficient of coupling between the loop circuits is at a minimum. After the antenna circuits are thus thoroughly tested, the loops can be moved to their right location.

"In order to compare this system with other directional systems it is necessary to measure its signal-to-noise ratio and compare it with the signal-noise ratio of some standard antenna system. So far the loop antenna has been our 'standard' for comparison. Such measurements require that both the selectivity and the 'set-noise' be the same for the standard system and the system the improvement of which is to be determined. In the case of the two-loop system it is easy to satisfy these requirements because the standard system may be obtained by merely short-circuiting one of the loops. The signal amplitudes received by a single loop and by the two balanced loops are equal when the distance between the loops is one-twelfth of a wave length, in which case the improvement in signal-noise ratio is equal to the increase in the noise when one loop is shorted. It is thus seen that it is not necessary actually to receive signals in order to determine the improvement of the system. If the dis-

(Please turn to page 42)

Figure 3. Two loops and receiver house where Friis' experiments were carried on

EUROPEAN BROADCASTING STATIONS

Compiled by H. de A. Donisthorpe

Wavelengths Meters	Name	Call Letters	Power (KW)	Schedule GMT
		AUSTRIA		
530	Vienna	.....	1½	3 p.m.-10 p.m.
399	Graz	.....	½	3 p.m.-10:15 p.m.
		BELGIUM		
288	Liege	.....	.....	
262	Brussels	SBR	1½	From 8:15 p.m.
205	Liege	.....	.....	
		BRITISH ISLES		
1600	Daventry	5XX	25	Relays London
495	Aberdeen	2BD	1½	3:15 p.m.-10:30 p.m.
482	Swansea	5SW	¼	3:15 p.m.-10:30 p.m.
479	Birmingham	5IT	1½	3:15 p.m.-10:30 p.m.
440	Belfast	2BE	1½	3:15 p.m.-10:30 p.m.
422	Glasgow	5SC	1½	3:15 p.m.-10:30 p.m.
404	Newcastle	5NO	1½	3:15 p.m.-10:30 p.m.
390	Dublin	2RN	.....	Weekdays 7:30 p.m. 10 p.m.
386	Bournemouth	6BM	½	3 p.m.-10:30 p.m.
378	Manchester	2Zy	1½	3 p.m.-10:30 p.m.
365	London	2LO	3	3 p.m.-10:30 p.m.
352.5	Cardiff	5WA	1½	3 p.m.-10:30 p.m.
338	Plymouth	5PY	¼	3 p.m.-10:30 p.m.
335	Hull	6KH	¼	3 p.m.-10:30 p.m.
331	Dundee	2DE	¼	3 p.m.-10:30 p.m.
324.5	Edinburgh	2EH	¼	3 p.m.-10:30 p.m.
323.5	Nottingham	5NG	¼	3 p.m.-10:30 p.m.
321.5	Leeds	2LS	¼	3 p.m.-10:30 p.m.
310	Bradford	2LS	¼	Relays Leeds
306	Stoke	6ST	¼	3 p.m.-10:00 p.m.
301	Sheffield	6FL	¼	3 p.m.-10:30 p.m.
		CZECHO-SLOVAKIA		
1160	Kbely	.....	.....	3 times weekly 7:30 p.m.-10 p.m.
730	Brunn	.....	1	From 5:20 p.m.
365	Prague	.....	5	From 7 p.m.
		DENMARK		
2400	Lyngby	.....	1½	News 8 p.m.
1250	Hjorring	.....	½	
1150	Ryvang	.....	6	Sundays, Church Services 9 a.m.
950	Odense	.....	¼	7 p.m.-9:30 p.m.
337	Copenhagen	.....	¾	From 7 p.m.
		FINLAND		
561	Jyvaskyla	.....	.2	
522	Helsingfors	.....	1½	Tues., Thurs., & Sat. 5 p.m.-7 p.m.
360	Tamadors	.....	.....	Relays Helsingfors
318	Helsingfors	.....	.....	
233	Cleaborg	.....	¼	
		FRANCE		
2740	Paris	FL	5	8:10 p.m. Concert (2740)
2650				5 p.m. concert (2650)
1750	Paris	CFR	1½	Noon to 10 p.m.
480	Lyons La Doua	.....	½	
458	Paris	FPTT	½	Concert 9 p.m.
441	Toulouse	.....	2	From 12:30 p.m.
410	Bordeaux	PTT	½	Relays Paris
358	Paris	.....	½	Concert 9:15 p.m.
351	Marseilles	PTT	.....	
318	Agen	.....	¼	8 p.m. News Bulletin
280	Toulouse	PTT	2	
280	Lyons	.....	2	8:30 p.m. Concert
250	Anjou	.....	½	8:30 p.m.-10 p.m.
		GERMANY		
4000	Berlin	AFP	10	
1800	Norddeich	KAV	.....	11 p.m. Weather report
576	Berlin	.....	2	7:30 p.m.-10 p.m.
505	Berlin	.....	4½	
485	Munich	.....	1½	3 p.m.
470	Frankfurt	.....	1½	7:30 p.m. Concert
462	Koenigsberg	.....	1½	7 p.m. concert 9 p.m. dance music
452	Leipsig	.....	1½	3 p.m. Concert
446	Stuttgart	.....	1½	7 p.m. Concert
416	Breslau	.....	1	7 p.m. Concert
410	Muenster	.....	1½	7 p.m. Concert
392.5	Hamburg	.....	10	7 p.m. Concert
297	Hanover	.....	1½	Relays Hamburg
294	Dresden	.....	1½	Relays Leipzig
283	Dortmund	.....	1½	Relays Muenster
277	Bremen	.....	¾	Relays Hamburg
273.5	Cassel	.....	1½	Relays Frankfurt
259	Elberfeld	.....	1½	Relays Muenster
251	Gleiwitz	.....	1½	Relays Breslau
241	Stettin	.....	1½	Relays Berlin
220	Kiel	.....	1½	Relays Hamburg
		HOLLAND		
2125	Amsterdam	PCFF	2	
1100	De Bilt	.....	.....	
1050	Hilversum	HDO	5	
315	Blormendaal	.....	.04	Sundays only, Church Services
		HUNGARY		
546	Budapest	.....	2	7:30 p.m. Concert
		ITALY		
425	Rome	IRO	1½	7:40 p.m. Concert
320	Milan	IMI	1½	9 p.m. Concert
		NORWAY		
382	Oslo	.....	1	7 p.m. Concert
350	Bergen	.....	.....	
		POLAND		
380	Warsaw	.....	.7	5 p.m.-7 p.m. concerts
		RUSSIA		
1500	Riga	.....	.....	
1450	Moscow	RDW	12	4:30 p.m. Concert
1010	Moscow	.....	2	9 p.m. Concert
1000	Kiev	.....	.....	
940	Leningrad	.....	2	6:30 p.m. concert
400	Moscow	.....	2	
310	Leningrad	.....	2	
253	Nijni Novgorod	.....	1	
		SERBIA		
1650	Belgrade	.....	2	
		SPAIN		
460	Barcelona	EAJ 13	1	9:15 p.m. Concert
418	Bilbao	EAJ 11	2	10 p.m. Concert
392	Madrid	EAJ 6	3	
373	Madrid	EAJ 7	6	2:30 p.m.-10 p.m.
360	Cadiz	EAJ 3	½	7 p.m.-9 p.m.
357	Seville	EAJ 5	1	
355	Salamanca	EAJ 22	½	
344	San Sebastian	EAJ 8	3	
340	Madrid	EAJ 4	1	
335	Cartagena	EAJ 16	1	
325	Malaga	EAJ 25	.....	
325	Saragossa	EAJ 23	.....	
324	Barcelona	EAJ 1	1	6 p.m. Concert
315	Bilbao	EAJ 9	1	7 p.m.-9 p.m. concert
300	Barcelona	EAJ 18	1	
300	Seville	EAJ 17	1	
		SWEDEN		
1350	Karlsborg	.....	2	
1200	Boden	SASE	1½	Relays Stockholm
545	Sundsvall	SASD	½	
428	Stockholm	SASA	1½	8:15 p.m.
370	Falun	SMZK	¼	
325	Galve	SMXF	¼	Relays Stockholm
322	Trollhattan	SMXQ	.12	
288	Göteborg	SASB	1	
270	Malmö	SASC	½	
		SWITZERLAND		
850	Lausanne	HB2	½	8:15 p.m. Concert
775	Geneva	.....	1½	7:15 p.m. Concert
515	Zurich	.....	1	2 p.m. Concert
315	Bern	.....	1½	3 p.m. Concert

Program schedules are all shown in GMT and where not stated as otherwise, are daily broadcasts.

YOU CAN Simplify *Battery* Charging

Considerable Time and Trouble May be Saved By the Methods Shown

By BRAINARD FOOTE

THIS time I'm talking to radio listeners who use storage batteries for lighting their radio tubes. I'll have nothing to say about the pros and cons of storage and dry battery systems, confining my remarks to suggestions for making the recharging of a storage battery easy and convenient, no matter how much one may use his receiver or how many tubes it may have.

Of course, if you have your storage battery attended to by the service man and have him supply a rental battery during the period when yours is away, being recharged, you probably don't think battery charging is much of a problem! But there are others of you who prefer to see to it yourselves—to keep tab on the condition of your own battery with a hydrometer—to see that it gets its quota of distilled water—to put it on charge when necessary and the rest of the story. It's much more economical to do your own charging, besides, as you probably understand.

The bother of disconnecting the battery from the set, connecting the charger to it, then plugging in on the electric light socket has no doubt been a nuisance and you dreaded the frequent occurrence of the charging time. Moreover the clip connectors of the charger are always getting dirty and corroded and you have to "jiggle" them often before good contact is made. How much better could you have the connections permanently fixed and merely have to turn a switch when the battery goes "dead"?

Simplest System

WELL, that is just what I'm going to suggest. The saving in trouble and temper is almost unbelievable. In addition you don't wear out wires and battery binding posts by operating them so much. In Fig. 1 is shown a very simple plan for easy battery charging. Of course, your charger may not look like the one pictured—probably it will be quite different. At any rate, there'll be a double cord coming out at some point with a plug on the end for insertion in the electric light socket. And there'll be two heavy, rubber-covered wires for connection to the battery.

Now then, the "apparatus" you should have comprises a double-pole, single-throw switch, as shown and a board long enough to stand the charger, switch and storage battery on. This keeps the floor clean and provides a base to which you can screw the switch.

The switch is used just as though it were two separate switches, each one a single-pole, single-throw switch, wherein both are operated by one handle. The left-hand side of the switch turns on the charger at the same instant that the right-hand side connects the charger to the battery. In this system, the wires from the storage battery to the set are left in place all the time. Unless your charger is a particularly good one, or a "trickle" charger (explained below) you will not be able to receive while charging on account of a buzzing noise that the charger causes in the loud speaker or phones

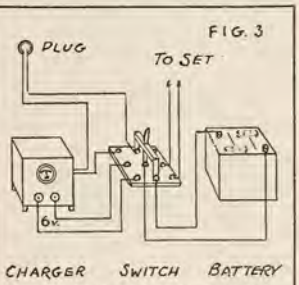


Fig. 3—With a triple blade switch you can turn the set on and off, besides connecting the battery to the charger and turning on the charger, with one instrument

It does no harm, however, to turn on the set while the charger is operating. Be careful about the connections. Get them clean and tight and if a wire looks frayed, wrap the worn spot with tape so that no possible short-circuit can occur. To connect the "charger" end of the switch, simply untwist some of the double cord about a foot from the charger and cut ONE of the wires, scraping the insulation from the ends of the two wires that are to be connected to the switch blade and contact. It makes no difference which wire goes to the switch blade and which to the contact.

The battery wires are connected as shown. One of the rubber-covered wires is cut to make connections at the switch. When the set is being used, the charger is left "off" except in special cases to be described, because the buzzing noise would interfere with clear reception. Each of the battery terminals should be unscrewed all the way and the removable parts taken off to permit a thorough cleaning of the terminal posts before the permanent connection is made. This is to clean off ALL the greenish corrosion matter. Scrape the terminals with a knife and then use a bit of sandpaper. Next replace the nuts and put on the wires—there being two wires for each post. After the terminals have been tightened well, wipe vaseline or automobile "cup grease" all over them to prevent acid from attacking the wires and corroding them. In this system it is not necessary to disconnect the wires at all, so that if you make a

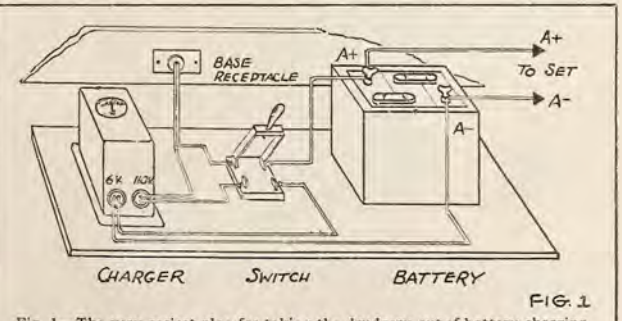


Fig. 1—The very easiest plan for taking the drudgery out of battery charging. A double blade knife switch is connected so that it turns on the charger and connects it to the battery in one operation

good job of cleaning and coating with grease there'll be no corrosion to affect the contact.

Duplex System

SLIGHTLY different is the plan sketched in Fig. 2, where a scheme is given that some of you may like better. This calls for a double-pole, double-throw knife switch instead. The storage battery wires are attached to the two middle terminals—or to the blades of the switch. When the switch is thrown to the right, as sketched, the current will be turned on to the radio receiver. When the switch is moved across to the left, the battery will be connected to the charger. To set the charger going, you must then insert the plug in the wall socket or receptacle. This is a safer plan, where children are apt to touch the switch. In addition it provides a ready means of turning the set on and off. The rheostats may then be left at the proper points, and, if the set already has an on and off switch on it, this switch is left in the "on" position, so that the control is done by the knife-blade switch. When the set is not being used, nor the charger being operated, the blades are left upright as indicated in the drawing.

This plan may be embellished further according to the scheme of connections given at Fig. 3, where a triple-pole, double-throw knife switch is selected. This really combines the ideas contained in Figs. 1 and 2, for besides providing a means of turning the set on and off it turns the charger on and off, too. In either this plan or that of Fig. 1 the set may have a "capacity" connection to the electric light line. Especially with Fig. 1, a "hum" may be heard in the speaker at first. To stop this, simply take the plug out of the socket and turn it around the other way. This places the "live" side of the house wiring circuit on the switch blade and not on the charger. In this way, the capacity path between the windings of the transformer that is contained within the charger is made to the "grounded" side of the electric light circuit, so that no hum is heard at all.

Wiring Hints

IF you are something of an electrician, the ideas contained in this story are probably already clear to you, but since a great many of you are not very much "up" on 110 volt circuits, a few words of advice may not be amiss. In the first place allow me to issue a warning—BE CAREFUL. Don't take chances with connecting wires that are "hot" or connected to the current. In any of these circuit arrangements, it is unnecessary to touch any of the 110 volt wiring while the plug is in the receptable and for this reason there is no excuse for anyone getting a shock. A 110 volt electric shock is not dangerous PROVIDING your hands are not wet or you are not holding on to a radiator or other ground wiring. But DON'T try to see what it feels like! Make your connections with the plug OUT of the socket, and don't put the plug in the socket until you check over the connections and are certain that they are in accordance with the diagram.

Now for some suggestions on making connection to the socket. Inasmuch as all of the ideas of this article involve a system where the plug to the charger is left in the socket continually it is perfectly plain that we do not want a scheme where someone is going to come along and pull out that plug to connect up a lamp, electric cleaner or iron. For this reason use a double outlet attachment on the socket. You may not have a floor receptacle handy, but if you have one that has only a single connection point that is needed for other uses you can buy a simple double attachment for a few cents at most any electrical supply shop. The type shown at Fig. 4a is what you need for such a purpose. It is a rectangular affair with plug points sticking out of it. In case the base or floor receptacle has an arrangement for a separable plug only, you will have to screw in the "screw" part of a separable plug first and then plug the double outlet attachment into this. In case you are in doubt as to what a "separable plug" looks like, one is illustrated at Fig. 4f. "S" is the screw part and "P" the plug part.

Now, in case you have to use an overhead or wall socket for connection to the charger you will want a different type of attachment. A useful kind is shown at Fig. 4b. This is screwed into a plain socket and the plug for the charger inserted in the receptacle that slants off to the side. In case the socket is being used already for a lamp, it will be necessary to place the lamp in the part of the attachment that hangs down straight. Of course, to turn the lamp on and off, the only way is to unscrew it a little in the socket. Where the wall or overhead outlet is not being used for a lamp, the double outlet shown at Fig. 4c is handy. It is much like that of 4b except that the two outlets go off at the same angle.

Double Socket

THERE is a double outlet socket manufactured which one can very easily substitute or have changed by an electrician for a single wall or overhead socket. It is shown at Fig. 4d. It consists of an ordinary "pull-chain" socket having a plug-in attachment point at the side. Pulling the light on and off doesn't change the current tap at the side, however.

Sometimes you will want to disconnect the separable plug from the end of the charger cord in order to run the wire through a hole in the back of a radio table. In doing this, you must use extreme care that you do not get the wires crossed so as to make a short-circuit when you put the plug back in the socket. You'll blow the fuse in the entrance box if you do.

(Please turn to page 43)

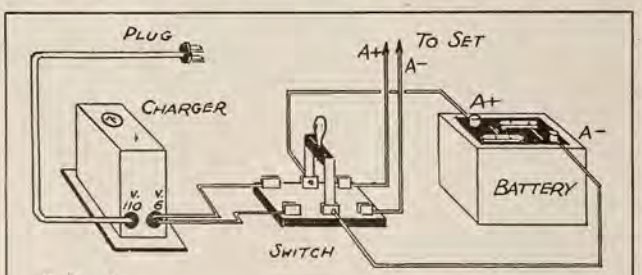


FIG 2

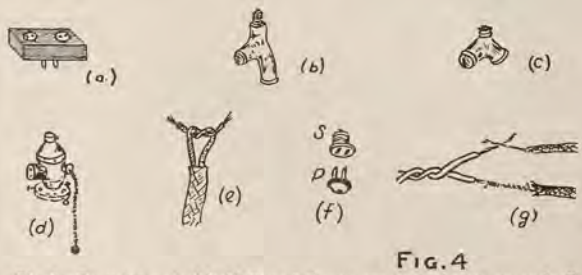


FIG. 4

Fig. 2—By using a double blade switch you can turn the set on and off, besides connecting the battery to the charger when necessary with one instrument.

Fig. 4—Some pointers on electric attachments. (a), (b), (c) different types of double outlet attachments. (d) pull-chain socket with side outlet. (e) how to prevent wires from pulling out of a plug. (f) what a "separable plug" looks like. (g) showing how to attach an extension cord to the charger cord.

Truly *Low Loss* Coils *and* Their Construction

Simple Manner Shown in Which You Can Make Self-Supporting Coils

By H. M. BISHOP

WORK as an experimenter naturally brings me to the use of many different coils, of all types and sizes. This experience has led me to the use, almost exclusively, of the type of coil to be described in this article, simply because it gives sharper tuning than any other type of coil I have ever used, and, as is well known, sharp tuning means low *effective* resistance and consequently real "low-loss."

Low effective resistance is secured, in the case of an inductance, by a proper balancing of, or compromise between (1) direct current wire resistance and, (2) distributed capacity. This involves several factors in design, which will be taken up in turn.

The first of these is the shape factor, which determines the physical proportions of the coil in question which will give the highest possible inductance with the least possible amount of wire. The type of coil which far and away is the best here (both theoretically and practically) is the simple, single layer, self-supporting solenoid, due to the fact that its overall resistance is lower than that of the basket-weave, spider-web, honeycomb, Lorenz, or toroidal types. This is in turn due to the fact that these types, because of the great amount of wire spacing, and the departure from the pure circular form very materially reduce the inductance of the coil, requiring greater wire length to obtain the desired inductance value, and hence greatly increase the D. C. resistance of the coil. It is true that these forms of winding greatly reduce the distributed capacity of a given inductance, but this does not occur in a great enough proportion to counteract the losses due to the increased D. C. resistance of the coil, and the total overall high frequency resistance is therefore higher. The absorption losses which are circumvented in this type of coil, however, make it more efficient than the conventional simple solenoid wound on a bakelite or hard rubber form, both of which types of forms cause increased distributed capacity as well as absorption. The solenoid wound on a cardboard form is slightly better, but the best form of all is the *self-supporting* solenoid, the construction of which will be described in the latter part of this article. The best shape factor for this type of coil, as obtained by exhaustive experimentation on the part of many authorities is approximately one (1.0) which means that the length of the coil should just about equal its diameter from use at broadcast frequencies, which at present extend from about five hundred fifty to one thousand five hundred kilocycles per second. Expressed in wavelength, this means a band of from five hundred fifty to two hundred meters.

Size of Wire

THE second consideration is size of wire. The third is:—Shall the coil be close wound or space wound? These two factors must be discussed together, as they bear more or less directly on each other. The size of wire most frequently used in broadcast receivers extends from about twenty-six gauge to eighteen gauge. Since radio-frequency currents travel practically altogether on the *surface* of the wire, and since the surface of the wire increases rapidly with the size of the wire, it would at first glance seem that the larger the wire the lower the resistance. This is true with direct current, approximately true with low frequency current, but only partially so with high frequency current. This is because the rapid alternations of this type of current cause eddy currents to be created in the core of the wire, which oppose the flow of the main current, and naturally these eddy currents will be much stronger in the larger sizes of wire, due to the greater amount of metal contained in the wire, the cross-sectional area of which increases far more rapidly than the diameter. Probably the best compromises here are the twenty-two gauge and the twenty gauge sizes. This is because, at broadcast frequencies, the combined D. C. resistance and eddy current loss is lowest for these sizes of wire. The twenty-four gauge and the eighteen gauge wire are very nearly as good, and may be used very satisfactorily if desired. In a close wound coil, distributed capacity varies with the size of the wire and the thickness of the insulation. The smaller the wire, and the thicker the insulation the lower the distributed capacity will be, hence, for, say a close wound coil using single cotton

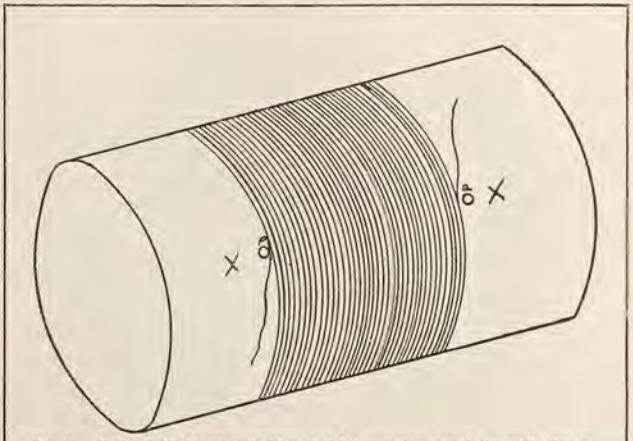


Fig. 1. Crush tube to remove from coil by pressing carefully with fingers at points "X" and "X". When crushed, fold together and withdraw from coil. "P" and "Q" are holes left by withdrawal of paper fasteners used to hold wire ends during winding of coil

or single silk insulation, use twenty-four or even twenty-six gauge wire. For a close wound coil using double cotton or silk insulation, use twenty or twenty-two gauge wire, preferably the latter. When using enamelled wire of any size, or silk or cotton insulated wire above twenty gauge in size, always use spaced winding.

I find for practically all broadcast uses, a close wound coil using twenty-two gauge double cotton covered wire has losses as low as are obtainable with the present knowledge of inductance designing. This is because this size of wire, with double-cotton covering, just spaces itself enough to effect the proper compromise between distributed capacity and D. C. resistance.

Approach Ideal

"BUT," you say, "how can one construct a self-supporting simple solenoid of true circular form?" The answer is that one cannot, but by the following method a very close approach to this ideal may be had, which in addition is satisfactorily rugged and is *moisture proof*, the latter factor being of paramount importance in portable sets or those used in damp locations, and helping to insure consistency of performance in the regular "home-entertainer" set.

Obtain a cylindrical cardboard form of the size desired to use as a temporary winding form. This need not be of good quality or finish as it is to be discarded later. Fasten the wire by any convenient method. I use an ordinary brass head paper-fastener, punched through the tube and bent over inside, winding the wire around beneath the head, as this method allows easy unfastening when the coil is finished. Now wind the coil, being particular to get the turns even and the wire taut and smooth. After about every five turns, push the wire together firmly to insure evenness and perfect matching if more than one coil is used in the set, and you desire all dials to log alike. When finished winding the coil fasten the end the same way the first end was fastened. The coil is now ready for the treatment which will render it self-supporting and moisture proof.

I know that many authorities are going to differ with me as to the advisability of the next step, but, nevertheless, I have found it to be highly efficacious, to make the coil rugged and strong, to effectively moisture proof it, and to cause so little increase in absorption and in distributed capacity that the increased losses sustained are so low as to be absolutely disregardable. The coil, when so treated, is far below any other I have ever used in losses, besides which the moisture proof feature alone is sufficient to commend it, as any one knows whose set becomes tricky and noisy whenever the weather is damp, due to the propensity of its cotton or silk insulated coils to absorb moisture from the air and cause current leakages which are far more disastrous to good reception, sensitivity, and selectivity, than the infinitesimal extra distributed capacity which is added by the following treatment.

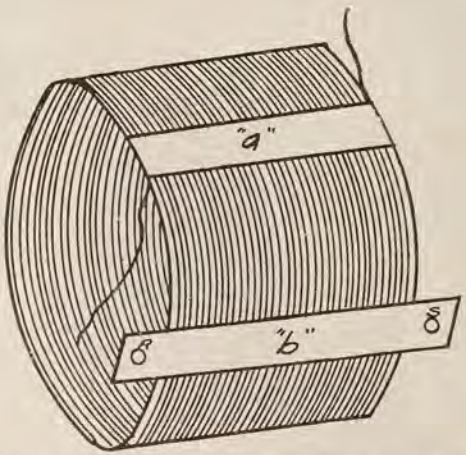


Fig. 2. "R" and "S" of section "b" are holes in mounting strip to take machine screws for fastening coils to mounting brackets

Flexible Collodion

OBTAIN from your druggist (to insure purity) an ounce or two of *flexible collodion*. Give the outside of the coil a thin but thorough coat of this, brushing it well into the insulation of the wire. Use the solution just as it comes from the bottle, or slightly thinner; not thinning it too much, however (thinning is accomplished with ether), as this reduces its mechanical strength and its water-proofing effectiveness. The actual painting of the coil must be quickly done, as collodion dries almost immediately. When the coil is thoroughly dry, which will take about five or ten minutes, remove the temporary cardboard form by carefully crushing in one side of it, as shown in Fig. 1, first taking out the paper fasteners which hold the ends of the wire, then carefully withdrawing it from the coil. Now treat the inside of the coil in the same manner as the outside was treated, brushing the collodion carefully and thoroughly into the cotton or silk covering of the wire. If cotton covered wire has been used, the inductance when dry will show a beautiful dull gloss; and if white silk covered wire has been used, the silk will become semi-transparent and the coil will have somewhat the appearance of burnished dull gold.

Anchor the Windings

TO make a firm anchor for the ends of the winding, the following method is resorted to. Obtain a few strips of transparent celluloid, of the kind used as windows in automobile curtains. Cut a strip of this about one quarter of an inch wide, and about two and one quarter times as long as the coil. Immerse this in water which is too hot for the hand to bear and preferably at almost the boiling point to render it soft and flexible. As soon as is is sufficiently soft, which will only take a minute or two, remove it from the water, dry it quickly, coat one side of it thickly with the flexible collodion, and while this is still wet, wrap it neatly around the coil as shown at "a" in Figure 2, imprisoning the wire ends, and allowing the ends of the celluloid strip to overlap for about one half inch on the inside of the coil, pressing these lapped ends tight down to the coil until they stick together. Now paint a thin coat of collodion over this strip, allowing it to lap over on the coil for about one-sixteenth of an inch on either side, which will serve to anchor it securely.

To mount the coil, put a similar strip of celluloid around the other side of the coil, folding it so that the ends project about a quarter of an inch as shown at "b" in Figure 2, and drilling or punching these projections to take a small machine screw, which is to be used to hold the coil to the mounting brackets.

This finishes the construction of a coil which will be found to be surprisingly strong mechanically, very low in effective high frequency resistance, pleasing in appearance, easy to make, and last but not least, *moisture proof*.

Radio on the Farm

By S. R. WINTERS

The above picture, while taken in the earlier days of broadcast reception, nevertheless typifies the scene usually encountered on the American farm, except where in the old days the listening was mostly done with head sets, now the American Farmer has his loudspeaker so the rest of the family may gain pleasure and profit from their radio

MORE than half a million farmers are warned of impending storms or other changing weather conditions instantly by means of radio; approximately 553,000 farms are equipped for receiving spot market quotations by radio; 24 agricultural colleges maintain broadcasting stations; and several hundred commercial or private broadcasting stations disperse agricultural information. Such, by way of summary, is the status of radio broadcasting in its relation to rural life as the year 1925 becomes history.

"At the close of the year there were 121 stations, located in 40 different States, broadcasting weather forecasts by radio telephone on regular schedules," states Professor Charles F. Marvin, Chief of the Weather Bureau. "About 95 per cent of all the powerful radio-telephone broadcasting stations in the United States," he indicates, "are now co-operating and many of them broadcast forecasts for several States, and people in every section of the country are being served. The scope of the radio-telephone weather service may be estimated when it is known that, for instance, in the State of Iowa alone there are over 33,500 receiving sets on farms. It is estimated that the weather forecasts are available by radio to more than half a million farms in the United States."

The Press Service of the United States Department of Agriculture issued

Receiving weather reports by radio at one of the forest ranger stations in the National Forests

103 statements, or so-called "agriograms," for use by private broadcasting stations. The market news service of the Department of Agriculture has speeded up the distribution of facts relating to supplies of commodities, shipments, prices, stocks and market trends, by means of radio. This swift medium of intelligence supplements long existing distributing agencies, such as press associations, newspapers, telephone and telegraph. Unlike all of these radio has the peculiar advantage of instantly disseminating information to millions—all within the twinkling of an eye, as it were.

Radio Spreads News

THE annual report of Secretary of Agriculture W. M Jardine contains a sub-title heading "Radio and the Farmer." This official cognizance of radio, as an agency for spreading information and entertainment to folks of the countryside takes into consideration, briefly, the history of radio as it pertains to agriculture, its rapid development, and its economic value to farmers.

"The department made its first experiment with radio in 1920," notes Secretary Jardine. "Since then," he indicates, "there has been a great develop-

ment in the use by farmers of this new means of communication. A survey made by county agricultural agents in 1923 indicated there were about 145,000 radio sets on farms throughout the country. In 1924 the estimated number had jumped to 365,000 and in 1925 to 553,000. The average number of radio sets on farms per county has increased from 51 in 1923 to 204 in 1925. This increase of 300 per cent is evidence that the farmer appreciates the broadcasting service provided for him.

"There has also been rapid growth in the number of radio-receiving sets on farms in States at great distances from good broadcasting service. In Florida, for example, the increase in 1925 over the estimated number on farms in that State in the preceding year was 1,955 per cent. Idaho increased the number of its farm receiving sets 850 per cent in the year, Alabama reported an increase of 850 per cent, Arizona of 460 per cent, and Louisiana of 600 per cent. In Pennsylvania, on the other hand, the gain in 1925 over 1924 was only 5 per cent.

Buy Good Sets

"FARMERS generally have bought very good radio sets. A questionnaire answered by 2,500 farmers in 1923 indicated the average price of their manufactured sets was $175. This sum will buy a better set to-day than it would two years ago. Yet farmers are not on that account reducing their investments in radio. Dealers in several parts of the country say that radio sets worth from $125 to $400 sell much more readily to farmers than those costing under $100. Farmers have discovered that they need good long-distance sets to get the weather and market reports and entertainment they demand.

"Twenty-four agricultural colleges maintain radio broadcasting stations. The colleges are becoming enthusiastic users of radio. They co-operate with the Department of Agriculture in broadcasting its weather, crop, and market reports. Several hundred broadcasting stations regularly obtain information for broadcasting from the department. Many farmers have more than saved the price of their radio sets by profit gained by the use of market information issued by the department for broadcasting."

Radio in its relation to agriculture had developed many interesting and more or less spectacular applications. For instance, recently during a heavy snowfall on the islands of southeastern Alaska vast numbers of deer were forced to the beaches and there threatened by starvation. Radiograms by the Bureau of Biological Survey of the United States Department of Agriculture called this unfortunate situation immediately to the attention of conservationists. As a result, a total of $2,309 was subscribed for the purchase of hay, thus averting wholesale destruction of deer in this northerly region. Thus, by virtue of radio, large numbers of deer were saved to perpetuate in that region a valuable game species.

IN OVAL above is shown Sam Pickard, newly appointed Chief of the Radio Service of the U. S. Department of Agriculture.

Below Mr. Pickard is a common sight in America today where the American Boy with a strong liking for radio, is putting up aerials over this broad land. In this picture a lightning switch, usually associated with transmitting sets, is shown on the window sill—a good precaution for residents of sections in which considerable summer lightning abounds.

Helps the Farmer

A COMMERCIAL broadcasting station relates the story of how a talk on animal tuberculosis broadcast by a veterinarian of the United States Department of Agriculture resulted in a farmer detecting the disease in his herd of dairy cows. He promptly disposed of the infected animals, and thereby avoided a spreading of animal tuberculosis. Sheepmen in the far West, by virtue of weather forecasts by radio, are enabled to protect their flocks of lambs from the wintry blasts and freezing rains, thus reducing the mortality rate among the sheep population of the country. Farmers who have not been to church for years because of snow blockades and impassable roads now, by the magic of the invisible radio waves, figuratively go to church each Sunday, hear the choir singing, listen to the sermon, and even know when the collection plate is passed around.

Such instances of the mission of radio to farmers could be multiplied but these serve to re-emphasize the blessings which radio has in store for the great open spaces. Radio recognizes no snow blockades, is not adverse to penetrating the lowly log cabin, is immune to the blasts of winter, is unafraid of darkness, and robs isolation of its terrors. Truly, radio brings the countryside nearer to the city and will answer in truth and reality the words of the popular song, "How Are You Going to Keep Them Down on the Farm?"

Millions Reached

LOOKING back over the year 1925, the Bureau of Agricultural Economics of the United States Department of Agriculture finds cause for gratification in the expanding opportunities offered by radio in quickly distributing its information relating to supplies of commodities, shipments, prices, stocks and market trends. This lightning-like medium of intelligence, unlike the telegraph, telephone and other distributing agencies, has the distinctive advantage of reaching thousands and even millions of persons instantly and at the same time.

"The use of radio for farmers has increased steadily during the year," notes the Chief of the Bureau of Agricultural Economics. "The number of radio sets owned by farmers has been estimated by various agencies," he continues. "In some States from 15 to 20 per cent of all farms own sets. The Bureau of Agricultural Economics contacts with radio stations which are maintained primarily from branch offices have been strengthened during the year by providing more complete reports. The number of stations has not increased greatly but the scope of the programs has been steadily expanded."

The progress report of the Bureau of Agricultural Economics singles out broadcasting stations in Texas, Illinois, Massachusetts, Minnesota, Ohio, Kansas, and Oregon as being especially helpful in spreading market reports. These stations, some of them, disseminate very complete programs of market news.

The comments of the Chief of the Bureau of Agricultural Economics follow:

WLS Has Program

"AN outstanding development has been the opening of broadcasting stations devoted primarily to agriculture. The station WLS of the Sears-Roebuck Agricultural Foundation at Chicago has cooperated from its beginning with the Bureau by presenting one of the most complete programs of market news ever attempted. In addition to daily broadcasts, a series of special talks on marketing by Bureau representatives has been used with excellent response from farmers.

"There has been a decided movement for various interests to cooperate in a given region and use a single station as the center of agricultural broadcasting. In New England, station WBZ covers practically all of the New England States. In the Northwest station WCCO, sponsored by a committee including representatives of all agricultural interests, presents a strong program for the Northwestern States. In other sections a similar development is in progress.

Reports Extended

"DURING the year the use of market reports by State college and university radio stations has been extended. Regular reports have been transmitted by university stations in Ohio, Indiana, Texas, and Iowa and arrangements are being perfected to use the stations in Kansas and Oregon.

"Summaries of the regular crop reports have been sent to branch offices for release by radio within a few minutes after they are released at Washington. Through the State crop statisticians local stories have been provided for many stations.

"Late in 1924 the first agricultural radio conference was held at Chicago in response to a call issued by the department and representatives of the Bureau participated in the discussions. This conference resulted in great increase of interest in radio broadcasting among extension directors and others.

"A feature of radio broadcasting developed during the year is the consumer talks which are now distributed weekly in Philadelphia, New York, and Chicago. These consist of description of market conditions and information of supplies of fruits and vegetables which is of value to consumers in determining their purchases for current use and for canning."

Permanency Feature

INCREASED power and improved broadcasting, together with better receiving sets, the department believes, will do much to aid in establishing the permanency of the use of radio for the benefit of agriculture.

One station alone in a period of three months broadcasting of market and weather reports received more than 3,000 letters of commendation from farmers, country banks, shippers of livestock, and small merchants in the towns in 12 agricultural states surrounding the station.

Interference among stations may gradually be eliminated, the department believes, as many of the less active stations are being discontinued, and technical improvements are being made in both broadcasting and receiving equipment. Of 1,458 radio stations of all sizes licensed to broadcast since broadcasting began, only 536 were active on January 1 this year.

Literally hundreds of stations have requested the privilege of handling the Government reports, but many of the requests have had to be refused, the department says, because the stations are remote from the department's market news branch offices.

History of Service

When the experimental radio market news service was announced on December 21, 1920, the report states, those in the Department of Agriculture who were directing the new activity hardly anticipated the wonderful possibilities of radio broadcasting as we now know it. A laboratory transmitter at the United States Bureau of Standards on a 400 meter wave length, a few enthusiastic amateurs within a hundred miles of Washington, and a 5 p. m. schedule of about 500 words by radio telegraph, composing what was called the "radio marketgram," constituted the elements of the experiment. The idea was that the amateurs would copy the marketgram and turn it over to the newspapers in their own towns or give copies to the banks or stores to be posted on bulletin boards. In every way it was a kind of laboratory experiment.

The practical results of this first experiment could hardly be called conclusive, but they gave encouragement to those in charge of it to push on in the quest of more and more evidence. On April 7, 1921, an announcement was made that arrangements had been completed with the Air Mail Radio Service of the Post Office Department to transmit by "wireless" market reports several times a day from Post Office stations at Washington, D. C., Bellefonte, Penn., St. Louis, Mo., and Omaha, Nebr.

Assuming an effective radius of audibility of 300 miles about each station, licensed amateurs in the areas covered were enlisted to copy the reports and to furnish them to shippers' associations, county agents, State Bureaus of Markets, Farm Bureaus and other agricultural agencies, banks, newspapers and local telephone exchanges. A number of licensed operators offered to copy the reports. By January 1, 1922, the market reports were being relayed and broadcast by radio telegraph from seven Post Office stations in a chain across the country.

During 1921, reports were furnished to three of the then very few radio telephone broadcasting stations. Since then, the service has grown by leaps and bounds until now there is practically no agricultural community in the country that is without official market reports on agricultural commodities. Well-established schedules of weather, crop and market reports are broadcast from more than 100 stations in all parts of the country.

Winding the coil is but a part of the job of making a home made set but the American Boy is adept at all of the details of radio construction

Here's Something for the Experimenter

Interesting Experiments Need Further Work to Determine the Theory

By K. B. HUMPHREY

SOME tubes to which is applied the reactivating process do not respond to the treatment. It seems that about five per cent is a fair figure to apply to this class of tubes, though it may run higher. A method has been found by which most of these tubes may be reclaimed. No theory has been advanced as to why they cannot be revived except that the probability is that there is no more thorium in the filament. This would seem to be disproved by the following method.

But first let us review the process as it is used at present. A socket is rigged up as shown in Figure No. 1 the grid and plate being tied together. A milliammeter is placed in the plate circuit as shown and 22½ volts of B battery are applied. Now, when a tube is placed in the socket the milliammeter will show a reading which will, in a way, indicate the condition of the tube. For tubes which are very far gone the reading will be very nearly zero. If a reading of at least 6 mills is obtained the tube is operative, especially as a detector. The normal reading of a good tube runs from 30 to 35 mills, though a reading of 20 by this method is considered good. It is good practice to take a reading before and after reactivating and then any improvement can be readily noted. This reading does not give any indication as to whether the tube is a good oscillator or not and is simply a comparative test.

Emission Normal

THE tube is then placed in another socket and a filament voltage of 16 volts is applied for *one* minute, no B voltage of any kind being used. The filament voltage is then reduced to 8 volts and allowed to be on for *ten* minutes. If another reading is taken for emission it will be found that it has increased to normal, or nearly so, and the tube is as good as it ever was. The life of the tube is probably shortened by this process but cases have been known of tubes which have been in operation over two years and have gone through this process three times.

The theory is that the thorium which is distributed throughout the filament slowly comes to the surface and is eventually burned off the outside by the continual use of the tube and it becomes what is known as paralyzed or dead. When excessive voltage is applied to the filament in the manner outlined above with no plate voltage, the thorium which is still in the interior of the wire is driven to the surface where it again comes into use in the normal way. That is, it facilitates the emission of electrons when the filament is heated to the proper temperature.

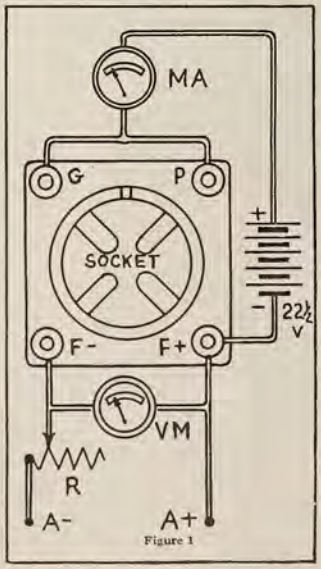


Figure 1

Sometimes a tube will not respond to this treatment no matter how often it is tried, and it has been customary to throw this kind of a tube away as being beyond repair. The reading obtained on the milliammeter will be found to be less after the reactivating process than it was before. With the standard voltage applied it is found that the filament current is only .22 amperes instead of .25 amperes at 5 volts as it should be. This would seem to indicate that the filament was of higher resistance due to an increase in resistance of the wire itself or a decrease in the diameter of the wire.

How it Happened

ONE experimenter who does a great deal of reactivating of tubes for his neighbors and friends had six tubes laying about his shop which were of this type. He hated to throw them away, and one day he happened to stick one of them in the test socket and the reading on the milliammeter read just about one-half mill with 7 volts on the filament. The telephone happened to ring at this instant and he was called away for perhaps half an hour. When he returned the milliammeter showed a reading of 6 mills. This was extremely interesting, and after about two hours more the tube was back to normal with a reading of 25 mills. The tube is working to-day in the intermediate stage of a eight tube superhetrodyne. After this experience the other tubes were treated in the same manner, that is, 7 volts on the filament and 22½ volts on the plate and grid, and they all responded with a normal reading. No theory is given as to why this happens or what takes place. The current reading after this treatment, comes back to nearly .25 amperes at 5 volts. It is sufficient to know the facts and apply them practically to the reclamation of tubes which will not respond in any other way. Note: If a so called good tube were to be treated in this manner it would be paralyzed.

THE matter referred to by Mr. Humphrey in his article was submitted to Dr. J. H. Dellinger, physicist at Bureau of Standards at Washington for an opinion of the theory involved.

Dr. Dellinger has the following to say regarding the experiments:

"I would not care to comment for publication on these interesting experiments as I have not had experience with the method given. This is a subject on which additional knowledge and publication are quite desirable."

Here's your cue, radio fans, see if you can work out a reason.

—The Editor.

How to Secure

AMATEUR RADIO LICENSES

Intimate Details Are Disclosed For the Prospective Amateur

By ROBERT E. EARLE*

IN RADIO circles the term "Amateur" has been generally used, apparently by common consent, to designate the operator of a radio transmitter who owns, operates and experiments with it for his personal amusement and for the purpose of increasing his general knowledge of the principles of radio communication.

There are several thousand amateurs in the United States and a gradually increasing number in other countries. The total number in this country varies from year to year and present indications are that an appreciable number of the newcomers are coming from the ranks of the broadcast listeners. The broadcast fan who is always experimenting with new circuits, working out new ideas is endeavoring to make new records of long distance reception, frequently feels an urge to venture into new fields and for such the change to a transmitting amateur is logical and relatively easy. He may be, and often is, encouraged by an acquaintance who has a transmitter or he may be so deeply interested as not to need outside encouragement. Occasionally some enthusiastic person will attempt to convert a receiving set into a transmitter by the addition of a few essential parts and will start transmitting without securing proper licenses for his equipment or for himself. In such an event he quickly encounters trouble because the radio communication law states that it shall be unlawful to operate apparatus for the transmission of radiograms or signals unless a license shall have been secured from the Secretary of Commerce. The same law also requires that the operators of transmitting stations must possess radio operator licenses and states that station licenses may not be issued to persons who are not citizens of the United States.

The more careful experimenter will first acquaint himself with the requirements of the law which makes liberal provisions for amateur radio stations. He then may ask what he must do to become a licensed amateur. Here is the answer.

Written Examination

THE prospective amateur should forward an application for licenses to the Supervisor of Radio for the radio district in which he resides. Such an application will bring a letter of instructions from which the applicant will learn that he must be capable of transmitting and receiving in the International Morse telegraph code at the rate of ten or more words per minute and further that he must pass a written examination covering the theory and practical operation of the transmitter and receiver to be used. He will also be informed that he should procure a copy of the Radio Communication Laws and Regulations of the United States from the Superintendent of Public Documents, Government Printing Office, Washington, D. C. This will be sent for fifteen cents and remittance should be made by money order. The law and the regulations relating to amateur operators and stations should be studied carefully.

Our May number has a good deal of matter intended for the prospective amateur, and with this in view we asked Mr. Earle to outline the steps by means of which the embryo amateur may get his government license with the minimum of trouble and misunderstanding.

This article by Mr. Earle in conjunction with that by Mr. Collins in the blueprint section of this issue, can be considered a thorough exposition of the amateur game, and should furnish interesting and beneficial reading for anyone desirous of enrolling in the ranks of the gentlemen who say it with dots and dashes.

—The Editor.

The regulations mentioned contain a copy of the International Morse code which is quite similar to the American Morse code used on the wire telegraph lines in this country. The ability to receive and transmit in this code can be attained only by continued practice with a telegraph key and a buzzer. Attendance of a radio code or the use of mechanical code transmitters or of phonograph records prepared for that purpose will be helpful. The time required to master the code depends entirely upon the individual; some will attain the desired speed in a few weeks with relative ease, others will find it more difficult and a few will find the task impossible.

Good Radio Book

INFORMATION on the theory of radio and on the operating characteristics of transmitters, receivers and accessory apparatus may be obtained from a number of good text books, including one written for the United States Signal Corps and now published and sold at a reasonable price by the Government Printing Office.†

The vacuum tube transmitter is used in practically all amateur stations today although there are other types of radio transmitters which may be used for radio communication such as spark, arc and high frequency alternators. If the applicant does not already possess the knowledge, he soon learns that because of interference caused to radio reception the use of spark transmitters by amateurs is practically prohibited and further that the operating characteristics of arcs and high frequency alternators make them unsuitable for use on the short wavelengths allotted for amateur operation. The tube transmitter, however, meets amateur requirements in a very satisfactory manner.

As soon as the applicant is confident that he is qualified he should make an appointment for a personal examination for an amateur operator license at the office of the Supervisor of Radio or at other points in the radio district where examinations are conducted at intervals. If successful in the examination he is granted an amateur first grade operator license; if unsuccessful, he must wait for three months before he is eligible for re-examination. If the applicant lives at a point remote from the district headquarters he may submit evidence of his qualifications to the Supervisor by mail and if the evidence is acceptable a provisional second grade operator license may be issued. Examinations are occasionally given in the larger cities of the radio district and the holders of these provisional licenses must appear at them and secure the regular first grade license or surrender the provisional operator and station licenses. Having secured the license form the amateur must take an oath to preserve the secrecy of all radio messages which he may hear and then return the license to the examining officer for signature. Until signed, the license is not valid.

Describe Transmitter

APPLICATION for a radio station license may be submitted to the Supervisor, using special forms supplied for that purpose, after the operator license has been issued or at the time the applicant qualifies for it. The transmitting apparatus must be described in detail and a very complete diagram of the transmitter and of the antenna sys-

(Please turn to page 47)

*U. S. Radio Inspector, Chicago, Ill.

†The Principles Underlying Radio Communication, Radio Communication Pamphlet Number 40. Price $1.00.

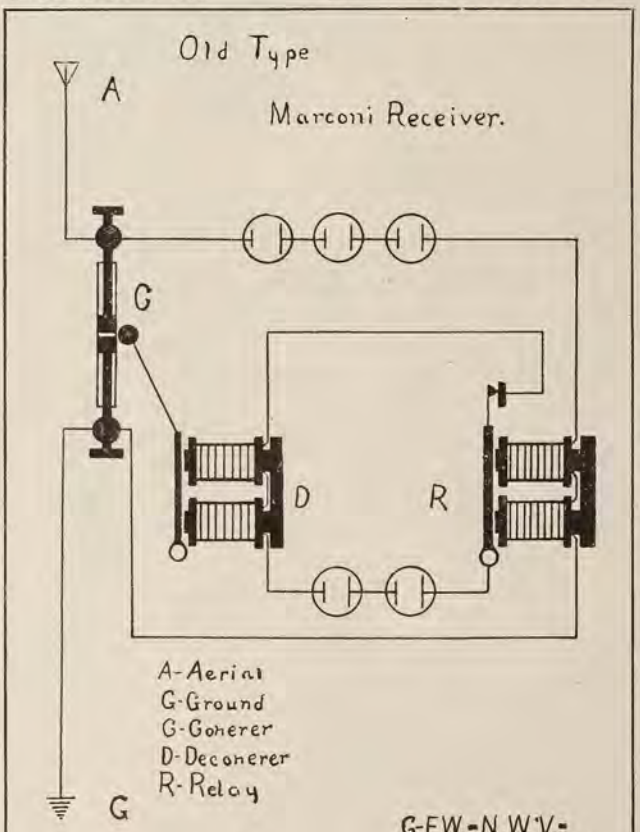
When Radio Was Young

Pioneer Days of the Art Held Much Interest for the General Public

By J. C. JENSEN*

BROADCAST listeners of today settle down into the cushions of an upholstered chair and drowsily listen to a "de luxe" program from a thousand miles distance, every note being clear and distinct on an eight-tube super. They probably have heard in an uninteresting sort of way of such pioneers as Maxwell, Hertz, Marconi and De Forest, but have given little thought to them or to their work. They take the present development largely for granted and would be surprised if told that less than thirty years ago Marconi was struggling hard to send telegraphic signals three or four miles and that it is less than twenty years since DeForest patented the audion.

*Radio Engineer In Charge WCAJ.



Old timers in the game will immediately recognize the now unheard-of coherer and de-coherer, while the present broadcast listener will probably sneer at such an unwieldy method of reception. Nevertheless it formed the basis for reception of signals in the good old days before the audion and the quenched spark transmitter

In those earlier days of experimentation the possibilities of radio-broadcasting had not been thought of, the general line of development of the art being in the direction of navigation. Consequently much less was known about the new discoveries at inland points than on the sea-board and people in the interior states passed them by as of no consequence to them.

School Experiments

DURING the years of DeForest's most important discoveries the writer was in charge of the public school system of a western Nebraska town and taught the high-school sciences, mathematics, and several other subjects for good measure. His interest in radio was aroused by newspaper articles, some of them greatly exaggerated reports, and by a local telegrapher who was fond of experimenting with electricity. A bulldog spark coil, a battery of dry cells and a couple of home-made Leyden jars formed the nucleus for the building of a small transmitting set. After repeated trials a coherer system similar to that shown in Fig. 1 was set up and responses obtained from one table to another. Separate tables were used because people were skeptical in those days and looked for concealed wires from transmitter to responder.

In a period so soon after the Spanish-American War, it was natural to think of radio in connection with military activities. A favorite experiment was to use the coherer and relay to close a circuit through a fine wire placed in a bomb so as to explode the powder when a battery current heated the wire. Another was to use the same relay device to start a motor which in turn operated other machinery.

Curiosity Aroused

SUCH demonstrations became a regular feature of the high-school physics work and were also made in connection with the Nebraska State Fair at Lincoln in 1906. The general public had read so much about signaling across the Atlantic without wires that its curiosity had become aroused and people were willing to pay to hear a discussion of the new invention just as they had paid to see a demonstration of the telephone and the phonograph some years before. In

(Please turn to page 46)

Ways to *Protect* Inventions While *Making* Experiments

This Story May Help You Over the Rocky Ground of Protection of Your Ideas

By LEO T. PARKER

MANY years ago the Patent Office of the United States maintained a "Caveat Department" especially for the purpose of offering protection to inventors who had experimental work to perform on ideas or inventions which were not fully perfected. By the payment of a small fee the drawing and a description of an invention could be deposited in the Patent Office, whereby the inventors who did not deem it advisable to file applications for patents might protect their ideas without the necessity of maintaining secrecy of the characters or structures of the inventions. In a way the "Caveat Department" proved beneficial because inventors felt justified in taking considerable time to reduce new ideas to practical forms after the caveats were filed and before filing the applications for patents.

However, this department is no longer a part of the Patent Office and inventors must seek other practical methods of protecting their ideas against unscrupulous persons when secrecy of the inventions cannot be maintained, or when it is desirable to establish a date of priority.

A very important thing for all inventors to know is that the ownership of a United States patent does not always depend upon who first files an application for the patent. In some of the foreign countries the first person to get an application in the Patent Office is given the patent, but this is not the case in this country. The United States patent laws were formulated with the idea of awarding a patent to the first inventor of a new thing.

File Application

OF course, there are many important reasons why an inventor should file an application for a patent as soon as the invention is sufficiently perfected so that it will operate successfully and practically.

A very fine example of this is given by the outcome of the recent ligation between Mr. Armstrong and Mr. DeForest, relative to the ownership of the regenerative patent. Mr. Armstrong perfected this invention in 1912, but he did not file an application for a patent until 1913. It is generally conceded that the controversy may have been settled with more points in his favor had he filed an application immediately after he completed the invention. His excuse for not doing so was that he had no money, but such an excuse is insufficient.

In a dispute between two or more inventors as to who shall be awarded a patent, priority of invention, that is: who conceived or thought of it first, is very important. To actually make the invention in its operative form is a great deal more important, however, than merely inventing it and making the necessary drawings and then having them signed and witnessed, as is customarily done by many inventors.

Finish the Work

THERE is no protection in simply having drawings signed and witnessed, and then depositing them into a pigeon hole without proceeding to patent the invention, but with the intentions of using them to obtain a patent only after some other inventor has invented and marketed the same thing.

To receive the best consideration from the Patent Office in later litigation, as to who deserves a patent, between two or more persons who claim the same invention, an inventor should introduce evidence to prove that he has proceeded diligently and honestly from the time he conceived the invention with the intentions of perfecting and patenting it. Unless he is able to prove this beyond a reasonable doubt he will experience some difficulty in obtaining a patent, even though he actually conceived the invention and made sketches and drawings of it previously to the date on which a diligent inventor filed an application for the patent.

Due to the character of radio inventions it is apparent that considerable and extended experiments often are necessary for the inventor to determine the most practical form in which to make the invention. This is true because the actual effect of radio inventions cannot generally be known by merely visualizing the apparatus, as is possible with mechanical appliances. This is especially true of the average radio experimenter who is unfamiliar with the scientific principles of radio. In a way this is in the favor of radio apparatus inventors, because there is a logical excuse for an unusual delay in filing an application for a patent after an invention is discovered. This statement is based on the outcome of a past patent litigation of considerable importance relative to the extended use of a new pavement before an application for a patent was filed. The law is, that no patent can be obtained on an invention which has been in public use for more than two years. The inventor of the pavement in question was uncertain whether the product would give good service over a long period of time, and so he laid a pavement on a public street. After the pavement had been there for six years and had proved satisfactory, he applied for and obtained the patent. In the later Court litigation, in which the validity of the patent was questioned, it was decided that the patent was valid, although the invention had been in public use for six years prior to the filing of a patent application, or more than four years longer than the law allows.

The reason for this decision is that two years public use of a pavement would in no manner give reliable information whether or not the pavement was practical, because a pavement that will not give at least six years satisfactory service will not justify the expense of laying it. So, therefore, a longer period of experimentation is required and permitted for certain kinds of inventions or apparatus, than for others. Of course, the inventor of this pavement was taking a great risk of losing his patent rights by not following the word of the law, but the decision of the Court which considered this case establishes a precedent of the correctness of this reasoning.

Certain Rules

THERE are, however, certain rules by which radio experimenters may be governed to secure for themselves the best protection that is possible to have while experimenting with inventions in view of obtaining patents on them.

A good plan is to make detail sketches of the invention, from which any person who is familiar with the art of radio may be able to understand and build the apparatus or circuit. These sketches should be made with ink on good substantial paper or card-board. On the same sheet, a complete description of the invention should be plainly written. The descriptive matter should refer to the various parts of the invention by numbers written on the corresponding parts in the drawing. Not only should the sketches and the written description be on a single sheet of paper, but it is best to have all of the matter on one side of the sheet. If any mistakes are made which require erasing, notations of explanations should be entered at the bottom of the sheet.

After the descriptive matter, the inventor should proceed to explain,

(Please turn to page 48)

Useful *Hints* For Your *Harmonic* Experiments

Interesting Work Can Be Done By Broadcast Listener With Simple Set

By KIRK B. MORCROSS

HARMONICS in oscillating radio circuits are some of the most interesting and useful phenomena which occur in circuits commonly available to the experimenter. Harmonics which are sometimes present in the transmitting circuits of broadcasting and other stations may, however, cause objectionable interference.

But it is not the purpose of this article to consider that phase of the subject. Instead I want to discuss some useful and instructive applications of harmonics. For those experimenters who have attempted a study of harmonics and met with indifferent success, let me say that I believe that this is largely due to the lack of a good background of the subject and that this article will help them to get straightened out.

Harmonics Defined

IN THE first place, what is a harmonic? It is a frequency or wavelength which is exactly two, three, four times, etc., the fundamental frequency or exactly ½, ⅓, ¼, etc., the fundamental wavelength of an oscillating circuit. All oscillating circuits produce harmonics unless such circuits have been expressly designed to suppress them. The oscillating circuit may be a regenerative receiving set, a "Hartley" circuit ("generator", "oscillator" or "driver") or any kind of receiving set which can be adjusted to oscillate.

Let us briefly discuss this relationship of harmonics. Suppose we have a circuit which is oscillating at a frequency of 1500 kilocycles per second,—a wavelength of very nearly 200 meters. This is the "fundamental" frequency; it is also called the "first harmonic." The "second harmonic" is 3000 kilocycles or 100 meters, the "third harmonic" is 4500 kilocycles or 66.7 meters, etc. Some persons think it a little confusing to call the fundamental the "first harmonic." This is the best plan, however, for when we speak of other harmonics as for example the "sixth," we know immediately that it is six times the fundamental frequency or one-sixth the fundamental wavelength.

Their Relationship

BEFORE reading further in this discussion, remember the two important principles suggested above. First, the harmonics in *any* circuit have the relationship of whole numbers (or simple fractions,—whole numbers as denominators) to the fundamental frequency (or wavelength). Right here it may be well to state also that no oscillator can generally be expected to produce a frequency *lower* than the fundamental or a wavelength *longer* than the fundamental. This may seem too obvious to require comment yet some experimenters *do* have an idea that such is the case. Second, remember the definition for the number of the harmonic; for example,—the fifth harmonic is five times the fundamental frequency (one-fifth the fundamental wavelength); the first harmonic *is* the fundamental.

In passing, let us note that an oscillating circuit has, theoretically, any number of harmonics although for the most general type of experiments the fifth harmonic represents roughly the highest which is convenient to use.

As a basis for a good working knowledge of harmonics, some interesting experiments may be performed with an oscillator and a simple receiving set. These experiments show how to detect harmonics from the local broadcasting station (or show that such harmonics do not exist), how to detect harmonics in the oscillator, and how to simultaneously detect harmonics in the broadcasting station and the oscillator.

Local Broadcaster

BY local broadcasting station is meant one within two or three miles. If you are situated at a greater distance than this from the nearest station, then the first and third of these experiments may not be so easy of accomplishment. This is due to the fact that the station harmonics are not very strong. In case the broadcasting station uses some scheme for suppressing harmonics then you will probably not be able to detect them at all. However in the case of the average broadcasting station your chances should be pretty good for detecting some harmonics although such harmonics might never be noticed under ordinary conditions.

The apparatus for the first of these experiments comprises an oscillator or "driver" which can be tuned to higher frequencies (shorter waves) than the local broadcasting station and a simple non-oscillating receiving set capable of tuning in the local station (a crystal set is excellent). The same apparatus is used in the second experiment except that the frequency range of the oscillator should include considerably *lower* frequencies (longer wave lengths) than the frequency of the local station. For the third experiment,—to secure most varied results,—the oscillator should have a frequency range extending well beyond the local station frequency, in both directions. In case of necessity, a second receiving set which can be made to oscillate may be substituted for the oscillator. This equipment is shown in the photograph, Fig. 1, on page 21.

First Experiment

NOW for the first experiment. Suppose that your local station is operating on 960 kilocycles (312 meters). (This wavelength, while in the heart

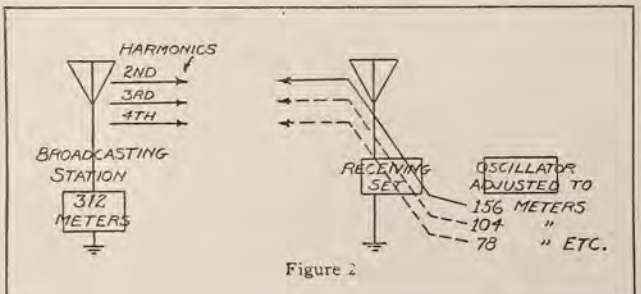


Figure 2

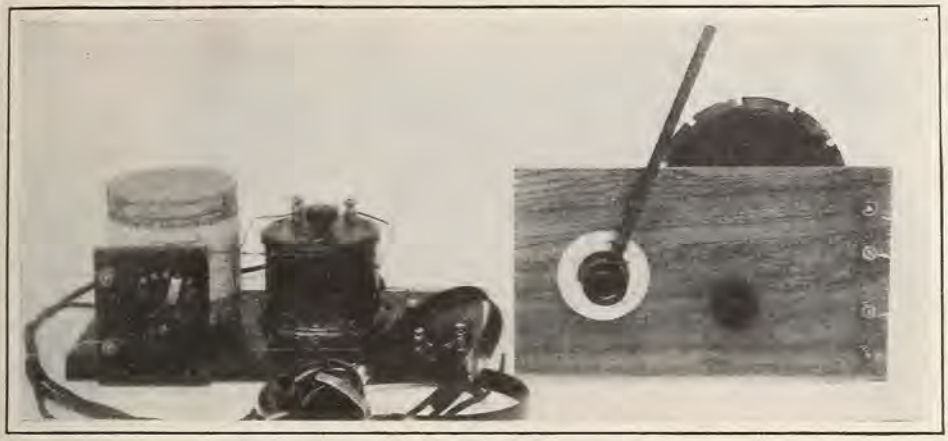


Figure I. Receiving set on the left and the oscillator on the right.

of the broadcast band, is at the writing of this article, not assigned to *any* broadcasting station; hence it is a safe one to choose in speaking of radiated harmonics!) Connect the simple receiving set to the antenna and tune it to the station. Place the oscillator close to the receiving set and adjust the oscillator condenser very carefully until a beat note is heard in the phones connected to the receiving set. (If another receiving set is used in place of this oscillator, it is not connected to the antenna. In this rôle the receiving set will sometimes give better results by connecting a small variable condenser across its antenna and ground binding posts to represent the antenna capacity).

Note the setting on the dial of the oscillator which gives "zero beat" then reduce this setting to obtain other "zero beats." It is very probable that you can obtain several zero beats in this manner, representing the second, third, etc., harmonics of the broadcasting station and it is not necessary that the receiving set be tuned to these harmonics of that station. The writer has detected as high as the seventh harmonic in this manner, using a crystal receiving set and making all adjustments on the oscillator (receiving set left tuned to the fundamental frequency of the broadcasting station). A graphical representation of this experiment appears as shown in Fig. 2 on page 20.

Get Proper Coupling

Success in this experiment and indeed in the other experiments as well, depends to a great extent upon proper coupling between the oscillator and the receiving set, upon the reduction of capacity between the observer and the oscillator and a very slow rotation of the oscillator condenser dial. "Proper coupling" is determined by varying the distance between the oscillator and the receiving set until best results are obtained. A very simple and effective means of practically eliminating body capacity effect and obtaining a delicate adjustment of the oscillator condenser is to attach a light strip of wood to the condenser knob. This may be done with sealing wax.

If you have good success with this experiment, you will probably find that some of the beats are considerably stronger than others. The weaker beats are formed between harmonics of the broadcasting station and harmonics of the local oscillator and will be considered in the third experiment. Note the settings of the condenser dial on the oscillator giving the stronger beats. If this condenser has semi-circular plates then these settings will have a certain relationship which can be readily determined and which assists in telling what harmonic has been obtained, thus furnishing calibration points on the oscillator. For example, suppose that zero beats are obtained with the following settings of the oscillator condenser: 90; 40; 22.5; 14.4 (remember we are ignoring the fainter beats for the present). Let us place these numbers in Table I as follows:

shown mathematically that these numbers or ratios always occur between successive dial settings when the dial settings give frequencies corresponding to the second, third, fourth and fifth harmonics. (The dial settings themselves need not of course be the actual numerical values given in the table). We can now fill in the harmonic designations in the second column of the table. The frequencies and wavelengths in the third and fourth columns are then determined by taking two times, three times (etc.) the fundamental frequency, or one-half, one-third (etc.) the fundamental wavelength.

Law of Ratios

BEFORE considering the other two experiments let us pause a moment for an explanation of *why* the ratios given above occur between dial settings of the oscillator. An understanding of this is of assistance in performing these experiments with harmonics.

The operation of the oscillator obeys the law of any tuned radio circuit that

TABLE I

Table for the First Experiment Using Harmonics of the Broadcasting Station
(Fundamental of Broadcasting Station, 960 Kilocycles or 312 Meters)

Setting of Dial on Oscillator Condenser	Number of Harmonic of Broadcasting Station	Harmonic of Broadcasting Station and Fundamental of Oscillator	
		Frequency in Kilocycles	Wavelength in Meters
90	[2nd]	[1920]	[156]
40	[3rd]	[2880]	[104]
22.5	[4th]	[3840]	[78]
14.4	[5th]	[4800]	[62.4]

For the present, imagine that the numbers in brackets are blank spaces (since at this moment we have not determined these values). In the first column, divide each dial setting by the one below it, obtaining these values: 2.25; 1.78; 1.56 (or in actual practice, *approximately* these numbers.) It can be

a change in capacity causes a related change in wavelength. The oscillator condenser being equipped with semi-circular plates, the settings of its dial may be considered to arbitrarily represent units of capacity. If the dial setting (or capacity) is reduced to one-fourth of a given value the wavelength

TABLE II

Table for the Second Experiment Using Harmonics of the Local Oscillator
(Fundamental of Broadcasting Station, 960 Kilocycles or 312 Meters)

Setting of Dial on Oscillator Condenser	Number of Harmonic of Local Oscillator	Fundamental of Local Oscillator	
		Frequency in Kilocycles	Wavelength in Meters
15	2nd (All 312 meters)	480	624
33.75	3rd	320	936
60	4th	240	1248
93.8	5th	192	1560

of the circuit is reduced one-half. In other words, square the change in wavelength to get the change in dial setting. Now this change in wavelength is represented by the ratio between the two wavelengths under consideration as for example, $\frac{156}{104}(=1.5)$. Squaring, $(1.5)^2=2.25$. This result is equal to the change in dial settings, $\frac{90}{40}$, where the dial settings of 90 and 40 give, respectively, the wavelengths of 156 and 104.

Take any other two wavelengths in the table above, say 104 and 62.4. Divide one by the other, $\frac{104}{62.4}=1.667$; $(1.667)^2=2.78$. The ratio of condenser dial settings giving these two wavelengths is $\frac{40}{14.4}=2.78$.

These principles at once suggest a definite use. Suppose, for example, that in performing the first experiment you have difficulty in locating the oscillator dial setting which produces a beat with the fifth harmonic of the broadcasting station. Divide the fourth harmonic by the fifth: $\frac{78}{62.4}=1.25$. Square the result: $(1.25)^2=1.56$ (the ratio between required dial settings of the oscillator for wavelengths of 78 and 62.4 meters). In making the experiment the dial setting for the fourth harmonic was found to be 22.5. The fifth harmonic will therefore be found at a dial setting of $\frac{22.5}{1.56}=14.4$.

If you are very successful in this first experiment, then you may wish to try for higher harmonics from the local broadcasting station. For this purpose you may substitute a smaller coil in the oscillator circuit and identify these higher harmonics by further application of the principles just given.

Second Experiment

THE second experiment (as previously suggested) utilizes harmonics from the oscillator which beat with the fundamental of the broadcasting station. If you have studied the preceding description you should have no difficulty in performing this experiment. Here the oscillator is adjusted to *longer* wavelengths than the wavelength of the broadcasting station tuned in on the receiving set and it may be necessary to substitute a coil of more turns in the oscillator circuit. Also the phones should be connected in the plate circuit of the oscillator. This second experiment has a wider application because only the fundamental of the broadcasting station is utilized and this station may be several hundred miles away. In this case it is of course necessary to use a sensitive receiving set. A schematic representation of this experiment appears in Fig. 3, page 22.

A table for this second experiment prepared along the same lines as the one for the first experiment appears in Table II.

It should not be necessary to give a detailed discussion of the table since the data follows the same laws previously discussed. One example should suffice. A loud beat is obtained from a certain setting on the dial of the oscillator condenser,—let us say 15 in order to make a direct reference to the table (above). Another zero beat is obtained at 33.75. Suppose we do not know which harmonics of the oscillator these dial settings represent. Divide one by the other: $\frac{33.75}{15}=2.25$. This result (ratio between dial settings) at once indicates the second and third harmonics as previously explained.

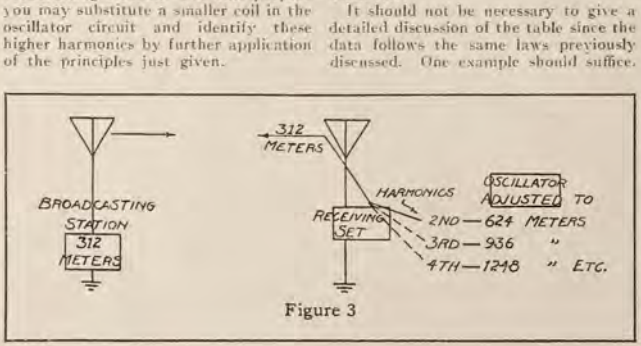


Figure 3

Oscillator Harmonics

IN this second experiment the harmonics of the *oscillator* are utilized and since these harmonics produce zero beat with the fundamental of the broadcasting station, each new harmonic from the oscillator represents another adjustment. This harmonic always equals the frequency or wavelength of the broadcasting station. For example, take from the table the fundamental wavelength of 936 meters given by a certain adjustment of the oscillator.

TABLE III

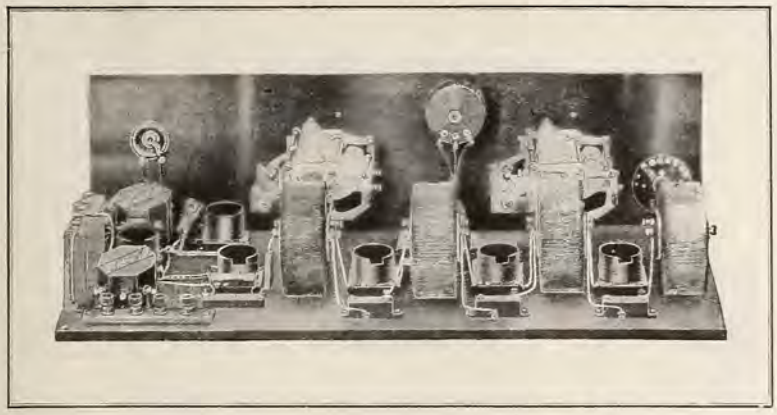
Table for the Third Experiment Using Harmonics of the Broadcasting Station and the Oscillator
(Fundamental of Broadcasting Station, 960 Kilocycles or 312 Meters)

Setting of Dial on Oscillator Condenser	Number of Harmonic of Broadcasting Station	Character of Beat Note	Fundamental of Local Oscillator		Number of Harmonic of Local Oscillator
			Frequency in Kilocycles	Wavelength in Meters	
14.4 [57.6]	5th 5th	Loud Faint	4800 [2400]	62.4 [124.8]	Fundamental 2nd

The third harmonic of this fundamental wavelength is utilized to produce zero beat with the broadcasting station as shown in the second column of the table. This third harmonic is, therefore, $\frac{935}{3}=312$ meters. Study the table and the diagram until this point is clear; its proper understanding is necessary for the next experiment.

We will now consider the third experiment. This utilizes harmonics from both the oscillator and the broadcasting station and you should have no difficulty in obtaining beat notes regardless of whether the oscillator is adjusted to higher or lower frequencies than the broadcasting station. The only real difficulty in this experiment will be to determine which harmonics are being utilized. In this experiment you should couple the oscillator more closely to the receiving set since the beat notes required are weaker than heretofore. Any loud beats which may be produced as you adjust the oscillator are caused by a fundamental wavelength from either the oscillator or the broadcasting station and have probably been noted in the first or second experiment. However the dial settings giving these beats should be recorded so that you may use this information as a means of determining the frequency adjustment of the oscillator giving the fainter beats. This

(Please turn to page 51)



Building the Counterphase Six

By RAY G. PIETY

REQUIREMENTS which present day broadcasting imposes upon a desirable set are such that good design in a radio receiver makes it absolutely necessary to obtain a balance between several factors which inherently tend to offset each other; these factors are selectivity, sensitivity, clarity, and in a multi-tube set, oscillation control.

The six-tube set which I am about to describe shows evidence of very successful efforts in its design in retaining a good measure of each of the desirable features mentioned.

The tremendous amount of effort which has been made during the past few years to improve radio apparatus has practically standardized several of the important elements of broadcast receivers, such as the type of tubes, the nature of the audio amplifier and the method of interstage coupling. There is very little room for improvement along these lines, until something radically new is developed, of which there seems to be little prospect in the immediate future.

The operating characteristic of the present day receiver, assuming of course that the standard parts are of good design, are almost entirely determined by the efficiency of the radio frequency transformers and the method of oscillation control.

A discussion of the nature of obtaining a good balance between the factors mentioned in the preceding paragraphs will, no doubt be of interest to every radio fan. In figure 1 is shown a schematic diagram of the coupling transformer. An analysis of the action of this transformer will show there are four variable factors which determine its efficiency when considered separately from the actual circuit itself. These factors are first, the value of the *inductance* in the secondary. Second, the *resistance* of the secondary. Third, the *mutual inductance* between the primary and secondary and fourth the value of the inductance in the primary.

Effects on Operation

TRACING these factors one at a time, we will see just what effect each one of them has on the operating characteristic of the transformer. First, the higher the value of the inductance in the secondary circuit of the transformer, the higher the value of the voltage impressed upon the grid of the tube will be. Therefore, it is best to select a value of inductance which will be as high as possible, yet still permit reception from 200 to 550 meters.

Second, the effect of the resistance of the secondary circuit is to reduce the voltage generated across the inductance and also to decrease the selectivity. To state it in mathematical terms, the maximum amplification obtainable from the transformer is dependent upon the ratio of $\frac{L}{\sqrt{R}}$, where "L" represents the secondary inductance and "R" is resistance. The selectivity is dependent upon the ratio of L/R directly. It can be seen that for amplification, the value of resistance is not as important as that of the inductance but for selectivity the value of the inductance is of equal importance with that of the resistance.

Third, the mutal inductance between the primary and secondary determines the amount of energy which will be transferred from the primary circuit to the secondary circuit and thus carried on through the receiving set. The correct value of this mutual inductance in order to obtain a maximum energy transfer is dependent upon a rather complicated formula which causes it to vary with the frequency, the inductance and resistance of the secondary and also the plate resistance of the tube with which the transformer is to be used. However, suffice to say the best value of mutual inductance necessary to give maximum amplification is comparatively high and is not being used to the writer's knowledge in any type of transformer on the market at present, due to the fact the energy transfer effects the selectivity of the set causing it to approach at maximum a selectivity one-

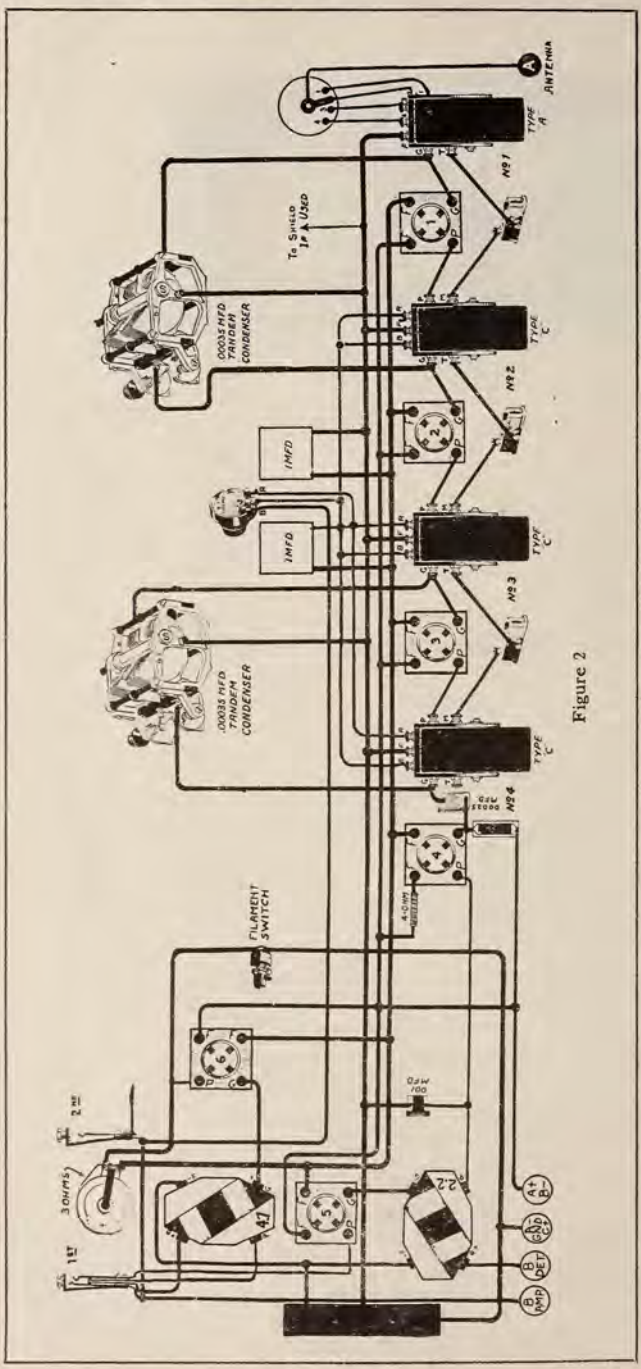


Figure 2

half of that of the secondary considered alone. A high value of mutual inductance also tends to make it very difficult to stabilize the receiver.

Inductance Value Low

THE fourth factor, the primary inductance, is not nearly as important as the first three. It is necessary, however, to keep the inductance in the primary to as low a value as will permit the obtaining of a mutual inductance high enough to give good amplification. It is best to use a low value of inductance in the primary as the tendency to oscillate is not as pronounced as it would be if a larger inductance with the same mutual were used.

The selectivity of the set is largely obtained through proper design of the secondary. The resistance was reduced by proper choice of the constants of construction to a very low value for a toroidal type of coil. This type of coil is used in order to eliminate to a great extent the disadvantages arising from inductive coupling between stages in an R. F. amplifier. By the use of three stages of tuned radio frequency, the combined selectivity to a point which permits the use of a high energy transfer between primary and secondary without reducing the selectivity of the set to a point where strong local stations would interfere with the weak and distant stations, provided the frequency ratio, i.e., the ratio of the frequency of the interferring station to the frequency of the station desired was of a reasonable value. Three stages of radio frequency amplification are made possible by the system of neutralization employed. This consists mainly in coupling a third coil to the primary of the transformer into which is induced a reversed potential which is connected through a small condenser back to the grid and there opposes the retroactive action of the primary through the tube itself. A variable resistance is placed in series with the "B" battery supply to the radio frequency amplifier in the complete set, which completes the operator's control of the circuit's tendency to oscillate.

Method of Control

THIS control permits the operator to hold his set continuously at the point of greatest amplification, i.e., the point of oscillation over the entire range of tuning.

This completes the analysis of the major points of the design of this receiver; although not in detail and complete, it will give the reader some idea as to just why such satisfactory results have been obtained with this circuit. Since the rest of the circuit is of standard construction, it is hardly necessary to discuss it in an article of this type.

The wiring diagram and baseboard layout shown will give the reader a clear idea of the method of construction.

Instruction Data

THE Pictorial view of the set is shown in Figure 2.

The baseboard should be of dry wood, shellacked or varnished on which all the apparatus except the toroid should be mounted as shown and screwed in place. The toroids should be mounted last in order to prevent injury. Proceed with

wiring as per the diagram, making sure that all connections are properly made. Do not attempt to crowd the set into a small cabinet, as this will invariably cause difficulties, which are of an irregular nature and difficult to trace to their source.

Recheck Wiring

AFTER completing the wiring of the set, the next step is to test it to make sure that all connections have been properly made. Carefully trace out the "A" battery circuit in order to make sure that it is not crossed with the "B" battery circuit. Then place the tubes in socket and connect batteries and antenna and tune in a station.

The antenna should be a single strand of wire placed in as high a position as possible about 20 to 75 feet long. The length is more or less dependent upon the amount of interference and your proximity to local stations. Make sure that all controls operate properly; the volume control should reduce the signal strength and the condensers tune sharply on the incoming signal. Then proceed with the adjustment of the mikro mike condensers. First disconnect the antenna and remove the first two R.F. tubes, leaving the tube ahead of the detector in the radio frequency amplifier alone. Then with a wood screw driver made by sharpening a suitable wooden road, slowly turn the mikro mike condenser from minimum value to maximum, at the same time keep the tuning condenser of No. 1 at a setting of about ten and slowly rotate the trimmer back and forth. This trimmer will cause a click to be heard in the receiving set which indicates that the receiver is oscillating. Rotate the mikro mike until no clicks can be obtained on any portion of the dial on the single stage of radio amplification. In adjusting the next tube, proceed in the same manner, rotating dials No. 1 and No. 2 until clicks are heard and setting the mikro mike condenser to such a point that clicks are heard at the minimum position possible on the tuning controls.

Tune Properly

PROBABLY the most important factor in determining the results which will be obtained with a good receiving set when properly equipped is the ability of the operator to tune properly.

The two dial control of this receiver makes it relatively easy to operate. However, it would be well to consider the following points very carefully.

The rear trimmers on the tandem condensers should be so set that upon tuning in a relatively weak signal the maximum volume is obtained when the front trimmer is half in. This adjustment is made by first tuning in a relatively weak signal, then by slowly turning the front trimmer on one of the condensers and at the same time rotating the main control back and forth across the station, the point of best volume can easily be determined. Rotate the rear trimmer condensers in the same direction in which you wish to rotate the resonant point on the first trimmer; the front and rear trimmer will follow each other so to speak, each of them either lagging or leading the other, a few degrees. This adjustment should be made at about a wave length of 400 meters which will keep the variation, on the trimmer, between the low and high wave lengths at a minimum. In attempting to bring a distant station up to maximum volume, the same procedure should be followed as that for adjusting the trimmer condenser. That is, the station after once having been heard may be brought up to good signal strength by rotating the main control back and forth across it and revolving the trimmer condenser until peak efficiency is obtained. Whenever there is a little static present, it is a good idea to use this as a guide in tuning, remembering that the best setting for static is also the best setting for distant stations. Figuratively speaking, the static is broadcasting on all frequencies, thus requiring exact resonance to tune that part of it at any particular frequency. By following the static across the dial you may be sure that you are keeping in countinuous resonance and should, therefore, pickup all stations within the range provided their strength is sufficient to actuate the receiving set.

List of Parts

One Type TA Torostyle Transformer.
Three Type TC Torostyle Transformers.
Two Type LD-17, Tandem Condensers.
Three Mikro Mike Condensers.
One Dual Resistance.
One 4-Ohm Fixed Resistance.
One set of Radio Frequency Leads, in code colors. Set of Blue Prints, Color charts and Diagrams.

Other parts required:

One Panel 7"x24".
One Wood Baseboard 9¾"x23½".
One audio transformer, Ratio 2.2 to 1.
One Audio transformer, Ratio 4.7 to 1.
Two Tuning Controls.
Two 1-MFD Fixed Condensers.
One .001 MFD Fixed Condenser.
One .00025 MFD Fixed Condenser.
One 2 meg. Grid Leak.
Six Type UL Sockets.
One Double Circuit Jack No. 104.
One Single Circuit Jack No. 101.
One Filament Switch.
One 3 Ohm Rheostat.
One Inductance Switch.
Five binding posts and Mounting Strips.
One "C" battery, 4½ volts.

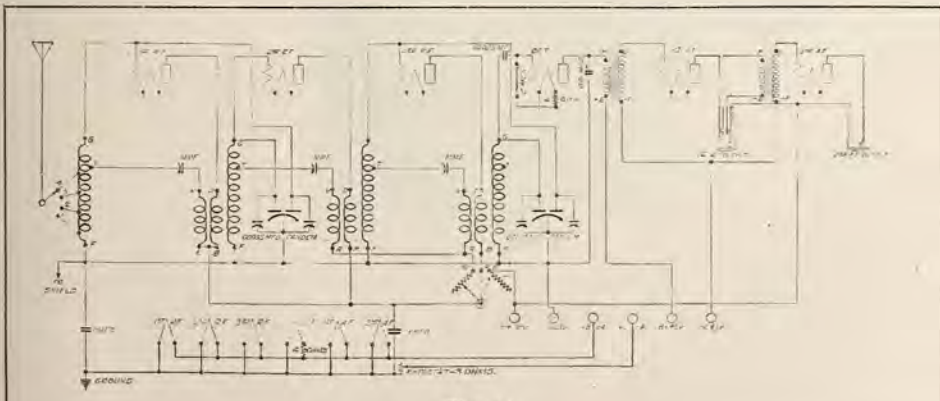


Figure 1

What the Broadcasters are Doing

ABOVE we have a picture of the announcer whom you always recognize by his "W----OK." It is George W. Allen, director and chief announcer of the Neutrowound broadcasting station in Chicago, whose studio is located in the Chicago Beach hotel. WOK broadcasts on 217.3 meters and has a consistent signal which should be uniformly heard throughout the country.

Thrills of One Night Stands Over Radio

PLAYING the radio theater is like being back in vaudeville, only faster, was the decision of Miss Nance O'Neil, who is catching her breath after a whirlwind tour of the eastern cities, doing an entire season's run in just one week, as leading lady in "The Night Herd," first prize winner in the radio play contest conducted by the Drama League of America and WLS, the Sears-Roebuck station, Chicago. Years of success on the legitimate stage had not prepared Miss O'Neil for the speed of the radio studio.

"I never saw anything like it," she commented wide-eyed. "Before the act ahead of ours was halfway through we were on the stage ready to start, and the moment our play was finished the next act was right there at our heels to take the microphones."

The radio station is rather disconcerting to the professional actor, according to Miss O'Neil and Will Ghere, who played with her. It is difficult to feel quite at home in one. Each studio is so different rom the others, especially in atmosphere. Theaters differ, one from another, admit the stage folk, but theater atmosphere always lingers in the dusty regions back of the stage.

"The Night Herd" is the first radio play to be put on the road, and it was a novel and successful experiment in treating a radio theatrical production as if it were a regular stage play. The play was first produced in a gala performance in the WLS Theater, Chicago, with Miss Nance O'Neil and Holbrook Blinn taking the leading parts, and George Arliss presenting the play to the public.

Wyoming Fan to Trap Wave

A WYOMING fan wrote Secretary Hoover recently and enclosed a dollar bill, asking that a wave trap be sent him as soon as possible. In view of the fact that Wyoming does not have much radio broadcasting and waves are scarce, some officials wonder if the fan thinks he can trap a good wave length with the apparatus he seeks.

Million Fans Sing

EVERY evening at 6:55 o'clock WGN presents favorite tunes, familiar to everyone, and listeners everywhere join in. This novel attraction is called "The Million Sing." It is a new form of community singing on an unprecedented scale.

Radio Station Asks For Better Movies

FOR the first time in California broadcasting history, a radio station is appealing to the radio public for better motion pictures.

KHJ, owned and operated by the Los Angeles Times-Mirror Company, Los Angeles, is asking its listeners and friends to send in 200-word letters suggesting a theme or idea for a really great picture.

The Times, in collaboration with Cecil B. De Mille, noted producer and director, is sponsoring the letter-writing contest in which $2,100 in prizes will be offered.

The first prize for the most suitable idea is $1,000; second, $300; third, $200; fourth, $100, and ten at $50.

"We are making this appeal through the air," De Mille said, "because the De Mille-Times contest editors feel it is the most productive of results."

Organ Leads Radio Popularity

IN spite of the craze for jazz and the saxophone, it seems the organ still takes the prize as the most popular radio instrument. This is illustrated by the experience of Henri A. Keates, organist of McVickers Theatre, who broadcasts every Wednesday and Friday midnight over KYW, Westinghouse station, Chicago.

Keates receives more mail than any other KYW star, with the exception of Uncle Bob, and almost ties him. Keates' request letters and notes of appreciation arrive by the bagful. And he sets a record in acknowledging his mail. Every letter is acknowledged, sometimes tardily, due to the vast amount of mail, but eventually every letter is acknowledged.

Art Linick, famous announcer and entertainer of KYW, does the acknowledging over the air. Keates has mail from as far as Paris, France and Honolulu.

Keates is famous in Chicago as the one organist who has made a success of "community singing." At each performance at McVickers Theatre he leads the patrons in song and *they sing*.

Stray Cat as Condenser Picks Up WENR Energy

CATS should remember the old adage, "Curiosity killed a cat," when they investigate radio stations. One old big yellow tom cat probably will hereafter.

One night while the operator of WENR, the All-American Radio Corporation station, Chicago, was watching his meters and controls, a stray tom cat, attracted by the glare of the big tubes and the hum of the generators, strolled in the operating room. He paused and arched his back against the framework of the transmitting set, then came over to make friends with the operator, who extended his hand to stroke his head.

The cat started to smell the operator's hand and a large, healthy spark, coming from the charge of electricity he had accumulated when rubbing against the transmitter, snapped between the end of his nose and the operator's fingertips. After massaging his nose the cat eyed the operator suspiciously and retreated behind the transmitting panel again. He emerged to smell of the large copper ground strip nailed along the floor, and received another shock.

That confirmed his suspicions about the place, and according to the operator's story, he scratched the floor considerably in his haste to depart.

The cat was merely repeating an old experiment performed countless times by students of electricity—but the cat did not appreciate his contribution to science.

Swiss Broadcasting

SWITZERLAND broadcasting for the French speaking citizenry is carried on by stations at Geneva and Lausanne. The stations have 500 watts power; that at Geneva broadcasts on 780 meters and the one at Lausanne on 318 meters.

Chicago Broadcasters To Be Held On Waves

NINE of the thirty odd broadcasting stations in and around Chicago, have been equipped with piezo crystal oscillators, calibrated to the stations' frequencies and designed to hold them on their allocated wave lengths.

The stations so equipped according to the Department of Commerce are KYW, WBBM, WFKB, WJJD, WLS, WEBH, WOK, WQJ, and WSBC. This new equipment, it is believed, will assist in decreasing local station interference in one of the most congested spots in radioland.

Want Better Airway Radio Communication

THROUGH the efforts of the Naval communication Service and the co-operation of the flying service, improvement and standardization in aircraft radio communication systems have been worked out. The present plans call for daily weather reports by radio, which would be available for flyers in the vicinity of the New York, Washington and Norfolk areas, and emergency message service.

As soon as the details are worked out it is the intention of the Navy to co-operate with the Army Signal Corps and Army Air Service for an extensive coordinated military program, and eventually to bring in the governmental services such as the Postal Service and Weather Bureau, and to extend the system so as to make useful to any pilot in this country. Communication on both short and medium wave apparatus is planned.

In a report the Navy Department states: "It has been found practicable to adopt a plan which will provide for the exchange of weather information between air stations in the New York-Washington-Norfolk area. These bulletins will be available for all radio equipped aircraft in flight. It is expected that this plan will be in daily operation within one month. It involves the use of high frequencies and normal frequencies so that it will be available to a plane equipped with either type of apparatus. In the same way movement reports of aircraft and emergency messages regarding them will be exchanged, all other traffic will of course be handled by normal channels.

"This general plan is being discussed with representatives of the Army Signal Corps, and Army Air Service with a view to reaching an agreement within the Services for a well coordinated military program. After this end is attained, the parts of the plan which are of interest to the civil departments of the Government who are concerned with aviation, such as the Department of Commerce, Post Office, and Weather Bureau, will be discussed with them.

"As a final result, it is hoped that a country-wide system of communication and weather reports will be available for all aircraft, naval, military and civil."

MAJ. GEN. CHARLES McK. SALTZMAN, Chief Signal Officer of the Army used to make his living pounding brass, years before some of his operators were born.

The General worked for the Western Union, the Rock Island, the Burlington, and the Chicago North Western before entering the military academy. One of the reasons why his Congressman rewarded him with the appointment was due to his ability as an operator and his willingness to work.

The General knows and appreciates the operating problems, and is glad for suggestions for the betterment of the Signal Corps Radio Net.

More Money for Radio Inspection

ALLOCATIONS of funds amounting to $335,000 for radio supervision during the next fiscal year, are practically assured the Department of Commerce by the passage of the current appropriation bills by the Houses and a favorable committee report in the Senate. This amount is $19,000 less than was allowed by the Budget, but is approximately $115,000 more than was provided for the current year. It will permit of better radio inspection and probably decrease interference, by providing increased personnel, testing equipment and three new radio test trucks.

New sub offices and more inspectors will probably be established at Dallas, Memphis, Portland, Los Angeles, Pittsburgh, Buffalo, Denver, Omaha, St. Louis, and Minneapolis. With additional inspectors, it is planned to carry on night listening in all radio districts.

ENGLAND is preparing radio facilities so that her ship owners can communicate with their vessels in all parts of the world in the near future. The marine radio station plans, it is understood, are in addition to the great land-station chain which already reaches practically all countries.

The new beam transmitters connecting London with Canada and South Africa were put in operation about May 1, it is reported to the Commerce Department, and the Australian and Indian circuits will be ready by July.

India's main beam transmitter is being erected at Kirkee, near Bombay. Five massive masts, 277 feet in height, form a line which points to the Skegness receiving station on the Lincolnshire Coast in England. Another row of masts at Dhond, points directly toward the British station at Grimby from which station it will receive messages for India.

The radio interests in India expect that eventually other lines of aerials will be erected for direct communication with Tokyo, Rio de Janeiro and probably South Africa by the beam system.

Even Singers Roll Their Own

THE Silver-Masked Tenor, radio's mystery singer with the Goodrich Silvertown Cord Orchestra has delved into the scientific mysteries of radio.

Though he is a concert singer of some fame and the demands upon his time are many, the fascination of building his own was too great to ignore and he became a full fledged radio fan.

He is averse to making any comments about his ability as a radio craftsman, but we did find out that his radio worked the first time and Mrs. Silver-Masked Tenor, who is receiving her first tuning lesson in the top picture, declares its tone is so realistic that her husband is just the same as at home with her on Thursday nights when he sings with the Silvertown Cord Orchestra from WEAF.

Their home is in New York, but to check upon her husband's voice through the network Mrs. Silver-Masked Tenor likes to DX a little on Thursday nights to see that the famous voice doesn't lose any of its sweetness through the relay to other stations.

What Price Radio Public Inquires

THERE have been sundry rumblings and mutterings going on in the radio listening world here of late. There have been various questions, interrogations, how-comes and what-fors hurtling through the blue. There have been eyebrows raised and palms uplifted. In other words, there has been exhibited, on the part of the radio listening world, a general disposition to know just what it is all about.

Time was when the radio listening world was content to adjust the head phones, take on a look of profound and delighted awe, open its ears and drink in, without question, what the ether had to offer it.

That time is past. The radio listening world is getting wise. It is getting curious. It wants to know things.

One of the questions that is agitating the minds of those vast millions who compose the listening world is: What price radio popularity? By this time almost everyone knows that unless a radio performer is attached to the studio staff he is not paid for his services. Well, then, inquires the radio listening world, why does he do it? What does he get out of it?

If information which I have obtained from radio performers in the last few weeks is at all reliable, radio popularity is getting them "plenty." In fact, it got one fellow so much that, according to a number of people who are in a position to know, he is now touring the country singing over radio as an advertising feature for a manufacturing company at the nice, palatable salary of $1,000 a week and expenses for his wife and himself.

OF course this particular performer is lucky. He got in the radio game early, got his name on the lips of every radio listener in the country and, when the manufacturing company conceived the idea of having a man broadcast songs in their behalf, they naturally thought of him.

There's a knack to radio broadcasting. I don't know what it is. Probably the people who have acquired it do not know the road by which they have arrived at it. But you must have the knack or, so far as radio popularity is concerned, you are lost.

The knack of broadcasting does not necessarily indicate the possession of a good voice. I know a young woman who has a peculiarly, light, sweet and exceptionally clear soprano voice, far and away above the average. I heard her on the air one night and you can believe me or not, the result was something terrible.

On the other hand, I have heard extremely mediocre voices go over the air like a shot. I have heard some mediocre voices which did not fall so pleasingly upon the ear but whose owners had acquired the knack of broadcasting and consequently "sold" their voices in many instances far better than singers with much better voices.

I have in mind two girls who, like the $1,000 miracle, had either the luck or good judgment to get into radio when it was young. When radio presented itself they were working for a song publisher at a salary of something like $40 a week, doing a "sister" act. They didn't sing especially well. They don't now. But somehow, when they got on the air, there was something about the combination of their voices that the radio listeners liked. Before either of the girls fully realized what was happening to them they were being offered engagements right and left at figures that must have staggered them. They probably wouldn't now for today these girls are drawing down anywhere from $200 to $350 a week, "working" clubs, luncheons, entertainments, etc.

CLUBS, luncheons, entertainments, etc., are the chief sources of income for the radio performer who wishes to cash in on his popularity.

The chairman of an entertainment committee for a business men's association went out in search of radio stars to appear at a banquet not long ago. He

Wendell Hall, the "Red-headed Music Maker" who was one of the original radio ukulele crooners and who has traveled over a large part of the world since he won popular attention as a studio entertainer at KYW in 1922

Radio Popularity?

Gwen Wagner Answers

wanted them to sing perhaps two or three numbers each during the evening.

"And what do you think they wanted?" he wailed to me later. "Fifty dollars a piece! Fifty dollars!"

Of course he didn't know it, but he was getting off pretty easy at that. A lot of radio performers won't "do" a banquet for $50, unless they can appear and make their get-away as quickly as possible—in time to make another club. Sometimes, a radio performer can do a luncheon, a club and a banquet all in one day and, at $50 a crack,—well, you can figure the net result for yourself.

A girl who had gobs of personality, a small voice, some knack of playing jazz music on the piano, and an exceedingly good idea of what the radio public would like, took herself over to a studio and got on the programs. She got on pretty often. In fact, within a few short months she was so well known that she had agents running around her in circles trying to engage her to appear in acts, cabarets, etc. Eventually, one offered to pay her $100 a week at a cabaret for the first few weeks and then, after she had "sold" herself, guaranteed her a substantial raise. The fact that the girl couldn't make the grade in the cabaret has nothing do with the question of "What price radio popularity?" Radio gave her the chance.

A theatrical producer not long ago heard two girls sing over the air. Their voices were undeniably lovely. He shut off his radio, hied himself to the studio in a cab, introduced himself to the girls and offered them contracts in one of the best and most successful musical comedies that has been produced in many, many seasons.

THREE years ago a young man who had a penchant for strumming the ukulele was a clerk at $25 or $30 a week. The $25 or $30 a week didn't go very far, especially when there was a wife to support. So the young man took himself and his ukulele up to a radio studio and asked to broadcast. The studio director let him. He went up regularly after that. He gave his ukulele a fancy name and he wrote some little doggerel rhymes and set them to little doggerel tunes and broadcast them. The radio listeners liked them. Now it's a poor week if the young man and his little ukulele with the fancy name don't bring in at least $200—and $200 can go pretty far in a week, even if there is a wife to support.

A former vaudeville writer who has dipped into radio pretty heavily of late boasted to me the other night that he could make anybody popular over the air in six weeks.

"Just give me enough publicity," he said, "and let me put 'em on the air as many times as they can be crowded on the programs and I'll make them known from coast to coast. They don't have to be clever. Just let me get 'em on the air often enough and they're *made*."

This particular ex-vaudeville writer also sings. He sings his own songs over radio and the success he's had with them would make the average song writer sit down and weep. He's now making records for a well-known phonograph company and altogether he's so busy he rarely has time to tell you what the possibilities of radio are. When he does find time, however, he'll tell you they're great.

ONE rare man whom I know, sings for radio not for the engagements he can get out of it but because he loves to do it. Daytimes he sells bonds and he once told me he had sold more bonds on the strength of his radio popularity than you could shake two or three sticks at.

A year and a half ago a young man landed in one of our thriving cities as completely and effectually broke as any of these picturesque down-and-outers you see in the movies. He'd come from a little town and, contrary to some of the ideas about speedy small-towners, he was pretty green. But he could play the

(Please turn to page 49)

Harry Snodgrass, "King of the Ivories," who played a piano so well while he was a prisoner in the Missouri state penitentiary at Jefferson City that he received hundreds of gifts from radio listeners. After his release he went upon the vaudeville stage.

KFNF's
Record-Breaking Anniversary Program

ON last Washington's birthday KFNF, of the Henry Field Seed Co., at Shenandoah, Iowa, put on an anniversary program which lasted February 22 and 23.

Results of the program were seen in the 217,000 telegrams which poured in, together with letters and cards showing up at the station at the rate of about 35,000 a day. This response is probably the largest one on record and is an evidence of the fact that the American public, especially that section of it in the rural districts, likes its programs human not too intellectual.

In the picture at the left top is shown a group of accordion players who participated in the anniversary program. At the right top is a view of the contestants entering the fiddlers contest.

In the picture below is shown Henry Field himself seated atop the pile of over 200,000 telegrams. Many of the telegraphers in small towns nearby drove over to Shenandoah and delivered the messages simply because of the congestion on the wires, which congestion remained until a day after the program was closed.

Henry Field, besides putting across a world's record radio program and having the largest competitive group of

old time musicians ever assembled under the sun, entertained the biggest crowd of visitors Shenandoah has ever had. Over 10,000 out-of-town folks were served lunch at the Henry Field Seed House. A laughing chattering multitude of folks milled in and out of the auditorium as fast as the stairways would permit, and the elevator could move them about.

Mr. Field through RADIO AGE wishes to thank the thousands who contributed to the success of the event and who perchance might not have been reached by radio the following night.

Radio observers have noted for some time the mail response on stations which specialize in material for the "old folks" generally is heaviest, while those catering to the younger generation do not get quite so much mail. As yet no one has made any analysis covering such a subject, but from the experience of those who listen in nightly the most popular stations are those that consider the fact their listeners are human and give them just enough of a mixture of the high class and the popular, to make their offerings welcomed by all types of human beings.

According to the latest announcement from the Department of Commerce KFNF has been granted permission to increase its power to one thousand watts, thus assuring even a wider circle of listeners than it has had before.

Probably ninety-five percent of KFNF's listeners are from the rural districts of this country but recent figures show that radio is taking an even greater hold on the people who live on the farms, and that radio manufacturers are taking greater strides to see that farm sales are pushed. KFNF's response shows the interest the farmer has in radio.

Things That Interested Me

Listeners With Real Catholicism of Taste Get Most From Radio

By DOROTHY B. STAFFORD

WHEN Mr. Arnold Bennett wrote his delightful book with the above title, he allowed his versatile mind to meander about at will and play with bits of impressions gained from everyday life, spinning many entertaining episodes from events, which to the ordinary mind would appear nothing but the most commonplace. A modern writer has said, "The material of every artist is life . . . . it is the stuff his dreams are made on." And while contacts would seem necessary to change the ruts of one's thinking, those of us belonging to that great unknown quantity which the announcers love to refer to as "the invisible audience," find that an evening with a radio set can put in motion more varieties of thought than many hours of personal contact with the more or less humdrum beings who make up our everyday life. We have a friend, who ever so often has to assemble several steamer trunks, a bale of woolly rugs and passports and sally forth to foreign lands. He comes back with a jumbled impression of strange peoples, the price of malacca sticks in Singapore, and what bears the English can be when travelling. He's probably absorbing culture and acquiring friends, but one doubts if he gets any more mental stimulus or thinks about a greater variety of things than we who sit at home and put our fingers into the great radio pie, and pull out things to marvel at and laugh about. True, they may not be matters of much moment, but they are diverting and keep one from being bored, which, after all, is what most of us are living for.

THOSE who are getting the most out of the radio game are the listeners with a real catholicism of taste. The man with decided, unalterable, prejudices is all out of luck when it comes to radio. He can find what appeals to him if he looks for it, but it is the happy-go-lucky spirit who can thrill one minute to an exquisite bit by Rimsky-Korsakoff, and then get a lot of enjoyment out of some such absurdity as "She Was Just a Sailor's Sweetheart," who is in his element as a radio listener. If you can laugh with Beau Broadway in the Morning Telegraph and still read the Times editorial page without a shudder; if you enjoy "Desire Under the Elms" one night, and the Follies the next; if you can read the Mercury all evening and then drop off to sleep with the SatEvePost, you are going to have a lot of fun with your radio set.

However, if you chance to belong to that small coterie, who can listen to nothing lighter than a Philharmonic concert, you'll do better investing your money in season tickets than in "B" batteries, for you will run across a lot of things in radio to harrow up your soul. And should you be one of that larger class with whom we have no more sympathy than with the former, whose stock phrase is "That-classical-music-is-all-right-for-people-who-are-educated-up-to-that-sort-of-thing-I-don't-understand-it," you also are going to have a lot to complain of. It is plausible that a very highly trained musical sensibility can no more stand Tin Pan Alley melodies than we can read Fannie Hurst, but these highly sensitive souls are few and far between, and the rhythm and technique of a first class dance orchestra is bound to be pleasing to anyone with an open mind.

The same is true in the other case. There is something wrong with one who can't enjoy good music after he has heard it often enough to become familiar with it. Few are born with a taste for grapefruit and caviar, and people like to hear the things they know. We've all seen Italian laborers of low mentality thrill to intricate opera arias, not necessarily because they have more musical appreciation but because they have been listening to good music all their lives. Within the past few weeks we attended one of the personal appearances of Roxy and his gang, and heard this shrewd student of human nature on this very subject. Mr. Rothapel criticised the producer who said good music was over the heads of the average audience, told his hearers that nothing was over their heads, and proved it, by drawing the greatest applause of the evening from that very mixed audience with a selection from La Forza del Destino. It is hard to change inbred habits of mind, but the radio can do it. We know a butcher, who now thinks the "Dio Possente" is the prettiest tune he's ever heard, and a college professor, who never misses Goldy and Dusty, and so it goes.

Yasha Bunchuk and his 'cello is another of the Capitol Theater artists who broadcasts frequently

WE WERE started on this wholly unpremeditated endeavor to set the world right by the diversity of subjects represented in the notes scribbled on the pad beside the radio set, a conglomeration of things we had heard in a few nights that touched on as many subjects as the dictionary.

WJAX—"*won*-derful Jacksonville," was broadcasting the Jackson and Lee ball. (And, by the way, we are getting awfully fed up with "wonderful Jacksonville." Aside from the many other advantages they have in this promised land, the way the Florida stations invade the north to the utter annihilation of the east and west, is something that should be taken up with the radio commissioner. It isn't fair for them to have everything.) But anyway, it was Robert E. Lee's birthday, and the flower of the old South was dancing to the strains of a very northern-sounding orchestra, and we began thinking about Robert E. Lee and wondered if this staunch supporter of

the lost cause *had* realized his great ambition, just where WJAX and wonderful Jacksonville would be today. And while the descendants of the brave old warrior of the Confederacy were Charlestoning to "Sitting on Top of the World," we were digging deep into the annals of the troubled '60s.

THE General had just laid down his sword at Appomattox, when we wandered up the dial and found WJZ broadcasting what might have been a bombardment of shrapnel. It finally developed into something like the bark of an infuriated Airedale, and when we got it down to five tubes and distinguished the words "senate rules," we were overjoyed, for we knew the world's worst broadcaster was at work, and a panic was apparently being staged in WJZ's control room. We have a friend who claims he has an infallible rule. If he tunes in on a speaker and hears the word "economy," he is sure he is listening to the president; if it is "senate" he knows he is hearing the volatile Mr. Dawes. We do wish something could be done about the vice-president. One knows he is to be depended upon to say something worth hearing, yet how are we to get it when he persists in hopping about, hammering upon the table, and behaving generally as though he were before a moving-picture camera instead of a microphone? When he is in good form and going strong on the shortcomings of the august body over which it is his pleasure to preside, no station on earth can modify his outpourings into intelligible human speech. There is a splendid opportunity for some genius to perfect a Dawes-proof microphone. On this particular night, WJZ apparently threw up the sponge and we did likewise.

ANOTHER thing that drew attention this night was such an epidemic of tenors that one longed to live in that Utopia "over the viaduct," where 'tis said "they kill all the tenors as soon as they're born." And this set us to pondering on just what sort of courage a young man must have in these days, who sets out deliberately to become a tenor. We know a respectable coal merchant who does some fancy tenor-ing on the side, but we've never met a man who was intrepid enough to stake his all on such an over-crowded profession. And speaking of radio tenors, there is none as satisfactory to us, week in and week out as Guiseppe de Benedetto of WEAF. We have been listening to him for more than a year, in the tabloid operas produced by this station and in studio recitals, and while the discriminating musical critic may demand more than de Benedetto can produce, to us he is highly satisfactory, and from long experience in broadcasting, his voice comes over the air with more pleasing effect than many voices of wider reputation that are heard but rarely on the radio.

And as tenors naturally suggest contraltos, we also confess to a decided prejudice in this voice. We have heard all the great contraltos the past winter, and none has given us the complete satisfaction we have every Sunday night when Marjorie Harcum sings at the Capitol. Again it may be familiarity with the demands of the microphone, but there is a quality of feeling and beauty of tone in Miss Harcum's voice that is wholly missing in that of any other contralto we have heard the past winter.

Marjorie Harcum, popular contralto, who often appears at Capitol Theater

And we can never refer to a Capitol program without thinking of Yasha Bunchuk and his 'cello, and we never thrill to one of Yasha's exquisite renditions that we aren't taken back to an unique experience one night last summer when, in the wildest, most desolate section of northern Michigan's lumber country, we ran across a boy in greasy jumpers sitting on a cracker-barrel in the back end of the general store and garage, nursing a battered cornet and listening to the broadcast of the Goldman band. A blow-out held us up for two hours in this God-forsaken, stump-dotted sand country, miles from anything that could be called a town, and in this corrugated iron shack we found a first-class home-built radio set and a boy who was wild about music.

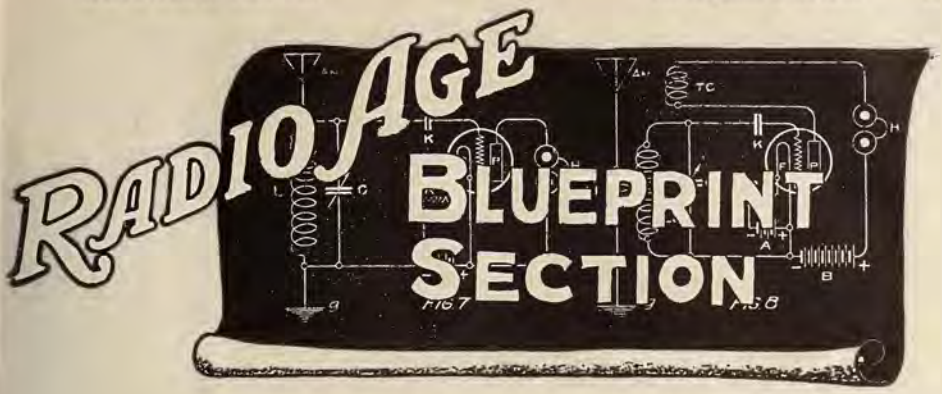
He told us he tuned in every Sunday night to hear the man play the "cornett" in the band down in Detroit, and we had a lot of enjoyment in telling him how the man wasn't playing in Detroit, but away off in New York, and describing as best we could the great crowd on the university campus, and how Waino Kauppi had become famous for his work as soloist with the Goldman band. We told him how the young cornetist had started to play when only twelve years old—the listener was tremendously interested to know he was a Finn, the boy himself being of Scandinavian extraction, and we questioned him about *his* ambition. And then he told us that while he was interested in the "cor-nett" because he had learned to play one, the prettiest instrument he had ever heard was one always played earlier on Sunday night that sounded like "a big fiddle." It wasn't hard to identify Yasha and his 'cello and so we told him about the young Russian, and the great theater he played in, but trying to present a picture of anything like the Capitol Theater to a boy who had never been inside a playhouse, reminded us of the futility of a previous effort to describe a hansom cab to a boy who had never seen a horse.

Waino Kauppi, cornetist with the Goldman band, who has been heard on the Pooley hour from WEAF the past winter

HOWEVER, it was an interesting experience, and one that has been brought back many times the past winter by the notes of Yasha Bunchuk's cello, and the several times we have heard Waino Kauppi play during the Pooley period. We would like to tnink that the boy who has never seen a 'cello might some day become a great virtuoso, but as we aren't writing fiction, we are content to know that he can at least sit up there in his isolated wilderness and hear the music he loves.

And so it goes in radio. One can't turn a dial without running across that intangible something, that the poets call, romance; the city editors, human interest, and the rest of us, life.

There is another note on the pad of something that aroused our interest though it didn't come over the air. Radio has actually invaded the columns of the sacred "Saturday Review of Literature," and what amused us is that Mr. Canby's austere organ of the literati in referring to WOR's estimable innovation in putting book reviews on the air, says that this station "broadcasted" these reviews. The editors of many radio magazines, whose literary standards could scarcely be mentioned in the same breath with that of the impeccable "Review," long ago decided that the past tense of the verb was "broadcast."



Full Details of a

Short Wave Transmitter

By ARTHUR A. COLLINS

(Radio 9CXX)

A PERSON who desires to gain a more intimate knowledge of high frequencies, and one who is willing to devote a good deal of time and study to his work, would be interested in the construction of a high frequency transmitter. A previous article has discussed the construction of a high frequency receiver for gaining an acquaintance with the amateur activities on the shorter wavelengths. In this article I shall attempt to give some helpful Information for a person just entering the transmitting end of the amateur game.

A grievous mistake often made by initiates is the thought that by copying exactly the equipment of some person who has been successful in any one line, they will be able to duplicate his results. This is rarely the case. The actual equipment counts for very little in the final analysis; it is the operator's knowledge of the technical why's and wherefore's that brings outstanding results. With this thought in mind, I am offering the following information for what it may be worth in starting the layman on an individual path which may lead to achievements of his own.

Circuits

THERE are fundamentally three oscillatory vacuum tube circuits, known as the Hartley, the Colpitts, and the Meissner, each with its own advantages, but of the three, the Hartley is perhaps the most popular among amateurs for high frequency work. The theoretical operation of each of these three circuits will not be entered into here.

Figure 1 shows these three elementary circuits. The Colpitts and Hartley circuits both have a "tank," or frequency determining circuit included in the primary, or vacuum tube circuit, the only difference between these two lying in the means of grid excitation, which is accomplished in the former by capacitative, and in the latter by inductive, reactance. The Meissner circuit differs from the Hartley circuit only in that the secondary, or antenna, circuit comprises the tank circuit, and for this reason this circuit is the least desirable of the three, since any change in the antenna constants will result in a change of frequency, which is very objectionable on the short wavelengths. The Colpitts circuit possesses the decided advantage that the ratio of external capacity is high with respect to the internal capacities of the tube. This relation keeps the radio frequency current values within the tube elements at a small value, thus reducing hysteresis losses in the tube insulation, and also the ensuing possibility of damage to the tube when operating on high frequencies.

Enthusiasts desirous of learning how to apply for amateur radio licenses should read Mr. Earle's story on page 17 of this issue which will acquaint them with the proper steps towards securing such a license from the United States government.

When a transmitting circuit is being chosen one thing must be kept in mind: although very good results can be obtained with any circuit, a thorough knowledge of the operating characteristics of all of them is almost a prerequisite for success. It is worth while to try them all with this end in view.

Construction Data

FROM a practical standpoint, the primary consideration of the beginner is usually the power tube. High power is by no means essential for long distance work on the short wavelengths. Single UX210's and even amplifier tubes daily connect U. S. amateurs with fellow "hams" in Australasia, Europe, and South America. High power is necessary only to maintain absolutely reliable contacts under adverse conditions, and inversely, to lessen one's dependence on

(Please turn to page 36)

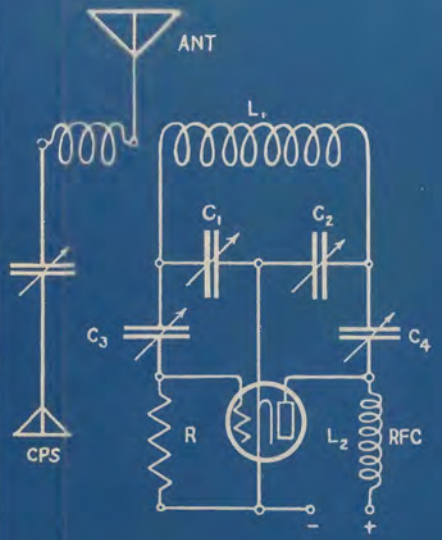


FIG. 1-A

COLPITTS CIRCUIT

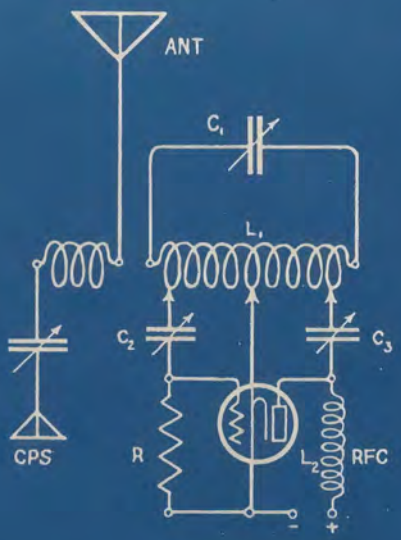


FIG. 1-B

HARTLEY CIRCUIT

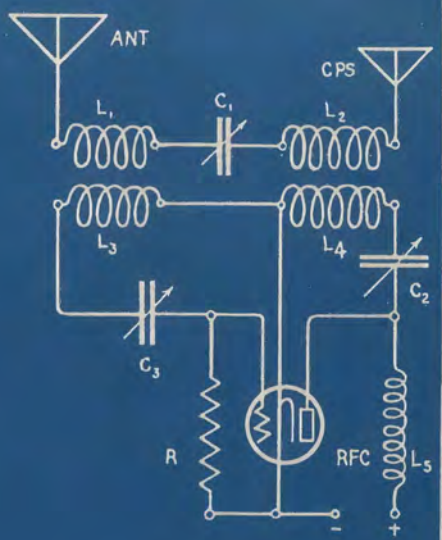


FIG. 1-C

MEISSNER CIRCUIT

FIG. 1

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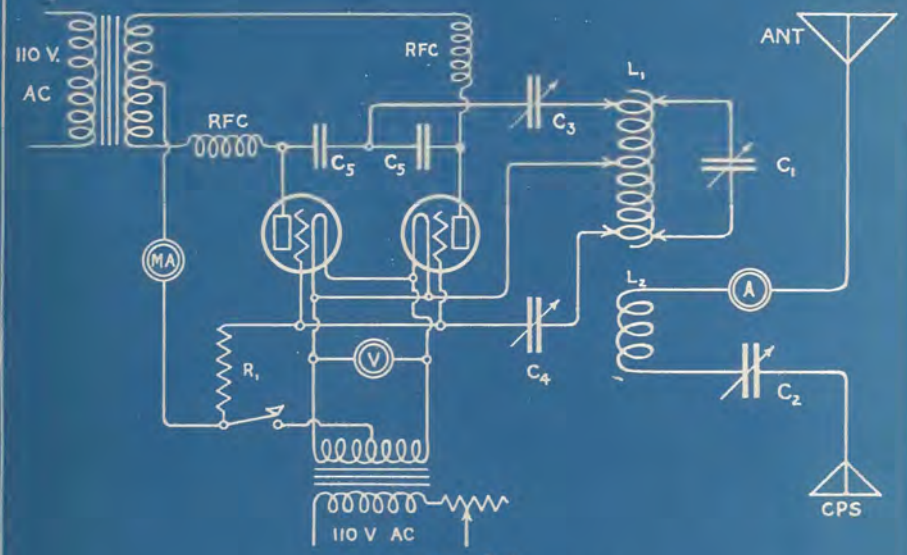


FIG. 2-A
SELF-RECTIFYING CW

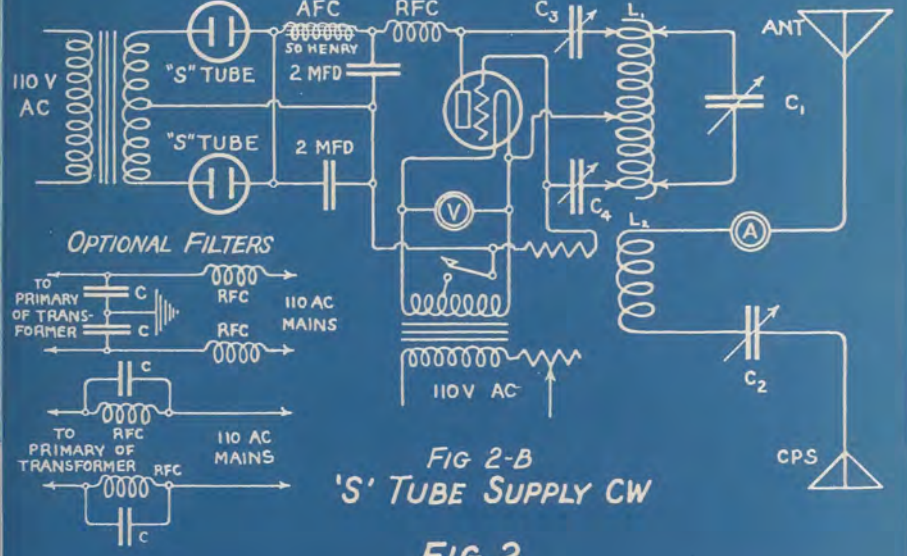


FIG 2-B
'S' TUBE SUPPLY CW

FIG. 2

W.T. GARLAND

kindly fates. I would not advise a novice to commit his initial crime on anything larger than a UX210 Radiotron. Parallel operation of tubes, at least in excess of two tubes, is highly impractical on high frequencies. The "A" type thoriated filament Radiotrons are favored above all others for high frequency oscillators. These can be bought in different sizes with rated outputs from 7.5 to 1000 watts, according to the size of your pocketbook.

A second problem is obtaining a source of power for the transmitter. The ideal supply is pure D. C. to plate and filament, but this can usually be only approximated in practice because of financial considerations. An amplifier tube may be supplied by dry cell "A" and "B" batteries, storage cells can be used with larger tubes, but their cost and upkeep soon become prohibitive for most of us as the power is increased. When an appreciable amount of power is used, it is usually more practical to convert the A. C. from your power mains. Common ways of doing this are by using a motor-generator set, kenotrons (thermion rectifiers), "S" tubes (gaseous rectifiers), chemical rectifiers, synchronous mechanical rectifiers, or by self rectification with two power tubes (one on each side of the A. C. cycle). These systems are named in order of their excellence, and also in order of their costliness—take your choice and pay the piper. Although good results can be obtained with a chemical rectifier, it is perhaps the least economical of any system, since one will require constant attention, and if the operator values convenience, it would be better to invest in a more reliable source of plate supply.

Filter Circuits

SMOOTHING or filter circuits should be used with any of the above power systems. A suitable smoothing system consists of two 2 mfd. high voltage condensers across the supply line separated in the positive lead by a 50 henry audio frequency choke coil. Power tube filaments are best heated by A. C. from a small step-down transformer with the grid and plate returns brought to a center tap in the secondary winding. It is best to buy specially designed transformers from a reputable company. In regard to power supply, two things cannot be over-emphasized. Do not exceed the rated plate and values of your tubes, and know exactly what you are putting into the tubes. Invest in reliable instruments for measuring filament voltage, plate and grid current, and even plate voltage, if possible. Observation of these suggestions will result in longer tube life, increased efficiency, improved wave character, and a greater chance for the operator to become acquainted with correct methods of engineering.

The radio frequency circuits next demand attention. "Low-loss" condensers adaptable for transmitting are being placed on the market by reputable firms. The condensers in the tank (c^1) and antenna circuits (c_2) in Fig. 2 and 2-A should be of about 100 mmfd. capacity and must be double or triple spaced for powers of 50 watts and above. Well designed variable receiving condensers of 150-250 mmfd. capactiy will serve in the grid circuit (c^4) and also in the plate circuit (c^3) for low powers, but, since the plate condenser must withstand the entire plate voltage, it is necessary to use specially designed mica condensers in the plate circuit for the higher powers. Such condensers are sold by the Radio Corporation of America and by the Dubilier Company, and should have a rated breakdown voltage considerably in excess of the plate voltage. Westinghouse mine locomotive condensers may be also used. They may be secured through your local power company.

Very acceptable inductances can be made by carefully winding quarter or three-eighths inch copper tubing around a piece of table leg, bed-post, or the like, about four inches in diameter, cutting off the required number of turns, and then carefully spacing the turns by sliding a flat object between them. Coils made in this manner can be supported on slender glass tubes, and should be rigid enough for practical purposes without further dielectric being introduced into their field. L1 and L2 should be approximately 10 and 5 turns respectively for 7500 kilocycles (40 meters) and 5 and 3 turns respectively for 15000 kilocycles (20 meters).

Although the transmitter shown in this article is adapted for powers on the order of 250 or 500 watts with the present constants, nevertheless the basic circuit may be used for anything from a 201-A with 200 volts on the plate, up to a 5 or 7.5 watt transmitting tube. The higher the plate voltage used (and naturally the larger tubes) the more need for design in which greater stresses are taken into account. A variable condenser that would serve your purpose with a five watter would not hold up under the strain of the energy dissipated by a 250 watter. While your inductance for a 201-A tube transmitter could easily be bell wire wound on an oatmeal carton, this arrangement would not be satisfactory for anything larger than a couple of five watt tubes. So in designing your transmitter make your calculations accordingly.

—*The Editor.*

R. F. Chokes

IMPORTANT items not to be neglected are the radio frequency chokes in the power leads to the plate and grid. For 20-40 meter work, coils consisting of 75 turns of No. 22 D. C. C. on a 1½ inch hard rubber forms are quite acceptable. These coils should be placed so that magnetic coupling to the inductances is at a minimum. Efficient radio frequency choking in the power leads will prevent loss of power and reduce blanket interference in the immediate vicinity of the transmitter—an important consideration if you want the family to hear its bed-time story. The choke in series with the grid leak, although not shown in the diagram, is fully as important as the plate choke and should be inserted between the grid terminal on the tube socket and the grid leak.

The instruments can be set up very neatly on a breadboard or drafting board, or even on a table-top, arranged much as they are represented in the circuit diagrams. A more permanent arrangement can be constructed in the manner shown in the diagrams of the "500 watt," 37.5 meter transmitter used at 9CXX. It is usually quite preferable to have the transformers and rectifiers separate from the transmitter itself. All radio frequency leads should be of heavy copper, as short and direct as possible, and supported in air as much as possible. Tube sockets should be of the best quality porcelain or glass. Following out the idea of low-loss design, all leakage paths in the radio frequency circuits should be reduced to a minimum and should be long and narrow in a good dielectric. Hard rubber, pyrex glass, glazed porcelain, and white-pine boiled in paraffin are considered the best insulators at high frequencies. Whether mounted on a panel or on a "breadboard," all apparatus should be arranged so that stray magnetic and electro-static fields around the instruments will interfere with each other as little as possible.

Operate Near Fundamental

THE antenna system will offer difficulties of its own. Large antennae have been operated successfully at harmonics on 40 and 20 meters, but smaller antennae operated close to their fundamentals are now gaining favor among amateurs. A single conductor vertical antenna with a single conductor horizontal counterpoise is a common form of this latter type. If one chooses to erect a system of this type, the following dimensions will be approximately correct: 40 meters, antenna and counterpose both 30 feet in length, and for 20 meters, both antenna and counterpoise 15 feet in length. A third type of antenna fast finding favor because of its polarizing properties is known as the Hertz antenna, and consists of a single horizontal conductor one-half of one wavelength long coupled to the oscillator by a R. F. feeder attached near the center. (This general scheme for reception was shown on page 14 of the April issue of RADIO AGE.)

The amateur will do well to adapt his antenna system to his location. (City cliff-dwellers please take notice.) An open location free from obstructions is highly desirable, but unusual results can be obtained in a very poor location if care is taken to make the best use of the available space. Keep the system as free from surrounding buildings, trees, wires, etc., as physically possible. Since short wave antennae are usually

diminutive, it is a good plan to locate the transmitter on an upper floor, if it cannot be housed separately, so that the lead-ins from antenna and counterpoise will not detract from the effective height of the system. It is a clever scheme to bring the leads into the house through the center of a window-pane, thus reducing the heavy losses encountered in most lead-in bushings. No. 8 or 10 enameled magnet wire will not corrode and is sufficiently heavy for a medium powered transmitter. The insulators should be long and slender of glass or porcelain—glass towel bars will usually serve admirably. Needless to say, all joints must be *well soldered.* Every antenna system has a frequency on which it operates most efficiently, so for best results this frequency, determined by experiment, should coincide with the operating frequency of the transmitter.

Operation

OPERATING a transmitter at highest efficiency requires, first, a thorough knowledge of "what makes the wheels go around," and, second, plenty of experience with blown tubes, blasted hopes, and depleted finances. Leaving the second requirement to the fates, I will briefly describe the method of putting a simple Hartley circuit into operation.

Check over the wiring, arrange the clips on the primary inductance in somewhat the relative positions shown in the circuit diagrams, apply the rated voltage to the filament and about 25% of the rated voltage to the plate. If there is no display of fireworks, touch the ends of the primary inductance with a wooden-handled screw-driver. A lively arc to the screw-driver indicates that the circuit is oscillating. With an accurate wavemeter (an *absolute requisite* for every transmitting station) find out on what wavelength the set is oscillating. By varying the tank circuit inductance and capacity, the set can be made to oscillate on the desired wavelength. The grid and plate circuits are now tuned for greatest efficiency, which is usually indicated by lowest input to the plate. Now place the antenna circuit in resonance with the driver and apply full power to the plate. The increased input and newly added load on the oscillator will require careful readjustment of all the circuits for greatest output. Re-check the wavelength and listen for harmonics in your receiver to discover whether or not the emitted wave is steady in character and free from thumps and warbles when the key is operated. With a little additional nursing, the set should be ready for business—but don't expect to talk to Timbuctu first thing. Really satisfactory operation can be expected only after a good deal of midnight oil and honest toil have been expended in "rehashing" the apparatus.

The character of the emitted signal counts for fully as much as signal strength in long distance work under adverse conditions. A swinging antenna will cause a wobbly note, and a poorly filtered power supply will cause a deep growl instead of a flute-like D. C. note. In each case the remedy is almost obvious. Loose coupling to the antenna, now required in all station licenses, has been of great assistance in sharpening and steadying our signals.

Crystal Control

A TRANSMISSION system not previously mentioned consists of a master oscillator-power amplifier arrangement. The only type of this system that is outstandingly successful on high frequencies utilizes a quartz crystal oscillator, frequency doublers and power amplifiers to supply an absolutely unvarying frequency to the antenna—the ideal arrangement, but too complex and expensive for the unseasoned experimenter.

Even if not pursued seriously, the amateur game is an avocation decidedly worth-while. A high frequency transmitter can gain you lasting friendships with young fellows all over the world. It can be a novel, yet effective, means of studying that ever-interesting abstraction, human nature, or it can be a substantial foundation upon which to base later scientific work.

It has been impossible in these pages to more than outline a few of the more essential points which must be considered in the construction of an amateur high frequency transmitter. Supplementary reading should, of course, be undertaken before one goes into the subject seriously. Ballantine's RADIO TELEPHONY FOR AMATEURS is revered almost as gospel by the amateur fraternity. Interested parties should by all means join the American Radio Relay League (Headquarters, Hartford, Connecticut), a mutual organization of practically all the active amateurs in the world. A membership will be a means of placing you in touch with all the worth-while developments in the amateur game.

The real thrill in amateur work comes not from talking to stations in distant lands, not from receiving multitudes of "QSL" cards from all the world, although these are things to stir your imagination, but from knowing that by careful and painstaking work and by diligent and systematic study you have been able to accomplish some feat or establish some fact that is a new step toward more perfect communication.

(Readers of RADIO AGE may gain considerable useful information from the story written by Mr. Earle and shown on page 17 of this issue—The Editor.)

Suggestions

For the benefit of fans embarking on amateur activities the following data will be useful.

For plate power transformers see *Thordarson, Acme, General Radio.*

For motor generators see *Esco* and *Emerson.*

For chokes see *Thordarson, Acme, General Radio.*

For filter condensers see *Dubilier, Radio Corporation, Westinghouse.*

For dry battery operation see *National Carbon Co., Burgess Battery Co., French Battery Co.*

For storage battery operation see *World Storage Battery Co., Willard, Philadelphia, Prestolite.*

For meters see *Jewell, Weston, Westinghouse.*

For tubes see *DeForest* and *Radio Corporation.*

For variable condensers see *General Radio, Cardwell, National.*

For grid leaks see *Crescent, Radio Corporation.*

For antenna wire see *Belden.*

For rectifier tubes see The Raytheon Mfg. Co., makers of the Raytheon.

For kenetrons see *Radio Corporation.*

For filament heating transformer see *Thordarson, Acme, General Radio.*

For insulators see *Ohio Brass Co., Pyrex Co.*

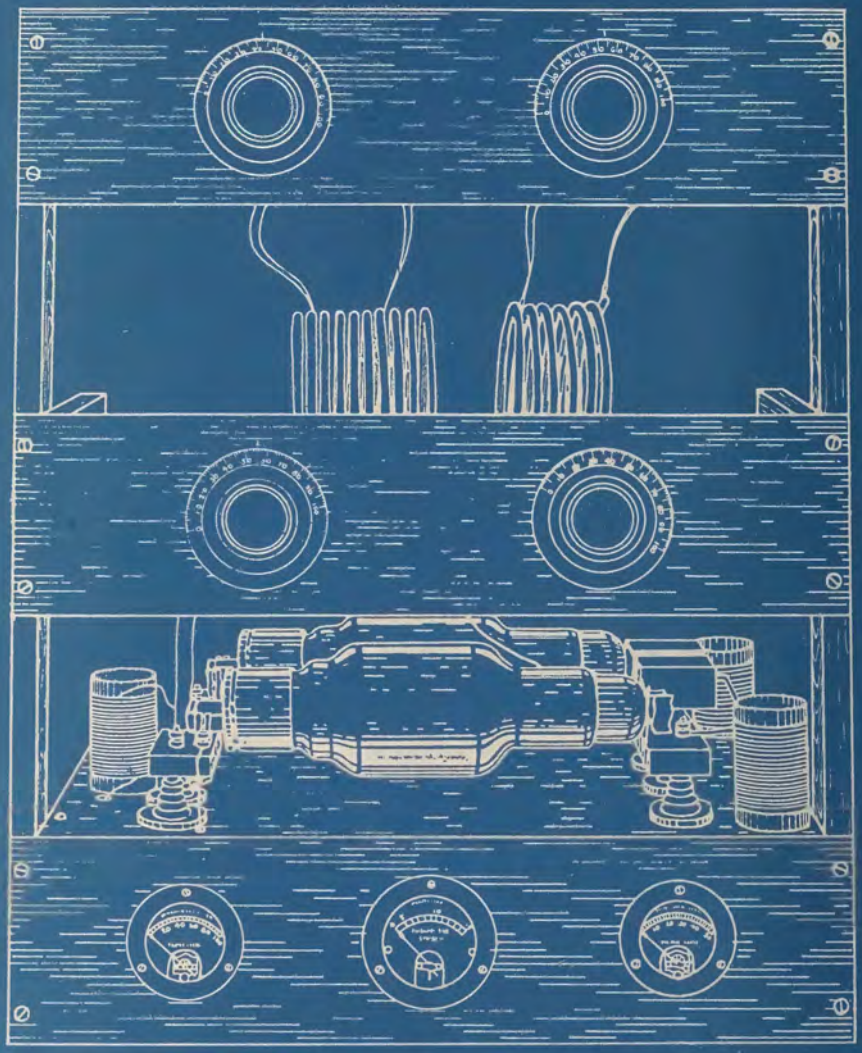
For wavemeters see *Jewell* and *General Radio Co.*

For electrolytic rectifiers see *American Aluminum Co.*

For telegraph keys see *J. H. Bunnell Co.*

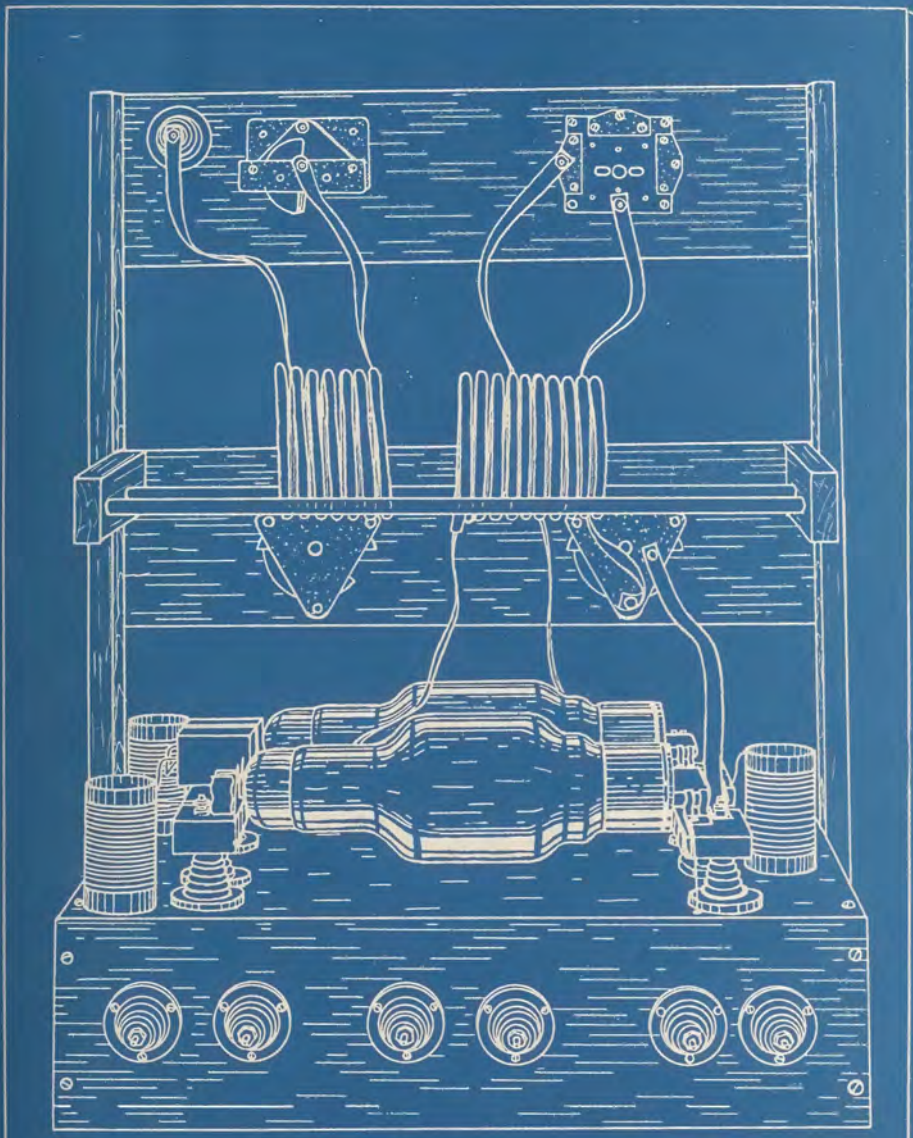
For high speed keys (bugs) see *Martin Vibroplex Co.*

For tube sockets see *DeForest* and *Radio Corporation* on high power; *any good socket makers* for lower powers.



FRONT VIEW OF THE COMPLETED
SHORT WAVE C W TRANSMITTER
FIG. 3

W.T. GARLAND



REAR VIEW OF THE COMPLETED
SHORT WAVE CW TRANSMITTER
FIG. 3 - A

W.T. GARLAND

Pick-ups and Hook-ups by our Readers

Conducted by Fred Hill

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

CONDUCTING a radio magazine as far as determining the desires of our readers is concerned is something like trying to recognize faces in the dark—you never know when you are right or wrong. To accurately judge the type of material which interests most readers we must have some knowledge of what our readers desire. Without that information we must be guided by what interests us. You as a reader of these columns can render us, yourself and your brother readers a service by telling us what type of articles please you; whether you like the technical, semi-technical or the popular presentation of the material. For instance we are printing in the June issue a full description, fully illustrated, of the Radio Age Golden Rule receiver, so named because it will not radiate except under extraordinary conditions. We believe it is an excellent four tube set; it certainly has met all our requirements. Now we would like to know whether it fills your needs. Just a note to the editor will give us a clue as to the kind of matter you like to see in the pages of your favorite magazine.

IN THESE columns recently we broadcast an appeal for correspondence from our readers in the republic of Mexico and first in the mail comes a letter from Salvador Tama, who lives at Velardeña, in the state of Durango, Mexico. His letter, written in Spanish, is very interesting and comments upon the possibilities opened up to him by our announcement that we would even welcome letters written in the language of that country. He is using a Radiola V and has logged the following stations, which we are printing in order to show the general type of reception encountered in that republic: WOAI, KOA, KPRC, WBAP, KFDM, KFKX, KGO, KFI, KFON, KTHS, KNX, KFOX, KFJE, KFH, KMOX, WCOA, KPSN, WOAW, WGHB, WHO, KDKA. Mr. Tama says reception in Mexico is good from November to April and after that poor audibility sets in with the result that logging is no longer a pleasure. In this respect conditions are not vastly different to those encountered in the southwest, except perhaps our southwestern country has a little longer season than that indicated by Mr. Tama in his letter.

DIAL TWISTERS

Salvador Tama	Velardeña	Mexico
H. S. Whitney	1429 W. 65th St.	Cleveland, O.
John Tomlin, Jr.	303 Madison Ave.	Atlantic City, N. J.
Wilbert E. Scheer	1329 Campbell Ave.	Desplaines, Ill.
Edward S. Mancher	1321 N. Wanamaker St.	Philadelphia, Pa.
Harry Whitton	687 George St.	Peterboro, Ont., Can.
George Poehlman	839 Van Buren St.	Milwaukee, Wis.
Edwin Manchester	722 S. 8th St.	Lincoln, Nebr.
Joe Homa	3203 E. 80th St.	Cleveland, Ohio
Joe Turck	1493 Weil St.	Milwaukee, Wis.
Lawrence Katz	920 Chauncey Ave.	Baltimore, Md.
J. Ernest Gribbin	841 N. Broad St.	Elizabeth, N. J.

SINGLE tubers still hold the esteem of Joe Homa, 3203 East 80th St., Cleveland, Ohio, who spends considerable time in logging broadcasters scattered over the country.

BUILDING the three tube neutrodyne described in the RADIO AGE ANNUAL for 1925, Joe Turck, 1493 Weil St., Milwaukee, Wis., secures excellent results and brings in stations from the four corners of the United States.

USING a six tube Atwater-Kent receiver, Lawrence Katz, 920 Chauncey Ave., Baltimore, Md., furnishes us with a formidable list of stations received, indicating a great deal of patience in dial twisting, especially in the Baltimore location which is said not to be any too good for long distance work.

QUOTING from a letter written by J. Ernest Gribbin, 841 North Broad St., Elizabeth, N. J. "I feel that RADIO AGE should receive a line of commendation from me as a humble radio bug and a reader of your magazine *from now on*. It is a wonderful source of information and general radio knowledge. Your blueprint section is worth double the price of the magazine."

IF YOU like our magazine—tell your friends. If you do not like it, give us the benefit of your suggestions so we can make a bigger and better RADIO AGE.

WE KNOW one man who is a fiend for punishment. He is Harry Whitton, 687 George St., Peterboro, Ont., Canada, who has a Radiola superhet and tunes in 67 stations in less than four hours. His list takes in all of the worthwhile North American, Cuban, Mexican and Canadian stations. The total list numbers 210 stations. Anyone who twirls the dials so industriously is certainly entitled to one of the DT emblems. Mr. Whitton tells us to keep up the good work with RADIO AGE and all the fan family will be happy.

GEORGE POEHLMAN, 839 Van Buren St., Milwaukee, Wis., is another of the dial twisters who occasionally has to use oil on the condenser shafts to keep them from developing a hot box. George uses a two tube regenerative, home made, and gets enough stations to keep any ordinary man busy putting them down on paper. Perhaps he will be interested in the four tube Golden Rule receiver which RADIO AGE is introducing to the fans in the June issue. Order your copy early.

CONGRATULATIONS are showered on this magazine by Edwin Manchester, 722 South 8th St., Lincoln, Nebr., who thanks us for the complete and accurate list of broadcast stations which we are printing every month. He also likes our articles and makes use of the many suggestions contained in RADIO AGE for the betterment of radio sets.

H. S. WHITNEY, 1429 West 65th St., Cleveland, Ohio, uses a two tube three circuit receiver in logging his stations and since the first of the year has accumulated quite a number. We wonder if our readers have found reason to complain of the audibility since the first of January compared to matters the same period the year before. Frankly our own results have not been up to expectations.

DESPITE all advice to the contrary on many occasions a ground is not a ground at all. In fact we have seen several cases where a ground did not even merit being given that name. Often in experimenting with your ground connection you will find interesting facts. For example in one case where one of our radio fans was using the conduit in the house for a ground he discovered it was just as good an aerial as the one he had. He grew suspicious on noting that he could use the ground connection from the set to the switch plate of his electric lighting circuit just as well for an antenna as he could for a ground. Taking about twenty feet of bell wire he ran a separate ground downstairs into the kitchen and hooked onto the cold water faucet. He then found he had a real ground which gave him excellent signals as a ground but which did no good as antenna. He is now cured as far as using the electric lighting conduit boxes for a ground. Many of our fans in the apartment houses in the larger cities are using either the vapor heating system or the radiator pipes for grounds when with a little extra trouble they could easily run a lead to a cold water pipe in the bathroom or the kitchen. If you do not want to make a permanent thing of it, just for the sake of argument take a piece of flexible wire and run it from the ground connection on your set to the cold water pipe in the bathroom or kitchen. If the results warrant, then you can run your ground lead, made out of No. 18 annunciator wire, around the baseboard of the room so it will be out of the way.

SPEAKING of grounds, one of our correspondents who lives in the country found his reception was largely determined by the amount of water from a pitcher which he poured on his ground connection every night. He has since abandoned this practice and now runs a copper wire out to the well and straps it on the iron pipe leading down into the well. Another resident of the same vicinity built himself a ground by digging a pit, burying a bunch of copper screen to which his ground lead was soldered, and then covering the hole with charcoal so moisture from above could easily reach the copper screen. It would take volumes to recount all of the experiences radio experimenters have had with grounds. Perhaps you have had some interesting facts developed by your own desires to have as nearly perfect a ground system as it is possible to have. Tell us so the rest of the DT family may profit thereby.

JOHN TOMLIN, JR., 303 Madison Ave., Atlantic City, N. J., using two sets, an Acmedyne and a Bremer-Tully Nameless 5, sends in a wonderful list consisting of 271 stations divided as follows: 3 Cuban, 1 Peruvian, 1 German, 1 French, 1 Spanish, 4 British, 1 Porto Rican, 13 Canadian, 1 Mexican and 245 American stations. It took a great deal of time to log up all these stations but we'll wager the satisfaction of hearing so many stations amply repaid our correspondent for his labor.

BECAUSE of the anti-blooping raid Wilbert E. Scheer, 1329 Campbell Ave., Desplaines, Ill., has discontinued using his single tube ultra-audion on which he logged the entire country, Canada, Mexico, Cuba and Porto Rico. He is now using a non-radiative design according to his letter.

TRAVELING salesmen when desirous of having their set with them must have one that is compact and light. Edward S. Mancher, 1321 North Wanamaker St., Philadelphia, Pa., writes RADIO AGE, thanking us for having helped him to find a set which he can carry on the road. While in his hotel room at night he unrolls a piece of "talking tape" and uses the radiator for a ground. Then he entertains himself the balance of the evening listening to the programs on the air. We do not know of any more profitable manner of spending the evening.

Twin Loop Divorces Static from Signals

(Continued from page 7)

tance between the loops is not one-twelfth of a wave length, then a correction factor must be added. The best method of measuring the increase in noise when one of the loops is shorted is to decrease the beating oscillator input, at the moment the loop is shorted, to such a value that the noise level remains the same. The decrease in beating oscillator input measures the improvement of the system.

Several Measurements

IF THE character of the interfering noise has not changed when one of the loops is shorted, it is not difficult for experienced operators to adjust the beating oscillator input for equality of noise level and check results. But often static interference is so variable that several measurements have to be taken. The measurements described above are generally checked by measurements which employ a local warbler signal introduced in one of the loops, and adjusted until it can just be heard through the noise. The improvement is then determined by the ratio of the warbler signal inputs corresponding to reception with one loop short circuited and with two balanced loops, respectively.

"It is desirable to measure the improvement in the signal-to-noise ratio of this long wave two-loop system. Such measurements would include continuous data on signal-to-noise ratios, strength of static, and direction of static. So far the system has been available only in the winter time, so that it has been impossible to make systematic measurements. However, valuable information has already been obtained and the results are, that whenever the improvement was only 2 to 3 times, it was found that the general direction of static was south-southeast, that is, the static direction was at right angles to the plane of the two loops while static from south, southwest, and west was always reduced 4-6 times, often 8-10 times, and sometimes even 20 times. On one day only could no improvement be noticed, but static was that day coming from the northeast. It may be emphasized that a 7-times reduction in static corresponds to a 7^2 or approximately 50 times saving in power at the transmitting station."

Davenport Now With Wakem & McLaughlin

E. A. DAVENPORT, formerly assistant Sales Manager of Jewett Radio and Phonograph Company, Pontiac, Michigan, was recently appointed General Sales Manager for Wakem & McLaughlin, Inc., Distributors, and Jobbers of Radio Equipment, Chicago.

Wakem & McLaughlin, Inc., of Chicago, for several years distributors and jobbers of Radio Equipment, have added to their line golf supplies, outboard motors, and camp equipment in general. It is their thought to be able to properly serve the dealer during the slack radio season.

You Can Simplify Battery Charging

(Continued from page 10)

The double cord should be fastened into the plug so that pulling on it will not place any strain upon the stranded wires themselves. A simple method of accomplishing this is to tie a single or double knot with the insulated wires as in Fig. 4e. If the hole in the plug is large you may require a double knot to prevent its pulling through. When you have the knot tied and have found that the cord will not pull out, loosen the two screws in the plug and wrap the ends of the wire—from which the insulation has been scraped—around each screw, making sure that not a single strand is loose from either screw or it may stray across and touch the other plug contact.

In case your charger cord is not long enough to reach from your radio table or cabinet to the socket you will have to put on an extension cord. Buy strongly insulated cord—"twisted pair" is the easiest to manage. Connect the ends together as indicated in Fig. 4g, resulting in a strongly twisted joint. Start the twist by cleaning off the insulation from each wire for about an inch, twisting the strands of each wire together and then laying the two wires to be connected across each other as shown at the top of Fig. 4g. Then twist each wire around the other firmly, to result in the appearance shown below it. Tape each joint thoroughly with good friction tape, to make sure that the two joints can NOT touch each other.

In charging a battery, a certain amount of hydrogen gas is given off at the period when the charging operation is almost complete. This is known as "gassing." Hydrogen and oxygen are given off on account of the tearing apart or decomposition of the water and this is the reason why you have to add fresh water to the battery every so often. But there is a little acid given off in vapor form and this may damage draperies or even nearby woodwork. Hence, it is always advisable to lay a pad of old rags on top of the battery to absorb this vaporized acid. The rags will turn black and you can then throw them away.

If you charge your battery at a very slow rate, the gassing action is practically eliminated, however, and you are less bothered by having to add water. For this reason, I would strongly advise any of you who are contemplating the purchase of a charger to buy a charger passing only a slow charge rather than a heavy one. Not only will this be less expensive to buy but it will be less expensive to keep going—buying renewal bulbs for etc. Of course, you will have to keep the charger going for a longer time, but if you have your switches conveniently arranged to turn on the charger at the same time that you turn off the set you needn't worry about the more constant use of the charger. Moreover, you won't have any worry about acid being vaporized. And the cost for electric light current is no more than with a larger charger running for a shorter period, of course.

Trickle Charger

WHAT is even better, to my way of thinking, is the so-called "trickle charger" that provides an extremely slow charging current of only a few tenths of an ampere. The trickle charger is intended to be used practically all the time. After a little practise you can find out about how much of the time the charger is to be put on to keep the battery full of pep. It is not necessary to wait till the battery goes dead before charging it. In fact, it is better NOT to let it go dead. The trickle charger provides a slow, steady reinforcement of energy that is healthful for your battery. Being so slow, it is noiseless, too.

If you use a standard size charger of the vibrator type, adjust it to charge your battery slowly. You won't mind turning on the charger oftener or letting it run a little longer when there's nothing to it but the simple moving of a switch. And you won't worry about the number of hours your family may keep six or eight tubes burning when you know the battery can be recharged without a second's loss of time or getting your hands dirty handling corroded connections and putting plugs into lighting sockets.

Radio Vise

A small and compact vise suitable for attaching to the radio fan's work bench has been issued by E. C. Stearns and Co. and is illustrated above.

Klosner Socket

MEETING the demand for a universal socket to take all type of tube prongs the Klosner Radio Corporation has begun marketing a universal socket designed to take care of the contact between the socket and the prongs of the old UV type as well as the new UX type tubes. The socket is designed for single hole mounting.

Beg Your Pardon

THROUGH a mechanical error in the April issue of Radio Age we printed the picture of S. M. Kintner, manager of the research department of the Westinghouse interests, over the story covering the awarding of the Liebman prize to Frank Conrad, assistant chief engineer of the same company.

WITH THE MANUFACTURERS

New Tungars Suitable for Permanent Connection

PERMANENT connection of the battery charger to the radio battery is an important convenience for the radio fan. Either of the two new model Tungar battery chargers which have been produced by General Electric Company can be permanently connected to the radio battery.

The latest development, a new 5-ampere Tungar, charges all radio "A" and "B" and automobile storage batteries and by means of a simple connection to one of three terminals, provides the following charging capacities: 2, 4 or 6-volt radio "A" batteries at five amperes and 12 volt auto batteries at three amperes; 24 to 96 volt radio "B" batteries at 0.1 or 0.25 amperes.

An insulating transformer embedded in compound eliminates practically all of the noise of operation.

A new model 2 ampere Tungar has also been introduced and this like the 5 ampere model is equipped with an improved insulating transformer imbedded in a compound which makes it quiet.

Humidity in Japan Bad For Sets

JAPAN'S humid atmosphere is apparently ruining radio receiving apparatus which is not especially treated and sealed hermetically, according to advices forwarded by the American Consul. Special attention should be given to receiving sets sent to Nippon to make them moisture proof, it is believed in order to keep the sets operative.

At first the deterioration of so many sets, including some American-made apparatus, was somewhat a mystery. Ordinarily noises similar to heavy static were heard, followed by a steady decrease in signal strength and ending in complete loss of receptive ability. Corrosion of the enameled wire in transformers was finally noted where no effort to make the cases airtight had been taken. Special treatment of transformers is suggested to exclude moisture.

Farm Radio Grows

There are nearly a million radio receivers on farms in the U. S. compared with about 550,000 early in 1925, the Department of Agriculture estimates. In some states there are now radio sets on from 25 to 40% of all farms.

Rolling Your Own

WINDING a honeycomb coil has been greatly simplified for the experimenter by the issuance of a neat little winder for that purpose, manufactured by the Morris Register Co., and shown below.

With this device, which is within the reach of any experimenter, three different widths of honeycomb coils may be wound. A turn counter is also provided to facilitate counting the windings. Half, three quarters and one inch are the widths provided for by means of removable eccentrics. The diameter of the coils may be altered by placing different sized spools on the winding spindle.

Bosch Sells Its Auto Ignition Business

SUBJECT to the approval of the shareholders, the American Bosch Magneto Corporation, through the unanimous decision of its board of directors has accepted the offer of the Electric Auto-Lite Company of Toledo for the purchase of its Starting, Lighting and Battery Ignition business.

This will enable the Bosch corporation to concentrate its plants and facilities upon the manufacture of automotive accessories, radio units and their accessories.

Freshman Makes Good Showing For 1925

THE annual financial statement of The Chas. Freshman Co., Inc., for the year ended Dec. 31, 1925, issued and mailed to stockholders, shows net earnings of $1,407,062.52 after all deductions for depreciation, etc. and Federal taxes or equal to $6.25 per share on the authorized and outstanding 225,000 shares of no par value common stock.

The management considers this an exceedingly good showing when consideration is given to the difficult readjustment period through which the industry has been going.

Our Radio Exports Jump in Five Years

LAST year was the banner year in radio exports, according to Department of Commerce statistics just made available. The total approached ten million dollars, nearly four million more than in 1924, and ten times the amount in value exported in the first radio year 1921

Canada led in accepting American-made radio apparatus; that country took $3,782,928 worth; Japan was second with $2,216,535, and Australia, third, receiving $675,483 worth. Next in order came the United Kingdom, Argentina, and Brazil. All of the countries except a few, increased their takings of American radio apparatus. The most notable instance was in Australia, which accepted over a million dollars worth of radio equipment in 1924, but dropped to $675,483 last year.

This year exports seem to be decreasing, the January figure was $285,000 less than last year. Exports of batteries were about 20% larger than a year ago.

Best and Associates Buy Out Frost

FLOYD C. BEST and associates announce the purchase of the company known as Herbert H. Frost, Inc.

Mr. Best, President and Manager of the Chicago Telephone Supply Company, now becomes President and Manager of Herbert H. Frost, Inc. This is in effect a consolidation of the selling and manufacturing division of the companies known as Herbert H. Frost, Inc., and Chicago Telephone Supply Company.

The executive family of Herbert H. Frost, Inc., effective March 1, 1926, follows:

F. C. Best, President and Treasurer.
D. S. Hill, Vice-President.
W. A. Nicely, Secretary.

De Jur Amplifier

The De Jur Amplifier is a compact rigidly constructed unit to be substituted for the audio transformers thereby changing a transformer-coupled to a resistance-coupled receiver. The panel is of Bakelite and is mounted in a mahogany case which fits into the audio side of any type set.

It is manufactured by De Jur Products Co.

Dillon Makes Radio Tour of Hawaii

RADIO fans living in Continental United States should thank the Commerce Department that all nine radio districts of the country are watched over by as many supervisors and about twenty inspectors. In our insular possessions there are no resident representatives of the radio section. Lack of funds and personnel prevents the maintenance of sub-offices in Alaska, Hawaii or in Porto Rico, but eventually it is felt resident inspectors will be very necessary.

To be sure, distant supervision is exercised; Alaska is in our Seventh District, the headquarters of which are in Seattle, but no personal inspection in Alaska has ever been made although radio activities are increasing tremendously. Porto Rico is part of the Fourth U. S. Radio District, although only three trips have been made to that island during the past five years. Hawaii, although lying far out in the Pacific is included in our Sixth radio district, is seldom visited by U. S. Radio Officials.

Colonel J. F. Dillon, Supervisor of the Sixth district, with offices in San Francisco, however, has just returned from a trip across the Pacific and filed the first report received in about three years. Hawaiian fans and commercial interests requested the inspection of the islands' radio transmitters and a report on the interference noted there.

COLONEL DILLON'S report, just received in Washington, states that considerable radio and other interference has been eliminated through the cooperation of local interests. He announces the creation of a permanent radio grievance committee which will handle the more important problems encountered. The membership of this unique committee includes amateurs, fans, commercial and other electrical organizations and businesses.

A confidential report on the new inter-island radio telephone service, which proposes to use a wave length between 171 and 199 meters, was also filed. This service, conducted for several months experimentally, anticipates a 24-hour service for commercial use between the islands. It looks practical, but is not officially authorized as yet, although few amateurs are using this channel.

Concerning the broadcast situation, Colonel Dillon says that although there is one local broadcast station owned and operated by the Advertiser, (at Honolulu) it is not comparable with the standard stations in the States. Most local fans strive for the reception of distant U. S. stations. This requires powerful and sensitive receiving sets, which when tuned sharply bring in many extraneous noises, including electrical disturbances as well as commercial, naval and ship code messages. However, while at Kamamea, Colonel Dillon succeeded in picking up the American stations KFI, KGO and KOA, with good results except for fading.

He urges the detail of a local inspector who would be on the job the year around. Through the cooperation of the local fans and other interests, however, he believes many difficulties heretofore encountered have been eliminated. Several night sessions of a group of listeners located sources of trouble, with the result that certain noises have disappeared. Commercial and Naval stations have tuned their transmitters to their assigned waves, and some stations have agreed not to send during the broadcast hours, or between 5:30 and 9:30 p. m. One station, using the 600-meter distress and calling wave length, has been adjusted to the 730 meter channel taking it far above the broadcast band. In general, the Hawaiian fans were enthusiastic and now expect to get our stations more frequently.

Spans U. S. On 13.1 Meters In Day Light

RECENT radio tests between the naval stations at Bellevue, D. C., and Mare Island, California, have demonstrated that the use of the short wave lengths 13.1 and 13.4 meters is practical in day time transcontinental radio communications, according to Naval radio engineers. This is said to be the first time signals have been transmitted successfully for 3000 miles in daylight on as low as 13.1 meters. Although the Navy is proud of its achievement, it is planning to try out even lower channels to ascertain what short waves can be used practically.

The aim of this particular experiment at the Naval Research Laboratory is toward economy, since short-wave messages can be transmitted with less power than when long-waves are employed. The Annapolis arc station, for example, uses about 350 KW in its long range transmissions, whereas the recent tests succeeded in shooting code messages to San Francisco with around 250 watts. If this research work proves practical, it is hoped that eventually the Navy may erect 1 KW transmitters, which can carry long distance on short waves. They would cost around $10,000 as against the present cost of hgh-powered long-wave stations approximating a million dollars. Such a saving would be far in advance of any practical economy plan contemplated and would be reflected also in the maintenance of stations, if only a hundredth or even a tenth of the power was required.

Although the 13.1 and 13.4 meter trails were one way; that is, from Bellevue to the Pacific station, there is no reason why a similar transmitter located in San Francisco would not carry eastward equally well. As it happened, the Mare Island station answered on the 70 meter wave, a channel found very serviceable at night.

The naval radio engineers are seeking even shorter waves available for practical use in daylight. They are attempting to disprove a theory that the channels between 10 and 14 meters are useless for this type of service. Their present plans include tests with wave lengths around 10, 11 and 12 meters. These channels are being tested out experimentally, to pick out a practical short-wave route for day traffic. They are not assigned exclusively to the Navy. The present short waves allocated to the naval service lie within the 16.6 to 18.7; the 21.4 to 26.3; 33 to 37.5 and 66.3 to 75. meter bands.

Naval experts point out, however, that these short channels are useful only in point to point service. The vagaries of the short waves with their strange inaudibility at some points, make those channels impractical for broadcast purposes or transmitting general dispatches to the fleet, the ships of which are at different distances from the transmitting station. For service between certain points or to ships in known localities they prove very useful. When short-wave messages must be sent to several points or to a number of vessels at different distances from a station, four separate wave lengths are used simultaneously. At least one of the four wave lengths, it is calculated, will be available, so that every station and ship can pick up the general dispatch. Each operator figures out the most desirable channel for his location and distance, and listens in on that alone.

All this work is experimental, but the results being achieved point toward the practical use of short-wave, low-powered transmitters in the future rather than the very high-powered, long-wave sending stations which cost so much more.

R. M. A. Meets in Atlantic City May 10-15

CHIEF interest in radio trade circles now centers on the coming convention of the Radio Manufacturers' Association to be held at the Ambassador Hotel, Atlantic City, the week of May 10 to 15 inclusive. It is planned to make the occasion a general gathering of radio interests for the discussion and solution of those problems that can only be met by the collective intelligence of the men of the industry.

Invitations have been issued by the executive offices of the Radio Manufacturers' Association to allied organizations and many have signified their intention of being represented in numbers. Indications are that the convention will be the most largely attended conference of radio interests ever held.

A program fully in keeping with the importance of the occasion has been arranged. A number of outstanding personages in radio, general industry, and governmental circles will speak. Jacob M. Arvey, chairman of the Mayor's Radio Commission of Chicago will discuss "Activities of the Municipality in Radio"; W. H. Lynas, a member of the Grand Council of Radio Manufacturers and Merchandisers of Great Britain, who spoke before the convention of the Association last year, will again address those in attendance on "Radio Conditions in Foreign Fields"; Major-General C. M. Saltzman, chief signal officer of the United States Army, will relate the extensive use of radio in our national defence.

When Radio Was Young

(Continued from page 18)

connection with these demonstrations and lecture engagements new experiences were constantly being met with. At the State Fair, the coherer had a tendency at times to go off in the most erratic manner when the sending apparatus was not operating, resulting in many a laugh on the demonstrator. It was not until noon of the second day that he connected the peculiar behavior of the coherer with the discharges of a large Toepler-Holz machine used by a lightning-rod agent in an adjoining building.

Another occasion when the coherer disgraced itself was in a church in a small town in southeastern Nebraska. It was mid-winter and very cold with a deep blanket of snow on the ground. After arriving in the afternoon, the apparatus had been taken to the church, set up and thoroughly tested out in spite of the low temperature. The janitor arrived at about six o'clock and, while the lecturer was enjoying a fine dinner at a home near-by, he proceeded to crowd the furnace to its fullest capacity. The church was in poor repair and by seven-thirty the room was at a temperature of 80° F. and the air saturated with moisture, the latter being caused by snow which had blown into the attic, melted, and dripped through the ceiling to the room below. Vapor particles became condensed inside the coherer so that its operation became altogether undependable and spoiled the best part of the demonstrations.

Radio Explosions

The explosion of gunpowder by radio was planned to come at an unexpected time for the audience itself so as to make the experiment more effective. Sometimes it gave even more startling results on persons not in the audience. On one occasion a bomb had been placed in the hall just outside the laboratory door in the school building. A ninth grade class passing through the same hall at the time was badly frightened by the sudden explosion. At another time, while demonstrating in a church, the bomb was placed outside by opening a window near the platform. The usual group of hangers-on, so characteristic of the small town, on hearing the window open hurried around to the side of the church with the expectation of being able to hear and see without paying the price of admission. This plan was suddenly abandoned a few seconds later when the lecturer pressed the transmitting key, to the great amusement of the audience.

By 1910 the coherer has been replaced by a crystal detector and the induction coil by a 1000 watt transformer, better known as a "stone crusher." Transmission over 1000 miles by amateurs began to be rather common and occasionally word would come of signals having been picked up on ship-board from our experimental, station, 9YD. But that is a different story.

How to Secure Amateur Radio Licenses

(Continued from page 17)

Where to Apply

1st District: Customhouse, Boston, Mass. States of Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, Connecticut.

2nd District: Old Treasury Building, New York, N. Y. States of New York (county of New York, Staten Island, Long Island, and counties on the Hudson River to and including Schenectady, Albany and Rensselaer) and New Jersey (counties of Bergen, Passaic, Essex, Union, Middlesex, Monmouth, Hudson and Ocean).

3rd District: Customhouse, Baltimore, Maryland. New Jersey (all counties not included in second district), Pennsylvania (counties of Philadelphia, Delaware, all counties south of the Blue Mountains, and Franklin County), Delaware, Maryland, Virginia, District of Columbia.

4th District: Haas-Howell Building, Atlanta, Georgia. States of North Carolina, South Carolina, Georgia, Florida, Tennessee, Porto Rico.

5th District: Customhouse, New Orleans, La. States of Alabama, Mississippi, Louisiana, Texas, Arkansas, Oklahoma, New Mexico.

6th District: Customhouse, San Francisco, California. States of California, Hawaii, Nevada, Utah, Arizona.

7th District: L. C. Smith Building, Seattle, Washington. States of Oregon, Washington, Alaska, Idaho, Montana, Wyoming.

8th District: Customhouse, Detroit, Michigan. States of New York (all counties not included in second district), Pennsylvania (all counties not included in third district), West Virginia, Ohio, Michigan (Lower Peninsula).

9th District: Federal Building, Chicago, Illinois. Indiana, Illinois, Wisconsin, Michigan (upper peninsula), Minnesota, Kentucky, Missouri, Kansas, Colorado, Iowa, Nebraska, South Dakota, North Dakota.

The headquarters of the various districts are located as indicated above, and, in addition at this particular time, branch offices in charge of Assistant Inspectors or Radio Inspectors are maintained at Norfolk, Virginia, Savannah, Georgia, and Philadelphia, Pennsylvania.

tem must be shown. The application must specify the power to be used and may be made for the use of continuous wave telegraphy (CW), interrupted continuous wave telegraphy (ICW) or radiophone. Interrupted continuous waves may be produced by the use of un-rectified alternating current power supply to the plates of the vacuum tubes or by employing a chopper or interrupter. The use of ICW is permissable only between the wave-lengths of 170 and 180 meters. Radiophone transmitters may be operated between 170 and 180 meters and also in the band between 83.28 and 85.66 meters (3600 to 3500 kilocycles). Transmission by means of continuous wave signals is permissable within the following bands:

200 to 150 meters; 1500 to 2000 kilocycles
85.7 to 75 meters; 3500 to 4000 kilocycles
42.8 to 37.5 meters; 7000 to 8000 kilocycles
21.4 to 18.7 meters; 14,000 to 16,000 kilocycles
5.35 to 4.69 meters; 56,000 to 64,000 kilocycles
0.7496 to 0.7477 meter; 400,000 to 401,000 kilocycles.

Spark transmitters are now banned because of the serious interference caused by their operation and to decrease further the possibility of interference with broadcast reception the use of conductive (direct) coupling in amateur transmitters is no longer permitted with any type of transmitter, except where loop antennae are used.

The maximum power input which may be used at an amateur station is one thousand watts and at stations located within five nautical miles of a naval or military radio station the power input must not exceed five hundred watts. The present day amateur does not regret these limitations as did the amateur of a few years ago when spark transmitters were used exclusively because with a power input of a few watts he can transmit distances undreamed of with apparatus then available.

Provisional License

IF THE application for license is approved, a provisional amateur radio station license is issued for a period of two years which authorizes the operation of the apparatus described in the application at the specific location stated in the license. A station call, composed of a numeral designating the radio district and followed by two or three letters, is assigned and must be transmitted with every call or communication. This call only may be used and it cannot be transferred to another station without proper authority being secured. Increase in power, changes in location or important changes in equipment may not be made until a new application has been filed, the approval of the Supervisor secured and the license amended.

The required licenses having been secured, the amateur may proceed with the operation of his station in accordance with the regulations governing such stations and under conditions set forth in the license itself. The station can not be operated between the hours of eight and ten thirty o'clock in the evening or during the broadcasting of church services of Sundays on wave lengths between 150 and 200 meters although it may be operated at any time on the alloted wave lengths below 85.7 meters, using continuous waves only, providing that no interference is caused to radio reception. If the amateur should cause interference on the broadcasting wave bands, the Supervisor of Radio upon receipt of complaints will withdraw the privilege of operating during the hours mentioned until such time as the amateur can prove that he has eliminated the cause of the interference.

The amateur radio operators of the United States enjoy unusual opportunities and privileges. That these are very generally appreciated is demonstrated by their efforts to be of service, by the number of amateurs holding responsible positions in the industry and by the many developments with which they are credited.

Not Leaving

DESPITE reports to the contrary, H. H. Roemer, director of sales promotion of the Zenith Radio Corporation, has not left the employ of that corporation, according to a statement received by RADIO AGE.

A report, printed in another magazine, stated Mr. Roemer was going with a Bridgeport concern, which the Zenith organization wishes to state is not correct.

Use the Log-a-Wave Chart
Page 64

Ways to Protect Inventions While Making Experiments

(Continued from page 19)

as best he can, the particular advantages of the invention and the principles of its operation. After all of this is completed, the inventor should take the paper to a notary public and have it stamped with his seal and the date. Then the inventor should take it to two or three or more of his dependable friends and permit them to carefully read and examine the paper. The invention should be thoroughly understood by them. It will not do to merely permit them to sign the paper without reading it and understanding the invention. The reason for this is obvious. If during the later Court litigation the witnesses are requested to identify their signatures, the sketches and descriptive matter, the inventor's case of establishing priority will be considerably strengthened if the witnesses are able to state, under oath, that the sketches and descriptive matter were thoroughly examined and understood by them on the date their signatures were affixed.

If, however, the witnesses can only identify their signatures and are unable to state whether or not the sketches and descriptive matter were on the sheet when it was signed by them, there is a doubt whether the sheet contained all or any part of the matter at that time.

An Example

QUITE recently an inventor was unsuccessful in obtaining a patent because he had permitted the witnesses to sign a folded paper containing a description of his invention. It was not difficult for the opposing attorney to establish a serious doubt in the minds of the Court that the paper contained any descriptive matter on the date it was signed by the witnesses.

The sheet of paper should also contain an explanation why it is being prepared, and when the inventor intends to file an application for a patent.

Of course, many inventors do not desire to disclose their inventions promiscuously before the patent applications are filed. It is unnecessary to do so, if the application is to be filed immediately. But if the invention is not perfected or if for any reason an application for a patent cannot be filed, it is good policy to disclose the operative parts of the invention to dependable friends, as otherwise when two persons are working independedly on the same invention, the patent rights may be lost to the negligent individual.

The "Reduction to Practice" of an unpatented invention is considerable better evidence to establish priority than merely having descriptive papers signed and witnessed. That is, if a person is unable to file an application for a patent, he should at once build it and put it into use. This method establishes priority to the date the invention is put into operation. Obviously persons must be permitted to see the invention, otherwise there would be no witnesses by which to prove its existence, in the event later litigation makes it necessary. The persons who see the invention should sign dated papers in acknowledgment. The inventor should keep these papers for future reference.

Can't Strip Name and Sell Sets

An order was signed by Judge William Clark in the United States District Court for the State of New Jersey on March 12th in the litigation between the Chas. Freshman Co., Inc. and Louis Solow, trading as the Solow Radio Company.

In this litigation the defendant acquired Freshman Masterpiece Receivers from people who were not authorized to sell same and proceeded to sell, advertise and offer for sale these receivers as Freshman products after he had stripped the receivers of the name-plate containing the trade-mark and serial number of the Freshman Co.

It was contended by counsel for the Freshman Co. that this was a form of unfair competition, which, if allowed to continue, would cause great injury because of the fact that its good will was dependent upon the ability of the Company to have its trade-mark, which established its good will, stay with its product until it reached the ultimate consumer, for only by such means could its good will be maintained and extended.

It was further contended that unless this practice was enjoined unscrupulous manufacturers would be able to duplicate in size, shape and appearance the Freshman receiver and advertise their products as Freshman products with the name-plate of the Freshman Co. stripped therefrom.

Judge Clark granted a preliminary injunction restraining the defendant in the above litigation from selling or offering for sale any Freshman products from which the name-plate or trademark of the Freshman Company had been stripped, either by or for the defendant.

What Price Radio Popularity?

(Continued from page 29)

piano. Somebody who knew something about radio heard him and immediately steered him to a studio.

The young man is doing pretty well today. He's making rolls for a player piano concern and he's got himself the sweetest kind of a job as a staff artist in a studio. Of course he got the studio job first. The job with the player piano concern followed in natural order.

It might not be out of place to mention, right here, that radio has done more to bring musicians and singers to the attention of piano roll and phonograph record manufacturers than any other factor in the amusement world, with the exception, of course, of the stage. In many ways, radio has the edge even over the stage. It takes a performer years to become known on the stage. In radio, if he's clever, he can become known all over the country in a few months.

What price radio popularity!

"Why I've done in two years what it would have taken me 15 to do in vaudeville," laughed a radio favorite to me the other day. "In radio you can become popular almost over-night. What other line can you think of that would do that for you?"

The story of the piano player who went from prison walls to the stage of the best vaudeville circuit in the country is now history. Any number of people are ready to admit that they have heard far better piano players than this particular one. But what made him? Radio! That, and the perhaps unwitting skill of the announcer who was able to weave romance into the sordid background of the prison. The whole country went into such ecstasies over the piano playing of this man that, before his term was up, he was made half a dozen offers for vaudeville and had received hundreds of dollars in money and gifts. I am told he broke house records in practically every town he visited.

OTHER radio performers have ventured into the field of vaudeville but not with the same degree of success. I am told that of the number of performers who have tried vaudeville only a meager 5 per cent of them have proved legitimately entertaining. Radio performers still seem better suited to the quiet of the studio than to the white blaze of the footlights.

It isn't all roses, though, this radio broadcasting. The fan mail tells the story. Let it begin to dwindle and the entertainer might just as well prepare to sing his swan song. Let his popularity wane and his appearance at the studio is desired about as much as a good case of smallpox. Gone then are his chances of selling the popularity that radio has given him.

Said a canny radio singer not long ago, "I'm going to get mine while the getting is good. I don't know how long this is going to last."

It may not last very long at that. I'm told the line between the good and the mediocre talent is being more firmly drawn every day. Indeed, I have been told of some studios who employ only their own staff of entertainers and who use no outside talent at all. Radio bookers are beginning to crop up. Every day it becomes harder for the amateur to jump into the ranks and get himself "made" over the air. But if he can make the leap; if he can hit the bull's-eye of public favor—well, as Briggs would have it, it sure is a grand and glorious feelin'.

Hawaii and South Africa Linked by Ham Radio

WHAT is believed to be a world's record for two-way short wave communication was established recently when the Ft. Shafter Signal Corps station at Honolulu, operating on a wavelength of 36.5 meters, carried on a thirty-five minute chat with amateur station OA4V, located at Johannesburg, South Africa. After exchanging greetings between the two countries a daily schedule was arranged.

The estimated distance the message was sent is between 11,000 and 12,000 miles, but in spite of this fact strong signals were reported by both parties. After the usual preliminary greetings, the following messages were exchanged:

Greetings half way around world from U. S. Army and Radio Amateurs of Hawaii—(signed) 6CDF.

To which the South African amateur replied:

Go ahead, old man. I called you yesterday but you did not get me. You are very loud here. Greetings from South African amateurs via Relay League to all the gang. Local time now is 6:30 A. M. It is full daylight here.

The South African message received in Honolulu at 6:15 P. M., and it is interesting to note that due to the particular time at which the exchange took place, the message was received the night before it was sent.

The Hawaiian station, operated by Sgt. H. W. Wilson, transmits under the amateur call 6CDF, and is also the experimental station for the Signal Corps at Fort Shafter. At the time the communication was effected very low power was used, and it is the opinion of Army officials here that a new record has been established. Confirmation from Washington is being sought and it is expected within a short time.

New Method to Measure Frequencies

THE Bureau of Standards has a new exceptionally accurate method for measuring the frequency of tuning forks, which are used in standardizing wavelengths.

The old system of driving the tuning fork by the "make and break" method is superceded by a "continual drive" which gives a much greater degree of accuracy.

Use the Log-a-Wave Chart on page 64

Arctic Expeditions To Be Radio Equipped

RADIO equipment has come to be one of the most important items considered by Arctic expeditions these days, when communication with bases is required on polar dashes by the air route. Commander Byrd, of the Navy is equipping his ship and plane with the latest medium and short wave apparatus, for direct communication, relaying news to amateurs and experimental tests.

His ship the S. S. Chantier will answer to the call KEGK on either spark of a special short wave tube set. The airplane will be furnished with the latest 50-watt tube set, operating on 61 and 44 meters, for an estimated range of at least 1000 miles. A portable short wave set will also be carried in the plane for use in the event of emergency landings.

The radio personnel of the expedition includes Chief Operator Lloyd K. Grenlis, of Chicago, and operator George H. James of Manchester, N. H. The radio equipment has been selected by Malcolm F. Hanson, who designed some of the apparatus.

Captain Wilkins of the Detroit Arctic Expedition is also carrying considerable radio equipment, including a short-wave airplane transmitter designed by Mr. Hanson. His plane will use the call KDA in transmitting news to members of the North American Newspaper Alliance on 60 and 44 meters.

The Amundsen-Ellsworth Polar Expedition which plans to fly towards the pole from Spitzbergen is also radio-equipped.

The U. S. Weather Bureau it is understood will cooperate by transmitting weather bulletins to the Polar fliers.

Court Upholds Radio Injunction

A FAR-REACHING decision clarifying the status of certain classes of radio broadcasting was seen in the opinion handed down recently by the Cook County Appellate Court, sustaining the John P. Bowles Company, cattle brokers, in an injunction against the Chicago Livestock Exchange, restraining that organization from interfering with the daily broadcast market reports by remote control from the stockyards over WHT, which is conducted as a public service by the brokerage concern.

The injunction is the outgrowth of a resolution adopted by the Livestock Exchange effective December 1, restraining any member of the concern from broadcasting market reports. The legal ruling was first granted by the Circuit Court and appealed by the Livestock Exchange to the Appellate branch.

The Bowles Company has conducted a remote control market service over WHT direct from its offices at the stockyards, for nearly a year. The character of the service was such as to have a tangible effect on the market, regulating shipments according to the state of visible supplies. Business of the broadcasting brokers became so great that other members of the exchange sought to restrain the company from further use of this medium.

Readers of Radio Age are invited to give us their comments on the Golden Rule four tube receiver to be described in full in the June issue of Radio Age, Order your copy now—25c from your newsdealer—or better still, make use of handy subscription blank elsewhere in this magazine.

Use Hints for Your Harmonics Experiments

(Continued from page 22)

data is most conveniently recorded in Table III.

This table is of course, not complete but it illustrates the method of determining which harmonics of the oscillator and broadcasting station are utilized. Ignoring the quantities in brackets for the moment (these have not been determined as yet) let us note that the other data in this table are from the first experiment. A beat note marked "Faint" is obtained at a dial setting of 57.6. What is the fundamental wavelength of the oscillator given by this dial setting? From the discussion following the first experiment this problem can be expressed by proportion thus:

$$\frac{\text{1st dial setting}}{\text{2d dial setting}} = \left(\frac{\text{1st wavelength}}{\text{unknown wavelength}}\right)^2$$

or $\frac{14.4}{57.6} = \left(\frac{62.4}{\text{unknown wavelength}}\right)^2$ from which, unknown wavelength = 128.4 meters.

This shows that an adjustment of the oscillator of 124.8 meters gives zero beat with the broadcasting wavelength of 312 meters, or to put it somewhat differently, a harmonic from each of these wavelengths gives zero beat. The question is, then, which harmonic of the broadcasting station and which harmonic of the oscillator is utilized?

To determine this we must divide 124.8 by a whole number and 312 by another number such that the two resulting numbers are identical. Thus it is found that $\frac{124.8}{2} = \frac{312}{5} = 62.4$ and this shows that the second harmonic gave zero beat with the fifth harmonic of the broadcasting station. This same method may be followed in determining other harmonics.

Good Knowledge

IF you have followed through these three experiments you will have obtained a good knowledge of harmonics. Imagine that these experiments are repeated by substituting a second generator for the broadcasting station and that the two generators are placed near each other. We can now perform exactly the same experiments as before except that we will now be able to adjust both generators (one "generator" was formerly the broadcasting station). This of course permits greater flexibility in the experiments and has a useful application in the calibration of wavemeters. In this case the beats are generally detected in phones connected in the plate circuit of one of the generators. The receiving set may be used to pick up a distant transmitting station of known frequency or wavelength in order to obtain an initial point for the wavemeter calibration.

Your experiments with harmonics will be greatly simplified if you make a preliminary calibration of the oscillator and plot curves giving frequencies or wavelengths over the range of condenser settings. Most experiments will require substituting different coils in the oscillator circuit and this requires a separate curve for each coil. This calibration can be obtained from broadcasting stations or other stations of known wavelengths, by the use of harmonics and by remembering the relationship between wavelengths and dial settings of the oscillator condenser.

IN all experiments requiring an adjustment of the oscillator to produce zero beat with the incoming signal,

one should assume that the beat notes are radiated and make the adjustments at such times when the minimum interference will result to other receiving sets.

If you are fortunate enough to have that latest addition to radio, the quartz crystal oscillator, you will find that a study of harmonics as outlined in this article is of great assistance in becoming familiar with this device. If you do not already possess a quartz oscillator you probably will sooner or later, if you belong to the experimental group of radio fans. The operation of the quartz oscillator is very similar to that of the ordinary oscillator with the important difference that the former will oscillate at certain definite fundamental frequencies, usually three, and that these frequencies remain constant ad infinitum. Like the ordinary oscillator, the quartz oscillator has numerous harmonics and these are generally quite pronounced.

General Insulate's New Star-Insulate

AN item on page 45 of the April number of RADIO AGE stated the General Insulate Co. had developed a new moulding compound in connection with the moulding of bakelite.

This statement was in error. The line should have read "The General Insulate Co., has developed a new moulding compound known as 'Star-Insulate'." This has nothing to do with bakelite since it is a different process.

RADIO AGE is glad to make this correction in the interest of accuracy.

Chain Broadcasting Was Forecast By Radio Age

FORECASTING the advent of chain broadcasting and the relay method of covering the nation with a network of radio stations, RADIO AGE in April, 1923, published a complete article together with maps and charts written by L. J. Lesh, outlining the method by which superpower could be accomplished from an engineering standpoint.

The article is interesting from the angle that such a scheme is now working successfully and used by the larger broadcasting interests.

IN CONNECTION with the Haitian educational program, American High Commissioner John Russell, reports to the Secretary of State that the Haitian Government has appropriated funds for the erection of a broadcasting station at Port-au-Prince. This public broadcaster will be of one kilowatt power and will start transmitting to the natives this spring. It is the plan to install receiving sets in the market places of the important towns where the people assemble on market days. Short talks in Creole, the language of the illiterate peasants, will be delivered on such subjects as education, the Haitian laws, and agricultural problems, such as planting and caring for coffee and cotton.

Radio Briefs

WM. E. DOWNEY, technical radio expert of the Department of Commerce has left Washington for a special inspection trip in the two southeastern radio districts. Mr. Downey, who is also rated as Supervisor of Radio will visit the Department's headquarters, cooperating with Supervisor Major Walter Van Nostrand, at Atlanta, in the Fourth Radio District and Supervisor T. G. Deiler, of the Fifth District at New Orleans. His survey of radio conditions in the southeastern states will probably require several weeks.

Farm Homes and the Radio; People's Preference Shown

ALMOST one-fifth of the farm homes in the United States have radio sets. This angle on rural life comes to light in a nation-wide survey of more than eighteen thousand farm homes which is being made by the farm women themselves, under the guidance of Mrs. Mary C. Puncke, of the Sears-Roebuck Agricultural Foundation.

Although the silver tongued salesman may sell the farmer his radio set as a business investment, once it is installed in the home its chief function is entertainment so far as the man of the house is concerned.

Twenty-five per cent of them prefer music to any other program; 24 per cent are making the most of the practical side of radio using them regularly to get the daily weather and market reports. This is especially true among corn belt farmers, in Iowa, Illinois, Missouri, Indiana and Ohio, where 42 per cent state that they rely almost entirely on weather and market information which their radio brings them. Down in the cotton country, both east and west of the Mississippi, farmers still pronosticate coming weather events by the look of the sky and the smell of the wind; 3 per cent only give this as an important feature of their radio programs.

The farmer is just waking up to the educational value of his radio set. Only 16 per cent are especially interested in the farm schools and lectures offered by Universities and other agricultural organizations. Radios are relatively few in the cotton states west of the Mississippi, Texas, Oklahoma, Mississippi, Louisiana, but 26 per cent of them are tuned in regularly to the call of the school bell. Twenty-three per cent of the wheat belt and 20 per cent of the corn belt farmers are going to school fairly regularly via radio. These three are the sections best served by stations which specialize in programs for farm folk.

CHURCH and sports via radio make little appeal to the farmer, according to his wife's report on him, and he still prefers to get his political opinions, first hand, at the general store.

Farm women, as a rule, like the household home makers' programs best, for 41 per cent tune in on these most frequently. Thirty-one per cent prefer musical programs, 8 per cent want lectures; 1 per cent are especially interested in farm talks on gardens and poultry and 3 per cent enjoy their radios most for the church services and sacred music it brings them.

The thrifty housewives of New England poll the largest vote for the home makers' hour, with its hints on economics and new recipes; corn belt farm wives run them a close second, probably due to the circumstances that these two sections are close to stations which specialize in programs of help and interest to rural homes.

Farm women in the tobacco lands, Kentucky and the Virginias, will tune in on anything, just so it is music, and they likewise are the most enthusiastic about church and religious programs. Women in the cotton growing states west of the Mississippi, like their husbands, enjoy the serious, educational programs; 37 per cent will always fish around in the ether after a lecture.

But farm folk on the whole are not prone to be fussy about the kind of entertainment they can get over the air; 18 per cent of the men and 16 per cent of their wives refuse to state a preference because they like it all so well.

The most radios are found in the New England States, New York and Pennsylvania where they have invaded 38 per cent of the homes. The central corn belt, Iowa, Missouri, Illinois, Indiana and Ohio, run a close second, 33 per cent. But the eastern cotton states should be the radio salesman's paradise, for radio has found its way into only 3 per cent of the homes.

The survey covers 18,456 typical American farm homes in forty-two states, and was gathered by some twelve hundred scouts or observers, each of whom studied carefully the conditions in a small group of homes in her own neighborhood; The survey is being made in an effort to help the farm woman herself find out how her home, her working conditions, her chances for social life and health protection for her family compares with those of women in other walks of life.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio Age, published monthly at Mt. Morris, Illinois, for April 1, 1926.

State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Frederick A. Smith, who, having been duly sworn according to law, deposes and says that he is the President of the Radio Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., F. A. Smith, President, 500 N. Dearborn St., Chicago, Ill.; Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; Managing Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; Business Manager, M. B. Smith, 500 N. Dearborn St., Chicago, Ill.

2. That the owners are: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Radio Age, Inc., 500 N. Dearborn St., Chicago, Ill.; Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; M. B. Smith, 500 N. Dearborn St., Chicago, Ill.; J. H. Lohbeck, 6429 Cates Ave., St. Louis, Mo.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

FREDERICK A. SMITH,
Editor, publisher.

Sworn to and subscribed before me this 25th day of March, 1926.

IRENE LAUER,
(My commission expires Sept. 4, 1926.)

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDYL	Newhouse Hotel	Salt Lake City, Utah	246
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. K. Azbill	San Diego, Calif.	216
KFBK	Kimball-Upson Co.	Sacramento, Calif.	248
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	Bishop N. S. Thomas	Laramie, Wyo.	270
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFDD	St. Michaels Cathedral	Boise, Idaho	278
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	250
KFDY	South Dakota State College	Brookings, S. D.	273
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Ore.	248
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Neb.	268
KFEY	Bunker Hill & Sullivan Min. & Con. Co.	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	242
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colo.	Gunnison, Colo.	252
KFHL	Penn. College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	468
KFIF	Benson Polytechnic Institute	Portland, Ore.	248
KFIO	North Central High School	Spokane, Wash.	265
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Daily Commonwealth	Fond du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	R. B. Fegan (Episcopal Church)	Junction City, Kans.	219
KFJF	National Radio Manf. Co.	Oklahoma City, Okla.	261
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Ore.	246
KFJM	University of North Dakota	Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son	Portland, Ore.	263
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	S. W. Baptist Theological Seminary	Ft. Worth, Tex.	254
KFKA	Colo. State Teachers College	Greeley, Colo.	273
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
KFKZ	F. M. Henry	Kirkville, Mo.	226
KFLR	University of New Mexico	Albuquerque, N. M.	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelical Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFLZ	Atlantic Automobile Co.	Anita, Ia.	273
KFMR	Morningside College	Sioux City, Iowa	261
KFMW	M. G. Sateren	Houghton, Mich.	263
KFMX	Carleton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	263
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	Chamber of Commerce	Burlingame, Calif.	226
KFON	Echophone Radio Shop	Long Beach, Calif.	233
KFOO	Latter Day Saints' University	Salt Lake City, Utah	236
KFOR	David City Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Board of Education, Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul. Minn.	252
KFPL	C. C. Baxter	Dublin, Texas.	252
KFPM	The New Furniture Co.	Greenville, Texas.	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	266
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co.	Fort Worth, Texas	263
KFQD	Chovin Supply Co.	Anchorage, Alaska	227
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. Riker	Holy City, Calif.	217
KFQW	C. F. Knierim	North Bend, Wash.	216
KFQZ	Taft Products Co.	Hollywood, Calif.	225
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFRW	United Churches of Olympia	Olympia, Wash.	219
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros. Music Co.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	239
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver ,Colo.	234
KFUR	Peery Bldg. Co.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	261
KFUU	Colburn Radio Labs.	San Leandro, Calif.	220
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	205
KFVE	Film Corporation of America	St. Louis, Mo.	240
KFVG	First M. E. Church	Independence, Kans.	236
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Fairmont, Minn.	227
KFVS	Cape Girardeau Battery Station	Cape Girardeau, Mo.	224
KFVW	Airfan Radio Corp.	San Diego, Calif.	246
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWA	Browning Bros. Co.	Ogden, Utah.	261
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWC	L. E. Wall	San Bernardino, Calif.	211
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	254
KFWI	Radio Entertainments, Inc.	South San Franciso, Calif.	226
KFWM	Oakland Educational Society	Oakland, Calif.	207
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	Wilbur Jerman	Portland, Oreg.	213
KFXB	Bertram O. Heller	Big Bear Lake, Calif.	203
KFXD	Service Radio Co.	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Colorado Springs, Colo.	250
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	Mt. States Radio Dist. Inc. (Port. sta.)	Denver, Colo.	216
KFXM	Neches Electric Co.	Beaumont, Texas	227
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Mary M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	205
KFYJ	Chronicle Publishing Co.	Houston, Texas	238
KFYO	Buchanan-Vaughan Co.	Texarkana, Tex.	210
KFYR	Hoskens-Meyers, Inc.	Bismarck, N. Dak.	248
KGO	General Electric Co.	Oakland, Calif.	361
KGTT	Glad Tidings Tabernacle	San Francisco, Calif.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii.	270
KGW	Portland Morning Oregonian	Portland, Oreg.	491
KGY	St. Martins College	Lacy, Wash.	246
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Seattle, Wash.	394
KJBS	J. Brunton & Sons	San Francisco, Calif.	220
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KLDS	Reorganized Church	Independence, Mo.	441
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	266
KMA	May Seed & Nursery Co.	Shenandoah, Iowa	252
KMJ	Fresno Bee	Fresno, Calif.	234
KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KMOX	Voice of St. Louis	St. Louis, Mo.	280
KMTR	Turner Radio Corp.	Los Angeles, Calif.	238
KNRC	C. B. Juneau	Los Angeles, Calif.	208
KNX	Los Angeles Evening Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322

KYW Begins Series of Compact Programs

WESTINGHOUSE Station KYW, Chicago's first radio station having pioneered the twenty-four hour daily schedules, which included every phase of broadcasting, is now pioneering a new policy of "compact programs" wherein KYW will be on the air only embracing a period of twelve hours, and in this schedule the first morning broadcast is heard in Mrs. Anna J. Peterson's Table Talks from the Peoples Gas Company and the last studio broadcast coming from the Hearst Square Studio of the Chicago Evening American, which studio signs off at twelve o'clock midnight, while the station's daily swan song is the Coon & Sanders revelry from the Congress Hotel, from 1 to 2 p. m. better known to the nation's listener-in as the "Insomnia Club."

It will be the effort of the staff of KYW to condense the station's programs. Quality rather than quantity is the goal in cutting down the broadcast period from 24 hours to 12 hours, several prominent features have had to be eliminated. The morning exercises (The Daily Dozen) broadcast from the Central Y. M. C. A. is now a feature of radio station WLS, as is the morning Board of Trade reports. The famous radio service known as the "World Crier" which was a 24-hour service, seven days a week, on the hour and a half, has been condensed to one broadcast—namely a fifteen minute period from 4:00 p. m. to 4:15 p. m. at which time the latest and most important news of the world will be put on the air, by cooperation of the Chicago Evening American.

TIME signals and weather reports will be a daily feature at 11:00 a. m. The "Table Talks" come on the air at 11:35 a. m.

At 12 noon, the Edison Company is voiced from its studio through Westinghouse Station KYW. Immediately following this one hour, is broadcast one hour of Congress Hotel dinner music, from 1:00 to 2:00 p m.

The next broadcast on this new schedule is at 2:30 to 4:00 p. m. on Tuesdays, Thursdays and Saturdays, when the already well-known "Frolic" is given from the Hearst Square Studio of high class popular program. During this particular broadcast the World Crier finds voice, for its fifteen minute period.

On Monday and Thursday from 4:15 to 4:30 p. m. John Cutting, better known as "cousin John" has a lot of interesting meat subjects to tell his listeners, and each Friday the "Women's Hour" under the guidance of Miss Mary Casey, is broadcast from 4:00 to 5:00 p. m. from the Congress Studio.

Market reports are featured from 5:45 to 6:00 p. m. each week day, the same being furnished by the Union Trust Company, The Chicago Journal of Commerce, and the United States Department of Agriculture.

DINNER music is broadcast from 6:00 to 6:30 every day but Sunday. This is relayed from Westinghouse Station KDKA East Pittsburgh by short wave and rebroadcast by KWY on its standard wave length. The following half hour is devoted to Congress Hotel music, and at 7:00 p. m. Uncle Bob, the children's friend, devotes a half hour to bed time stories and children's songs.

On Tuesday, Wednesday and Thursday, the American Farm Bureau has a half hour from 7:30 to 8:00 p. m. to give their advisory talks to the farmer, and from 7:30 to 9:00 each Saturday the Chicago Evening American broadcasts the "Home Lover's Hour."

8:00 to 9:00 on Tuesday, Wednsday and Thursday is devoted to a classical and semi-classical program from the Congress Studio under direction of Edwin Borroff.

Tuesday, Thursday, Friday and Saturday from 9:00 to 10:00 p. m. is the Edison Musical Hour under direction of Morgan L. Eastman. This is from the Edison Studio in the Fine Arts Bldg.

BACK to the Hearst Studio at 10:00 p. m. on Tuesday, Wednesday, Thursday and Friday, where popular programs will hold sway until the hour of midnight. The only break in this last program will be the time signals and weather reports, which will be put out at 11:00 p. m.—after which the program continues.

Sunday is given away to the ecclesiastical. 11:00 a. m. is given to Central Church, and broadcast is continued to the end of the services. 2:30 to 3:30 p. m. is devoted to a Chapel Service from the Hearst Studio, and from this same studio is broadcast the Sunday "Hour of Music" from 4:30 to 5:30 p. m. under the direction of Edwin Harper. This is a very select program on which only leading artists are heard.

The Sunday Evening Club, a feature of several years standing with KYW goes on the air at 7:00 p. m. and the last musical program on Sunday comes from the Edison Studio during the hours of 9:30 to 11:00 p. m. Time signals and Weather Reports conclude KYW'S Sunday broadcast at 11:00 p. m.

GLETTKAU, in the Free City of Danzig, is the site of a new government radio station which will handle communications with the rest of Europe. Under the direction of the German Telefunken Company, the construction is going forward but delays have been encountered.

A NEW radio club known as Radio Sociedade Mayrirk Veiga has been formed in Rio de Janeiro, under the auspices of the radio and electrical dealers. The society owns its own ten-watt transmitter, broadcasting phonograph music every afternoon and vocal and instrumental music on four evenings.

KOAC	Oregon Agricultural College	Corvallis, Oreg.	280
KOB	N. Mex. College Ag. & Me. Arts	State College, N. Mex.	349
KOCH	Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Monarch Manufacturing Co.	Council Bluffs. Iowa	278
KOWW	Blue Mt. Radio Assn	Walla Walla, Wash.	256
KPO	Hale Bros.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Post Dispatch	Houston, Texas	297
KPSN	Star-News Publishing Co.	Pasadena. Calif.	316
KQP	H. B. Read	Portland, Oreg.	213
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KQW	Charles D. Herrold	San Jose, Calif.	231
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Printing Co.	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad Co.	Santa Maria, Calif.	210
KSO	A. A. Berry Seed Co.	Clarinda, Iowa	242
KTAB	Tenth Ave. Baptist Church	Oakland, Calif.	240
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	Brown's Radio Shop	Portland, Ore.	263
KTCL	American Radio Telephone Co. Inc.	Seattle, Wash.	306
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa	256
KTW	First Presbyterian Church	Seattle, Wash.	454
KUOA	University of Arkansas	Fayetteville, Ark.	300
KUOM	State University of Montana	Missoula, Mont.	244
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	231
KVOO	The Voice of Oklahoma	Bristow, Okla.	375
KWCR	H. F. Paar	Cedar Rapids, Iowa	278
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWKH	W. G. Patterson	Kennonwood, La.	261
KWSC	State College	Pullman, Wash.	349
KWUC	Western Union College	Le Mars, Iowa	252
KWWG	City of Brownsville	Brownsville, Texas	278
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZIB	I. Beck	Manila, P. I.	250
KZKZ	Electrical Supply Co.	Manila, P. I.	270
KZM	Preston D. Allen	Oakland, Calif.	240
KZRQ	Far Eastern Radio	Manila, P. I.	222
KZUY	F. J. Elser	Manila, P. I.	360
NAA	U. S. Navy Dept.	Arlington, Va.	434
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAW	Omaha Grain Exchange	Omaha, Nebr.	278
WABB	Harrisburg Radio Co.	Harrisburg, Pa.	204
WABC	Asheville Battery Co., Inc.	Asheville, N. C.	254
WABI	1st Universalist Church	Bangor, Me.	240
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	278
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt. Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	258
WAFD	Albert B. Parfet Co.	Port Huron, Mich.	275
WAGM	R. L. Miller	Royal Oak, Mich.	225
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	316
WAIT	A. H. Waite Co.	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Radisson Radio Corp.	Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	248
WARC	American Radio & Research Corp.	Medford, Mass.	261
WATT	Edison Electric	Boston, Mass.	244
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAL	Consolidated Gas & Elec. Co.	Baltimore, Md.	246
WBAO	James Millikan University	Decatur, Ill.	270
WBAP	Wortham-Carter Pub.(Star Telegram)	Ft. Worth, Texas	476
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment Co.	Chicago, Ill.	226
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf.Co."B" 118th inf,	Charleston,S.C.	268
WBBZ	C. L. Carrell	Chicago, Ill.	216
WBCN	Foster & McDonnell	Chicago, Ill.	266
WBDC	Baxter Laundry Co.	Grand Rapids, Mich.	256
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBNY	Shirley Katz	New York, N. Y.	210
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBPI	I. R. Nelson	Newark, N. J.	263
WBRC	Bell Radio Corporation	Birmingham, Ala	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Elect. & Mfg. Co.	Springfield, Mass.	331
WBZA	Westinghouse Elect. & Mfg. Co.	Boston, Mass.	242
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufmann & Baer Co. & The Pitts. Pr.	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAO	A. A. and A. S. Brager	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Tel. Co.	Washington, D. C.	468
WCAR	Southern Radio Corp. of Texas	San Antonio, Texas	263
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur C. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Charles Swarz	Baltimore, Md.	229
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Mester	Providence, R. I.	210
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCLO	C. E. Whitmore	Camp Lake, Wisc.	231
WCLS	H. M. Couch	Joliet, Ill.	214
WCOA	City of Pensacola	Pensacola, Fla.	222
WCSH	Henry P. Rines	Portland, Maine	256
WCSO	Wittenberg College	Springfield, Ohio	248
WCWS	Chas. W. Selene (Portable)	Providence, R. I.	210
WCX	Free Press and Jewett R. & P. Co.	Detroit, Mich.	517
WDAD	Dad's Auto Accessories, Inc.	Nashville, Tenn.	226
WDAE	Tampa Daily Times	Tampa, Fla.	273
WDAF	Kansas City Star	Kansas City, Mo.	366
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	268
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	261
WDBE	Gilham-Schoen Elec. Co.	Atlanta, Ga.	270
WDBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio.	227
WDBO	Rollins College, Inc.	Winter Park, Fla.	240
WDBZ	Boy Scouts, City Hall	Kingston, N. Y.	233
WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDRC	Doolittle Radio Corp.	New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
WEAN	Shepard Co.	Providence, R. I.	270
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEBC	Walter Cecil Bridges	Superior, Wisc.	242
WEBD	Electrical Equip. & Service Co.	Anderson, Ind.	246

Planning Agenda for American Radio Conference

PLANS for the International Radiotelegraph Conference scheduled to be held in Washington, sometime next spring, are finally under way. Following the suggestions of the International office of the Telegraph Union at Berne, relative to preparing agenda, the State Department has designated a sub committee of its radio advisory committee to draw up the American program in detail.

This committee is headed by W. D. Terrell, Chief Radio Supervisor of the Department of Commerce, and includes the following technical experts: Major J. O. Mauborgne, Signal Corps; Lieut. Commander A. H. Tawresey, Naval Communication Service; Lieut. E. M. Webster, Coast Guard; H. C. Moore, Chief of the Shipping Board Radio Section and W. M. Greene, State Department.

The committee held its first meeting on March 15th, when the communication from Director Etienne of the Berne Bureau was studied, and is now meeting each week.

EACH of the forty-two nations invited to participate in the sessions to be devoted in bringing the London radiotelegraph convention up to date, will prepare its own suggestions for inclusion in the final program of the conference at Washington. The Berne Bureau is to classify, edit and translate these reports into French prior to their publication sometime in July. Following their distribution it is believed a definite date for the opening of the sessions can be fixed, but it is pointed out that the completion of the work to be performed by the Bureau is necessary before a date can be set.

The invitation of the United States set forth as a general program, the revision of the London Convention and Regulations with additions to and changes thereof, concerning particularly: Radio Communication between fixed points, radio telegraphic broadcasting (including press), radio telephony (including broadcasting), assignment of frequencies to various services, measures, to be taken to eliminate interference as far as possible, distress messages, radio aids to navigation and all other international uses of radio.

IT IS probable that the international code of signals and visual signalling will be added to the agenda of the Washington Conference. The Germans have also proposed the addition of the radio provisions of the International Convention for the safety of life at sea (London 1914).

The Radio Corporation of America and the American Telegraph and Telephone Company have prepared a complete set of proposals for consideration by the United States Government in preparing its proposals.

The International Telegraph Conference which took place in Paris last fall recommended that the governments, consider the amalgamation of all the international communication agreements relating to radio, cables and land wires into one convention, since they are usually connected and closely related.

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City .....
State .....

Send cash, money order or draft. (5-26)

WEBE	Roy W. Waller	Cambridge, Ohio	234
WEBH	Edgewater B. H. & Herald Examiner	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co	New York, N. Y.	273
WEBL	Radio Corp. of America (Portable)	New York, N. Y.	226
WEBQ	Tate Radio Corp	Harrisburg, Ill.	226
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBW	Beloit College	Beloit, Wisc.	268
WEBZ	Savannah Radio Corp	Savannah, Ga.	263
WEEI	The Edison Elec. Illuminating Co	Boston, Mass.	349
WEHS	Robert E. Hughes	Evanston, Ill.	203
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	285
WENR	All-American Radio Corp	Chicago, Ill.	266
WEW	St. Louis University	St. Louis, Mo.	248
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
WFBE	John Van De Walle	Seymour, Ind.	226
WFBG	The Wm. F. Gable Co	Altoona, Pa.	278
WFBH	Concourse Radio Corp.	Richmond Hill, N. Y.	273
WFBI	Galvin Radio Supply Co	Camden, N. J.	236
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	Onondaga Hotel Co	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co	Indianapolis, Ind.	268
WFBR	Fifth Inf. Md. Nat'l Guard	Baltimore, Md.	254
WFBZ	Knox College	Galesburg, Ill.	254
WFDF	F. D. Fallain	Flint, Mich.	234
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	F. K. Bridgman	Chicago, Ill.	217
WFRL	Robert Morrison Lacey	Brooklyn, N. Y.	205
WGAL	Lancaster Elec. Supply & Const. Co	Lancaster, Pa.	248
WGBB	Harry H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co	Evansville, Ind.	236
WGBI	Frank S. Megargee	Scranton, Pa.	240
WGBM	Theodore N. Saaty	Providence, R. I.	234
WGBR	George S. Ives	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	316
WGBU	Florida Cities Finance Co	Fulford By-The-Sea, Fla.	278
WGBX	University of Maine	Orono, Me.	252
WGCP	D. W. May, Inc	Newark, N. J.	252
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGHB	G. H. Bowles Developments	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGMU	A. H. Grebe & Co. Inc., (Portable)	Richmond Hill, N. Y.	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co	Buffalo, N. Y.	319
WGST	Georgia School Technology	Atlanta, Ga.	270
WGY	General Elec. Co	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquett Univ. & Milw. Journal	Milwaukee, Wis.	275
WHAM	Univ. of Rochester (Eastman S. of M.)	Rochester, N.Y.	278
WHAP	W. H. Taylor Finance Corp	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Elec. Specialty Co	Wilmington, Del.	266
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chas. W. Howard	Bellfontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co	Ft. Wayne, Ind.	234
WHBL	C. L. Carrell	Chicago, Ill.	216
WHBM	C. L. Carrell, (Portable Station)	Chicago, Ill.	216
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBP	Johnstown Automobile Co	Johnstown, Pa.	256
WHBQ	St. John's M. E. Church South	Memphis Tenn.	233
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Ind. Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc	Rochester, N. Y.	258
WHK	The Radio Air Service Corp	Cleveland, Ohio	273
WHN	George Schubert	New York, N. Y.	361
WHO	Banker's Life Co	Des Moines, Ia.	526
WHT	Radiophone Broadcasting Corp	Deerfield, Ill.	238
WHT	Radiophone Broadcasting Corp	Deerfield, Ill.	400
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAS	Home Electric Co	Burlington, Iowa	254
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WIBI	Frederick B. Zitteli, Jr.	Flushing, N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	Billy Maine (Portable)	Chicago, Ill.	216
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBR	Thurman A. Owings	Werton, W. Va.	246
WIBS	New Jersey Nat'l Guard Hdqs. Co	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Grid-Leak, Inc	Utica, N. Y.	205
WIBZ	A. D. Trum	Montgomery, Ala.	231
WIL	Benson Radio & The Star	St. Louis, Mo.	273
WIOD	Wonderful Isle of Dreams	Miami, Fla.	248
WIP	Gimbel Bros	Philadelphia, Pa.	508
WJAD	Jackson's Radio Eng. Laboratories	Waco, Texas	353
WJAG	Norfolk Daily News	Norfolk, Nebr.	270
WJAK	Clifford L. White	Kokomo, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAZ	Zenith Radio Co	Mt. Prospect, Ill.	322
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	Financial Journal	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co	LaSalle, Ill.	234
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co	Decatur, Ill.	270
WJBO	Valdemar Jensen	New Orleans, La.	268
WJBR	Geusch and Stearns	Omro, Wis.	227
WJBU	Bucknell University	Lewisburg, Pa.	211
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WJR	Jewett Radio & Phon. Co. & D. F. P.	Pontiac, Mich.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	New York, N. Y.	454
WKAF	WKAF Broadcasting Co	Milwakuee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	285
WKAV	Laconia Radio Club	Laconia, N. H.	224
WKBB	Sanders Bros	Joliet, Ill.	214
WKBE	K. & B. Electric Co	Webster, Mass.	231
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKRC	Kodel Radio Corp	Cincinnati, Ohio	326
WKRC	Kodel Radio Corp	Cincinnati, Ohio	422
WKY	WKY Radio Shop	Oklahoma City, Okla.	275
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBL	Bureau of Marketing	Stevens Point, Wis.	278
WLIB	Liberty Magazine	Elgin, Ill.	303
WLIT	Lit Bros	Philadelphia, Pa.	394
WLS	Sears Roebuck & Co	Crete, Ill.	345
WLSI	Lincoln Studios	Cranston, R. I.	441
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Mfg. Co	Cincinnati, Ohio	422
WLWL	Miss. Society of St. Paul the Apostle	New York, N. Y.	288
WMAC	C. B. Meredith	Casenovia, N. Y.	275
WMAF	Round Hills Radio Corp	Dartmouth, Mass.	441

Here's Way to Do a Little Experimental Receiving Work

ALL radio listeners who have short wave receivers and who are interested in the progress of broadcasting are asked to cooperate with the engineers of the General Electric Company who are conducting a series of tests in wave propagation on 32.79 and 65.5 meters. Beginning April 3, special telegraph tests were made on 15, 26.4 and 50.2 meters.

Every evening, except Wednesday and Sunday, 2XK, using 65.5 meters, and 2XAF, operating on 32.79 meters, are broadcasting the programs of WGY. The ways of the longer waves, particularly those in the present broadcast band, are familiar to the engineers, but much remains to be learned of the characteristics of shorter wavelengths and it is for the purpose of accumulating a vast fund of information, that the engineers are transmitting and seeking reports on these particular wavelengths.

From April 3 until April 29, a formal series of wave propagation tests are run, the regular programs being replaced by two 24-hour schedules each week, one from Wednesday noon to Thursday noon and the other from Saturday noon to Sunday noon. During these transmissions on the short waves the WGY programs will be broadcast through 2XAF and 2XK during the times when they are regularly on the air. Through the rest of the 24 hours telegraph transmissions will be made. In addition to 2XAF on 32.79 meters and 2XK on 65.5 meters, there will also be the following telegraph transmitters: *2 XAW at 15 meters or 20,000 kilocycles. 2 XAD at 26.4 meters or 11,370 kilocycles. 2 XAC at 50.2 meters or 5970 kilocycles.*

All who can cooperate during these are asked to send their names to the Radio Department of the General Electric Company so that special report forms may be supplied them.

Research in radio transmission calls for extensive observation at a great many points, over a considerable period of time and under a great variety of conditions. It is impossible for a small group of men to accomplish this adequately and, for that reason, the General Electric Company, has invited the cooperation of everyone equipped with short wave receivers to report.

A large number of experimenters in this country and abroad have volunteered their services and have already contributed to the reception data at hand. Listeners in the United States and Canada, in Europe, South Africa and the islands of the Pacific are assisting. Members of the American Radio Relay League are particularly active and have performed a great service in reporting on reception and in intercepting messages from abroad reporting in code, the results obtained.

Experimental transmitter work, except in the field of observation, is beyond the scope of the amateur and the average individual experimenter because of the space and equipment required and the almost prohibitive cost of establishing and maintaining a great laboratory. With its developmental station at South Schenectady, with many different types of antennae and many transmitters, the General Electric Company has the facilities to inaugurate these tests.

To a small extent engineers of the company have been able to make reception tests but their work is only a fraction of what is necessary to arrive at any definite conclusion. Within the past few months observer-engineers traveled by truck north, east, south and west from Schenectady, recording the characteristics of the short waves as they get farther and farther away from the station. The tests carried them as far south as Jacksonville by land and on the return trip they made their observation by water. Simultaneously with the work of these two men, a special agent was detailed to travel by boat to Panama.

Those who are willing to assist in making observation are asked to make careful statements of signal strength, quality, fading and static. Quality should be judged from the standpoint of the broadcast listener, that is, is the signal capable of giving pleasing reproduction of a whole program? How does it compare with the local station?

The frequencies of both transmitters, that is the 32.79 and 65.5 meters, are accurately determined and are held constant by crystal quartz control.

For several months the engineers experimented with a wave 41.9 meters and then changed to 35 meters and now to 32.79 meters.

Signals on 32.79 meters were rebroadcast by a Johannesburg, South Africa, station, Saturday night, March 13. The signal of 2XAF was reported of full load speaker volume and the relay transmission exceptional.

Alaskans Hear WTAM with Regularity

RADIO furnishes one of the few means of entertainment and amusement to Alaskans according to William R. E. Moore, Bureau of Education, Department of the Interior, Pilot Station, Alaska.

Moore says, "On good nights we are able to bring in far east and mid-west stations with as much volume as the Pacific coast stations.

"WTAM at Cleveland, Ohio, is among the extra loud distant stations which we are receiving more or less regularly.

"Radio is a great pleasure to us and the stations throughout the country keep us in close touch with world affairs."

Pilot Station is 150 miles from Bering Sea on the lower Yukon river. With the exception of one "squaw man" the men with the United States Bureau of Education are the only white folks in this village, the nearest white settlement being forty-five miles away.

WMAK	Norton Laboratories	Lockport, N. Y.	266
WMAL	M. A. Lesse Optical Co.	Washington, D. C.	213
WMAN	First Baptist Church	Columbus, Ohio	278
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Mercer University	Macon, Ga.	261
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	250
WMBC	Michigan Broadcasting Co.	Detroit, Mich.	256
WMBF	Miami Beach Hotel	Miami Beach, Fla.	384
WMC	Commercial Appeal	Memphis, Tenn.	500
WMCA	Hotel McAlpin (Greenley Sq. Hotel Co.)	New York, N.Y.	341
WNAB	Shepard Stores	Boston, Mass.	250
WNAC	Shepard Stores	Boston, Mass.	280
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Bros. Co. (Frederick Lenning)	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNJ	Radio Shop	Newark, N. J.	252
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plant & Structures	New York, N. Y.	526
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOAN	Vaughn Con. of Music	Lawrenceburg, Tenn.	283
WOAW	Woodman of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	A. E. Newton	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, N. J.	224
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Otto Baur	New York, N. Y.	233
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
WOQ	Unity School of Christianity	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOWL	Owl Battery Company	New Orleans, La.	270
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAK	N. D. Ag. College	Agricultural College, N. D.	275
WPCC	North Shore Cong. Church	Chicago, Ill.	258
WPDQ	H. L. Turner	Buffalo, N. Y.	205
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAC	Gish Radio Service	Amarillo, Tex.	234
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	263
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Horace D. Good	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wynne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio & Electric Co.	Coldwater, Miss.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRHF	Radio Hospital Fund	Washington, D. C.	256
WRHM	Rosedale Hospital, Inc.	Minneaoplis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., M.Y. "MU-1"	New York, N.Y.	236
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRR	Municipal Station	Dallas, Tex.	246
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publisher Co.	Allentown, Pa.	229
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marien	Chesham, N. H.	229
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	210
WSBF	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	275
WSDA	Seventh Day Adventist Church	New York, N. Y.	263
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amuse. Co. & Maison B. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wisc.	246
WSRO	Radio Company	Hamilton, Ohio	252
WSSH	Tremont Temple Bap. Church	Boston, Mass.	261
WSUI	State University of Iowa	Iowa City, Iowa	484
WSVS	Seneca Vocational School	Buffalo, N. Y.	219
WSWS	Illinois Broadcasting Corp.	Wooddale, Ill.	275
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	266
WTAD	Robt. E. Compton	Carthage, Ill.	236
WTAG	Telegram Pub. Co.	Worcester, Mass.	268
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Williard Storage Battery Co.	Cleveland, Ohio	389
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	C. S. Van Gordon	Eau Claire, Wisc.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAW	Agricultural & Mech. Col. of Texas.	College Sta., Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	250
WWAE	Electric Park	Plainfield, Ill.	242
WWAO	Michigan College of Mines	Houghton, Mich.	263
WWGL	Radio Engineering Corp.	Richmond Hill, N. Y.	213
WWI	Ford Motor Co.	Dearborn, Mich.	266
WWJ	Detroit News	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275

Use the Log-a-Wave Chart on Page 64

White Bill Now Past the House

CONGRESSMAN White's radio regulating bill passed the House with a vote of 218 to 124 on March 15. It stands virtually as last reported, although a few clarifying amendments have been incorporated. It is now sent to the Senate where it will undoubtedly be referred to the Interstate Commerce Committee which has been considering a similar bill backed by Senator Dill.

What the Senate will do with regard to questions such an anti-monopoly, slander over the air, and transferring control to a commission instead of the Secretary of Commerce, considered but lost in the House, remains to be seen; no one will predict.

The most spectacular action in the House was the voting down of Mr. Blanton's amendment which sought to define radio slander and punish offenders for using derogatory language over the air. This amendment, although accepted in the Committee of the Whole, was defeated on the floor by a vote of 287 to 57.

Practically the only changes in the White Bill were the inclusion of a section requiring all active stations to secure new licenses within a certain time, and an amendment taking from the Secretary of Commerce the authority to remit fines.

Congressman White, author of the bill, described it as conferring sufficient authority upon the Secretary of Commerce to properly regulate radio communication in interstate and foreign traffic, imposing upon him power and duties which should bring great public good. Briefly the bill brings the old 1912 law regarding radio up to date; and aims to prevent further interference by reducing, or permitting a reduction in, the number of stations on the air, and by authorizing the Commerce Head to control channels, power and locations of stations. Licenses will be limited to periods of five years; the right to transfer or sell licenses or wave channels is denied licensees, except with the approval of the Secretary of Commerce. Authority for the revocation of licenses for cause, is given the Secretary, who will be assisted by an advisory committee of five members in matters found difficult for him to settle. Appeal through the courts is provided for aggrieved persons.

Mr. White points out that all the laws relating to monopolies and agreements in restraint of trade are made applicable to radio as well as to other industries, the Federal Trade Commission being authorized to deal with such matters, while the Interstate Commerce Commission has jurisdiction over inter-state radio communication rates as well as over railway rates.

Goes Abroad

M. Openshaw of the Radiall Company left New York during March for an extended trip to Europe, where he will visit all the important radio centers in the interests of his company.

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg Co., (Ltd.) Can.	Montreal, Que.	411
CFCH	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n.	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	329
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCL	Dominion Battery Co.	Toronto.	357
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co. (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co. (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	312
CNRC	Canadian National Railways	Calgary, Alta.	436
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	435
CNRR	Canadian National Railways	Regina, Sask	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	384

Republic of Mexico

CYB	Mexico City	380	CYL	Mexico City	400	CZE	Mexico City	350

Republic of Cuba

PWX	Cuban Telephone Co.	Habana 400	2LC	Luis Casas	Habana 250	6DW	Eduardo Terry	Cienfuegos 225
2BY	Frederick W. Borton	Habana 315	2MG	Manuel G. Salas	Habana 280	6XJ	Frank H. Jones	Tuinucu 275
2CX	Frederick W. Borton	Habana 320	2MN	Fausto Simon	Habana 270	6KW	Frank H. Jones	Tuinucu 340
2EV	Westinghouse Elec. Co.	Habana 220	20L	Oscar Collado	Habana 300	8BY	Alberto Ravelo	Stgo. de Cuba 250
2HC	Heraldo de Cuba	Habana 275	2TW	Roberto E. Ramires	Habana 230	8DW	Pedro C. Anduz	Stgo. de Cuba 275
2HS	Julio Power	Habana 180	2WW	Amadeo Saenz	Habana 210	8FU	Andres Vinnet	Stgo. de Cuba 225
2JD	Raul Parez Falcon	Habana 105	5EV	Leopoldo E. Figueroa	Colon 360	12AB	Alberto S. de Bustamante	Habana 240
2K	Alvara Daza	Habana 200	6BY	Jose Ganduxe	Cienfuegos 300	16AZ	Valentin Ullivarri	Cienfuegos 200
2KD	E. Sanchez de Fuentes	Habana 350	6CX	Antonio T. Figueroa	Cienfuegos 170	20K	Mario Garcia Velez	Habana 360

Great Britain

2LO	London	365	5XX	Daventry	1600	5NO	Newcastle	404
5IT	Birmingham	479	2RN	Dublin	390	5SC	Glascow	422
5WA	Cardiff	353	6BM	Bournemouth	386	2BD	Aberdeen	495
2BE	Belfast	440	2ZY	Manchester	378			

France

YN	Lyons	550	8AJ	Paris	1,780
FL	Paris (Eiffel Tower)	2,650	ESP	Paris	458

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the June issue must be sent in by April 25.

AGENTS WANTED

SELL MARVELOUS NEW RADIO INVENTION THAT IMPROVES summer reception 100%. Effaysee marvel inside antennae gives better tone, greater selectivity, less static. Sells to every radio owner for only $4.00. Write today. Fishwick Radio Co., 135 Central Parkway, West, Cincinnati, Ohio.

Sell Five Tube Radio Sets. Thirty days free trial. Three sales weekly pays $90 profit. Experience unnecessary. DIRECT RADIO, 197-FF Fourteenth St., Milwaukee, Wisconsin.

AGENTS—STEADY INCOME, LARGE Manufacturer of soaps, perfumes, toilet articles and pure food products, etc., wishes representatives in each locality. Manufacturer direct to consumer. Big profits. Honest goods. Whole or spare time. Cash or credit. Send at once for particulars. American Products Co., 5796 American Bldg., Cincinnati, Ohio.

Agents Make $60.00 weekly. Distribute quality food and toilet preparations among friends and neighbors. No money or experience necessary. Free automobile. Desk BG3. Healtho Products Co., Cincinnati, Ohio.

Agents Wanted VANCY Guaranteed Radio Tubes with imported filament all types BEST BY TEST also transmitters. Sample tubes $1.50 each Post Paid. Send cash or money order. Van Clef-Deforest Radio Company, Great Kills, S. I., N. Y.

FORDS. 60 miles on one gallon of Gas. It has been proven such mileage can be made. AIRLOCK guarantees to increase gas mileage; also prevents radiator boiling in summer or freezing in winter. Cools, Fuels, Decarbonizes the Ford motor. Splendid territory open. AIRLOCK PRODUCTS, Box 703G, Willow Street, Long Beach, Calif.

RADIO—Join our sales organization and make big money. We want a man in every county to sell well advertised sets and parts made by the leading manufacturers. Widener of Kansas City makes $350.00 weekly. You can do as well or better. Write today for catalog, and discounts. Name your county. Waveland Radio Company, Div. 52, 1027 No. State St., Chicago, Ill.

MANUFACTURER'S AGENT calling on Radio-Electrical Jobbers, Chicago and vicinity, has opening for 3 additional lines carrying volume business, as we cater to large jobbers. Edelstein, 1804 McCormick Bldg., Chicago.

Man wanted for this territory to sell wonderful value men's, women's, Children's shoes direct, saving consumer over 40%. Experience unnecessary. Samples supplied. Big weekly permanent income. Write today. Tanners Mfg. Co., 1334C St., Boston, Mass.

$50 WEEKLY EVENINGS. DEMONSTRATING A super selective 6-tube radio set. Selectrodyne Radio Co., Dept. M-325 West State, Rockford, Illinois.

RADIO SALESMEN and SET BUILDERS in every county write Grenzer Radio, 1479 Hodiamont, St. Louis, Mo.

AUTOMOBILES

Light weight ALOY-NUM pistons for all cars and trucks, low prices, get circular. Egge, 7704 South Main Street, Los Angeles, California.

BOOKS AND MAGAZINES

Big savings monthly, exchanging RADIO Magazines. List mailed free. Spencershield Agencies, West Los Angeles, California.

EXPERIMENTAL RADIO by R. R. Ramsey, Professor of Physics Indiana University. The only scientific experimental manual. Enthusiastically endorsed by the American Radio Relay League for amateur use. Used in colleges, universities and Government schools. Measure, adjust, and perfect your set. 85 experiments. Price $2.00 post paid. Hugh Ramsey, Bloomington, Indiana.

ELECTRICAL MENI LOCATE TROUBLE ON ELECTRICAL APPARATUS. PRACTICAL EXPLANATION WITH BLUE PRINT DIAGRAMS OF MOTOR & CONTROLLER CONNECTIONS. GREAT HELP & GUIDE TO MEN IN THE TRADE. COMPLETE BOOK FORM. PRICE $2.00 POST-PAID. U. S. SALES & TRADING COMPANY, 1457 BROADWAY, NEW YORK, N. Y.

BUSINESS OPPORTUNITIES

Drafting, Expert Commercial, Architectural, Licensed, Reasonable. Union Service, Liberty, Indiana.

Pecan-Orange-Fig Groves "On the Gulf." Guaranteed care. Monthly payments. Big quick returns. Suburban Orchards, Dept. K, Biloxi, Mississippi.

$100 weekly up. We want experienced Radio men to operate branch assembling plants. Part or whole time. Barfield Radio Co., 13 Tillery Street, Dept. A. R. Brooklyn, New York.

CRYSTALS

Supersensitive Galena Crystals: Pound 75c prepaid. ALKEMITE. All sensitive Crystals 50c. Buskett, Geologist, Joplin, Missouri.

DOGS

BEAUTIFUL REGISTERED BULL PUPS $15. Bulldogs, 501 Rockwood, Dallas, Texas.

WHITE Spitz Puppies. Beautiful, Intelligent, companionable. Fifteen Dollars. Brookwood Kennels, 2626 East 18th Street, Indianapolis.

HELP WANTED

RADIO SALESMEN and SET BUILDERS—We need you and you need us. If you are reliable and well known in your community, we will appoint you our representative and furnish you with standard well advertised sets and parts at prices that will enable you to sell at a handsome profit. Write at once for catalog and sales plan. Waveland Radio Co., Div. 53, 1027 N. State St., Chicago, Ill.

MEN wanting forest ranger, railway clerk and other government positions, write for free particulars of exams. Mokane, Dept. B-33, Denver, Colo.

MEN WISHING TO ENTER DINING, SLEEPING CAR SERVICE AS CONDUCTORS, PORTERS, WAITERS, WRITE 123 RAILWAY EXCHANGE, KANSAS CITY.

INVENTIONS

NEW IDEAS WANTED—Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and salesble. Address: Mr. R. F. Devine, Room 1101, 116 West 32nd St., New York, N. Y.

MUSIC

SONG Poem Writers—If you have your words put to music let a gifted Melody Writer do it. Write Francis Conover, (Composer) AVON, New Jersey.

"MUSIC COMPOSED" TO WORDS. BAUER BROS., (formerly of Sousa's Band), Oshkosh, Wisconsin.

PATENTS

FOR SALE: U. S. and Canadian Patent on an Attachment for Phonographs, is the most beautiful invention of the age. Address Chas. F. Smith, Huff, N. Dak.

RADIO

NO MORE BATTERIES. You can eliminate all batteries and operate your set on light current, AC or DC—no hum—any kind of set—any type of tubes. Complete blue prints and instructions, guaranteed $2. Engineers' Service Company, Suite 203, 15 Park Row, New York.

A real DX Circuit! 5 tubes over 3000 miles range with loud speaker volume. Send $1.00 for circuit and instructions. Tuttle Radio Laboratories, Diamond, Ohio.

SAVE MONEY on radio sets and parts. List free. All merchandise guaranteed. GERMAD COMPANY, 631 E. Okmulgee, Muskogee, Okla.

"$1.00 For Your Old Tubes regardless of make or condition towards the purchase of each new Standard $2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. Order today. Luxem & Davis Mfg. Co., 6229 Broadway, Chicago, Ill. Paste this ad in your set."

201A and 199 tubes rejuvenated 30c. Charles Bloedorn, 1394 Detroit Street, Denver, Colorado.

B BATTERY ELIMINATORS—BUILD YOUR OWN cheap; no hum; acid or anything to get out of order; blueprint and instructions 50 cents, money order or cash. Web Radio Co., Dept. A, 5823 Calumet Ave., Chicago, Illinois.

Standard solderless radio Jacks. Binding post attachments. Double circuit. One dollar bill. Postpaid. Clinton Seward, Jr., New Paltz, New York, N. Y.

Three Cosmopolitan Phasiformers, each $5.50, book of instructions included. F. A. Mall, Tripoli, Iowa.

RADIO DEALERS

DEALERS—Write for our illustrated catalog of reliable Radio Merchandise. Resistor-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

RADIO SUPPLIES

HAVE YOU SEEN THE NEW DIALITE, THE UNIQUE lamp that lights up your panel and adds a decorative touch to any radio set? Retails at $2.75, complete. Send for folder and dealer's proposition on this fast moving article. Also, we are distributors for the famous Knurled Walnut Cabinets, the most beautiful cabinets made. American-Universal Radio Co., 6255 Broadway, Chicago, Ill., Box 11.

SALESMEN WANTED

SELLS for $3.75. Prints ad on wrapping paper, envelopes, etc. $4.00 commission. Send 10c for sample work. Automatic Ad-Stamper, Joplin, Missouri.

Make $100 WEEKLY in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 126 F. Austin Ave., Chicago.

66 MILES ON 1 GALLON—SCIENTIFIC GAS SAVER. All autos. 1 free to introduce. Critchlow, A-90 Wheaton, Illinois.

STAMPS

69 stamps, 4 cents. Book Stamp Company, 642 Meredith Street, Dayton, Ohio.

STAMPS, 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S., 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5950 Cote Brilliante, St. Louis, Missouri.

WIRELESS

Want to Memorize the Wireless Code? The Coryden Snyder Code Method. Patented is quickest. Send 25c coin, or M. O. to C. C. Snyder, 1423 Elmdale Ave., Chicago, Ill.

TELEGRAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Govt. and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co., 13 F Hudson St., New York.

PERSONAL

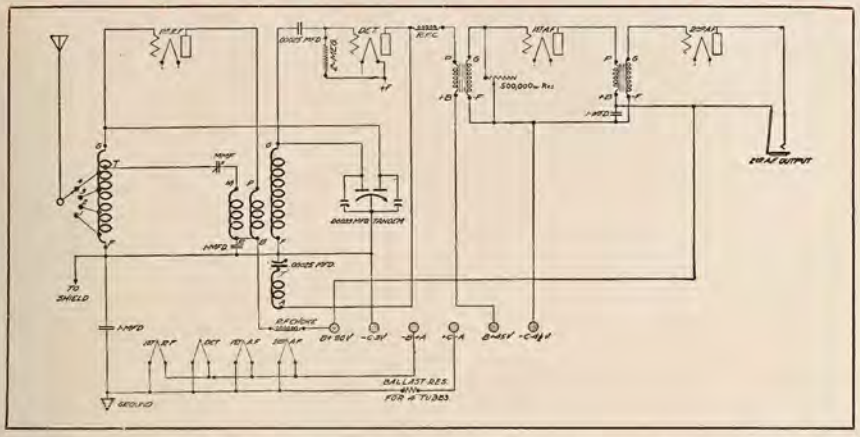
LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Eva Moore, Box 908 Jacksonville, Florida. Enclose stamp.

Radio Age Classified Ads Bring Results

KC	Meters	STATIONS	DIALS 1	2	3
1480	202.6				
1470	204.0				
1460	205.4				
1450	206.8				
1440	208.2				
1430	209.7				
1420	211.1				
1410	212.6				
1400	214.2				
1390	215.7				
1380	217.3				
1370	218.8				
1360	220.4				
1350	222.1				
1340	223.7				
1330	225.4				
1320	227.1				
1310	228.9				
1300	230.6				
1290	232.4				
1280	234.2				
1270	236.1				
1260	238.0				
1250	239.9				
1240	241.8				
1230	243.8				
1220	245.8				
1210	247.8				
1200	249.9				
1190	252.0				
1180	254.1				
1170	256.3				
1160	258.5				
1150	260.7				
1140	263.0				
1130	265.3				
1120	267.7				
1110	270.1				
1100	272.6				
1090	275.1				
1080	277.6				
1070	280.2				
1060	282.8				
1050	285.5				
1040	288.3				
1030	291.1				
1020	293.9				

KC	Meters	STATIONS	DIALS 1	2	3
1010	296.9				
1000	299.8				
990	302.8				
980	305.9				
970	309.1				
960	312.3				
950	315.6				
940	319.0				
930	322.4				
920	325.9				
910	329.5				
900	333.1				
890	336.9				
880	340.7				
870	344.6				
860	348.6				
850	352.7				
840	356.9				
830	361.2				
820	365.6				
810	370.2				
800	374.8				
790	379.5				
780	384.4				
770	389.4				
760	394.5				
750	399.8				
740	405.2				
730	410.7				
720	416.4				
710	422.3				
700	428.3				
690	434.5				
680	440.9				
670	447.5				
660	454.3				
650	461.3				
640	468.5				
630	475.9				
620	483.6				
610	491.5				
600	499.7				
590	508.2				
580	516.9				
570	526.0				
560	535.4				
550	545.1				

Hookups Like This One Get Results!



You'll Find Them in The Radio Age Annual for 1926!

BLUEPRINTS
are the predominating feature of the RADIO AGE ANNUAL for 1926. Eighteen pages of actual-color blueprints of every kind of hookup, from efficient crystal set to six tube tuned radio frequency, with blueprints of a modern power supply device to top off the list.

Have you seen the new RADIO AGE ANNUAL for 1926? Thousands of fans have already bought their copies, and the end of the first edition supply is not far off. Hundreds of buyers of the ANNUAL for 1926 have supported our contention that it is the biggest radio dollar's worth ever published. Scores of new hookups, tried and tested in the RADIO AGE laboratories, many isometric, circuit and photographic illustrations, and 18 full page blueprints are some of the features that make this 96 page book invaluable to the technical fan. The expert will find the latest in experimental and multi-tube hookups, while the beginner will feel at home with a group of "how to do it" articles written especially for him.

$1.00 a Copy

RADIO AGE ANNUAL FOR 1926

$1.00 a Copy

Some of the Features:

Review of Radio During 1925
Radio Symbols and Crystal Hookups
Three Tube Inductive Coupled Receiver
An Improved Three Tube Reinartz
A Windless, Pipeless, Pipe Organ
Adding a Good Amplifier to the 3 Circuit Tuner
Taking Care of Your Radio
Audio Amplifying Circuits
More Data on a 4 Tube Tuned r. f. Set
Unique Radio Map
Inductance, capacity and wavelength chart
Single and Dual Tuning Control
Plug-in Inductances for Maximum Receiver Efficiency
Two Controls for 4 Stages of Tuned r. f.
How to Make a Power Supply Device
How to Wind a Low Loss Coil
Negative B Returns to Negative A Battery
Some Soldering Hints
Tuning With Chart Curves
Corrected List of Broadcast Stations
Log-A-Wave Chart

RADIO AGE ANNUAL COUPON

RADIO AGE, INC.,
500 North Dearborn St., Chicago, Ill.

Gentlemen: I want to be sure of getting the RADIO AGE ANNUAL FOR 1926. Enclosed find $1.00. If I am not satisfied with the ANNUAL I will return it within five days and you will refund my dollar.

Name.....

Address.....

City.....State.....

526

ZENITH
LONG DISTANCE RADIO

In Buying Radio Instruments Don't Consider Price Alone—

Price alone does not govern value. Merit is the prime consideration when estimating cost

Super-Zenith IX

Built-in Zenith loud-speaker; ample compartments for dry and storage batteries or eliminators.

Zenith is made in Chicago to operate in a territory where 27 broadcasting stations are located—the most difficult conditions for radio reception in the world. Excellent results in Chicago mean unmatched performance elsewhere.

The complete Zenith line includes ten models, each in its class an outstanding value. The price range is from $100 to $2500.

(All Prices F. O. B. Chicago)

Individuality and elegance of appearance have placed Zenith instruments on a different plane from that of any other radio. Zenith is convinced that potential radio buyers will insist on the best in reception, the best in design and individual style, even though Zenith Radio does cost more.

For these reasons Zenith was created. Its performance is certain; and its owners include all those who are glad to pay what they consider it is worth, in order that they may have outstanding performance, individual beauty and certainty of service.

Whatever else you do—see Zenith—listen to Zenith—in your own home. Remember, you do not need the full purchase price to start your ownership. You can place in your home the finest Zenith made on a down-payment of only $80.

Your nearest Zenith dealer will gladly demonstrate the model that appeals to you—in your own home—whatever evening suits you best. No obligation. Write us for his name and complete descriptive literature.

Zenith Broadcasting Station WJAZ Schedule

Dance Orchestras on Tuesday, Wednesday, Friday and Saturday Nights from 9:00 P. M. until 2:00 A. M. ℄. Musical Program from the Zenith Spanish Garden Studio 9:00 until 12:00 o'clock Thursday Nights and Special Programs 7:00 until 9:00 Sunday Nights. ℄. Central Standard Time. ℄. Authorized Wave Length, 322.4 Meters.

Zenith Radio Corporation

Straus Building, Chicago

They Cost More—But They Do More!

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