COMMERCIAL RADIO

JULY-AUGUST 1934

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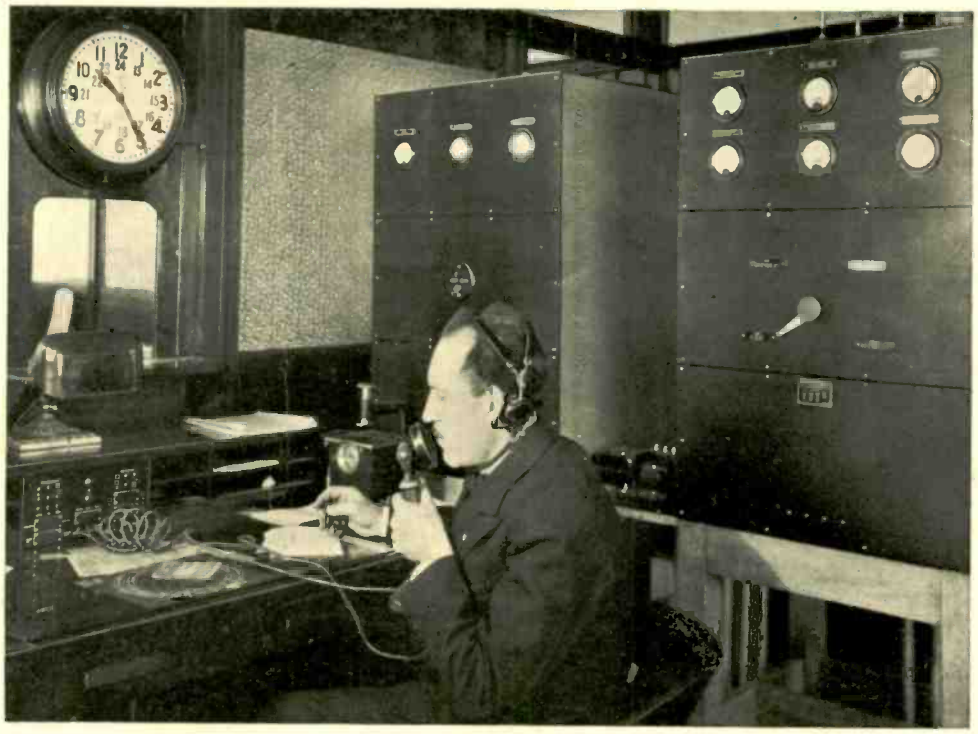

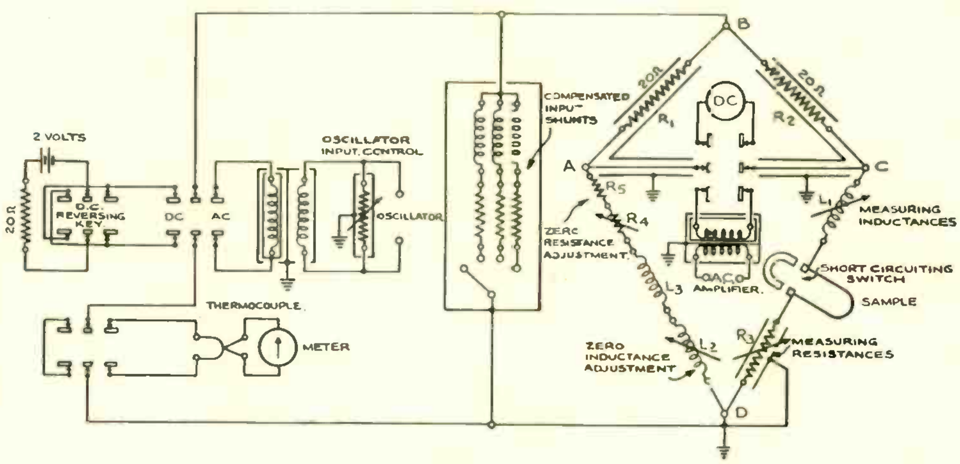

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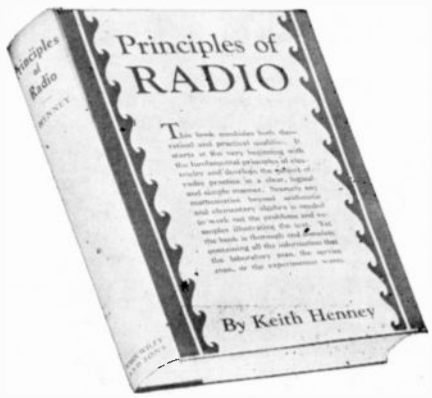

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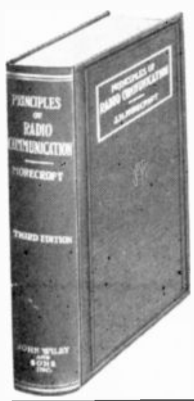

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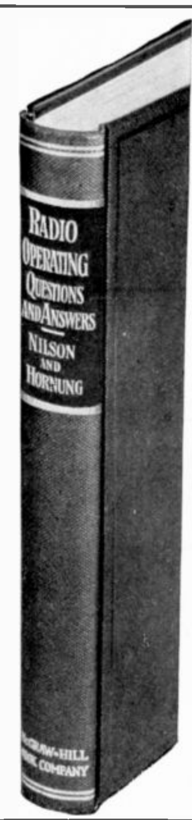

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VOLUME III NO. 11

The new Federal Communications Commission will have plenty of time to show their metal, it is hoped. They started July 11th, and it is believed many who were not satisfied with the old Federal Radio Commission will be satisfied at least temporarily with the new Commission.

Instead of an entire new set up, the appointments for the most part show an inclination to continue the work along the line of the old path. This will satisfy those who were satisfied with the old Commission, but will only help to irritate those who were not. On the other hand, there are several new faces on the newer Commission, and there are missing on the new board several of the faces of the older Commission. This in turn may satisfy those who were not satisfied with the old board, but will not please those who were.

Along with the multitude of duties of the old Federal Radio Commission, the new Federal Communications Commission will have to devote much of their time to the studies and problems of both the telegraph and telephone field. Much interest will center in the report next February which the Commission will have for Congress in the way of recommendations for new legislation.

COMMERCIAL RADIO

(FORMERLY "C-Q")

The Only Magazine in America Devoted Entirely to the Commercial Radio Man

Contents for July-August, 1934

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THE NEW "STANDARD" RADIO RECEIVERS FOR COMMERCIAL LINKS*

By L. J. HEATON-ARMSTRONG and L. T. HINTON

TABLE I

European Wavelength Service Allocation

Type	Wavelength	Frequency	Service	Receiver
SHORT WAVES	10 to 50 Metres	30,000 to 6,000 Kcs.	This band is divided into 32 separate sections allocated to Fixed Land Stations, Mobile Aircraft and Marine, Broadcasting, and Amateur services. It is employed chiefly for long distance communication, telegraphy and telephony.	←13.5 m
	50 to 200 Metres	6,000 to 1,500 Kcs.	This band is allocated to Fixed Land Stations, Mobile Marine and Amateur services and is used chiefly for short distance telephony and telegraphy.	—RM6
MEDIUM WAVES	200 to 545 Metres	1,500 to 550 Kcs.	Broadcasting	
	545 to 822 Metres	550 to 365 Kcs.	Marine Mobile	←250 m
	822 to 938 Metres	365 to 320 Kcs.	Aircraft Mobile	
	938 to 1,132 Metres	320 to 265 Kcs.	Marine and Aircraft Beacons	—RM7
	1,132 to 1,875 Metres	265 to 160 Kcs.	Broadcasting	
LONG WAVES	1,875 to 3,000 Metres	160 to 100 Kcs.	Mobile and Marine	←1,500 m —RM8
	3,000 to 30,000 Metres	100 to 10 Kcs.	Fixed Land Stations, Press Service	←5,000 m ←22,000 m

General

In considering the design of modern commercial receivers the first step is to review the requirements which have to be met. These may be divided into three categories:

(A) Service to be catered for.
(B) Performance.
(C) Cost.

A brief survey will make it clear that a single receiver is not likely to meet all the requirements. For instance, the wavelengths in commercial use range from 15 cm. (micro-ray) to 30,000 metres. The performance required varies from that for telegraph reception on ships to high quality transatlantic broadcast relays.

From the cost standpoint, receivers can range from a simple TRF set to the multi-valve equipments which are used for long distance radio link telephone traffic.

Certain specialised services must have receivers specifically designed to meet their individual requirements. Examples are the 15 centimetre micro-ray receiver, portable equipments working at less than 10 metres, and transatlantic short-wave sets.

The wavelength allocation shown in Table I and agreed to at the Madrid Convention, in its range from 10 to 30,000 metres, covers many of these specialised services. It embraces, however, a very large number of less specialised services which can be covered by what we have conveniently classified as "Commercial Receivers." The problem in design, therefore, resolves itself into finding the best economic solution to provide commercial receivers for the range shown in the table.

Requirements for Commercial Receivers

(A) Service

Receivers should be capable of handling telegraphy, continuous wave as well as modulated continuous wave, and telephony—in some instances, of broadcast reception quality. They must also be extremely reliable and simple to operate.

(B) Performance

The basic performance requirements are that the receiver shall have satisfactory selectivity, audio frequency response and sufficient gain so that the output is limited only by the inherent tube noise. It is also desirable that the receiver should be capable of working either from alternating current mains power supply or from batteries.

(C) Cost

The receivers should be designed at a price commensurate with the service and performance required.

*Reproduced from "Electrical Communication," July, 1934.

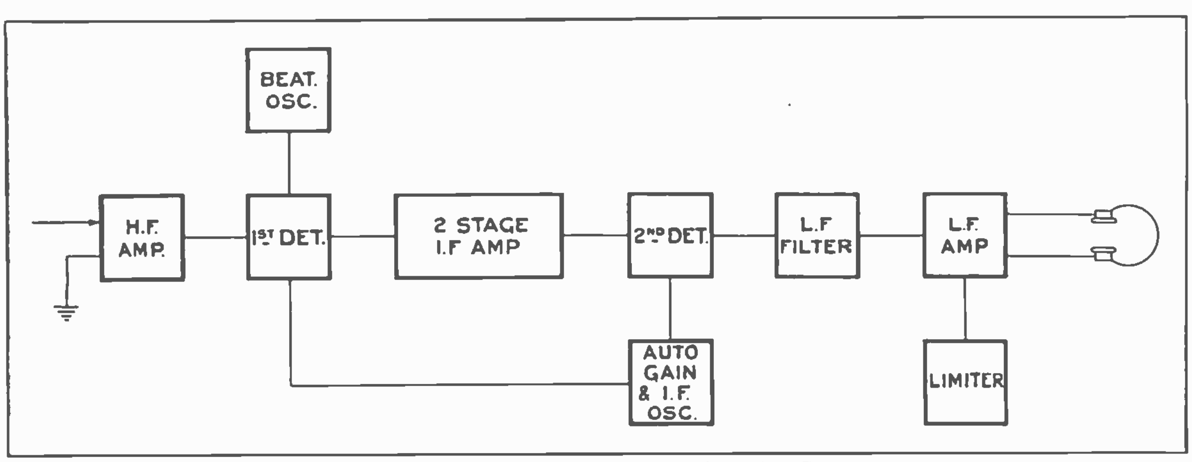
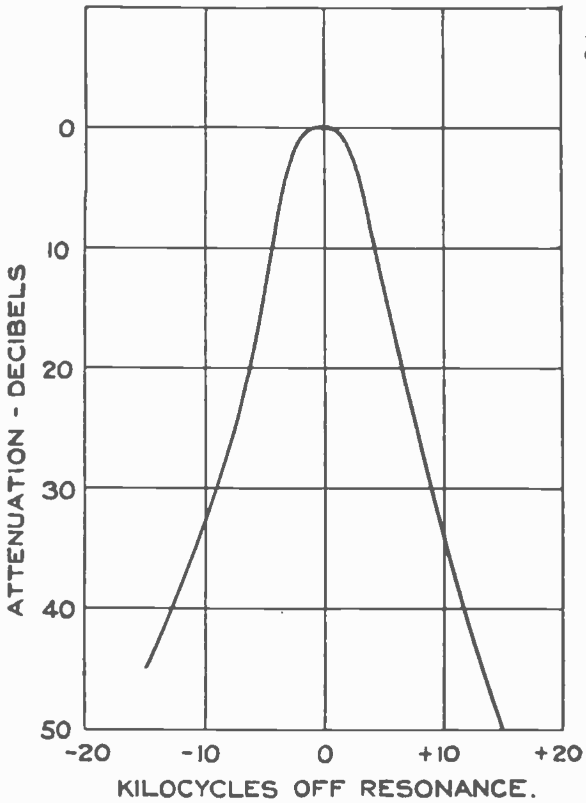
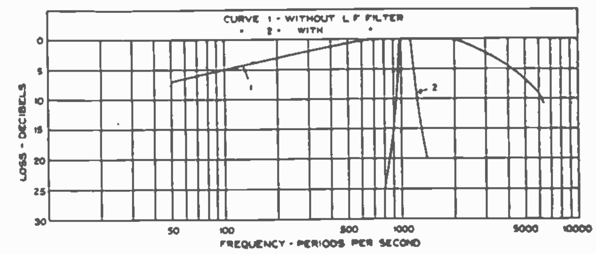


Fig. 1—Block Schematic of R.M.6 and R.M.7 Receivers.



(Left)
Figure 2—Selectivity Curve of R.M.6 Receiver.

(Right)
Figure 3—Typical Overall Audio-Frequency Characteristics of Commercial Receivers.



From a technical point of view one single receiver could be designed to give the required performance for the whole range, but it would be so complicated and costly that the other requirements would not be met.

A study of the individual types of service indicated in Table I, bearing in mind all the requirements to be met, has resulted in the production of three new Standard receivers to cover the range of 13.5 to 22,000 metres. These receivers are coded R.M.6, R.M.7 and R.M.8 and will be described in more detail below. The wavelength ranges of the receivers are indicated in Table I and it will be seen that they meet the service requirements with the minimum amount of equipment.

Wavelengths shorter than about 13.5 metres are not at present generally in use for commercial services, so that this is the lowest wavelength covered. The short-wave receiver covers the range from 13.5 to 250 metres, while the medium wave receiver covers from 250 to 500 metres. No overlap has been considered necessary on these receivers since 250 metres lies in the medium-wave broadcast band.

The medium and long wavelength receivers overlap from 1,500 metres to 5,000 metres. This arrangement has been chosen to avoid the use of two receivers, which would be necessary under certain service conditions if a division had been fixed without overlap. At the end of the range, a wavelength of 30,000 metres is well within the audible limit and is not used in practice. It is, therefore, considered that there is no need to cover wavelengths longer than 22,000 metres.

The power supply equipment for these receivers has been carefully studied and a separate a-c. power supply unit capable of feeding any one of the three receivers has been designed. This power supply unit works from alternating current mains of the types normally met with in practice and supplies the necessary voltages and currents for the operation of the receivers which use indirectly heated valves throughout. If it is desired to use batteries instead of a-c. mains supply, they can be connected directly to the receiver.

The last few years have seen remarkable advances made in radio receivers, particularly in the field of broadcasting. New and highly efficient valves have appeared and the improved mechanical design of component parts has made it possible to build very efficient and compact equipments.

A commercial receiver, as distinct from a broadcast receiver, must be built so that its performance can be guaranteed under rough treatment, and its components must be extremely reliable under all conditions of use. Further, many features, such as alternate telephone and telegraph reception, as well as metering facilities, acoustic shock limiters, etc., not necessary on broadcast receivers, must be incorporated in the commercial design to fulfil the demands made from the operating field.

Short-Wave Receiver

The R.M.6 is an eight valve receiver employing the superheterodyne principle, and is shown in block schematic form in Fig. 1.

The valves are employed as follows: one high-frequency amplifier, first detector, beat oscillator, two intermediate frequency amplifiers, second detector, output

(Continued on Page 17)

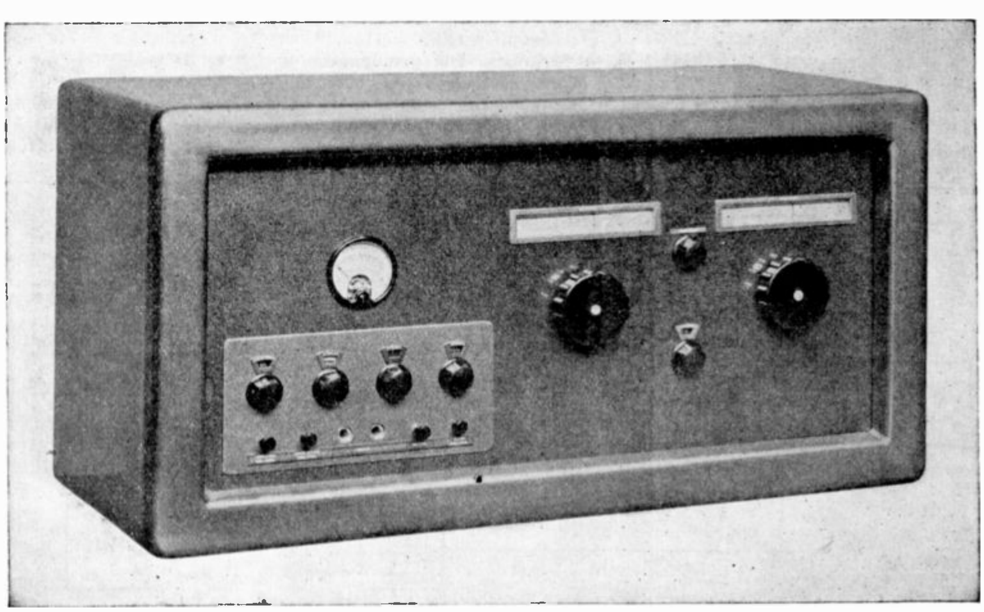


Figure 4—R.M. 6 Receiver (13.5—250 Metres).

SOME INFORMATION FOR THE OPERATOR-FREIGHT CLERK

By DAVID T. WILLIAMS

Many operators have signed on the articles for a foreign voyage as "Radio Operator and Freight Clerk" without knowing anything whatever of the duties which he is expected to perform as "Freight Clerk" or as "Purser."

Perhaps some general information on this subject will be of timely assistance to many operators who, sooner or later, may be confronted with such a combination job.

The clerical work on American vessels calling at foreign ports may be divided into two classes, namely, (1) SHIPS DOCUMENTS which enable the vessel to proceed from port to port and consist in general of: (a) Crew's Articles, (b) Ship's Register, (c) U. S. Consular Bills of Health, (d) Alien Crew List, (e) Tonnage Dues Certificate, (f) Clearances, (g) U. S. Department of Commerce Official Crew List. and;

2. CARGO PAPERS which include: (a) Revenue Manifests, (b) Hatch Lists, (c) Cargo plans, and other papers prepared by the freight clerk and used by the agents and stevedores at the various ports in locating and checking the cargo when discharged from the vessel.

In addition to the papers named above, there are special forms provided by the customs officials at each foreign port to be typed up such as "List of Arms & Ammunition," "Hatch Plans," "Entrance Forms," etc. These forms are usually self-explanatory. The same is true of Engineer's and Mate's papers which are usually typewritten by the Freight Clerk. These consist of requisitions and various reports to be forwarded to the steamship company office.

The SHIPS DOCUMENTS are of primary importance and must be prepared carefully in order that the vessel will not be delayed unnecessarily in entering and clearing foreign ports. A brief description of these papers follows:

(a) **Crews Articles** state the ageement between the members of the crew and the steamship company as witnessed by the U. S. Shipping Commissioner. This agreement is signed by all members of the crew at the beginning of each voyage and must be returned to the Shipping Commissioner at the end of the voyage with all changes in the crew notated thereon. These notations are made by the American Consul at the port or ports where changes are made on a supplementary form which is attached to the articles.

(b) The **Ships Register** is usually sent ashore with the agent at each port and requires no attention of the freight clerk.

(c) **Bills of Health** must be obtained in duplicate from the American Consul in each foreign port where cargo is loaded for discharge in the United States. The Bills at each foreign port of call are attached by the Consul to the bills issued at previous ports.

(d) The **Alien Crew List** is prepared by the freight clerk on forms provided as soon as the vessel leaves the U. S. for a foreign port. This crew list represents a collective passport for the entire crew and is necessary to enable the crew to re-enter the United States. Data necessary for its preparation are obtained from the Crews Articles. All changes in crew in foreign ports must be shown on this list by the American Consul in the port where changes are made.

(e) **Tonnage Dues Certificate and Fumigation Certificate** accompany ships documents but require no further attention.

(f) A **Clearance** must be obtained at each port before departure. This clearance is presented at the next port to show that the vessel was regularly cleared and free to leave the previous port.

(g) The **U. S. Department of Commerce Official Crew List** is made out by the vessels Custom House brokers, the data being obtained from the ships articles or "crews articles" as named heretofore. One copy is kept up to date in regard to changes in crew during voyage. The changes are made by the American Consuls in ports where changes are made in the same manner as on the Alien Crew List. A number of additional copies of this list should be made up by the freight clerk. These will be used by custom officials who board the ship and muster the crew at each port.

Description of CARGO PAPERS:

(a) **Revenue Manifests or Freight Manifests** are prepared by the shipping office while the cargo is being loaded in each port. The shipments are all listed showing their destination, to whom consigned, marks and numbers identifying the shipment, name of shipper, weight, character of goods, and the freight charges made for the shipment by the steamship company. It is sometimes necessary for the freight clerk to make out additional copies of these manifests as needed. All the data regarding the cargo necessary to prepare custom entrance forms may be taken from these manifests.

(b) **Hatch Lists** are required by the stevedores in the various ports. The cargo in each hold is listed on plain paper showing the amount, marks and numbers. kind of cargo, and to whom consigned. These are used to check the cargo as it is discharged from the vessel and must be prepared by the freight clerk while out at sea. The data is obtained from the "Mates Receipts" a copy of which is in the Mates' possession. Several copies are required for each hatch from which cargo will be discharged at the next port.

(c) **Cargo Plans** are also required by the stevedores and ships' deck officers in discharging cargo. The plan consists of a cross-section sketch or outline of the vessel (printed form) which shows each of the vessels holds. The mate or supercargo writes in each shipment as it is loaded showing its position in the hold of the vessel and other information such as marks and numbers, destination, number of pieces, port of discharge and consignee. The freight clerk is required to make several copies showing the cargo to be discharged at the next port of entry for use at each port. As cargo is loaded and discharged, a new plan is required upon leaving each port.

There is also a **U. S. INWARD FOREIGN MANIFEST** that must be prepared by the freight clerk on forms provided and consists of a complete list of all cargo and other articles including bunkers and ship stores obtained in foreign ports to be entered in the United States. It is used by the U. S. Custom Officials and the steamship agents in clearing the cargo in the Custom House. Data are obtained from the freight manifest (revenue manifest). This manifest should be kept up to date from the time the first cargo is loaded in a foreign port as there may not be sufficient time later on.

IN GENERAL: The Ship's Documents described are usually taken care of by the skipper, though their preparation will be left to the freight clerk. Cargo papers are made out and taken care of by the freight clerk. Custom forms should be made up carefully and prepared before entering port. If reports regarding the cargo loaded and discharged daily from the vessel are required by the steamship company, the data may be obtained from the head checker and other information regarding the arrival, departure, delays, etc. from the deck log book which is always accessible for this purpose. The steamship company's agent will be on hand when the ship is docked to take care of any cargo papers to be used on the dock or ashore and will advise the freight clerk in regard to their proper preparation if necessary.

"In Baltimore"

By WILLIAM D. KELLY

When you hear W3AHA on 160 meters busting up a lot of air, that is George Proter Houston 3rd, the Chief at WCBM.

Sydney Bassford at WCAO is scheduled for a hookup in August.

Ed Laker, who hails from the West Coast and has put some time on the Balto. Mail Wagons is now at WCBM and bids to be the "Speed King" on the "General" wire.

Charles Sibold is going to try amateur radio and has spent his bucks for a CW rig.

Frank Snyder of WCBM is a math hound and shows up fast with a key too.

Eddie Stover of the Transmitter Staff at WFBR has his own broadcast station now—they named it Eddie.

Jimmy Schultz, Chief of WCAO, has gone in for 80 meter phone and is using 500 watts.

Al Kries is another oldtimer and is watching meters at WCBM Transmitter.

Clem Holloway, WFBR Control Room, is a S/W DX hound and is saving his dov to buy an AUSTIN.

C. E. Hendrick is a new man at WEEB.

Carlton Nopper (WFBR Transmitter) sez that he is going to get hooked up this September.

Urban Lynch, who twirls dials at WCAO, likes to service auto sets with vibrators—nix.

NEW AIRPORT RECEIVERS

By H. B. FISCHER

Member of Technical Staff, Bell Telephone Labs

An installation of a No. 11B Radio Receiver at the American Airways' Hangar, Newark Airport, emphasizes the value of this recent contribution of the Laboratories to commercial aviation. Two-way telephonic communication between aircraft and ground has grown very rapidly in recent years. Today all the large commercial aircraft operating companies, engaged in the transportation of passengers and mail, employ such two-way radio telephone systems, and put them to a variety of uses. Over them the position of the ship is reported at regular intervals, weather information is secured to supplement that received from the beacon stations maintained by the Department of Commerce, and their constant availability greatly simplifies the dispatching procedure. In addition to these routine uses, the two-way system is of great value in emergencies such as a forced landing.

Foreseeing the desirability of such service, the Laboratories developed the necessary apparatus several years ago, and it was widely sold by the Western Electric Company. The equipment provided was very satisfactory under the conditions existing at that time, but the rapid increase in the number of such systems installed has considerably changed the situation. Because of the many channels that must now be accommodated within the comparatively narrow band of frequencies allotted to two-way aircraft communication, local stations are frequently only from twenty to thirty kilocycles apart. Since the lowest aircraft frequency is three thousand kilocycles, this means that the frequency separation is less than one per cent. Anyone who has ever had difficulty in separating stations in the broadcast range, where the spacing between local stations is from five to ten per cent, can imagine the difficulty when the separation is less than one per cent.

The earlier receivers employed for this service were not selective enough to be satisfactorily used under these conditions. An extended program of experimental work on the part of the Laboratories, however, resulted in an airport receiver for this class of service, known as the 11 type, which meets all requirements. It is of the highly selective superheterodyne type, while the earlier receiver—the 9B—was of the tuned radio-frequency type. This receiver is made in two forms: the 11A and 11B. The former is continuously tunable over the frequency range from 2700 to 6500 cycles, and is designed for use where there is no great amount of electrical noise in the immediate vicinity. The 11B, on the other hand, has two fixed frequencies, to accommodate the two frequencies used by a system, and is designed to be located at a distance from the airport where it will be out of reach of any disturbances that may exist near the airport.

The selective characteristics and mechanical arrangement of the two forms are essentially the same. Both are mounted in self-supporting metal cabinets, the 11B being shown in Figure 1 and the 11A in Figure 2. The circuit of the 11A, which is like that of the 11B except as noted later, is shown in Figure 3. It consists of one stage of tuned radio-frequency amplification, a modulator, an oscillator, three stages of intermediate-frequency amplification, a rectifier used as a detector and volume control, and two stages of audio-frequency amplification.

To obtain the extremely high overall selectivity required by the very severe service conditions, two types of selectivity must be provided. It is necessary first, to provide sufficient selectivity so that no signal is heard from stations operating at a frequency as little as twenty kilocycles from that of the wanted station. This selectivity is obtained in the intermediate-frequency amplifier, which operates at 385 kilocycles. This is known as "closeup" selectivity since it is concerned with signals very close in frequency to that of the wanted signals. The characteristics of the new receiver for this type of selectivity are given in Figure 4, which shows that a signal only ten kilocycles from the wanted signal is attenuated about 70db.

In addition to this close-up selectivity, which is concerned with side bands very close to the desired one, selectivity in the radio-frequency circuits must be pro-

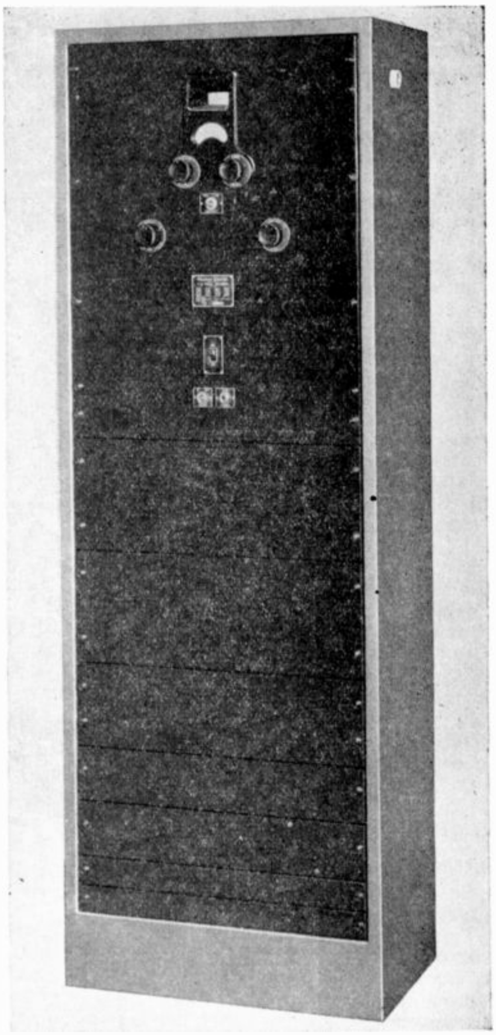


Figure 2, right—The 11A receiver differs in appearance from the 11B chiefly in having a gang-tuning dial on the front panel

Figure 1, left—The 11B receiver, like the 11A, mounts in the 6A cabinet, which is rugged and self supporting vided to prevent adjacent carriers, differing from the desired frequency by more than 30 kc, from entering the modulator in sufficient amount to produce objectionable cross-modulation. If this were not done, some of the frequencies of the cross-modulations might be of a value to be passed and amplified by the intermediate-frequency stage, and so would appear as undesired frequencies in the audio output. Discrimination of this type is performed by tuned radio-frequency circuits. The high value of overall selectivity obtained by this arrangement is given in Figure 5, which shows the values of undesired signals, at various frequency separations from the desired signal, which will produce an interfering signal 20 db down on a wanted signal of 50 microvolts.

High-frequency signals generally have a tendency to vary widely in level because of changes in the transmission path. Also, the airplane from which the signals are being received is changing its distance from the ground stations, which introduces a change in signal level in addition to the fading caused by change in path. The new receiver, therefore, is provided with an automatic gain control which maintains a substantially constant output for wide variation in signal input. To obtain this regulation, a voltage is developed in the detector circuit, which is proportional to, but considerably greater than, the incoming carrier, and this voltage is used to adjust the grid bias on the high-frequency tubes and thus, by changing the gain, to maintain the desired output for different values of signal input. Such automatic volume control makes the operation of the receiver much more satisfactory since it is not necessary for the operator to change the gain except at infrequent intervals.

The three stages of high-gain intermediate-frequency amplification in addition to the radio-frequency amplification, provide a higher sensitivity than is normally required. The result is a reserve of gain which insures satisfactory operation under abnormal conditions. A signal input of one microvolt is sufficient to give full output at the loud speaker.

At a busy airport, where various types of electrical machines are operated at frequent intervals, thus producing a considerable amount of electrical noise, the operation of a sensitive receiver would be unsatisfactory. For such airports, therefore, it is desirable to locate the receiver at some distance away, and to operate it over a wire line. It was to meet such conditions that the 11B receiver was designed. Although continuous tuning over the operating band is desirable, the additional cost required to obtain it with a remote-controlled set is not justified. Since each operating company employs only two frequencies in its communication system, the 11B receiver is designed for operation at either of the frequencies—the frequency desired being selected by operating a dial at the airport. The two frequencies employed may be changed manually to any frequency within the band from 2700 kc to 6500 kc as is shown being done in Figure 1.

The chief differences in circuit between the 11A and 11B receivers are in the radio-frequency amplifier. Since it is not necessary to have a unitary control in a fixed-frequency receiver, individually adjustable condensers are provided for each tuned circuit, and a switching relay is associated with each by which it may be shifted from high to low frequency or vice versa. The beating oscillator is maintained at a constant frequency by the use of Western Electric quartz plates. Once adjusted, no further tuning of any kind is required for satisfactory reception.

A regular telephone line is employed for carrying the voice currents, and for controlling the receiver. Pulses for shifting the receiver from one to the other of its two frequencies, and for varying its sensitivity are sent over this line from a control unit located at the operating point. To change frequency and control the sensitivity, the operator merely operates a dial. The output of the receiver is sufficient to give satisfactory headset operation at the airport. Should loud-speaker operation be desirable, some audio-frequency amplification is required at the airport. Although the 11B receiver was designed for locations remote

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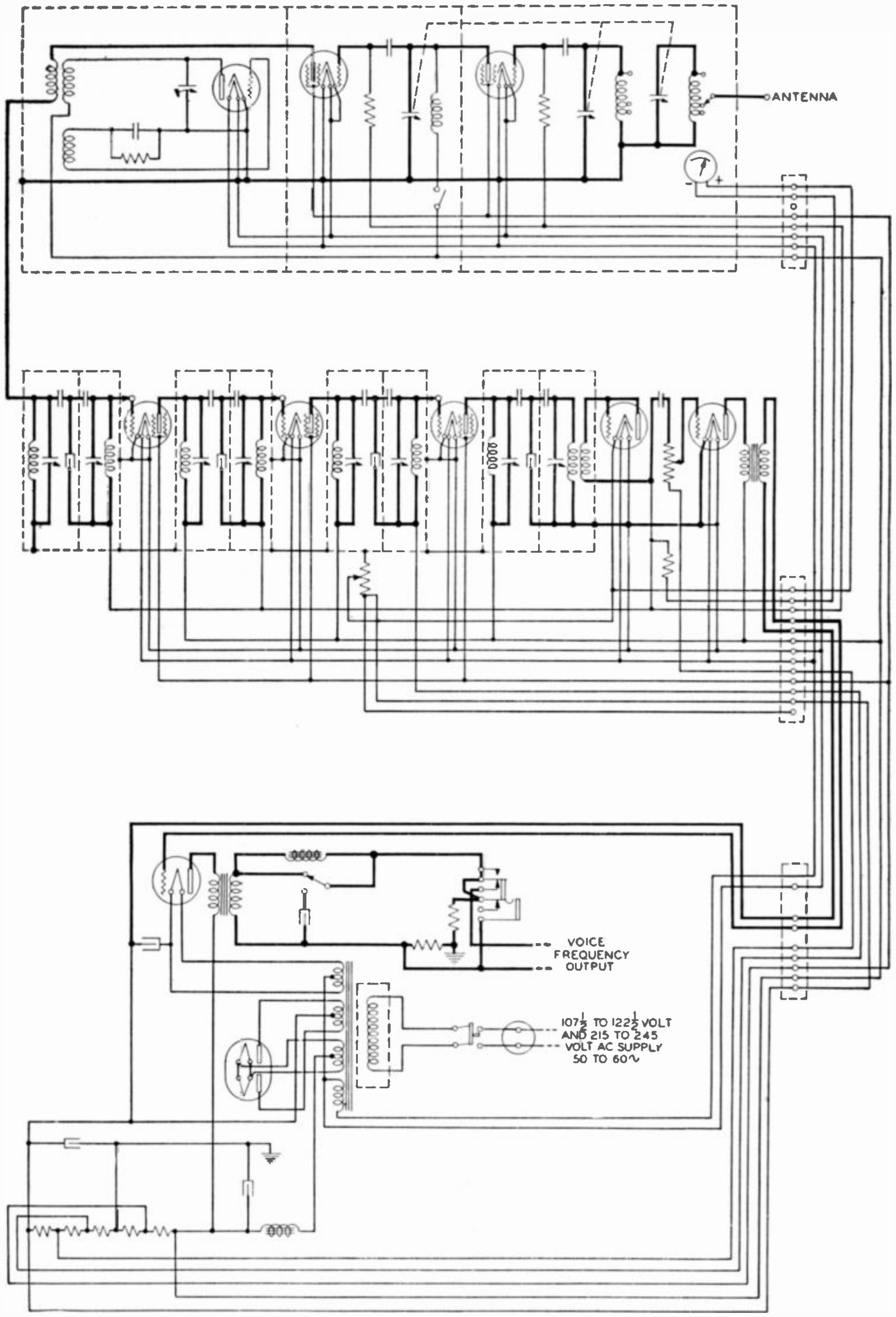

Figure 3—Simplified schematic diagram of the 11A radio receiver

FEDERAL COMMUNICATIONS COMMISSION

The new Federal Communications Commission, which absorbs the old Federal Radio Commission, started operation on July 11th. This commission will not only control all radio function previously in the hands of the Federal Radio Commission, but will as well supervise the telegraph and telephone industry of the country.

The new Commission consists of Judge E. O. Sykes, Chairman, 7 year appointment.

Thad Brown, 6 year appointment.
Paul Walker, 5 year appointment.
Norman S. Case, 4 year appointment.
Irvin Stewart, 3 year appointment.
George H. Payne, 2 year appointment.
Hampson Gary, 1 year appointment.

Latest information is that Herbert L. Petty, Secretary of the old Federal Radio Commission will act as Secretary of the new Commission, and the entire staff of 232 employees of the old Radio Commission will be transferred to the new Federal Communications Commission.

RUSH FOR POWER

The following broadcast stations were either given permission to install new equipment or make such changes as necessary in present equipment increasing their daytime power from 1 KW or less to 2½ KW.

WSPD—Toledo Broadcasting Co., Toledo, Ohio.

WDAY—WDAY, Inc., Fargo, N. D.

WSAI—Crosley Radio Corp., Cincinnati, O.

WMT—Waterloo Broadcasting Co., Waterloo, Ia.

WDGY—Dr. George W. Young, Minneapolis, Minn.

KLZ—The Reynolds Radio Co. Inc., Denver, Colo.

WKRC—WKRC, Inc., Cincinnati, O.

WADC—Allen T. Simmons, Tallmadge, O.

WDAG—Nat'l Radio & Broad. Corp., Amarillo, Tex.

WMC—WMC, Inc., Memphis, Tenn.

KOIL—Mona Motor Oil Co., Council Bluffs, Ia.

KSD—Pulitzer Pub. Co., St. Louis, Mo.

KMBC—Midland Broad. Co., Kansas City, Mo.

KWK—Thomas Patrick, Inc., St. Louis, Mo.

Some other stations who have applied for this 2½ KW daytime power permission are:

KFWB—Warner Bros. Broad. Corp., Hollywood, Cal.

KGBZ—KGBZ Broadcasting Co., York, Nebr.

WOW—Woodman of the World, Omaha, Nebr.

WGCP—May Radio Broadcast. Co., Newark, N. J.

WDAF—Kansas City Star Co., Kansas City, Mo.

WSPD—Toledo Broadcasting Co., Toledo, O.

KLRA—Arkansas Broadcasting Co., Little Rock, Ark.

WTMJ—The Journal Co., Milwaukee, Wisc.

NEW FEDERAL RADIO COMMISSION RULINGS

THE Federal Radio Commission adopted the following Rules and Regulations:

30a. Additional examining cities.—The following is a list of cities where examinations will be held for radio operators' licenses in addition to Washington, D. C., and the radio district offices of the Commission. Other cities may also be designated from time to time for the purpose of conducting commercial and Class A amateur operators' examinations only. (See Rules 2, 404, 408 and Part V).

Schenectady, N. Y.	Oklahoma City, Okla.	Cleveland, Ohio
Winston-Salem, N. C.	Des Moines, Iowa	Cincinnati, Ohio
Nashville, Tenn.	St. Louis, Mo.	Columbus, Ohio
San Antonio, Tex.	Pittsburgh, Pa.	

Examinations for commercial and Class A amateur privileges will be conducted not more than twice per year in the following cities, which are not to be construed as examining cities under the rules which apply for Class B and C amateur privileges:

Albuquerque, New Mexico	Boise, Idaho	Phoenix, Arizona
Billings, Montana	Butte, Montana	Salt Lake City, Utah
Bismarck, North Dakota	Jacksonville, Florida	Spokane, Washington
	Little Rock, Arkansas	

309a. The licensees of special and general experimental stations, experimental broadcast stations and experimental visual broadcast stations may, subject to change upon further order, operate stations on any frequency above 110,000 kilocycles, without separate licenses therefor, provided the following rules are complied with:

(1)' The licensee shall operate a station only in the class for which he possesses a license, i. e., the licensee of a general experimental station shall operate a general experimental station only, and other licensees the class of station for which their respective licenses are issued. In each case the Commission's rules governing the class of station for which the license is issued shall be complied with when operating on frequencies above 110,000 kilocycles in the same manner as if the station were operating on a frequency specifically referred to or designated in the license.

(2) Licensees shall restrict their operation on frequencies above 110,000 kilocycles to matters pertaining to fundamental research.

(3) Records shall be maintained of all transmissions in accordance with the provisions of Rule 310.

(4) Licensed radio operators shall be employed in accordance with the provisions of Rule 445.

Rule 368. Licenses for mobile stations and portable-mobile stations will not be granted to amateurs for operation on frequencies below 56,000 kilocycles. However, the licensee of a fixed amateur station may operate portable amateur stations (Rule 192) in accordance with the provisions of Rules 384, 386 and 387; and also portable and portable-mobile amateur stations (Rules 192 and 192a) on authorized amateur frequencies above 56,000 kilocycles in accordance with Rules 384 and 386, but without regard to Rule 387.

Rule 374a. The licensee of an amateur station may, subject to change upon further order, operate amateur stations on any frequency above 110,000 kilocycles, without separate licenses therefor, provided:

(1) That such operation in every respect complies with the Commission's rules governing the operation of amateur stations in the amateur service.

(2) That records are maintained of all transmissions in accordance with the provisions of Rule 386.

Rule 384. An operator of an amateur station shall transmit its assigned call at least once during each fifteen minutes of operation and at the end of each transmission. In addition, an operator of an amateur portable or portable-mobile radiotelegraph station shall transmit immediately after the call of the station, the break sign (BT) followed by the number of the amateur call area in which the portable or portable-mobile amateur station is then operating, as for example:

Example 1. Portable or portable-mobile amateur station operating in the third amateur call area calls a fixed amateur station:

W1ABC W1ABC W1ABC DE W2DEF **BT3** W2DEF **BT3** W2DEF **BT3 AR**

Example 2. Fixed amateur station answers the portable or portable-mobile amateur station:

W2DEF W2DEF W2DEF DE W1ABC W1ABC W1ABC K

Example 3. Portable or portable-mobile amateur station calls a portable or portable-mobile amateur station:

W3GHI W3GHI W3GHI DE W4JKL **BT4** W4JKL **BT4** W4JKL **BT4 AR**

If telephony is used, the call sign of the station shall be followed by an announcement of the amateur call area in which the portable or portable-mobile station is operating.

Rule 386. Each licensee of an amateur station shall keep an accurate log of station operation to be made available upon request by authorized Government representatives, as follows:

a. The date and time of each transmission. (The date need only be entered once for each day's operation. The expression "time of each transmission" means the time of making a call and need not be repeated during the sequence of communication which immediately follows; however, an entry shall be made in the log when "signing off" so as to show the period during which communication was carried on).

b. The name of the person manipulating the transmitting key of a radiotelegraph transmitter or the name of the person operating a transmitter of any other type (type A-3 or A-4 emission) with statement as to type of emission. (The name need only be entered once in the log provided the log contains a statement to the effect that all transmissions were made by the person named except where otherwise stated. The name of any other person who operates the station shall be entered in the proper space for his transmissions). (Continued on Page 22)

PIONEER WIRELESS OPERATORS

By DR. LEE DE FOREST

(Continued from June issue)

Lee de Forest tells of the first transatlantic radio message. Items never before revealed are coming direct from the notes of the author, brought up-to-date from his diary kept at the time. Do not miss these writings of the great "father of modern radio."

McNEIL began forthwith to assemble all that was left of his tetrahedral kite cells into 2½ kites. Our old standby which had staunchly withstood all of the crack-ups of Glengarriff, and which he had affectionately named "Mabel the Third" after Horton's wife, was still with us, although somewhat weather-worn and battered.

But now ensued uninterrupted bad luck. Either the first of O'Sullivan's statements regarding no wind, or his corrected version "strong winds all day and night" proved undeviatingly correct. Long calms were succeeded by lashing gales, usually with heavy rains. So that, morning after morning we would find our kites torn to bits; and then McNeil would patiently cut out the broken cells and sew these together into a new kite. Thus it happened that he was the only member of our party who was kept busy during those last trying days at Cahermore, Ireland.

After a week of this inactivity and maddening delays, without one fair chance to get our antenna aloft and tune in for D. F., Horton was summoned back to London, leaving McNeil and me alone to battle on.

Then one night, April 11, 1906, just about a week after Mac and Mable had left us, we got the winds we were waiting for—steady and strong, from off the wide Atlantic. With blustering aid from the very windy O'Sullivan we got out our last remaining kite at 2 A. M. and sent her aloft without mishap. She went up 2000 ft. and I tuned in while McNeil was slowly unreeling cable. Here is my last bulletin on that occasion:

"Thursday, April 11th.

Static bad at 1000 ft. and above. At 4 to 4:05 A. M. static quited greatly, nearly 2000 ft. wire up—single wire (we had sometimes used two wires to tether the big kites in strong gales).

Heard N. Y. sending. Quite faint, but readable; stopped at 4:05. Tuning on C P. c. (pancake coil) quite close at 2 div's A p. e. at 5½, 1 V. C. in Antenna —all in (180). Did not hear N. Y. with this V. C. cut out.

LdeF"

Had Horton been able to remain one week longer he would undoubtedly have been able to copy that night the first wireless messages ever transmitted across the Atlantic; certainly the first from West to East. The speed of D. F's sending was far too fast for my fist to follow. But his style of sending was strictly American, his spark-frequency was characteristically much higher than that of the British ships, to say nothing of the splashy "plop—plop" of Poldu. And I got his sign-off. The test therefore, while I cursed my luck that Mac could not have stayed on another week to actually copy the stuff, was equally as convincing as was the succession of triple-dots which Marconi pulled in from a kite string four years before. (By the way, did you ever wonder why, on that historic occasion, the Poldu operator was never instructed to intersperse his--with a few words of English in continental morse? Just in case Marconi should succeed in picking up the letter S, you understand. The copied words would have been so much more interesting and convincing, you know!)

But I, not foreseeing the long wind delays and Horton's too early departure, erred in the other direction—messages and press only, and at 25 or 30 words per minute—and no simple succession of dots at all.

However all that is long ago over the dam and washed up—washed out by a thousand 20-watt oscillating tube hamsets on both sides of the Atlantic—and the Pacific and Antarctic oceans as well, with audion detectors and amplifiers, the latter not even conceived until a half year later.

But strange to relate, although I had tried in every way to keep quiet the news of my mission with kites to Ireland, I was greeted upon my return with old McNeil to Castletown two days later, enroute to Cork and England, with the following gem from his Majesty's G.P.O. officialdom:

"General Post Office, London
April 10, 1906

Dear Sir:

I am directed by the Postmaster General to say that he is informed that experiments in connection with the receipt of wireless telegraphic signals transmitted across the Atlantic have recently been carried out by you in the neighbourhood of Glengarriff by means of kites or balloons.

I am to enquire whether the Postmaster General's information is correct, and if so under what authority the experiments in question have been conducted. I am at the same time to point out that operations of this nature, if carried out without the Postmaster General's permission, constitute a misdemeanour under the Wireless Telegraphy Act 1904.

I am to ask you to be good enough to let the Postmaster General have an early reply.

I am, Sir,
Your obedient servant,
Wm. Ardron."

I couldn't suppress a chuckle, to think how narrowly our little band had escaped Scotland Yard, as I penned my reply:

"Castletown, Ire.
April 12, 1906

Hon. Post Master General,
London.
Dear Sir:

Replying to an enquiry received from Mr. Ardron today I beg to state that inasmuch as the object of the Wireless Telegraphy Act is, as I understand it, to prevent undue interference between various wireless stations, and as I have used no transmitter whatever I do not understand how I have acted in violation of said act.

The object of my experiments with kites and balloons was two fold:

(1) To determine how far kites could be relied upon on these coasts to maintain an antenna.

(2) At what altitude a single wire must be placed to receive messages from a powerful station in New York.

The object of these experiments having been accomplished they are now discontinued. (sic)

While I may be wrong in my ideas of equity and law, it strikes me as strange, to say the least, that objection could be urged to such experiments as I have carried out, with receiving apparatus alone.

I cannot understand why work of such harmless nature, and of such scientific interest and value should not be encouraged instead of frowned upon or prohibited by the officials of England.

Very respectfully,
Lee de Forest"

Was it possible, or even conceivable that the alarm expressed by the G.P.O. over my kite-flying wireless tests was even remotely connected with those of December 1901?

Or was it prompted by apprehension of a coming war between Great Britain and the United States? In any event I never knew, for I heard nothing further from Mr. Ardron of G.P.O.

The mail at Castletown contained also the very welcome news from New York that the U. S. Navy had at last and finally accepted all five of our high power stations, Key West, Pensacola, Colon, Guantanamo, and Porto Rico.

Fully mindful from my own observations and experiences of what my plucky construction-operators had undergone to bring these five pioneer big stations to final acceptance, I took the opportunity offered by the slow tug-boat trip back from Castletown to indite the following letter to all those lads. Perhaps its reproduction, even after all these years, may serve to encourage some faraway radio operator who today may be struggling under great handicaps to carry on, in face of difficulties and discouragement. Or some employer of such fine operator or engineer, to show them that their efforts to establish new lines of communication are properly appreciated, even if improperly recompensed:

"London
April 20th, 1906

Messrs. Butler, Iredell and Curtis,
Dorchester.
Dear Sirs:

Upon the occasion of the final acceptance by the U. S. Navy of the five large stations of which you have been in charge, I wish to extend to you, on behalf of myself and of the American De Forest Wireless Telegraph Co., congratulations, hearty and sincere, and to felicitate you all upon your safe return to God's country.

Too often is it the case that while the faults and blunders of men receive good and severe criticism, the merits of their work, the vitality of their services pass unacknowledged, even if fully appreciated by their employers. I trust that

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A HIGHLY SELECTIVE WEATHER AND BEACON RADIO RECEIVER FOR AIRPLANE USE

By W. E. REICHLE

Member of Technical Staff, Bell Telephone Labs

THE remarkable regularity with which air transport companies are adhering to fixed schedules is due, to a large extent, to the weather and beacon receiver which is standard equipment on every mail and passenger airplane. With this receiver the pilot can make use of the frequent weather broadcasts transmitted by the Department of Commerce, and he can employ the beacon signals to guide him to his destination. In addition to the services rendered by the beacon and weather stations, operated by the government, some of the air transport companies are installing low-power beacon transmitters of their own, which are located at the airport and mark the runway of the field so as to help the pilot to land the airplane although the visibility may be extremely poor.

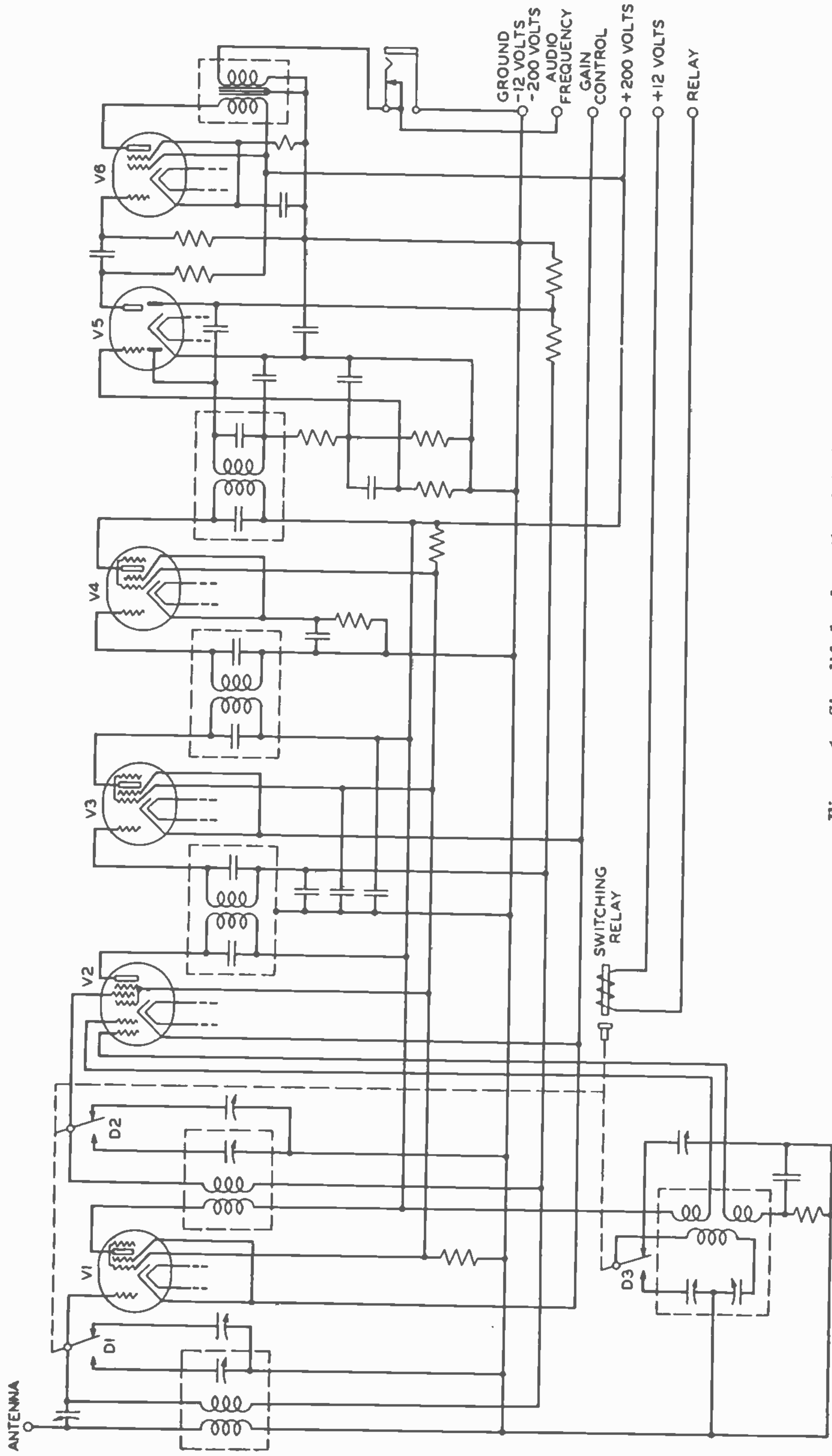

Figure 1—Simplified schematic of 14A radio receiver

Since the number of beacon and weather transmitters is constantly increasing, the selectivity of the radio receiver is becoming more important. This is especially true when a pilot has to receive signals from a low-power runway-localizing beacon while he is in the immediate vicinity of a strong airway beacon or weather station. To meet these stringent selectivity requirements Bell Laboratories has designed the 14A radio receiver. With the 12A receiver, designed for telephone communication between airplane and ground, it provides for aircraft complete radio-receiver equipment of the highest quality and dependability. The 14A covers the frequency band from 200 to 400 kilocycles—which is the band assigned for beacon and weather stations—and the several improvements incorporated in it mark this receiver as a distinct advance over existing equipment.

A signal separated only six kilocycles from the desired signal is attenuated 55 db. Although the sides of this curve are extremely steep, the transmission band is sufficiently wide to provide good intelligibility when weather broadcasts are being received. Moreover the high frequency-stability of the receiver, combined with the fairly wide band width, permit the use of a mechanical station selector. The gain obtained is so high that circuit noise is the limiting factor of the sensitivity of the receiver, and sufficient voltage step-up is provided in the antenna circuit to allow signals that impress as little as one microvolt on the antenna to be used. An automatic volume-control circuit is employed, which operates on the carrier and automatically adjusts the sensitivity of the receiver so that the output remains virtually constant regardless of the received signal strength.

A simplified schematic diagram of the receiver is shown in Figure 1. To obtain the required overall gain and selectivity a superheterodyne type of circuit is employed. The receiver contains a stage of radio-frequency amplification, a converter stage which combines the functions of oscillator and modulator in one tube, two stages of intermediate-frequency amplification, separate diodes for detection and automatic volume control, and two stages of audio-frequency amplification. The two diode elements and the triode used in the first stage of audio-frequency amplification are contained in a single tube

The radio-frequency and intermediate-frequency amplifier tubes are pentodes, the detector is a duplex diode-triode, and the output tube is a pentode capable of delivering approximately 600 milliwatts of audio-frequency power to a low-impedance headset. These tubes have heat-

(Continued on Page 20)

THE GIRL AND THE PEARLS

By VOLNEY G. MATHISON

A good story for "wireless" men as only Volney Mathison can write it. Fiction? Yes, but you can almost feel the story as you go along. Many readers can actually identify characters, many of which are taken from life in Mr. Mathison's story. Get a new thrill out of life reading this one.

SAMUEL JONES has got into the lime-light for fair. There appears this morning in one of the 'Frisco papers this headline:

"WIRELESS OPERATOR OUTWITS CUSTOMS
SMUGGLES PEARLS WORTH THOUSANDS"

Beside this front-page caption there is a real picture of the notorious brass-pounder and below comes this amazing item:

"In spite of a minute search and an extreme watchfulness on the part of the local customs inspectors, Samuel J. Jones, the chief wireless operator of the big passenger liner 'La Hermosa,' just in berth from Panama and Mexican coast ports, is believed to have successfully smuggled ashore a package of pearls, said to be worth $225,000.00."

"The details surrounding the affair are most extraordinary. The pearls, which belong to the well-known mining millionaire, Carter Jackson, are alleged to have been stolen from him last summer by Lucerita Carmello, a Spanish dancing-beauty, rumored to be one of the mining man's former flames, who, gaining access to a private safe in his residence at Burlingame, secured the pearls and disappeared. The jewels were eventually recovered in Mexico City; but when Mr. Jackson had them brought up on one of the Pacific Mail steamers, he was informed by Rudolph Merboler, in charge of the local customs, that since there was nothing to prove them the identical ones stolen, and, in fact, nothing to prove that the originals had ever been lost at all, the pearls from Mexico City would not be admitted without the payment of the full duty, which would amount to almost ninety thousand dollars. At a Federal hearing, the decision of Merboler was sustained, but Mr. Jackson, declaring the duty had been paid once, when the pearls were originally brought in, refused to pay it again, and sent the jewels back on the Mail steam to Mazatlan.

"It appears that when Jackson formerly lived on his copper-mining properties at Santa Rosalia, in Lower California, he owned a yacht, the 'Querida,' upon which Samuel J. Jones was for a time radio operator. It is said that the wireless man stands on a remarkably friendly footing with his former employer; and when the difficulty over the pearls arose, he offered to run them through the customs for the other.

"Merboler, learning of the plan, put a small package agent on board the 'La Hermosa' last trip, who saw a small package delivered to the radio man, when the ship touched at Mazatlan, northbound. Upon the liner's arrival yesterday, the customs inspectors went over the ship with a fine tooth comb, without finding anything; and though every precaution was taken to prevent the pearls being smuggled ashore, nevertheless, it is rumored that Carter Jackson received them safely last night."

"Well, I don't see nothin' wrong about it," insisted Samuel Jones, blinking a rather black-looking eye, as with his friend Cunningham he stepped out of the elevator, on the way to lunch: "Jackson paid the duty once; so why should he pay it again?"

"No-o, not if they're the same pearls," qualified Cunningham.

"Well, they are," averred Samuel Jones, "On the last trip of the 'Querida,' when Jackson moved up here to Frisco from Mexico, the pearls was on board then, an' I saw 'em declared; six in a settin' an' forty-one in a string—some beauts, too!"

"But that don't prove these are the same ones," doubted the audiotron man.

"If you'd seen 'em, you wouldn't say that—there's nothin' like 'em in all Mexico. That guy Merboler knows they're the same ones, too, but there's a lot to this business the newspapers an' nobody else ain't onto. Merboler used to be the main squeeze in the Frisco branch office of Jackson's mines, but finally one day Jackson caught him in a dirty, double-crossin' deal, an' kicked him out—an' not only that, but Merboler was after that Spanish jazz-baby himself, an' he's got a grudge like death against Jackson because he beat his time—believe me, I know all the ins an' outs of this racket."

"Perhaps you're right. At any rate, you were lucky to get by the customs men as you did."

"Humph, that's somethin' else the fool newspapers ain't onto", sniffed Samuel Jones, "I had a hunch somebody'd gave me away, an' so—" he paused and looked around, cautiously, "—an' so I never brought the pearls up a'-tall. Jackson's makin' the papers an' everybody else think he's got 'em, so's to put Merboler off the track; an' I'm really bringin' 'em up next trip—but, here, come with me: I'm goin' to show you a new eatin' joint."

With this abrupt shift of the subject, Samuel Jones led Cunningham to a large marble basement-stairway.

"Say, here, where are you going," objected Cunningham, reading the inscription, "Leighman's Cafeteria"; "I thought you said you wouldn't eat in a cafeteria."

"Well, I'll eat in this one, anyway," declared Samuel Jones, determinedly, "come on."

"I'd like to know what's the confounded idea," protested Cunningham, ten minutes later, as carrying a large luncheon-filled tray, he stumbled over somebody's umbrella and narrowly avoided a disastrous collision with the rear end of a detestably fat woman, "you know I never had any use for these wait-on-yourself places; and you always said you wouldn't be found dead in one of them—and now here—!"

Cunningham's complaint died on his lips. Approaching their table was a dream of girlish deliciousness, a Venus-shaped, rose-bud-lipped little chicken, who in a stiffly starched white uniform and cap, looked like a real, living doll.

"How are you today, Mr. Jones," she asked, glancing shyly at Cunningham, and bestowing a charming smile upon Samuel Jones, as she began taking the dishes from his tray and carefully arranging them for him on the table.

"Fine an' dandy, Miss Sweetness," answered Samuel Jones, returning her smile, "—an' I know you are too, if you feel a thousandth part as good as you look—but excuse me—Miss Lillian Vernaldt, Mr. Cunningham."

The little blonde smiled demurely in acknowledgment; and after a moment's chat with Samuel Jones, drifted off to resume her task of spreading fresh white linens on vacated tables.

"No wonder you insisted on coming down here!" exclaimed Cunningham, admiringly, as he watched the girl threading her way among the crowded tables; "some little peach, all right!"

"Well, you don't need to gape your confounded head off!" growled Samuel Jones, with ill-concealed jealousy, "I brought you down here to eat."

"Go ahead and eat yourself, and quit looking so green in the face," retorted Cunningham, good humoredly. "But, joking aside, she is a pippin. How did you happen to meet her?"

"By gettin' this," enigmatically answered Samuel Jones, tenderly feeling his blackened left eye.

"What, did she give you that!"

"No, of course not!" exclaimed Samuel Jones, indignantly. "You know, last night I was out to Burlingame to see Jackson an' tell him why I didn't bring up the pearls this trip. I left his place about ten o'clock, an' was standin' just outside his high iron lawn-fence, when all of a sudden, somewheres pretty close, I hears a scream. There's lots of trees along the streets out there, makin' things pretty dark; an' right in the darkest place, I hears somebody scufflin'. I advances along the sidewalk, navigatin' pretty cautious like at first but when I gets up close, I sees it's a girl grapplin' with a fellow. Course then, right away, I rushes in an' slams the guy one—an' quick as a cat, he turns on me, an' cracks me right square in the eye! Believe me, that was all he ever did, too!—I just lit into him an' hammers the everblastin' daylights out of him, finishin' him up with a tap under the jaw that lays him out on the sidewalk. I was thinkin' of calling a cop to cart him to the cooler, but first I lights a match to have a look at the geiser; an' who should it be but one of the cadets on the 'La Hermosa.' Though he's been on the ship only a trip, I'd already sized him up for a sneaky, yellow-livered skunk, an' I had no use for him, but when I recognizes him there on the sidewalk, I thinks to myself that shipmates is shipmates, an' he's probably only full of jackass moonshine, anyway; so, instead of callin' a cop, I just disposes him comfortable in the gutter an' leaves him there. Then I takes Peaches-an'-Cream home — an' that's how I met her."

"She lives near Carter Jackson, in Burlingame, then?"

"No, she lives in Oakland, but last

night she was out to Burlingame to visit a sick friend, she said.''

Cunningham suddenly became thoughtful.

"That sick friend business is surely old stuff,'' he remarked, cryptically.

"I don't get you.''

"I mean, I think you're a bigger sucker now than you were ten years ago fresh from the hay ranch. On the identical night you go to Burlingame, this girl, who belongs across the bay in Oakland, happens to be way out there; and just at the very minute you come out of Carter Jackson's place, she is attacked right close by—and then you fall for a silly story about a sick friend, and forget all about the fact that right now you are the object of a lot of attention on the part of certain government officials—for you know, they may have a suspicion that you haven't brought up those pearls yet.''

"An' this little chicken picked up the cadet somewhere, an' slipped him a five or a ten spot to start all the racket last night—she's the queen of the secret service out to string me, I s'pose, huh!''

"She's mighty pretty and clever looking to be working here.'' Cunningham was serious.

"Aw, fergit it!'' scoffed Samuel Jones. "Because some of the hams use your audion bulbs till they get dark inside an' burn out from pure old age, an' then send 'em back to you an' say they're no good, you're beginnin' to think the whole world's crooked! Anybody can see that this is just a sweet, jolly little dame—''

"Oh, you're in love again—and every time you fall, you fall harder. Come on and eat, if you're going to.''

One afternoon, a few days later, Samuel Jones was leisurely strolling down Market Street. It was Thursday, Lillian's day off, and Samuel Jones was going to meet her at three o'clock. She had expressed a desire to see the "La Hermosa'' and he was going to take her down to the Mail pier and show her over the big ship. Drifting down Market Street, Samuel Jones paused before a big show window, filled with a dazzling display of artificial diamonds and pearls. He lingered thoughtfully before the window for a few minutes, and finally entered the store.

Later emerging, he wandered on down Market; abstractedly turned into Battery, and, almost before he knew it, found himself in the chill shadow of the customs house. Involuntarily quickening his step, he was about to hasten by, but chancing to glance up at the entrance, who should he see coming out of the revolving door but Lillian Vernaldt. Samuel Jones stopped abruptly, and then the girl saw him.

"Oh, hello,'' she smiled, coming to him, "I never thought I'd meet you down here.''

"Well, I never expected to run into you here, neither,'' answered Samuel Jones, constrainedly.

"I just came down here a few minutes ago looking for sister,'' she replied. "Sis is a stenographer here in the hydrographic office.''

Samuel Jones looked penetratingly into the sweet young face, but he could read nothing of deceit in it. If she was stringing him, she was indeed an artist.

"I was just wanderin' around killin' time, waitin' for three o'clock,'' he remarked, rather awkwardly. "Shall we go down to visit the 'La Hermosa' now?''

The girl assented, and they took a car to the Mail docks. Assisting the little blonde up the ship's gangway, Samuel Jones observed up on the bridge deck, the hulking figure of the cadet he had thrashed the night at Burlingame.

The fellow looked as though he had just returned aboard from his long drunk, and Samuel Jones wondered that the man had not been discharged from the ship. His clothes were soiled and rumpled and his coat-tail was conspicuously ripped. Catching sight of the girl and her escort, he slunk out of sight into the wheel house.

Samuel Jones spent an enjoyable hour showing his pretty charge over the big liner. At last they came to the wireless room.

"This place looks pretty good now,'' remarked Samuel Jones, after he had gone through the time worn explanation of the radio equipment, "but you ought'a seen the shack the first day we came in, after that blasted customs bunch got through with it. It sure was a wreck, all right.''

"What's this funny looking thing for?'' curiously asked the girl, picking up the shiny brass mouth-piece of the wheel house speaking tube.

"That's what I hid my pearls in last trip,'' jested Samuel Jones, taking the tube from her hand. "You see, there's a whistle in the mouthpiece that's held shut by a spring; an' so all I had to do was to slip the pearls into it and—but I'll be darned if that confounded whistle hasn't fell out again!"—Stooping and searching about the floor, he picked up a little conical metal object. "I don't know what's the matter with this blamed thing,'' he grumbled, scrutinizing the convex disc closely, "it seems to keep fallin' out of the mouth piece all the time, lately—''

"Oh, mercy, do you know, what you just said about those pearls of yours reminds me of something I was going to tell you,''—broke in the girl, a troubled look in her pretty eyes. "Remember, just now, I told you about sister's working in the hydrographic office?"

"Yes,'' prompted Samuel Jones, wondering.

"Well, oh dear, maybe there's nothing to it, but sister told me just last night that as she was going down a corridor in the customs house yesterday afternoon, she heard some men telling another one that you haven't brought those pearls at all, as the papers say you did; and she said she heard the man say he was pretty sure you would have them with you next trip.''

"Sufferin' wildcats! Jackson was right!'' ejaculated Samuel Jones, half-involuntarily.

"Who?"

"The man the pearls belong to,'' answered Samuel Jones. "You know, the reason I was out to Burlingame the other night when I met you, was to tell Jackson why I'd left the pearls behind last trip. We was in his library, which has a big French window openin' onto his garden, an' somehow he had a hunch all the time that somebody was snoopin' around outside listenin' to us—an' I guess he was right, too!''

"Then you actually are going to bring up those wonderful pearls next trip?''

"Yes, I'll have 'em next trip, all right, an I don't give a whoop if that confounded customs crowd do know it—they're only a bunch of boneheads, anyway.''

"And are you really going to put them in that thing there?'' she queried wonderingly, pointing to the speaking tube, which Samuel Jones still had in his hand.

"No, I was only jokin' you about that—that's the first place they'd look,'' answered Samuel Jones, smiling at her innocent credulousness. "There's all kinds of places to hide a little package like that aboard this big ship but the idea is to put it in something it can be slipped ashore in—an' believe me, I've got a humdinger of a scheme for doin' it too.''

"How?'' she asked, simply.

Samuel Jones seemed unconsciously driven on by the little blonde's infantile gaze of wide-eyed curiosity. Opening a locker, he took out an audion B-battery.

"You see, this thing is all full of little dry cells,'' he explained holding the object up to view, "Now, s'posing, I take this battery to pieces an' dig the filler out of every cell, I can put two or three pearls in the bottom of each one, then I can shorten up the little carbons an' put 'em back with the filler, seal up the tops, an' finally put all the cells together in the box an' run it full of the sealing-compound. If the job's done careful, it'll look natural, but the best of it is, the B-battery will give juice, same as ever, an' I can put it right into the receivin' cabinet an' use it. Then, when we get into Frisco, I'll bust a wire or somethin' in the cabinet, so the wireless company's inspector'll have to send it ashore to the shop. The B-battery will go with it; an' it'll be no trick for me to breeze into the shop long about lunch time an' get the battery out—an' the stunt's all done.''

Once more the "La Hermosa'' made the run to Panama. Northbound at Mazatlan, the **package of priceless pearls** were delivered aboard, into the hands of Samuel Jones, and the audacious brass-pounder made but little effort to conceal the fact.

In the course of his watches north, he carefully took apart, and reassembled, the spare B-battery. Having brought some extra sealing compound along for the purpose, he did the job with such minute and painstaking care that when finished the B-battery appeared to have never been tampered with. It showed an almost normal voltage, and Samuel Jones put it into the receiving cabinet, removing the other one.

The night before the arrival of the "La Hermosa" at San Francisco, there came a message from KPH:

"Jones La Hermosa Found serge Beware Jackson.''

A strange message; but Samuel Jones thought he understood it, and he smiled, grimly.

Almost before the big liner had dropped anchor in quarantine, the customs' tugboat was alongside. Samuel Jones sat in the radio cabin, calmly awaiting developments. He had not long to wait. The wireless room door was thrown open, and in marched two inspectors. With them was their blotchy-faced, coarse-featured chief, Merboler himself. Also in the party, and carrying his tool kit, was the sour-tempered wireless company's inspector. It was he who spoke first.

"So you're going to play me for a sucker with your pearl game, eh?'' he snarled, sarcastically. "Well now we'll proceed to see who's the biggest sucker!''

He advanced to the table, opened the receiving cabinet, and took out the B-battery. Laying it on the floor, he got a hammer out of his kit and began to

(Continued on Page 22)

THE MEASUREMENT OF SMALL VALUES OF INDUCTANCE AND EFFECTIVE RESISTANCE*

By J. K. WEBB and C. BROOKES-SMITH

Introduction

THE behaviour of cables used for communication purposes depends on the four parameters, dielectric capacity, leakance, inductance, and effective resistance. In experimental work considerable saving may be effected if these can be determined accurately on very short samples of the order of about two metres upwards. From these measurements a reliable forecast of the constants of the final cable may be deduced.

In the case of dielectric capacity and leakance the well-known capacity and conductance bridge fulfils all requirements, but for the measurement of the remaining two parameters, no analogous bridge has been available and consequently it has been necessary to develop one.

This bridge, known as the a-c.-d-c. bridge, in addition to inductance, measures the resistance to alternating and direct current of the sample under test and hence, by subtraction, the increment of resistance due to inductive effects such as the skin effect in the copper conductor, and the eddy current and hysteresis loss in the loading material.

Measurements with a-c. and d-c. may be made without disturbing the sample in such quick succession that errors due to change of temperature are obviated.

The bridge can also be used to measure the magnetic properties of very small samples of the loading material, i. e., permeability hysteresis, and eddy current loss at known field strengths and, in the case of cables for carrier frequencies, the effect of the screening, lead sheath, and armour on the resistance increment. Tests performed before and after removal of the metallic components surrounding the conductor enable valuable empirical data to be obtained. It has been found possible to obtain complete magnetic and loss data on a length of only two metres of 0.1 millimeter loading wire.

Bridge Circuit Employed

Since there are a variety of well-known methods available for the accurate measurement of small inductances, the main problem has been the determination of effective resistance in increments as low as 0.0001 ohms at very low field strengths in the loading material and, hence, correspondingly low currents in the sample.

The range of measurement found most desirable was inductance from 1 to 300 microhenries, and resistance from 0.0001 to 10 ohms over the frequency range of 100 to 70,000 cycles p:s. These limitations greatly restrict the choice of circuit in order that accuracy may be combined with sufficient sensitivity while errors, due to stray capacities, inductances, and contact resistances, may be kept negligible.

A simple substitution method has been found most effective in meeting these requirements, the circuit being given on front cover. This is essentially an equal ratio bridge in which an initial zero balance is obtained with the sample short circuited. After the short circuit across the sample is removed, balance is restored by decreasing the variable inductance and resistance in the same arm as the sample, the other three arms of the bridge remaining undisturbed. The amount of such decrease gives a measure of the effective resistance and inductance of the sample. Similar measurements are made both with a-c. and d-c., and from these the increment of effective a-c. resistance over the d-c. resistance may be computed.

Any errors due to stray capacities, etc., are thus seen to be confined to the one arm, CD, of the bridge in which the sample is inserted; the remaining three arms, being fixed, merely serve to complete the bridge network, and all errors in the latter cancel out on account of the double balance.

The inductance L_1 consists of three separate variable inductances in series, having maximum values of 350, 20, and 0.1 microhenries respectively. Each is constructed astatically and is sufficiently isolated to reduce mutual effects to a negligible value. The chief trouble in connection with the design of these inductances lay in their tendency to change their effective resistance with different settings but by using litzendraht wire, carefully spacing and supporting the coils by the minimum of solid dielectric material and supporting them in holders without having resort to any metal in the form of screws, spindles, and bushes, such trouble was almost entirely overcome. The smallest inductance is provided mainly to obtain the high degree of bridge balance necessary to observe small changes in resistance.

In the design of the variable resistance R_3 the main problem was to obtain a total variation of about 10 ohms in increments of 0.0001 ohm without appreciable error due to contacts. This was successfully achieved by adopting the form of a five-dial shunted coil variable decade resistance, the five decades having ten steps each of 1.0, 0.1, 0.01, 0.001, and 0.0001 ohm, respectively. In this arrangement each of five single coils is successively shunted by ten coils so as to provide a complete decade, with the result that very small increments of resistance can be obtained without any great difficulty in adjusting individual resistance coils and without the introduction of errors due to contact resistance of the switches.

The connections to the shunted coil decades are so arranged that increasing dial readings decrease the resistance in the circuit. In the same way the measuring inductance L_1 is arranged so that increasing dial readings actually correspond to decreasing inductance in the circuit. By this means the resistance and inductance of the sample is read on the dials directly if L_1 and R_3 indicate zero when the sample is short circuited.

In order to effect this zero adjustment a small variable resistance and inductance is provided in the adjacent AD arm of the bridge. Four shunted coil decades of total variation of about 1 ohm and a small variable self-inductance L_3 are provided for this purpose. The total resistance of both the AD and CD arms is in each case made up to 20 ohms, by the addition of fixed resistances.

Since measurements on magnetic samples are usually a function of current and, in practice, this latter is often extremely small, some method of determining the current traversing the sample

*Reproduced from "Electrical Communication," July, 1934

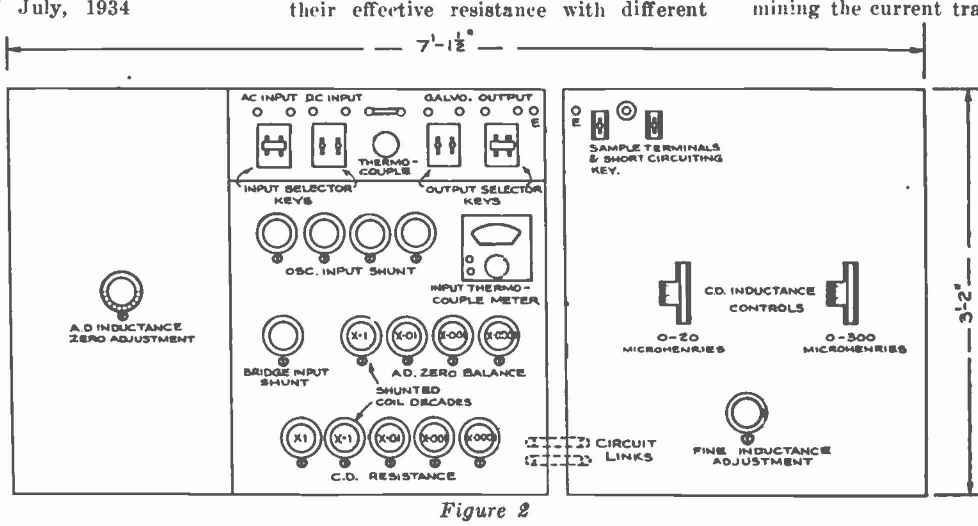

Figure 2

was found essential. This was simply and effectively done by shunting known fractions of the total input current into the bridge network. The total current is of such a value that it can readily be measured by means of a thermocouple ammeter. Three shunts are provided, and are connected as in Fig. 1. The switch positions are marked with powers which indicate the ratio between the measured total input current and the current in the sample. In order that the ratio may not vary with frequency, each shunt is designed to have the same time constant as the bridge network, this being effected by making the shunt coils of manganin wire having small toroidal inductances of copper wire in series. The difficulty of reading very small currents with a thermocouple is thus overcome.

Keys are provided to connect either a-c. or d-c. to the bridge input, and either an amplifier or d-c. galvanometer to the output. For a-c. work up to 3000 or 4000 p:s., an amplifier having a gain of 80 db. is used, and above this fre-

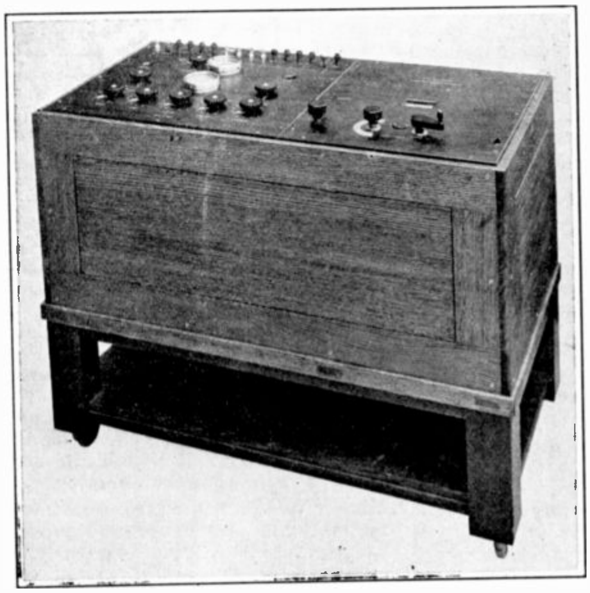

Figure 3

quency a heterodyne detector. For d-c., in cases where it is undesirable to circulate other than an extremely small current in the sample owing to trouble due to unilateral magnetisation effects, sufficient sensitivity is obtained by using a Paschan type galvanometer. If, however, it is permissible to pass a larger current through the sample, any ordinary galvanometer will suffice, although its resistance should preferably be less than 20 ohms.

Construction

A semi-portable truck type of construction has been adopted, the general plan of the layout being given in Fig. 2. As the bridge assembly is nearly 3½ metres long, it has been divided into two truck units which couple together rigidly when the bridge is set up for use, but which may be uncoupled to facilitate movement about the laboratory or test-room. The principal unit includes all the input circuits, controls, etc.; the second unit containing only the variable inductances in the d-c. arm. This arrangement gives a satisfactory grouping of the component apparatus, and also keeps the variable self-inductances as far as possible away from metallic objects. The screening is of the simplest type and is restricted to a single earth screen round the ratio arms, the leads to the output transformer and the measuring resistance in the CD arm. To avoid magnetic pick-up, the input and output transformers are magnetically shielded. The D corner of the bridge is connected to earth, and the side panel of the truck nearest the operator is lined with metallised paper which is also earthed. There is no metal in sufficient proximity to the variable inductances to give rise to any error due to their tendency to change their effective resistance with change of inductance. Fig. 3 is a photograph of an earlier model of the bridge, which, however, does not incorporate a number of the refinements subsequently found advisable, although it serves to show the type of construction adopted.

Accuracy

The bridge may readily be calibrated for inductance by comparing measurements made on fixed inductances covering its entire range with those obtained by any of the several alternative methods which are available and of unquestioned accuracy. This has been done without difficulty.

The calibration of the bridge in terms of effective resistance, however, has presented a real problem, since there is no good alternative method available for purposes of cross-checking. A close consideration of the problem led to the adoption of the following method as the most practical and reliable.

A series of inductive resistances was constructed, the various values of the inductances being chosen to cover the range of the bridge. The increment of a-c. effective resistance of these coils over the d-c. resistance was reduced to a minimum by using litzendraht copper wire wound in the form of a single layer coil, air spaced, with the minimum of support on an ebonite former. The dimensions of the coils were chosen to give as large a time constant as practicable. No metal was permitted within a considerable distance. The increment of effective resistance of such coils, while being quite small, may be calculated at 70 kc., the value being about 12% only of the d-c. resistance. These effective resistance standards were then measured by means of the bridge, and results compared with the calculated values, the difference giving the bridge error.

The curves in Fig. 4 show the results thus obtained, the correction being expressed as the increment of resistance which must be deducted from the figures obtained on a sample at any particular value of inductance, and for the frequency at which the measurement is made.

The change of phase angle of the shunted coil decade resistance with alteration of setting has been examined, but with each individual coil manufactured and adjusted to give as low a phase angle as possible, errors due to this cause are negligible.

The sensitivity of the bridge balance leaves little to be desired; an increment of 0.0001 ohm is readily observed under

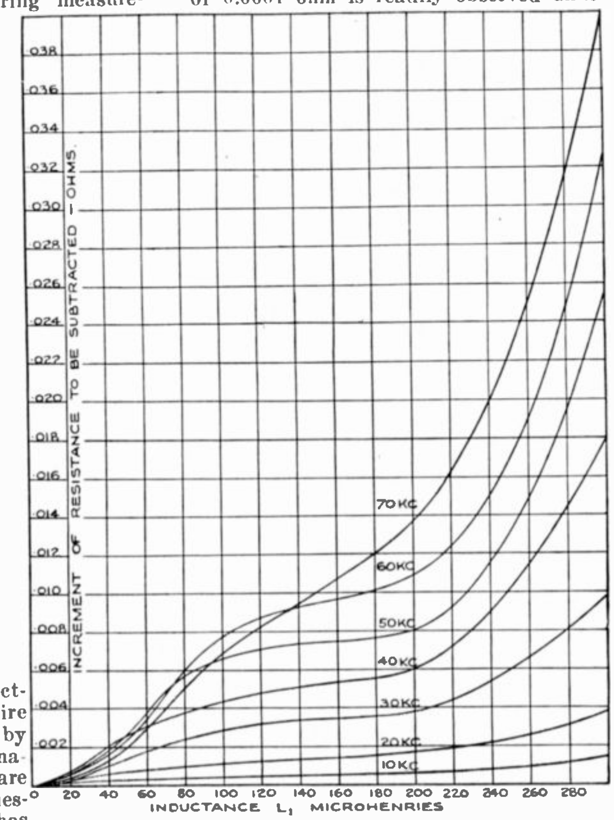

Figure 4

normal conditions, both with a-c. and d-c. In balancing with d-c., possible errors due to thermo-electric effects are ruled out by always working with the galvanometer circuit closed. In this case, however, an approximate inductive balance should also be obtained to avoid inductive kicks on the galvanometer when switching the current on and off. All connections in the d-c. circuit are also made of copper so that thermo-electric currents hardly exist.

While the accuracy obtainable is to some extent dependent on the nature of the sample and other circumstances, in general, the effective resistance of an inductive resistance of value 0.1 ohm may be obtained with an accuracy better than 1% at all frequencies up to 70 kc. While this is the highest frequency for which the bridge has been used up to date there is, of course, no reason why measurements should not be made at even higher frequencies.

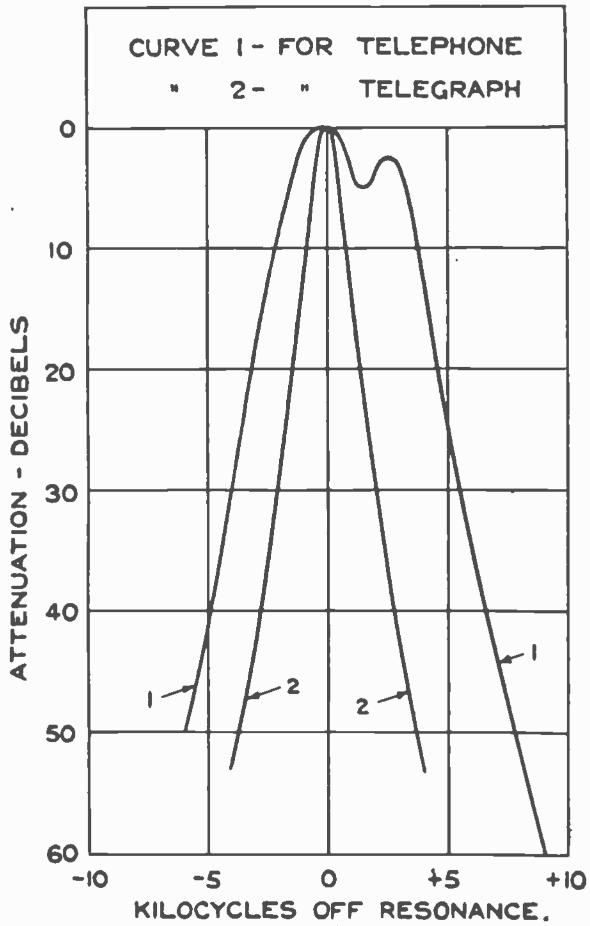

Figure 5—Selectivity Curve of R.M. 7 Receiver

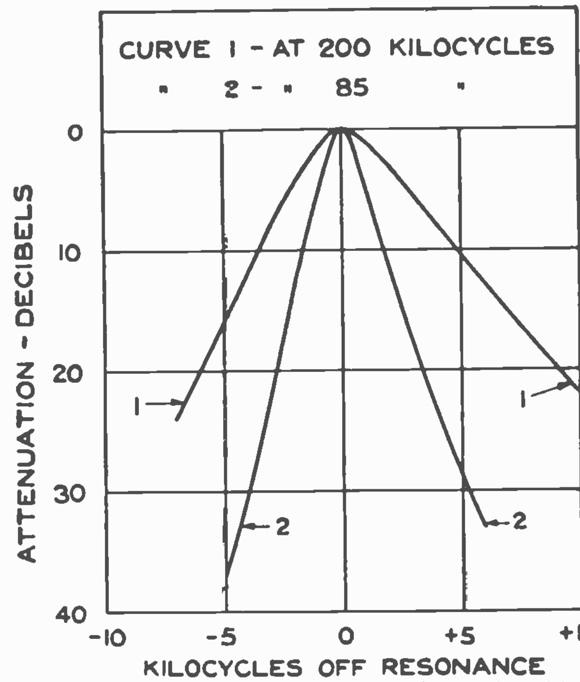

Figure 7—Selectivity Curve of R.M.8 Receiver

NEW "STANDARD" RADIO RECEIVERS

(Continued from Page 6)

power pentode, and automatic gain control valve. The latter can also be made to oscillate for the heterodyne reception of C.W. telegraph. The high and intermediate frequency amplifiers are variable mu pentodes which are silent and very stable in operation and which give high gain.

The wavelength range (13.5 to 250 metres) is covered by means of a three-position switch and variable condensers. No plug-in coils are used, thus making for very easy operation. The radio frequency signal is fed through a tuned circuit to the high frequency amplifier valve which is coupled to the first detector through two further tuned circuits. Three tuned circuits are included so that second channel interference (image frequency) may be sufficiently attenuated.

The intermediate frequency amplifier operates at 600 kilocycles, and incorporates a two-position band-width circuit. The selectivity may be altered by the simple action of operating a switch, a facility which is of considerable value in the operation of the receiver. The operator can first set the selectivity for broad tuning under which condition the band-width will be about 35 kilocycles and then switch to the other position when the required signal is found, thus narrowing the band and increasing the selectivity.

Following the second detector, the signal is amplified by a pentode valve which is provided with an output transformer to give an output impedance suitable for working into a 600 ohm line.

The automatic gain control valve is used to keep the signal steady during fading periods. The automatic gain control characteristic is such that for an increase of field strength of 40 db. the output level of the audio signal is increased only by 2 db. The time constant for the automatic gain control circuit can be changed by means of a switch from a value of approximately 0.8 seconds to approximately 0.2 seconds. The longer time constant is used when the receiver is operating on high speed telegraphy and will take up slow fading without being falsely operated by the telegraph impulses or noise. The shorter time constant is used for telephone reception. It will be appreciated that the automatic gain control in conjunction with the volume limiter described below, will result in a very constant output and low noise level.

When the receiver is used for the reception of C.W., the automatic gain control valve is made to oscillate. This setting is also used in searching for the carrier of a telephone system upon which no modulation is present, an audible beat note being obtained when the operator passes through the carrier in searching for the station.

A signal limiter or click suppressor is included in the receiver to limit the strength of the audio signal, thus protecting the operator's ears from acoustic shock when passing through the field of a powerful transmitter. The limiter consists of a copper oxide rectifier whose resistance at a predetermined voltage drops rapidly, thus limiting the signal. It should be noted that the time constant of the limiter is negligible and it will, therefore, take up static and other shocks of a similar nature. It therefore follows that in addition to its protective function, this limiter will often be of assistance in reading weak signals through heavy static.

In order to increase the signal to noise ratio when the receiver is taking telegraphy, a band pass filter is connected in the output of the second detector. This filter passes a frequency band from approximately 850 to 1250 cycles per sec-

(Continued on Page 21)

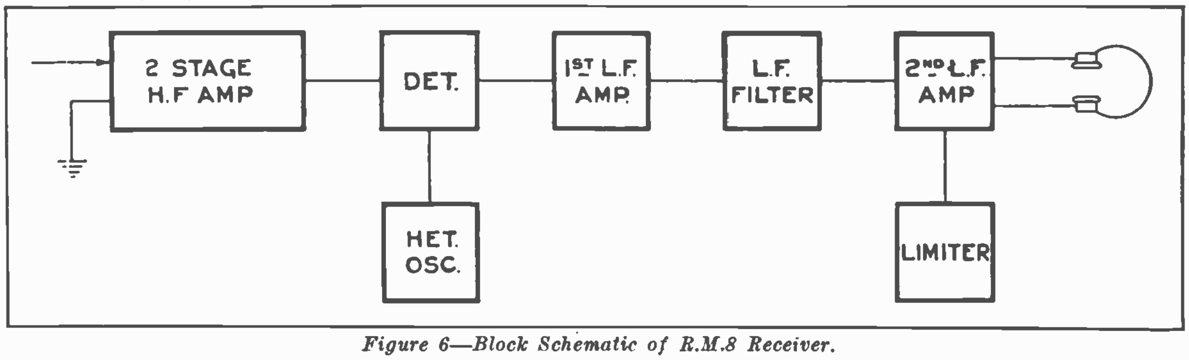

Figure 6—Block Schematic of R.M.8 Receiver.

SIMPLIFIED DISC RECORDING

By E. E. GRIFFIN

Chief Engineer, Universal Microphone Co., Inglewood, Cal.

(Continued from June Issue)

The turntable proper upon which the recording blank is placed for recording should be as heavy as possible to produce a stored energy in rotation that overcomes any braking effects of heavy modulation in the recording. A 16 in. disc turntable should weigh approximately eight to ten pounds minimum to insure results—highly professional equipment will weigh thirty-five to forty pounds.

Recording Heads

The Universal combination pickup and recording head offers an excellent recorder and playback in one instrument where minimum installation space and weight are of prime importance, and when used with Universal 12 in. lead screw, makes the ideal compact installation. It is of proper impedance to match the primary side of a standard No. 1089 microphone input transformer when used as a playback; and is matched by a No. 1152 tube-to-line transformer when used as a recording head.

Unweighted, the needle pressure upon the record is 6 oz.; an additional weight of 8 oz. being furnished for use when recording. Five watts of energy can be safely handled by this recorder and it should not be confused with ordinary phonograph pickup, the parts, magnetic field, voice coil—in fact the entire unit is made to receive power.

For professional use. the Universal Power Recording Head is recommended. This device can safely handle 10 watts of energy, and is provided with screw damping adjustments, in addition to being adjustable for needle pressure and needle angle. Lever adjustment for pressure provides variation from 2 to 12 oz. A 12 ohm Electro-magnetic field coil, which must be supplied 6 volts, provides a powerful concentrated field, thus overcoming the inherent difficulties of a permanent magnet. The special alloy armature is mechanically and electrically balanced between four pole pieces affecting a true push-pull action, thus assuring high fidelity and maximum sensitivity to all frequencies. When properly matched to a high quality amplifier, this recording head provides a depth and brilliancy unobtainable by any other recording device.

The adjustable feature of a recording head allows it to be tuned while in operation. This is accomplished by resting the stylus on the edge of a thin wooden partition such as cigar box wood, making damping adjustments for volume and quality by ear.

Types of Record Material

Choice in the type of material to be recorded upon depends entirely upon the individual. Excellent results being obtained on either the processed Universal aluminum, cellulose, or the blank celluloid.

There are three types of grooves in use for recording involving three entirely different methods of obtaining results.

In the first instance pregrooved records either of metal or composition are available. The needle used has a blunt nose following in the groove and modulated by the amplifier to bend the already constructed groove to the frequency applied.

The proper needle for *pregrooved aluminum* and for pregrooved black composition records is type B, which should be used at an angle of from twenty-five to twenty-eight degrees from vertical in both recording and playback. In recording on pregrooved aluminum. weight should be applied to the recording head so as to give the needle an actual weight upon the record of from 12 to 16 ounces.

Pregrooved aluminum discs offer the simplest method. These records can be played back instantaneously, that is, immediately after they are made, using a non-metallic needle such as a thistle or cactus needle.

In playing back, a needle pressure of 4 to 6 oz. is sufficient. Maximum fidelity and brilliancy will be obtained when playback is made with the same needle as used in recording. Record life, however, will be sacrificed, as each playing with the hard needle tends to smooth out the groove modulations. If it is desired to preserve the record indefinitely, playback should be done with type "F" needle only.

The next method of operation, and one which is rapidly supplanting pregrooved is blank records in combination with a lead screw which is driven from the center of the turntable and carries the cutting head across the disc while the recording is going on, making the groove and modulating at the same time. In other words, the groove is cut at the various angles during the time it is being grooved in the material. In the case of the aluminum, this groove is not actually cut out of the metal, it is instead "spun" or "creased" in the metal.

For *ungrooved aluminum* records the special shape point type "A" is necessary, and recording should be done with the stylus set 28 degrees from vertical. Actual needle pressure upon the record should be from 10 to 14 oz. A lead screw, driven from the center spindle of the turntable guides the recording head across the face of the record at the proper speed to give 80 to 100 grooves per inch. In this type of recording, the record is not cut, the groove being "creased" in the surface of the aluminum, retaining the polished nature of the surface; resulting in recordings with a minimum of surface noise. Playback on this type is best obtained by the use of type "F" needle with a pressure of 4 to 6 ounces.

In the case of aluminum records it has been found that the groove being spun in the metal, guided by the lead screw, modulated by the amplifier, retains the surface finish of the metal for the side walls of the groove. This is done by the use of an extremely highly polished sapphire needle having the proper point and operated at angles that experience has shown to be best for this purpose, namely, from twenty-five to twenty-eight degrees from vertical.

Aluminum blanks and pregrooved discs both are furnished processed with a buffed-in lubricant to supply that very necessary element while the recording is being done and to eliminate tearing and scratching of the very delicately polished surface of the aluminum blank and at the same time makes for a silent background and eliminates needle scratch as it is sometimes called.

For records such as cellulose nitrate coated discs, celluloid, cellulose acetate, gelatine, etc., the cutting stylus actually cuts out from the surface of the disc, a small shaving or thread of the material, leaving a groove of the shape and with the irregularities corresponding to the frequencies fed to the cutting stylus by means of the amplifier and recording head. In the case of above types of records, a special cutting needle, type "D," is required; operated at an angle of 2 degrees from vertical. The point of this needle is similar in shape to a lathe cutting tool and in operation, it actually cuts out a fine thread of material from the record. The pressure of the needle on the record should be from one to two ounces, depending upon the density of the material being cut.

When cutting this material with the Universal Power Recording head, a type "E" stylus is used. The sapphire point of this needle is identical to the type "D" but is provided with a shank bent on an angle of 28 degrees, allowing the head to be used for either aluminum or cellulose without change of head angle.

Playback on this type of record can be accomplished by the fibre needle type "F," or a bent shoe type of trailing needle.

This last method although possessing a high degree of fidelity, has the disadvantage of high surface noise level, especially when the cutting edges of the needle become dull. Surface noise can be compensated for by a scratch filter of proper value, depending upon the impedance of the playback head.

Playing Back of Records

In playing back aluminum records, whether pregrooved discs or blank and cut with the lead screw as described above, a non-metallic needle has been found best because it will remove the surface sound and reproduces a tonal quality not obtained by other types of needles. To play an aluminum record with an ordinarily steel phonograph needle so mutilates or scratches it, that it is destroyed as to musical value.

All composition may be played back with bamboo or non-metallic needles and give very good results without damage or deterioration of the record groove. For the playing of aluminum records a non-metallic needle, known as the fibre-bamboo needle, has been found to be most satisfactory with the one disadvantage of wear. It is necessary to resharpen after each playing. The general procedure is to have a quantity of these sharpened and to change the needle between each playing and thus maintain a high quality output at all times. Needles may be sharpened with a small hand sharpener in a few seconds—the sharpener, needles, etc., all being shown in the Universal Microphone Company's catalog named at the beginning of this article. While the sharpening of needles between each playing might appear irksome to some users, the quality of reproduction and the safe-guarding of the record from deterioration due to the use of improper needles fully offset the slight disadvantage of the necessity of sharpening between playings.

When using the Universal 400 ohm pick-up for playback, the Universal Tone Control provides an adjustable filter eliminating surface noise to the minimum.

Mounting the Lead Screw

In the actual mounting of the lead screw, the main bearing with clutch collar should be firmly pressed down upon the spindle of turntable and pressure applied against the record with the top thumb nut loose.

While downward pressure is applied with one hand, the thumb screw should be tightened firmly with the other hand, this action serving to further increase the bind-pressure against the record.

The outboard bearing should be placed so there will be no binding effect laterally upon the main bearing. After finding this position, the outboard bearing should be screwed to the turntable mounting board. Then the turntable should be further rotated with the set screw of the outboard bearing loosened, allowing a slight up and down motion until the average position vertically has been determined. The threaded rod should assume a position parallel to the face of the record.

The set screw should then be tightened and the device allowed to run a few minutes to determine whether there is a binding effect at the bearing point. If the turntable spindle is mechanically true, there should be no noticeable load or additional power required to operate the device.

Mounting the Pick-Up

Next in importance is the location of the phonograph pick-up arm. This position can be found by placing the pick-up head at a midway position between the outer rim of the record and the inside limit of recording space or, in other words, the inside diameter of the maximum allowable recording space.

With the head in this half-way position, the arm should extend exactly at right angles to the threaded rod of the lead screw. In such position, the head will be the same distance from the threaded rod when starting the record at the edge of the disc as when it finishes cutting at the center.

When the head is at the centered position it should be as close as possible to the threaded rod without actually touching. The guide should then be attached to the pick-up head, and a right angle bend made in the spring as close to the head as possible, allowing just sufficient pressure so that the shoe rides in the groove of the thread without side play.

The best results will be obtained when the guide shoe and spring are in an almost horizontal position, since in this manner only will the pressure on the record be the same at the outer rim of the record as when in the center.

When the turntable does not run perfectly level it will be necessary to apply slightly more pressure to take up the variation, in which case more weight will necessarily have to be used on the recording head.

Weight on the Recorder While Recording

No hard fast rule can be given in regard to the weight upon the recording needle while recording, but in general it has been found that the best results on aluminum are obtained by the use of from 10 to 14 ounces and in the case of non-metallic material, depending upon the exact nature and type, one to two ounces is all that is required, being due to the fact that in one case you actually spin a groove as explained above, and in the other case the sapphire stylus is in reality a minute cutting point such as would be used in a turning lathe and removes, as stated above, a fine thread of the material while the disc is rotating.

Playing Time of Records

Playing Time of Records—80 lines per inch

At 78 R.P.M. 12 in. record plays 4 min.—16 in. 6 minutes.

At 33 1/3 R. P. M. 12 in. record plays 10 min. 16 in. 15 minutes.

Playing Time of Records—100 lines per inch

At 78 R.P.M. 12 in. record plays 5 min. 16 in. 7½ minutes.

At 33 1/3 R.P.M. 12 in. record plays 12 min. 16 in. 18 minutes.

Discussion

If a sustained musical note has a waver or tremble or does not sound like the original, the cause most likely lies in the turntable drive, either the motor hasn't sufficient power, or the driving clutch is slipping or there is irregular action in the turntable.

If the playback needle does not stay in the groove either the groove is not deep enough or the playback needle is dull or the tone arm binds or is not properly installed, or the turntable not level.

Cross grooving is caused by over modulation. Just enough modulation for volume in playback should be used. This angle must be watched.

Groove noise or scratch is not always in the material itself. Make a few grooves, disconnecting the amplifier from the cutter but using the same cutter, weight, etc. In other words make a silent groove and play it back at same volume control adjustment as when playing a regular record, then make a few grooves with amplifier connected but the input to amplifier disconnected and make comparisons.

In making your first test record make a dozen grooves at various settings of volume, and with various weight adjustments, write down on a piece of paper or announce thru the microphone the setting that particular series of grooves were made at, when played back the best result will indicate the proper adjustments as to volume, etc. It is not necessary to use an entire record for each test. A dozen grooves are enough. You can turn off switch on turntable leaving everything intact, then change adjustments, start turntable for another test of 12 grooves or more and continue until all settings are determined.

Remember 12-inch discs are cheapest in the long run for tests and for use. Use every care and precaution in assembling for recording in the wiring and every detail. Thrown together parts will not give results or satisfaction.

The use of a good magnifying glass to enable the record grooves to be examined is of great help, and often saves much time and expense in experimentation. A jeweler's eye glass, or other medium powered glass enables the individual groove to be examined for defects such as cross modulation, side tearing and side cutting. Cross cutting of the grooves when over modulated becomes immediately apparent when examined under a glass. On ungrooved aluminum, a roughened groove fringe will cause excessive surface noise in playback, and is caused by either too much needle pressure or by a roughened or worn needle.

On cellulose or celluloid material, the sharpness of the needle edges is of utmost importance in the eliminating of surface noise. As the edges of the needle become dulled, a tearing of the groove sides takes place. Such a condition of the needle or of the groove can be determined only by the use of a glass.

On certain types of composition records, wearing quality can be improved by the application of a thin high grade vaseline, which is applied to the record surface immediately after it is recorded upon, the surplus being wiped off with a soft cloth. Such procedure also tends to reduce surface noise.

On celluloid records surface noise can be reduced by the application of a solution of equal parts of distilled water and alcohol, thoroughly wiping the surface of the blank with a soft cloth moistened in the solution, just before recording. The solution has a slight softening action upon the record surface thus permitting a smoother cut. If a few drops of acetone are added to the alcohol before being mixed with the distilled water, this softening action is greatly increased, but the record must be allowed to thoroughly dry after the recording has been done, in order that it may gain its original hardness.

Finally, it must be remembered that the quality of recordings obtained by any method, will be governed by the attention to detail in every particular. If due care is exercised in the set-up of all parts from the sound source, through the amplifier, to recording head, and lastly, to the actual grooves of the record, high quality recordings will be assured.

Birmingham Goes IBEW

The three broadcasting stations in Birmingham, Ala., recently signed working agreements with the IBEW. The terms are a forty hour week and thirty dollars a week minimum.

Pioneer Wireless Operators

(Continued from Page 11)

this may never be the policy of our Company. . .

Our President, and all the officials of this Corporation have watched with intense pride the heroic efforts you boys have made, the great patience through long months of discouragement and difficulties which have necessarily preceded this success for which all have generally striven. I myself deeply appreciate the nature of your labours, your trials, the hardships you have undergone, for it has been my good fortune to have been with some of you at your posts, and shared in while directing your work.

This work, these experiments, these long-drawn out tests, carried on in the face of unpleasant and manifold difficulties have, I believe not only achieved the wireless success intended, but have been the means of developing character, a determination to bear and achieve like good soldiers, have ripened a friendship and a loyalty to one another and to a worthy cause, which constitutes in life element so of even greater value than commercial success.

We do not, we cannot forget the obstacles you have had to face and which you have bravely overcome.

For tedious months away from home in foreign lands in climates scorching and unhealthy, deprived of all usual comforts of life, tormented night and day by insect pests, distressed but not baffled by static, unknown to any other wireless workers, delayed month after month by breakdowns of Navy apparatus, continually called upon to make repairs, often without proper tools, facing skeptical criticism, some of you surrounded by hostility, open or concealed on the part of officials, from whom we had every reason to expect cooperation and interest—yet you have stuck to your posts, have triumphed over one difficulty after another, have forced new secrets from Nature, and having by your tenacity, patience and skill accomplished your ends, you have won at last an unwilling acknowledgement of the success of the system from the entire Naval Department, and set a new standard in the art of Wireless Telegraphy.

In view of your services in this unexampled undertaking, we wish to express, although in inadequate words, some portion of praise you so well deserve, and to express our confidence that this Navy work is but a beginning of the greater things we are yet to accomplish together in wireless.

Very sincerely yours,
Lee de Forest"

(To be continued in another issue)

Employment and Payrolls

A chart prepared by the United States Department of Labor extending from the year 1919 to 1934, in which the years 1923-1925 are considered averaged at 100, shows that the present payroll totals are a little better than 65% having come up from 40% the low for the period which was reached in early 1933. Employment runs at a little better than 80%, the low for the period showing around 60%. This would indicate that while employment and payroll totals are slowly moving up, salaries are still staying low, and continuing a trend started to be most pronounced the middle of 1931.

A Highly Selective Receiver

(Continued from Page 12)

er elements designed to operate at ten volts, and thus all the tubes may be operated in parallel from a 12-volt battery. A ballast lamp is used in series with the heaters and provides adequate regulation for variations in heater supply voltage from 11.5 to 14.5 volts. The total current required for the heaters is 1.9 amperes, while the plate circuit drain is approximately 40 milliamperes at 200 volts. A small dynamotor operated from the 12-volt battery furnishes this plate supply.

To allow weak signals to be received with a good signal-to-noise ratio, the step-up from the antenna to the grid of the first tube has been made high as already noted. In addition the antenna circuit had to be designed so that comparatively large changes in antenna capacity would not seriously affect its tuning. The antennas used for beacon reception are practically pure capacity with a very low resistance. During bad weather, when the operation of the receiver becomes doubly important, the antenna may become covered with a thick coating of ice which greatly increases the capacity. With the antenna circuit of the 14A receiver, the antenna capacity may be increased to several times its original value without seriously affecting the step-up between the antenna and the grid of the radio-frequency tube.

Since the radio equipment on an airplane is usually located at some distance from the pilot who operates it, the 14A receiver has been designed for remote control. Tuning may be accomplished either by a mechanical drive coupled to the receiver by a flexible shaft, or by the motor-driven tuning mechanism. Either of these controls selects any of the particular beacon frequencies that may be desired. In addition to these, however, the frequency of 224 kilocycles has been assigned for the operation of low-power airport transmitters. A fixed frequency channel has been provided in the receiver for the reception of these airport transmitters. It is not selected by the regular control but by a single switch located in one of the control units. This enables the pilot to shift easily and quickly from the main airway beacon to the local transmitter or vice versa.

To protect the receiver from the vibrations normally encountered, a shock proof mounting has been designed for installing the receiver in an airplane. A plug on the receiver engages a jack on the mounting and makes all necessary electrical connections as soon as the receiver is fastened in place. This arrangement permits the receiver to be quickly removed from the airplane for routine inspections which are made at frequent intervals.

NEW AIRPORT RECEIVERS

(Continued from Page 9)

from the airport, it may be used as a local receiver when it is desirable, by the elimination of tuning controls, to insure that the receiver is always tuned to the correct frequency without attention from the operator.

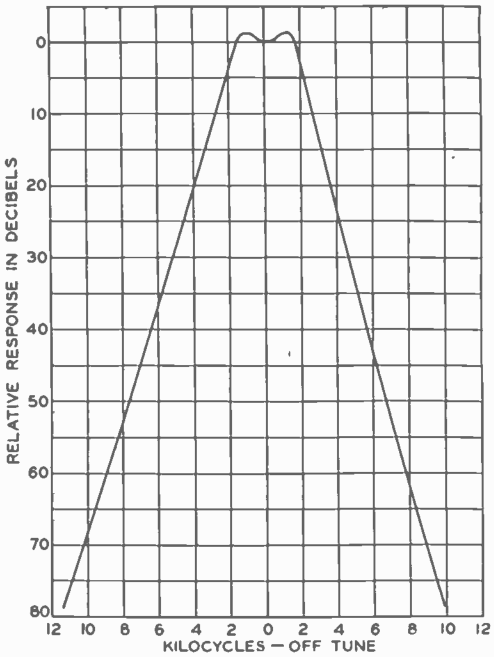

Figure 4—Close-up selectivity of the 11 type receiver

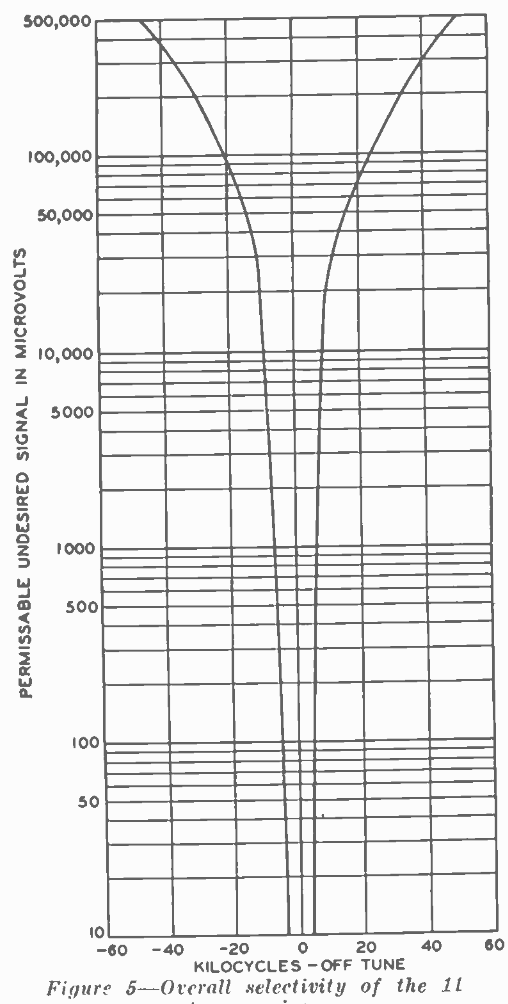

Figure 5—Overall selectivity of the 11 type receiver

The New "Standard" Radio Receivers for Commercial Links

(Continued from Page 18)

ond, and in the average case the use of the filter will increase the signal to noise ratio by 10 db.

The selectivity curve of the R.M.6 receiver measured at 20 megacycles (15 metres) with the selectivity set for telephone reception is shown in Fig. 2. It will be seen that the loss at 3.5 kilocycles on either side of the tuning point is 6 db. and this setting will give adequate quality for commercial telephone work. The curve for broad tuning used when the operator is searching for a station has a loss of 6 db. at approximately 17.5 kilocycles on each side of the tuning point.

The sensitivity is such that the receiver will furnish an audio-frequency output of 50 milliwatts for a signal input of 5 microvolts modulated 30% at 400 p:s. from a 70 ohm line. This sensitivity will give good reception from telephone signals having a field strength of 1 microvolt per metre received on a half-way dipole, providing atmospheric conditions permit.

In Fig. 3 are shown typical overall audio-frequency response curves for these receivers. The curve marked 1 is used for telephone reception, while curve 2 is used for telegraph reception and is obtained by the inclusion of the band-pass filter mentioned above.

Two volume controls are provided. The first is located immediately before the output valve, thus controlling the level to the line when the automatic gain control is in circuit; the second operates on the high frequency circuits and is used for obtaining the best operating conditions from the point of view of the automatic gain control and for the reduction of cross modulation.

A meter and a rotary switch permit measurements to be taken of the filament voltage, plate voltage and the plate current of each valve.

The receiver is mounted on a chassis which slides into the back of a metal box. A front view of the receiver is shown in Fig. 4 and it will be noticed that the front panel of the chassis is set back from the edge of the case. Mechanical protection is thus afforded for the various switches mounted on the front of the receiver. Particular care has been taken to render all parts of the receiver accessible and it has been built to stand rough usage in service.

The receiver is provided with the necessary terminals so that it may be connected to an ordinary open antenna and ground, or to a directive antenna by means of a transmission line. This transmission line may be of the balanced open-wire type or the concentric conductor type. The latter may be constructed of copper tubes insulated from each other or may be specially designed single-core radio frequency cable.

Medium-Wave Receiver

The R.M.7 receiver is in design essentially the same as the R.M.6 shown in the block schematic of Fig. 1.

It has all the features of the R.M.6 differing only in regard to the wavelength range of 250 metres to 5,000 metres and to the intermediate frequency which, in this case, is 45 kilocycles.

The selectivity curves of this receiver taken at 1,000 kilocycles (300 metres) are shown in Fig. 5. The first curve shows the receiver with the switch in the position for telephone reception where the loss is 6 db. at approximately 2.5 kilocycles on either side of the tuning point. The second curve shows the response when the switch is set for the reception of telegraphy where the loss is 6 db. at approximately 0.5 kilocycles on either side of the tuning point. It is of interest to note that the loss is some 60 db. for a total band-width of 9.0 kilocycles in the telegraph position and 16.5 kilocycles for telephony.

In addition to these two degrees of selectivity, there is another position provided, and by operating a switch the receiver may be converted to a straight set using one high-frequency amplifier, detector, and two audio-frequency amplifiers. In this position the tuning is very flat; for example, a band-width of 30 kilocycles may be received on 600 metres, so that the receiver may be used for picking up ship traffic or for other work where a close watch has to be kept on a wide frequency band. The sensitivity of this receiver is such that it will deliver an output of 50 milliwatts for an input signal of 5 microvolts modulated 30% at 400 p:s. from a small antenna. This sensitivity is sufficient to receive all signals which would be audible above the normal atmospheric noise level. Means of connecting the receiver to the antenna are similar to those employed in the R.M.6 described above.

The size of the R.M.7 receiver is the same as the R.M.6 and the two sets are almost identical in appearance.

Long-Wave Receiver

The R.M.8 receiver differs from the two preceding equipments as it is a tuned radio frequency set instead of a superheterodyne. The receiver employs six valves: two variable mu high frequency pentodes, detector, low frequency amplifier, output pentode, and separate heterodyne oscillator. The wavelength of 1,500 metres to 22,000 metres covers the long waveband. A block schematic of the receiver is shown in Fig. 6 which clearly indicates the system used.

In view of the comparative absence of fading on the waveband over which this receiver works, there is no necessity to include an automatic gain control valve, as for the shorter wavelengths. When a beat note is required for the reception of telegraphy, the separate heterodyne oscillator is adjusted to give this beat frequency in the detector circuit.

The signal limiter previously described is of particular value in this set in that it greatly facilitates reception under bad static conditions prevalent on long wavelengths.

The wavelength switch, band-pass filter and metering system are similar to those previously described, but only one gain control is fitted in place of the two necessary with automatic gain control on shorter wavelengths.

Selectivity curves are shown in Fig. 7, one curve corresponding to a radio frequency of 200 kilocycles (1,500 metres) and the other, to 85 kilocycles (3,530 metres). The band-width is sufficient for commercial telephone reception, and the band-pass filter allows the response to be narrowed for telegraphy in the manner shown in Fig. 3.

The receiver has a sensitivity such that on 150 kilocycles a signal input from the antenna of 20 microvolts will give an audio output of 50 milliwatts. When used with a normal antenna, the sensitivity is, therefore, adequate to give good reception from any signal likely to be audible above the normal atmospheric noise level.

Power Supply Unit

The power supply for these receivers is obtained either from batteries or from the mains by means of a power supply unit. When working with batteries, the filaments are connected to a 12 volt battery and the plate circuits to a 130 volt battery. The drain on the filament battery is 3 amperes for the R.M.6 and 7, and 2 amperes for the R.M.8 receiver. The plate supply drain varies somewhat depending on the service for which the receiver is being operated but the maximum value is 70 milliamperes for the R.M.6 and 7, and 45 milliamperes for the R.M.8 receiver.

When any of the receivers are required to operate from an a-c. mains supply a unit has been designed which is equally applicable to all three receivers. By means of a stepdown transformer this unit supplies the 12 volts necessary for the filament circuit of the indirectly heated valves. It also includes a full-wave rectifier valve of the micromesh type, with the necessary smoothing filter which furnishes the plate supply at 130 volts d-c. The power supply unit will function from a-c. mains having voltages from 110 to 250 volts and a periodicity from 40 to 60 cycles per second.

TRY THIS ONE

A Department of Commerce radio beacon station recently had trouble with their transmitting equipment. The key was broken in such a way that the coil spring which opens the keying contacts would not stay in place. The bracket which held the spring and carried the spring pressure to the contact arm was broken off from the rotary part, and the signal was garbled and meaningless.

Rapid repairs were impossible, so Junior Radio Operator B. H. Barker at the Des Moines, Iowa, station solved the problem in very good fashion.

He found that by stretching a rubber band to the contact point a spring pressure was accomplished, and that by adding another rubber band or so the pressure could easily be adjusted to any desired strength.

The practical value of this to any transmitting key where the spring has been lost or broken and a new part is not readily obtained can easily be seen. Some time when you are getting ready to key out your message, try it out for experimental purposes. Possibly in an emergency you may have occasion to use Barker's method for your own use.

ON THE GOOD SHIP—

Robert C. Mathewson is on the ss Seminole of the Clyde Line.

V. C. Eberlin, well-known Tropical Radio man is now chief op. on the ss Calamares of United Fruit.

Frank L. Aciero has had a few runs on the ss Eldia of the Morgan line.

Howard C. Wagar is with the Standard Shipping boat ss John Worthington.

Delery Freret is on the United Fruiter ss Zacapa, out of New Orleans.

L. Juhring is now on the ss Cuyamapa.

Charles S. Smith gave up his ss Hadnot berth and joined with RCA-Victor Co. at Camden, N. J.

Alvin Corcoran has gone on the ss W. E. Fitzgerald, a Laker.

Paul R. Leitner is on the steamer Alpena out of Detroit.

NEW FEDERAL RADIO COMMISSION RULINGS

(Continued from Page 10)

c. Call letters of the station called. (This entry need not be repeated for calls made to the same station during any sequence of communication provided the time of "signing off" is given.)

d. The input power to the oscillator, or to the final amplifier stage where an oscillator-amplifier transmitter is employed. (This need be entered only once provided the input power is not changed.)

e. The frequency band used. (This information need be entered only once in the log for all transmissions until there is a change in frequency to another amateur band.)

f. The location of a portable or portable-mobile station at the time of each transmission. (This need be entered only once, provided the location of the station is not changed. However, suitable entry shall be made in the log upon changing location, showing the type of vehicle or mobile unit in which the station is operated, and the approximate geographical location of the station at the time of operation.)

g. The message traffic handled. (If record communications are handled in regular message form, a copy of each message sent and received shall be entered in the log or retained on file for at least one year.)

Rule 387. Advance notice of all locations in which portable amateur stations will be operated shall be given by the licensee to the Inspector in Charge of the district in which the station is to be operated. Such notices shall be made by letter or other means prior to any operation contemplated and shall state the station call, name of licensee, the date of proposed operation and the approximate locations, as by city, town, or county. An amateur station operating under this rule shall not be operated during any period exceeding thirty days without giving further notice to the Inspector in Charge of the radio district in which the station will be operated. This rule does not apply to the operation of portable or portable-mobile amateur stations on frequencies above 56,000 kilocycles authorized to be used by amateur stations. (See Rule 368.)

THE GIRL AND THE PEARLS

(Continued from Page 14)

break it to pieces. Pulling apart the cells, he got out a jack-knife and cut one of them open.

There was absolutely nothing in it but carbon and filler! The next one was the same, and is were all the rest.

For a moment, Samuel Jones, himself, was amazed; then, in a flash, he realized that in changing the B-batteries, he had got them mixed up, and had put the same battery back in the cabinet he had taken out. Involuntarily, he glanced toward the locker, in which the other B-battery was lying. The customs men saw and immediately interpreted his glance. Opening the locker, they took out the spare battery. Breaking it into pieces, likewise, the company inspector cut open a cell, and there, in the bottom wrapped in a bit of tissue-paper, now ammoniac-soaked, were two large pearls.

"Well, that's all of them,'' said the shop man, ten minutes later, as he tore up the last cell, "forty-seven altogether.''

"That's about right," returned Merboler, smirkingly, "we understand there was six in a setting, and forty-one in a necklace, which makes—what the hell!'' —the chief was picking up the pearls, and, as he did so, his face assumed an expression of amazement and disgust. "Pearls, you call them!'' he sneered, staring at them closely, "the damned things are light as feathers—they're fakes!" He pinched one and it broke to pieces—a mere shell!

Everybody gaped in amazement.

Merboler's face was distorted by a mocking grin.

"Somebody's been double-crossed for fair, I'll say!'' he chuckled derisively. He threw the things onto the table, and they fell as lightly as a shower of popcorn.

"Sorry you had all that work for nothing, young man,'' said Merboler, tauntingly, to Samuel Jones, who sat looking extremely crestfallen, "take your pearls to Carter Jackson, with my compliments!"

When the "La Hermosa'' had berthed at the Mail dock, and the passengers were all ashore, the chief radio operator, no longer in uniform, violently kicked a certain hulking cadet down the gangway. Once on the pier the obstreperous brass-pounder set upon him, blacking his eyes and battering him unmercifully, before a half-a-dozen members of the crew could rush ashore to the rescue of the half-killed cadet.

"I'll eat my hat, if I can make head or tail of it,'' declared Cunningham to Samuel Jones, as the two threaded their way through the five o'clock crowds of homeward-hastening office folk, "the pearls turned out to be fakes, and you've half-murdered a poor harmless cadet, and judging by the way you talk, you're just as crazy as ever about that little squab who double-crossed you! What's the answer to all these riddles, anyway?''

"The answer is that you're all wrong about the girl, an' the pearls, an' the poor harmless cadet,'' answered Samuel Jones, enjoying the other's mystification, "an' when I give you the dope you'll see why. You know I never was much doubtful of Lillian, but still I was afraid Merboler might get next some way to my havin' left the pearls behind last trip; an' so I figures out a swell scheme to make the whole game dead safe. I goes into a jewelry store an' buys forty-seven big artificial pearls; an' like you already know, those are what went into the bottom of the B-battery cells. I had it all planned out to send Merboler a anonymous letter, tippin' him off about the B-battery scheme, but the way it turned out I got that done for me by the cadet—''

"By the cadet?''

"Yes. You see, when I took Lillian aboard the 'La Hermosa' last trip I see the cadet sneakin' into the wheel-house, an' a little later in the wireless shack, I happens to discover that the whistle is out of my speakin' tube, which runs up to that same wheel-house. The whistle was lyin' on the floor, an' when I picked it up, I sees that it'd not fell out a'tall, but had been yanked out—an' you know, if a fellow listens in on a speakin'-tube that's got no whistle blockin' it at the off-shore end, he can hear darned near everything that's said anywheres near it. Knowin' the cadet's in the wheel house, I sees through his little game right away; so I gives Lillian a spiel about the B-battery scheme—an' all the time I'm holdin' the tube right in my hand, so's the stool-pigeon will be sure to hear it. A little later, I takes the girl up to the wheel house, showin' her around an' soon's I get a chance, I drifts over an' gets hold of the radio room speakin' tube—an' sure enough, it's still warm where the fellow's been holdin' it to his ear!

"Then, besides that, I'd noticed a piece ripped out'a the coat tail of the sneak's shore clothes which looked kind'a queer to me, someway. On the run south I gets to thinkin' how the night out at Burlingame, Jackson had thought he'd heard somebody eavesdroppin' on us; an' pretty soon, just like the dick in the dime-novel, I gets the idea that the stool-pigeon might have ripped his coat scramblin' over the iron fence around Jackson's garden, which is high an' sharp-pointed an' would be a darn mean one to climb. It all figures out pretty good; so I wires Jackson from Mazatlan to have his fence searched all around for a rag of blue serge. Sure as shootin' the night before we makes Frisco, I gets a wire from Jackson, sayin' he'd found it. Of course then I knows for sure the cadet is Merboler's stool pigeon.

"In quarantine, in the mornin', Merboler an' his gang comes rushin' aboard, an' as per the cadet's dope, digs right down into the B-batteries. Then, when they found the pearls was all flooey, they just thought somebody's cold-decked the deal down in Mexico. The idea tickles Merboler so much the damn fool never thinks to look around for any other pearls—an' there I am sittin' with the whole works right in my pocket! Of course, I reckon the fake pearls bein' salted down so nice an' neat that way would've fooled even a brainy guy, not to speak of Merboler, who ain't got no more brains than the back end of a burro.

"So they goes ashore an' the ship docks; an' I was feelin' so hell-fired happy I just chases that sneaky yellow-livered stool-pigeon down onto the dock an' drums the daylights out'a him—I just couldn't help it, I felt so good!"

"Then I suppose Jackson has his pearls, at last?''

"You'd do more'n just suppose it, if you'd saw the check he gave me,'' returned Samuel Jones, exuberantly, "it's got four figures in it—an' the first figure's no small one, neither—an' oh boy! —this evenin' the little blonde baby an' I are going to charter a buzz wagon an' have one grand blow-out! Believe me, there's goin' to be a hot time in the ol' town tonight!''—and parting with Cunningham at the corner, Samuel Jones turned his face toward "Leighman's Cafeteria."

Broadcasters to Cincinnati

The National Association of Broadcasters will hold their meeting this year in September, at Cincinnati, Ohio. It is expected that much interest will be taken by members in the WLW, Crosley, 500 KW installation at the time of their meeting.