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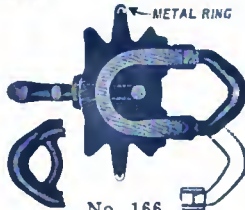
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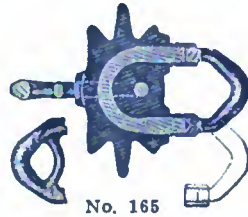
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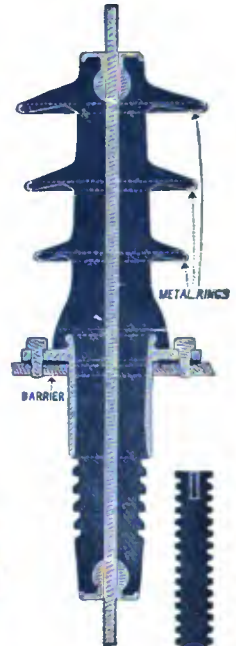
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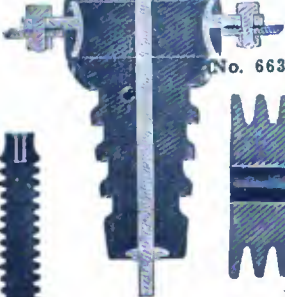
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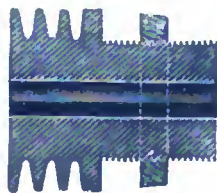
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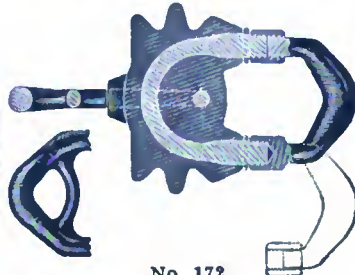
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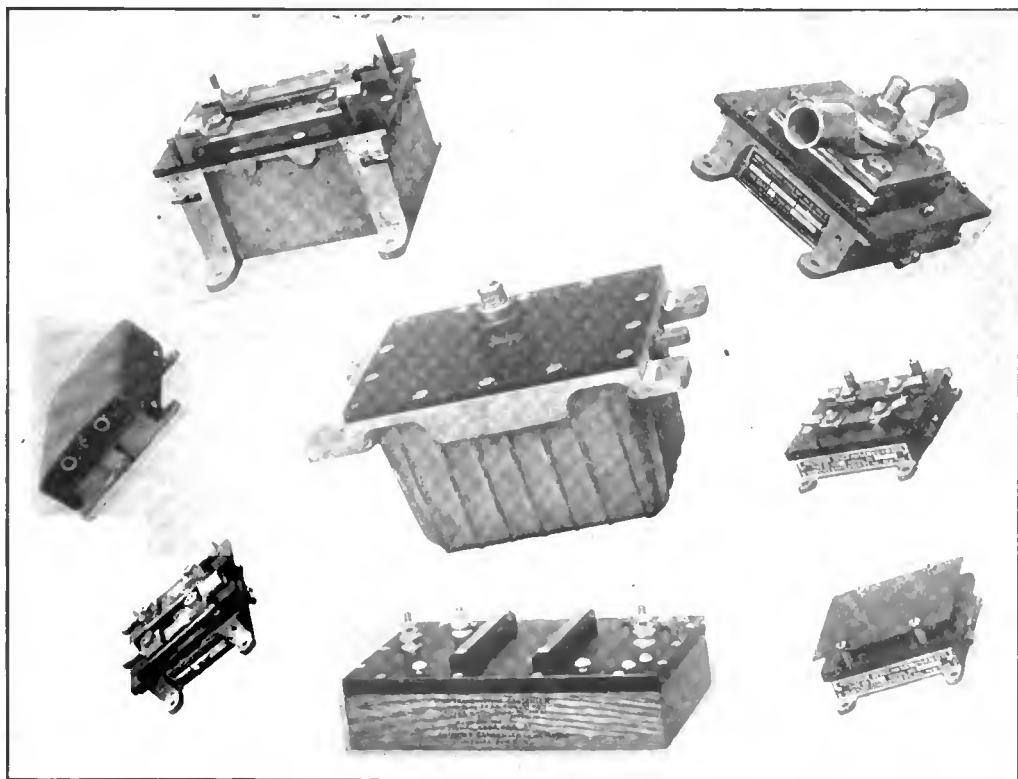
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THE BATTLE FIELD OVER THE SOMME

The painting of which this is a photograph shows vividly how the soil has been turned up by shell fire. The flame and smoke indicated are made by bursting shells covering the entire field. The story shown in the painting is that of a Condron, which, in order to see what is passing on the ground, flies low and between the bursting shells. Profiting by this aerial promenade along terrific lines of battle, the bombardier shoots soldiers in the trenches



THE WIRELESS AGE

WORLD WIDE WIRELESS

Salvador-Mexico Wireless Opens

WIRELESS communication has been established between Mexico City and San Salvador. The wireless plant at the Salvadorean capital was presented to that country by Mexico and installed by Mexican electricians.

British Ship Regulations More Stringent

THE Defense of the Realm Regulations which make compulsory the installation of the wireless telegraph on certain British ships of 3,000 tons and upward, has been amended by the reduction of the tonnage to 1,600.

Wireless News Agency Reorganizes

THE reorganization of the Agence Radio is announced from Paris. In the Spring of 1916 newspapers began printing news dispatches "By Agence Radio." Thus the world believed that a rival had been created to the long-established, semi-official Havas. The old agency had been crippled because most of its young employees resigned to engage in military service. So the new organization, employing only men free from military obligations, was able to make a good showing. Little was known about it for some time, beyond that it seemed to specialize in Greek news and was understood to be financed by a wealthy Greek, M. Basil Zaharoff, long resident in Paris.

The agency was founded in February, 1916, as a private company, with one stockholder, who had supplied a capital of exactly \$305,000. This company is being liquidated and a new one formed, an ordinary limited liability company, to which various manufacturers and business men have promised to subscribe.

The Radio Agency did not spring into existence in 1916 without previous incubation. As a matter of fact, M. Turot, its director, had been at work for some years before the war on a plan to establish an opposition agency to Havas, to be called "The Potentia Agency," and had made many journeys abroad to look for representatives and connections. This preliminary work was utilized when Radio was started.

Mexicans Foil Plans for Secret German Plant

UPON a lonely spot near Alamo on the Lower California Coast, Germany plotted to erect a secret wireless plant through which was to be flashed to Berlin military information gathered by the Kaiser's spies in America and elsewhere.

Details of the plot, hatched in San Francisco in September, 1914, were drawn from the lips of Gustav N. Koeppel, San Diego shipping broker, by United States Attorney John W. Preston, recently in the German-Hindoo revolt trial in San Francisco.

Central figures in the plot, which failed, the witness said, only because of the alertness of the Mexican authorities, were named as Robert Capelle, agent of the North German-Lloyd Steamship Company, and E. H. von Schack, former German Vice-Consul in San Francisco.

In September, 1914, the witness said, he was summoned by telegraph to San Francisco by Capelle. Here he met Vice-Consul von Schack and the three discussed plans, he testified, to erect a wireless plant at Alamo, Lower California. His understanding was, Koeppel testified, that he was working for Capelle, whom the Government accuses of being the Kaiser's "paymaster" on the Pacific Coast.

Renewed objections by the defense and the admission of Preston that this plot was distinct from that charged to the defendants on trial prevented a detailed narrative of subsequent events. The witness asserted that a wireless plant and men were sent down to Alamo in a small boat, but there the Mexican Government interfered and several agents were arrested. To secure the release of these men, Preston asserts, was the reason for the "mystery trip" of Lieutenant Wilhelm von Brincken to Mexico, which figured in the trial of Bopp, von Schack, von Brincken and others and their conviction on charges of violating American neutrality.

In the transaction, the witness said, he handled large sums of money from Capelle, but could not give amounts. He received as compensation for his services in the wireless plot and in aiding the alleged conspirators in the shipment of arms and ammunition on the steamer Annie Larsen from San Diego two drafts for \$1,000 each and his expenses.

German Raider Foiled by Operator

A DRAMATIC incident of the sea, in which a young wireless operator fooled the enemy, was related in the prize court in London recently, when the crown was asked to condemn the steamship Edna on the ground of unneutral service and enemy ownership.

The attorney-general, Sir Frederick E. Smith, described the kaleidoscopic history of a vessel which flew two flags. The plucky operator was "one Smith, an Englishman," who since has received a commission in the R. N. A. S.

Frederick Jebson, a German, said Sir Frederick was a prominent man in San Francisco shipping circles. He chartered the vessel and was believed to have perished afterward in a German submarine. The vessel was built at Bergen in 1902 and in those days sailed the seas as the Jason. Jebson used the vessel for his Mexican business. He had been in the German navy and was in the naval reserve.

Jebson purchased the vessel, the ownership of which was vested in the Lloyd Mexican Societe Anonyme, in which he held the bulk of the shares.

Finally he managed to get back to Germany disguised as a Scandinavian seaman.

The Edna took on board wireless and gun-sight apparatus and tried to communicate to the German cruiser Leipzig the dates when British vessels left port—an attempt which was frustrated by the resourcefulness, ingenuity and courage of Smith.

In an affidavit read by the attorney-general, Guy Duncan Smith, the wireless operator, said that he was on board the vessel when the war broke out. He awoke one night at midnight and heard the steamship Aztec announce that war had been declared between Russia and Germany.

At this time the vessel had "Hamburg" painted on the stern. After the announcement that war had begun, "Hamburg" was removed from the vessel, "La Paz" was painted in and the Mexican flag was run up.

Before leaving San Francisco he had heard that the coal taken on board was intended for the Leipzig. Information was sent to the British consul, and the authorities at San Francisco demanded that the coal should not be delivered to the cruiser.

A German wireless operator was taken on board and Smith was told that if he refused to do his duty the German would take his place. The German operator, however, did not understand the Marconi system. Smith shortened the length of the waves, and though he appeared to be sending out calls for the Leipzig no vessel could pick up the message.

The German operator spent three nights and three days trying to call up the Leipzig. Smith returned later, and then occasionally called up the German cruiser, putting the wireless in order to allay suspicion, but the wireless was always out of gear when the German operator tried to use it. At La Paz, Smith forwarded a message to the admiral on the American cruiser California.

Some of the officers threatened to shoot Smith and throw him overboard if he did not send a code message to the German cruiser, and he then pretended to send it.

The only thing that Smith sent to the Leipzig was an inquiry as to where she was, which brought forth the reply that she was hanging around waiting for the Edna. Finally the Edna was commandeered by the Mexican Government, which put an officer on board, and Smith said that "after that things were more comfortable."

Florizel's S O S Means of Rescuing Forty-four

A WIRELESS appeal for help, adding that the steamship was breaking up, was all that was heard from the Florizel on February 24th, until rescue parties reached the scene.

Huddled into the wireless room of the wrecked steamship Florizel, the passengers and crew who had not been drowned or killed when the Red Cross line vessel was piled up on the ledge off Broad Cove, watched many of their number die before their eyes or saw them swept to death in the raging sea. They stood so closely that they could not sit or lie down.

Without water, food or adequate clothing to protect them from the bitter

weather, they faced death aboard the rapidly breaking up vessel, until the forty-four survivors were rescued by means of as gallant and daring seamanship as has ever been displayed, even by the men of Newfoundland, the best seamen in the world. They were there twenty-six hours. Some, injured by flying timbers, blocks and other wreckage, died as they stood. The stronger cheered and encouraged the weaker to hold out. Cecil G. Carter, wireless operator was among the survivors.

Another Sayville Disclosure

WHEN broad-gauged men enter into the field of wireless investigation, many interesting things are bound to follow. In John R. Rathom the United States has a contributor in the field of a unique order. Formerly a war correspondent in the Soudan and in Cuba, and member of expeditions to New Guinea and Alaska, this citizen of the world is becoming as well known to wireless men as those who have disclosed technical advances and unraveled engineering problems. The WIRELESS AGE has chronicled Mr. Rathom's exposures of German intrigue before and readers have found them of absorbing interest because of their connection with the operations of the Sayville station, the spark of which, before the declaration of war, was almost as familiar to amateurs as the sound of their own voices.

In a recent address to the Traffic Club of Chicago Mr. Rathom added further interesting details of his work and that of his associates on the Providence Journal in ferreting out the sinister activities of the German Government's agents while this country was neutral. His early efforts in the wireless espionage he outlined as follows:

"On the day that war was declared with Germany by the various European nations, some good fortune or some good angel suggested to us that we listen in on Sayville and Tuckington. We began to listen in, and for a period of nearly five months with operators working in shifts of two men eight hours a day apiece, we accumulated fifty or sixty thousand sheets of wireless messages, without saying anything to anybody about what we were doing. We then presented a brief—we were not lawyers—but a common sense brief to the Government of the United States. One night at the White House, with the Secretary of the Navy and the President and several members of the Cabinet and members of the Neutrality Board, we made our disclosures, covering a period of four or five hours, and we proved exactly the character of organization that this Sayville station was. The Navy Department had been instructed by the Government, at the beginning of the war, to listen in on Sayville from the Brooklyn Navy Yard, but unfortunately that had not been done; and the only existing record that we knew anything about of what transpired during that first five months was our record.

"When I was able to show to the President that in one week little Anna, the daughter of a very prominent New York banker—a German-American so called—had died six times in eight days, and that on each occasion her body had been placed in a differently named room in a house, and she had died of a different disease, and was to be buried next day in a differently named circle—I asked him if he believed that little Anna did die six times in eight

days, and he said he did not. An then we proceeded to give to the Government an immense mass of names, positively proving that several hundred very prominent German-Americans in this country had been acting for four or five months as treasonable correspondents of the German Foreign Office.

"As a further result of our wireless revelations—and I may as well say that from that day to this, until the day that Sayville was closed up, we maintained our watch over that station—we were enabled to secure positions in a number of consulates throughout this country, and in the German embassy itself, for our own representatives."

Mr. Rathom declared that well known commercial houses of German extraction in the United States were outposts of the German Foreign Office and on this line remarked:

"The Siemens-Halske Company of Germany, as most of us know, is the great electrical company of Europe, and probably the greatest electrical corporation in the world. They have their agencies in every great city in the world, all through North and South America, the Philippines and everywhere else.

"One day we discovered through one of the consular general offices, the existence of a blueprint map of the Philippine Islands, accompanied by a letter from the Siemens-Halske Company to their own agents in the City of Manila, the letter making this statement: 'We send you herewith a blueprint map of the Philippine Islands with names and numbers of fifty-four locations for wireless installations marked. This map must be carefully guarded. It comes direct from the Foreign Office.'

"These people were instructed to bid so low on wireless construction, under our Government work, that nobody else could possibly get the bid, and after securing the bid to notify our Government or people that they could only undertake the work if their superior radio knowledge was consulted as to the location of the stations.

"This order was given to this concern, Siemens-Halske Company, and through them to their agents, that these stations must be located as marked on this map, so that when Germany comes into possession of the Philippines they will be exactly where they are wanted."

Search for Enemy Station Near New York

THE activities of German agents still here has been largely speculated upon in connection with the possibility that reports of troopships sailing from New York are sent by secret wireless stations in or near that city. Early in March the metropolis was thoroughly searched, the investigation being based on the fact that several weeks previous radio experts at Fort Totten discovered that there was a powerful wireless station in the city in communication with Europe. Partly decoded messages caused a suspicion that reports of departing steamships may have been sent to Germany or to commanders of submarines.

A secret detecting station was established on the roof of the Hotel Majestic. It was said the search for the undiscovered wireless is very difficult because probably no aerials are necessary for its successful operation. Any

steel construction in the roof of a building will act as a carrier for the radio waves. It is believed to be in the top of a skyscraper.

The delicate instruments necessary for the detection of the concealed wireless were installed in the valets' room of the hotel, under the roof. The receiving mechanism was attached to the huge electric sign on the roof. Day and night intelligence officers sat under the roof, with head phones fastened on, "listening in" to all the radio messages that vibrated through the air.

One by one their source was detected and accounted for. They came from all directions along the coast, and, when checked up, proved bona fide. Then a cipher message, evidently generated by as powerful a machine as is used by the Government, was suddenly intercepted.

It was received at night and was instantly identified as a hostile message.

Sensitive instruments able to measure distances convinced the intelligence officers that the dangerous wireless they were seeking was within a very few miles of the hotel. Some clue led them to the Trinity Building.

The tower's tenant was found to be Richard Pfund, a German-American, who is a radio expert and who showed credentials to prove he is in the service of the Navy Department. Prior to the European War he was general manager of the great Telefunken Company's wireless plant at Sayville. He was present when the officers arrived. He refused to allow them to enter the tower, which he said he used as an electrical laboratory and experimental station, until he obtained permission from the Navy Department.

When Pfund was questioned he satisfied the army men he was connected with the navy and engaged in Government work. He had checks and other credentials to prove it. Examination of the wireless convinced the Government agents it had not been used for some time.

On the same day, in upper New York, discovery by the State Constabulary of two suspicious wireless outfits, one completely set up, in the custody of W. I. Roemer, a German, in Hortonville, Orange County, created a sensation. The police are now on the trail of secret stations, one of which, they are informed, is in a New York suburb.

Roemer was employed on the large farm of A. K. Woodman, a wealthy resident wintering in Palm Beach, and was in charge when State policemen made the discovery. The troopers saw knobs and other apparatus on the roof of a gristmill on the Woodman place and, going inside, found the apparatus and another complete outfit which was not set up. The troopers intimated in their report that Woodman, who is away, probably knew nothing of the plant. According to the police, a powerful dynamo in the gristmill assured the wireless apparatus of power for a wide radius.

The police say that the vicinity is a hotbed of pro-Germanism. The law requires that any one having wireless outfits must have them sealed by the Government, but these were never sealed. The State police notified the naval intelligence officers, who confiscated the equipment.

Brazil to Have New Station

A RADIO STATION is to be established at Boa Vista do Rio Branco, in the State of Amazonas, Brazil. Consul-General A. L. M. Gottschalk reports that the sum of \$50,000 (U. S. currency) has been appropriated for this purpose. The station will be under the control of the Brazilian Ministry of Transportation and Public Works.

Radio Science

Antenna Control for Radio Telephony

IT is quite probable that the vacuum tube has solved the problem of control of radio frequency currents in wireless telephony. But in the face of all the research work conducted along this line there has been devised a method of antenna control by Mr. Paul Hackett in which mechanical features predominate.

As shown in the accompanying drawing, figure 1, the inventor first generates continuous oscillations by means of the direct current arc, the oscillation circuit of which is inductively coupled to an antenna in the usual manner. Across the secondary inductance is shunted a series of special air condensers the capacity of which is altered at vocal frequencies by means of microphones and magnetic telephones as shown. In figure 1, wire 8 is connected in parallel to the flexible diaphragms 10 of one or more air gap condensers. The wire 9 is connected to the rigid diaphragms 11.

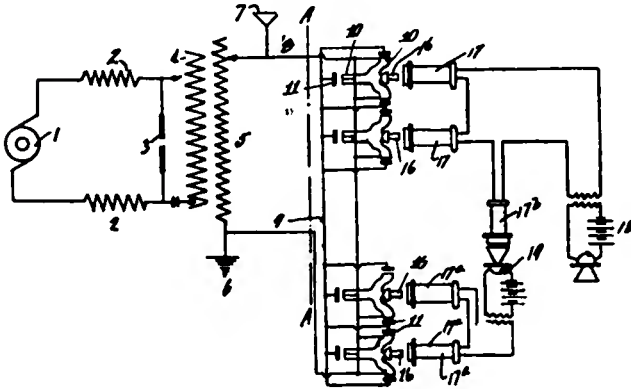


Figure 1—Method of antenna control in which mechanical features predominate

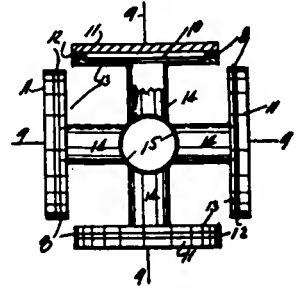


Figure 2—A detail of the condenser

A detail of the condenser is shown in figure 2, where pairs of the diaphragms are separated by an insulating ring 12. A complete unit of condensers consists of two or, preferably, four condensers which are connected by cover plates 13 having tubes 14 which terminate in a single tube 15 and mouthpiece 16. Each condenser unit is actuated by ordinary telephone receivers as shown at 17 and 17a.

These receivers may be connected either in series or in parallel with a high power transmitter such as 18.

Additional receivers may be inserted in the circuit between the transmitters 17 and 18, as, for example, the receiver 17b which actuates the transmitter 19.

When the transmitter 18 is spoken into an amplified action is obtained upon the diaphragms 10 which varies the capacity of the condensers shunted about the secondary winding 5. The amplitude of the radio frequency current is modulated

at a vocal frequency and the speech is reproduced in the receiving apparatus in the usual manner.

An Improved Target for X-Ray Tubes

A DIFFICULTY of considerable magnitude in the X-ray tubes heretofore employed has been the heating of the ray target or anode. With tubes operating by virtue of ionization of the residual gas and supplied with rectified alternating current, large power inputs could be used for a few moments because of the intermittent nature of the applied current, but under continued use disintegration of the anode results. Tubes employing the *pure electron discharge*, however, may be operated continuously on low powers without excessive heating. But when they are employed at high powers disintegration or tearing of the anode results. Experiments have shown that this disintegration is the result of the mechanical tearing caused by the rapid expansion and contraction due to the intermittent conveyance of heat from the ray-receiving face to the cooled section of the anode.

A tube has been designed by W. D. Coolidge, in which the anode is preserved intact by making its face of sufficient thickness to afford heat storage capacity great enough to transfer the variable heat input to the actively cooled parts of the metal at a rate nearly uniform. Coolidge's method of construction is particularly applicable to an anode comprising a face plate of highly refractory metal such as tungsten, and a backing of other metal such as copper.

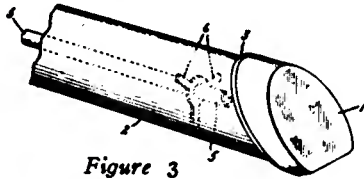


Figure 3

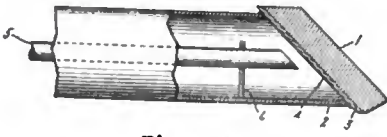


Figure 4

Figures 3, 4—X-ray target in perspective and cross-section

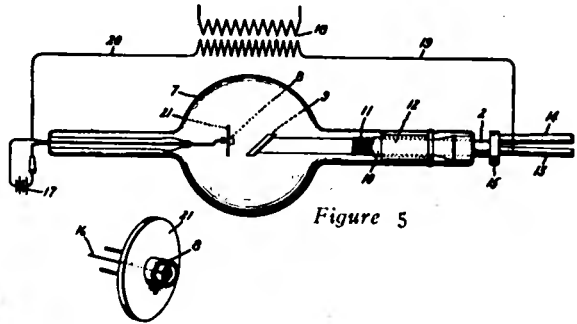


Figure 5

Figure 6

Figure 5—X-ray tube with improved target
Figure 6—Detailed view of cathode

Figure 3 illustrates an X-ray target in perspective; figure 4 a cross-sectional view, and figure 5 an X-ray tube with the improved target. Figure 6 is a detailed view of the cathode. The target shown in figures 3 and 4 comprises a ray-receiving plate 1 consisting of tungsten or other highly refractory metal, and a backing tube 2 the end wall 3, which is in intimate heat conveying-relation to plate 1. When the end wall 3 of the cooling device consists of copper, a weld may be secured by melting boronized copper in contact with the tungsten plate in a vacuum. The copper plate 3 may then be soldered or welded to the tube in any convenient way; for example, as indicated at 4. A tube 5 supported and centered by lugs 6 permits the introduction of a cooling fluid such as water.

The target, 1, should be relatively thick as compared with face plates heretofore employed in water cooled X-ray targets. A tube capable of operating with a current of about 0.1 amperes at about 50,000 volts and at a frequency of 60

cycles requires a tungsten plate about $\frac{1}{4}$ inch in thickness. The heat delivery will then be uniform enough to reduce the tearing or disintegrating effect of rapid expansion and contraction of the backing metal. Such tubes will have a very long life.

Figure 5 shows one form of X-ray tube in which the target has been operated continuously for days at a time without breakdown. It comprises the usual glass envelope 7, an electrode emitting cathode 8, and a water cooled anode 9. The tube 2 is mounted on an iron tube 10 bound by a wire 11. A glass tube 12 joined to the envelope serves to center and support the tube 2. The cooling fluid is supplied by tubes 13 and 14 through the junction box 15 to the anode. The cathode filament, figure 6, is heated by a battery 17 or other convenient low potential source. The main current is supplied by a transformer 18.

The tube is evacuated to a pressure so low that traces of positive ionization are substantially absent. When the tube is operated with alternating current any slight amount of gas evolved from the anode is electrically precipitated by a discharge emanating from the electrode 9 when acting as the cathode for a current wave negative with respect thereto, thereby vaporizing or sputtering copper. When a uni-directional current supply is used, the focusing ring 21, figure 6, is made of copper or other metal which is readily sputtered. Positive ionization of residual gas causes positive ion bombardment of the cathode and sputtering of the focusing ring resulting therefrom improves the vacuum.

Preparation of the Cathode for Pure Electron Discharge Apparatus

SOME of the characteristics of the pure electron discharge are absence of conductivity in the space between independent unheated electrodes, a variation of the current over a certain range with the $\frac{3}{2}$ power of the voltage, the absence of blue glow in the space, the absence of gas fluorescence, and the lack of cathodic disintegration. It has been found that the electronic emission of platinum, carbon, tungsten, molybdenum, while differing to some degree is of the same order of magnitude, but Dr. Irving Langmuir has discovered that the electronic emissivity of pure thorium exceeds that of any of the elements mentioned.

The electrodes need not necessarily consist entirely of thorium. When, for example, a thorium compound such as the oxid has been added during the process of production to one of the highly refractory metals such as tungsten, and the metal subjected to a preliminary heat treatment in a high vacuum, the electron emission is enormously increased. The increase is not due to the presence of thorium oxid, but according to all indications is a property of metallic thorium on the surface of the cathode.

Apparatus for preparing a thoriated cathode is shown in figure 7, in which the anode consists of a film of refractory metal on the inside wall of the envelop produced by vaporizing a refractory metal of a high temperature. Figure 8 is a device operable as a rectifier having a thoriated cathode and plate-shaped anodes. Figure 9 illustrates a modification in which active thorium material may be transferred to the cathode from an independent thoriated conductor.

The device shown in figure 7, comprising an envelop 1 consisting of glass or quartz, provided with two filamentary conductors 2, 3, of highly refractory metal, such as tungsten, at least one of which, say filament 2, is thoriated. They are connected to leading-in wires 4, 5, sealed to a stem 6. The envelop is connected to a vacuum system by a tube 7, containing a trap 8 which may be surrounded by a freezing bath, such as liquid air, contained in a Dewar flask 9, or even an ice and salt mixture. It is the function of the freezing bath to prevent mercury, or other vapors, from the vacuum pumps from reaching the envelop. The usual methods of producing a high vacuum are employed for the preliminary evacuation of the envelop. This includes baking out the envelop to remove water

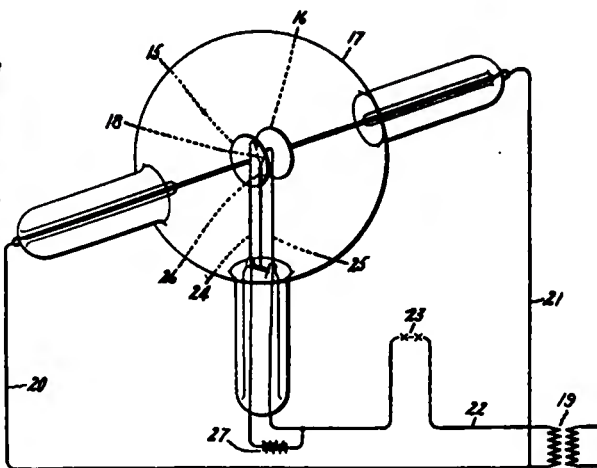
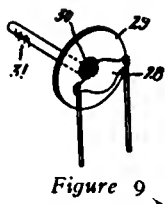
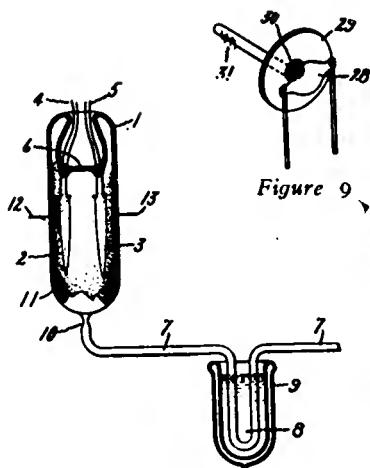


Figure 7—Apparatus for preparing a thoriated cathode

Figure 8—Device used as a rectifier; having a thoriated cathode and plate shaped anodes

Figure 9—Another form of rectifier, having active thorium material transferred to cathode from an independent conductor

vapor. The final stage is preferably carried out by a Gaede molecular pump to the highest possible vacuum obtainable by this means, namely, about .001 micron. While the apparatus is still on the pump the filaments 2, 3, are heated to a temperature of about 2,900° K. (absolute) for a short time and the envelop 1 is baked out in an oven at a temperature of about 360° to 450° K. The apparatus may then be sealed from the vacuum system at the contraction 10. It is then preferably immersed in liquid air and both filaments 2, 3, aged by heating for about ½ hour to a temperature of 2,400° to 2,500° K. One of the filaments, for example, filament 3, is then incandesced by a passage of current to a temperature of about 3,000° K. which causes rapid vaporization of the metal, thereby producing a gas-free conducting deposit or coating 11, which has been shown in the inner surface of the envelop. Conductors 12, 13 sealed into the envelop make contact with this coating and enable it to be used as an anode for an electrical discharge.

The cathode conductor 2 is prepared by introducing a thorium compound, such as the nitrate of thorium to the oxid of the refractory metal before reduction, or by adding either thorium nitrate or thoria to the metal powder after reduction, but before consolidation of the metal by sintering and mechanical working to the solid metal state has taken place. The proportion of thoria in the unsintered metal usually varies from about ½ to 10%, but in some cases may be even greater.

The thoriated cathode 2 is now heated to about 2,900° K. for about one minute. The treatment of the filament at a temperature of 2,900° has no marked effect on the subsequent electron emission of the cathode when at lower temperature, but appears to be desirable for purifying the surface of the cathode. The cathode is then incandesced from say 2,000° to 2,400° K. and by this temperature treatment some change is produced in the cathode which enormously increases its electron-emitting property. The greatest activity is obtained between about 2,200° to 2,300° K. and the treatment at this temperature is usually continued for about one minute, but even outside of this range a marked change is produced. Apparently a concentration of metallic thorium or of some other

oxidizable thorium material takes place on the surface of the filament. The filament 2 may now be used as a cathode at a temperature below the forming temperature.

With a filament thus prepared at a temperature of about $1,300^{\circ}$ to $1,380^{\circ}$ K. substantially the same electron emission per sq. cm. has been secured as with a pure tungsten filament at about $2,000^{\circ}$ K., that is about three milliamperes per sq. cm. Preferably a thoriated cathode is operated around $1,700^{\circ}$ to $1,800^{\circ}$ K., at which temperature its life is indefinite.

One of the most striking proofs that the active surface film is not due to the effect of the thoria as in the Wehnelt cathode is furnished by the effect of a minute trace of oxygen on the behavior of the cathode. If in some manner a trace of oxygen is admitted, the electron emission immediately falls as low or even lower than the low value observed when a cathode of pure tungsten is slightly oxidized. In other words, the electron emission becomes very much lower than that of the unoxidized metal. When subsequent to oxidation a trace of hydrocarbon vapor is admitted, the electron emission suddenly rises as though reduction were taking place.

Another proof that the high electron emission is due to a skin of thorium is the fact that metallic thorium itself, particularly when free from surface oxidation, exhibits a very high electron emissivity for a given temperature as compared with tungsten. Difficulties are encountered with the use of metallic thorium as cathode material due to its relatively low melting point and its susceptibility to oxidation.

The apparatus shown in figure 8 does not differ essentially from the apparatus shown in figure 7, plate shaped anodes 15, 16, consisting of a highly refractory metal such as tungsten, being used instead of the film anode of vaporized metal used in the apparatus shown in figure 7. The envelop 17 is baked out and evacuated as already described in connection with figure 7. The ionizable gas should be removed from the anodes during the final stages of the exhaust, after the pressure has been reduced below about $1/10$ of a micron of mercury by subjecting the anodes to an electron discharge from the cathode 18, whereby ionizable gas is evolved. This gas should be removed as fast as liberated and the discharge voltage progressively increased, care being taken not to materially exceed the voltage at which blue glow takes place, so as to avoid injury to the cathode. The final stage of the evacuation is produced by vaporizing a tungsten conductor in a side chamber (not shown in the drawing), thereby producing the very high vacuum necessary for the operation of the thoriated cathode. The anodes 15, 16, may be both connected to one terminal of a secondary of the transformer 19, by conductors 20, 21, the cathode being connected to the other terminal by conductor 22, including a load circuit 23.

It is not absolutely necessary that the thorium should be introduced into the body of the metal during the process of manufacture. As shown in figure 9 a cathode 28 located opposite an anode 29 is provided with a film of active thorium material vaporized from the coiled filamentary cathode 30 heated by a battery 31. The cathode 30 may consist either of a thoriated cathode prepared as already described, or of metallic thorium. The inclosing envelop has not been shown, but it is to be understood that these parts are to be operated in a high vacuum. When the coil 30 consists of thoriated wire it is first rendered active by heat treatment at a temperature of about $2,200^{\circ}$ to $2,300^{\circ}$ K., as already described, and is then heated to a temperature of about $2,900^{\circ}$ K. to distil off active material, some of which is condensed on the cathode 28. When the coil 30 consists of metallic thorium, it should be heated to a temperature near its melting point to distil some of the thorium on to the surface of the cathode 28.



Professional Operators



Edward Hilson

Captured By The Germans

Experience of the Operator on the
First American Ship Deliberately
Sunk by a German Submarine—
Enemy U-49 Activities in Sub-
marine Campaign

BY EDWARD HILSON

Chief Operator on S. S. Columbian

OUR ship offered a very tempting target for submarine attack. The Columbian was under charter to the French Canada S. S. Co., and carried 1,500 horses and 10,000 tons of steel and copper, bound for France. Then again the German submarine U-53 had just made its raid off Newport, sinking five vessels,

and shipping was growing nervous. Anticipating trouble the ship was equipped with a powerful auxiliary wireless apparatus in addition to its ordinary set. While loading the horses at Boston, late in October, 1916, a rumor prevailed that the Columbian and her sister ship The Mexican, which was also loading horses for France, would be torpedoed. Several of the engineers quit the ship when they heard the report, and it was necessary to send a radio asking for new engineers and other men to take the places of those who had left. Soon after, one very dark night, we left Boston with our valuable cargo bound for St. Nazaire, France. Counting officers and crew there were 130 aboard the Columbian.

Half way across the Atlantic a fire was discovered late one night in the hay down among the horses, but luckily it was quickly extinguished. As the war-zone was approached all the life boats were swung outboard and fully equipped for any emergency, while the men were given frequent drills. A few miles out from port the ship was boarded by a French mine pilot who conducted us through the mine fields and then through the locks to the naval dock, where commenced the unloading of the horses. A squad of French soldiers did the unloading and a group of German prisoners waited on the dock to lead the horses away.

Many German prisoners of war were at work unloading ships, stacking lumber and loading railroad cars. We stayed at St. Nazaire three days and then started on the way to Genoa, Italy, with the rest of the cargo.

Two days later, in the morning, we were startled by the report of a cannon. I was on duty at the time. When the shot had splashed in the water on the port bow, the captain ordered the ship stopped and came down to the radio room and gave me the ship's position, Lat. 44.01 North, Long. 8.31 West. I was directed to hold it, however, until orders were given to send. From the port holes in my room I could make out the submarine cruising about at a distance of three miles. Twenty minutes later a second shot was fired. The captain promptly ordered me to send the S O S, which I proceeded to do.

With the engine's stopped we rolled in a terrifying manner, the waves surging across our decks, smashing in horse stalls and deck fittings. My first S O S brought no answer, nor did the second attempt, but a third call brought a reply from the Spanish Government land station at Cape Finisterre. The German submarines often use the distress call to lure ships to their destruction, which explains why we received no answer to my calls. The S O S often warns them to keep out of danger. I told the Spanish station that a submarine was cruising about and firing at us, but did not mention it was German; they asked if there were any ships near by to help us in case we were torpedoed.

The submarine now flew signal flags, but we could not read them. The captain ordered me to stop sending. We got under way again and the captain directed me to notify the Spanish station that the submarine had missed us. We had begun to breathe more freely when an hour afterward the submarine was again sighted, cruising three miles off. Shortly after she fired on us. The under-sea craft was flying signals, but we could not make them out. The Spanish station now asked me what was my nearest port, when the submarine for the first time used her wireless and commanded us, "Stop using your wireless, ask no questions or I will shoot." It was then too late to talk with Cape Finisterre, but we picked up her message telling us, if we could not send any words, to send a long dash and they would know what had happened and would send a ship to our assistance.

The German meanwhile bombarded us with such messages: "Follow me or I will shoot," "Where are you bound?" "What is your cargo?" and "Where bound from?" They ordered us to turn, and because we could not turn quickly enough in the rough sea they threatened: "Turn at once or I will shoot."

We had passed a steamer that morning which, we afterward learned, the submarine had captured. During the night the submarine moved up to within five hundred yards of us, while the steamer kept on the other side of her. Near midnight I heard an English warship call Cape Finisterre to get information, but she received no answer. Early in the morning when I resumed duty I heard the Spanish King's yacht, the Giralda, calling to give us assistance, but I could not answer. She was at Coruna and had been sent to us by the Spanish Government. Every time I answered the submarine I signed off with the ship's call letters and used full power, but the German operator did not notice it. It was an anxious time for all of us. Throughout the night and early morning the waves swept the decks and now and then there would be a crash as deck fittings and horse stalls were swept overboard. I changed my clothes and put what valuables I could carry in my pockets, ready for the worst.

The Spanish station kept calling me, fearing the worst had happened, but I could not answer. At daybreak the submarine ordered us to "Come nearer and send a boat over to the submarine," and a little later, "Send the captain with papers to us." Meanwhile, a boat containing the first officer and crew returned from the submarine with a German lieutenant and eight Germans. Before our captain could leave the ship, the Germans were aboard.

As soon as the Germans came on deck, they lowered the aerial, and the Hun operator made a bee-line for the radio room. He relieved me of the phone, stating he was now in charge. I noticed he carried two large bombs; these, he said, were for the purpose of blowing up the ship.

The Teuton immediately began to dismantle the wireless apparatus. Just then a German lieutenant came into the room with a drawn revolver; pointing it at me he said, "Don't you know you should not use your wireless when a submarine is around? We should have torpedoed you. I ought to shoot you."

I told him that I had obeyed the orders of the captain, and that when the submarine had told me to stop, I had stopped. This made him relent a trifle in manner, but he ordered me not to touch anything in the room and not to take my log book or any ship's papers out of the room under penalty of death.

After he had left, I asked the German operator to let me take the log book in which had been recorded every detail from the first shot until the Germans boarded us, but he refused. The book was lying on the table, and when the German's back was turned, I grabbed it, put it under my coat, and slipped out.

I found that the men were being lined up on the boat deck, all wearing life



When loaded our ship offered a very tempting target for submarine attack; we carried 1,500 horses and 10,000 tons of steel and copper, bound for France

belts. The captain was taken over to the submarine where, by the way, he was kept a prisoner until we landed in Spain. As the boat drew away, he shouted cheerily, "Goodbye, boys! I hope to see you soon. Obey orders." The boats were then lowered over the side. It took four husky sailors to keep the life boats from being smashed, as one by one the men climbed down a ladder and jumped into the tossing craft.

The Germans took one of the life boats and filled it with part of the wireless apparatus and provisions from the ice chamber. We were wet through, and the boat was half filled with water from the huge waves, so that it took us three-quarters of an hour to row to a steamer a mile away. When we reached the steamer, which was a Norwegian ship named the Balto, now a German prize, we climbed aboard and were lined up by the Germans. I saw that the men were being searched so I threw the log book into a little mess room back of me.

When my turn came to be searched, they took me to a room on the bridge where a German officer took my camera, razor, and all personal papers and valuables which I had saved, saying that I would get them back after the commander had seen them. I never saw the razor and camera again.

When all were off the Columbian, the two bombs were fired. All watched her for forty-five minutes, but we did not see any sign of her sinking. The submarine then maneuvered into position and fired a torpedo which struck her amidships, throwing a fountain of water as high as her smokestacks. She began to sink rapidly. Her after deck was soon awash. Her stern then dipped under and her bow rose straight up. She came up once and then the stern disappeared. The bow rose perpendicularly, the funnel level with the water, and then quickly disappeared, strewing the ocean with oil and wreckage.

Meanwhile some of our crew were compelled to load the provisions and supplies on the submarine and all fresh water was taken from the life boats. All the officers were ordered to stay in a little saloon and the crew to keep aft, some in the coal bunkers. That night we slept on the floor, or any place where we could lie down, and none of us had anything to eat. Next day we saw a steamer coming toward us and we were told to get ready to take to the boats which had been hoisted on deck. So once more we were obliged to enter the fragile craft.

I had thrown away my life belt as had most of the others. During a row of a mile before we reached this other steamer which the submarine had captured during the night, a big school of sharks followed our boats, and some of the sailors stood up and tried to hit them with their oars. She was a Swedish boat named the Varing. The Balto, which we had just left, had been in German hands for two days and a half before we sighted her. She had only a little cargo for a Portugese port, but it was clear that the Germans meant to sink her. After our crew and that of the Balto were aboard the newly captured Varing, several barrels of oil which were part of her cargo were thrown overboard and picked up by the submarine. A few minutes later the Balto was blown up by bombs. She caught fire and for several hours burned fiercely, sending up clouds of black smoke. Gradually she sank by the stern and burned until she disappeared.

We hoisted all the small boats then on the deck of the Varing and the Germans painted out the names of the two sunken ships. The officers were put into a small saloon and the crew distributed below decks. We made a hungry, dirty crowd as we tried to sleep in these congested quarters on the floor. We got our first meal the next day. It consisted of a plate of pea soup, meat and potatoes. The day was bitterly cold and we lay on the deck around the fire and engine room in our overcoats trying to keep warm. The submarine proved to be the U-49. She was about two hundred feet long and carried, I was told, forty-eight men and two guns. Her crew had rigged up a temporary wireless outfit on the Varing, but used flags and lights to signal the submarine, which was never more than a mile away. The undersea craft also had a wireless aerial, and carried a long wireless mast fastened to the deck for long distance work. She had no marks or anything to identify her.

Late in the afternoon a steamer was sighted, the Norwegian Fordalen. The submarine started after her. She tried to escape, but the German soon overhauled her, hurrying her officers and crew into the boats, which were then rowed to the Varing. She was sunk by bombs in the same manner as the other ships.

We now numbered over two hundred, including one hundred and thirteen of our own men, with all our life boats.

That night was clear with bright moonlight. During the same night the submarine sighted a steamer with all lights out. We prisoners were all ordered off the deck to our quarters. The first man seen on deck was to be shot. I watched the steamer from a port hole. She turned out to be a transport and must have noticed something suspicious about us, for she put on full steam and the submarine could not overtake her. Bombs had been placed all over the Varing, and in case of mutiny we would all have been blown up.

At two o'clock in the morning we were told that the Germans had decided to release us. The boats were lowered and we climbed into them; the captain



*Deck view of the vessel printed from a role View of a rough sea taken on eventful trip
of film the Huns overlooked of the Columbian*

left before the German lieutenant had given him permission. The officer ordered him back, pointing a gun at him and threatening to shoot if he was not alongside in a minute. The demand was quickly complied with. Then without further incident we rowed toward the Spanish coast. Our boat was in charge of the captain of the Fordalen. Two men with us, having had their ribs crushed, were in the care of our doctor.

We rowed all morning, two to an oar, with the water to our knees. At noon we entered the little harbor of Camarinas. We found the submarine there and our boat was ordered to come alongside. Then we rowed a little longer and soon reached a fishing village, where I was certainly glad to land. The Germans were on the deck of their craft and they certainly were a dirty looking crowd. But I guess we were no better. We were weak, hungry, and smeared with grime. Water and wine were at once given to us and the crews were assigned to quarters, while the officers and myself, by the arrangement of the captain, were put up at the best hotel in the place. It seemed a palace to us. We could not wait until a meal was cooked, so the hotel people brought the food to us half done. Some of us slept two in a bed, and others on mattresses laid on the floor, but we all had something to eat.

We stayed there three days, when automobiles arrived to take us to Coruna, a day's journey. While there the American consul took our statements of the sinking. After eight days in Coruna we started on a journey of twenty-three hours to Madrid. Ten hours later a train took us to Cadiz, another day's trip. Here we stayed for over two weeks waiting for passenger accommodations back to the States.

By this time we were not looking any too slick, most of us having only what we stood up in. The consul had to give us heavy underwear on account of the cold weather. When we went to Algeciras, opposite Gibraltar, a long night's travel, it was without sleeping accommodations; the Spanish trains have no Pullmans. Here we had another enforced stay of over two weeks, making several trips to Gibraltar to secure passage, but without success. At last we moved on again, this time on a little Spanish steamer, the Llovera to Tangier, Morocco, half a day from Gibraltar, and thence to Cadiz. Here we waited more than a week, but finally left on a Spanish steamer, the Alicante, especially chartered to carry us and the crew of another American ship, which had been sunk by a submarine. We were scheduled to land in New York on Christmas Day, but owing to a rough passage of twenty days, we were disappointed. We did get in on New Year's Day, however, which wasn't so bad, all things considered. Beginning a new twelve month with feet firmly planted on the soil of Liberty is a very secure feeling, as may well be imagined after an experience such as mine. Try it once, and I think you'll agree.



Coaling the Vaterland in the days before she took on her camouflage paint and a cargo of American soldiers

Our New Troop Ship

Some Aspects of the S. S. Vaterland of Peace Days, Now a Soldier-Carrier for Uncle Sam

IN the world's largest steamship, the Vaterland, which is now under the American flag, may be found an excellent model for the construction of our merchant marine in the future. The newest ideas in construction evolved by the most expert of Germany's ship builders are embodied in this giant craft. No time or expense was spared in designing and constructing this largest and most luxurious of ships. By the fortunes of war the great liner, which was the pride of Germany, has come into America's possession, so that every detail of her construction and equipment may be studied and imitated with ease. It has already been announced that she has carried American troops abroad and it would be interesting to know the reflections in friendly and enemy minds during the voyage.

The Vaterland is not only the largest ship ever constructed, but in many respects the safest vessel afloat. She combines enormous carrying capacity with great speed and economy of space. In the event of her being attacked by submarines it is expected that her safety devices would render her practically immune. It is amazing to find that German genius in shipbuilding

may thus be employed by America to combat Germany's most effective weapon, the submarine. The Vaterland is built with a complete double skin extending well below the waterline. A large portion of this outer hull could be damaged, even be blown completely away, and the inner hull would remain intact, so that the ship could proceed on her way undisturbed.

The Vaterland is divided into upwards of forty compartments by strong steel bulkheads. Should a well directed torpedo fired from a submarine succeed in penetrating her double hull, tearing a great hole in her side, it would only succeed in flooding one or two of these compartments. The ship would continue to float even if several of her compartments were completely filled with water. In most ships which have been sunk by collision, the blow has fallen amidship where the engine room has been flooded. The Vaterland is especially provided with longitudinal bulkheads extending through her great engine room, so that even a terrific blow at this vulnerable point would not sink her.

The safety of the great vessel again is largely due to the marvelously efficient system by which the doors of the steel bulkheads are controlled by a single hand from the bridge. A great system of electric communication, comparable to the nerves of the human body enables the captain to control the furthestmost corner of the ship. Should an accident, a submarine attack for instance, occur, the fact would be communicated instantly to the bridge. A single touch of a lever would cause the steel doors of the great bulkheads to clang shut without an instant's loss of time, thus localizing the trouble. A diagram of the ship's compartments has been placed on the bridge in which the position of every door is indicated by a small electric light. If any one



The Teutonic point of view in equipping the wireless cabin of Germany's greatest ship seems to have been favorable to establishing a laboratory, examination of the illustration disclosing a half dozen types of apparatus, probably replaced now with more businesslike equipment made in the U. S. A.

of these doors for any reason fails to close the light burns a warning red, and assistance may be instantly rushed to the danger point.

The preparation made to prevent fire or combat such danger should it arise is probably unequalled on any other ship afloat. The staircases and passageways have been especially treated with fire-proof material, rendering it practically impossible for fire to spread, exactly as in the case of our modern fireproof buildings. The crew of the *Vaterland* has included, trained fire fighters completely equipped with chemical engines, smoke helmets and other up-to-date fire fighting apparatus. The permanent equipment of the ship also includes automatic fire extinguishing apparatus, so distributed that in the event of the temperature rising above a certain point the deck would be automatically flooded with water. Still another precaution has been provided in the electric thermometer, which connects the remotest parts of the great ship with the bridge. Should fire break out, it would be quickly detected by the rise in temperature, and an alarm bell would ring on the bridge, indicating the scene of the trouble.

The staircases and passageways throughout the great vessel are very wide and commodious, and several batteries of electric elevators have been placed in different parts of the ship, so that one may rise or descend through half a dozen decks in a few seconds. All this equipment would prove invaluable when the ship was loaded to capacity with troops. In the event of a fatal accident thousands of soldiers could be quickly assembled at any point on any of the decks without loss of time. The complete system of telephone connections would also prove of invaluable assistance in maintaining instant communication between the bridge and every part of the ship. A telephone central station makes it possible to get a connection as quickly as on land.

The great deck and cabin space of the *Vaterland* would seem to have been designed especially for use in transporting great bodies of troops. A regiment of soldiers may drill on her decks, or in bad weather indoors in her great salon. The length of her decks makes it possible for the soldiers to keep in perfect physical condition throughout the sea voyage. There are, besides, two completely equipped gymnasiums with mechanical exercising devices to prevent the men from becoming "stale" during the voyage.

In normal peace times the *Vaterland* carries 5,000 passengers and a crew of over 1,000. She could readily carry 10,000 troops without undue crowding. The feeding of this army would offer no difficulties since the ship is equipped with three great kitchens. The newest mechanical devices for labor saving have been provided, including electric potato peelers, bread mixers, and similar devices. Troops can be comfortably, even luxuriously, served in three great dining rooms, the largest of which seats upwards of 1,000 persons.

It would seem that the present danger of attack from submarines had been anticipated in the construction of the *Vaterland*, so complete is her equipment for warding off such attacks. She has a highly sensitive microphone attachment which enables her to detect the approach of submarines for a considerable distance. This submarine device was employed in peace times to pick up submarine signals at the entrances of harbors. The great ship may be steered with this assistance into a harbor in a dense fog. The microphone attachment is placed well below the water line and is connected with a telephone device on the bridge.

On the broad decks will be found gun mounts placed with intelligent care at the most advantageous points to repel possible attacks. It is a simple matter to mount comparatively powerful guns on her decks, thus converting her into an effective cruiser. In constructing the ship all this has been anticipated and the decks strengthened to carry such guns without fear of weakening her frame. The *Vaterland* besides carried powerful wireless equipment. She had two complete sets, one for short distance work over a radius of a few hundred miles, and a second powerful set capable of sending messages across the Atlantic.

It was one of the boasts of the Vaterland officers that she carried lifeboats and rafts capable of caring for every soul on board, even when loaded to her extreme capacity. Her broad decks can readily carry sufficient lifeboats to provide for all the troops she may carry. These boats are provided with special apparatus for launching, operating electrically so that they may be lowered to the water in a few seconds. In peace times the Vaterland also carried powerful steam launches which could take these lifeboats in tow. The launches in turn were equipped with wireless apparatus, so that even in the event of a wreck when the ship must be abandoned they could summon assistance across the water wastes.

The overcrowded troop ship has been one of the discomforts of war. Troops transported by the Vaterland or any ship with her equipment should



Aside from safety factors, America's new troopship has a decided claim for the beauty prize in transports, as instanced in the dining room shown here

escape every hardship. They can not only be comfortably housed and fed, but have every want anticipated. In the great Roman bath of the Vaterland the soldiers can enjoy the pleasure and healthful stimulus of salt water bathing throughout the voyage. By utilizing the plunge throughout the twenty-four hours several thousand soldiers could thus be accommodated every day. The ship has besides upwards of 600 private bath rooms. The equipment also includes a completely equipped hospital with an operating room and stores of medicines.

On the whole the Hun appears to have made a valuable contribution toward the solution of the problem represented in the cry for America to get "ships, ships, and more ships."

Wartime Wireless Instruction

A Practical Course for Radio Operators

ARTICLE XII

By **Elmer E. Bucher**

Instructing Engineer, Marconi School of Instruction

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EDITOR'S NOTE—This is the twelfth installment of a condensed course in wireless telegraphy, especially prepared for training young men and women in the technical phases of radio in the shortest possible time. It is written particularly with the view of instructing prospective radio operators whose spirit of patriotism has inspired a desire to join signal branches of the United States reserve forces or the staff of a commercial wireless telegraph company, but who live at points far from wireless telegraph schools. The lessons to be published serially in this magazine are in fact a condensed version of the textbook, "Practical Wireless Telegraphy," and those students who have the opportunity and desire to go more fully into the subject will find the author's textbook a complete exposition of the wireless art in its most up-to-date phases. Where time will permit, its use in conjunction with this course is recommended.

The outstanding feature of the lessons will be the absence of cumbersome detail. Being intended to assist men to qualify for commercial positions in the shortest possible time consistent with a perfect understanding of the duties of operators, the course will contain only the essentials required to obtain a Government commercial first grade license certificate and knowledge of the practical operation of wireless telegraph apparatus.

To aid in an easy grasp of the lessons as they appear, numerous diagrams and drawings will illustrate the text, and, in so far as possible, the material pertaining to a particular diagram or illustration will be placed on the same page.

Because they will only contain the essential instructions for working modern wireless telegraph equipment, the lessons will be presented in such a way that the field telegraphist can use them in action as well as the student at home.

Beginning with the elements of electricity and magnetism, the course will continue through the construction and functioning of dynamos and motors, high voltage transformers into wireless telegraph equipment proper. Complete instruction will be given in the tuning of radio sets, adjustment of transmitting and receiving apparatus and elementary practical measurements.

This series began in the May, 1917, issue of *THE WIRELESS AGE*. Beginners should secure back copies, as the subject matter presented therein will aid them to grasp the explanations more readily. If possible, the series should be followed consecutively.

GENERAL CONSIDERATIONS

(1) Elevated wires or conductors which are set into oscillation to radiate electromagnetic waves are termed **aerials** or **antenna**.

(2) The function of the antenna wires is two-fold:

- (a) To radiate electric waves;
- (b) to absorb energy from passing waves.

In other words, the same aerial is used for transmitting and receiving.

(3) A plain aerial without localized inductance or capacity at the base, oscillates by virtue of its **distributed inductance and capacity**. Hence, if a transient electric charge is given to the aerial such as by excitation from a series spark gap connected to a high voltage transformer, the antenna wires will oscillate energetically at a radio frequency determined by its electrical dimensions.

(4) The length of the wave radiated by an aerial can be determined from knowledge of its inductance and capacity, i.e., $\lambda = 38 \sqrt{LC}$ where L is the distributed inductance in centimeters, and C, the distributed capacity in microfarad. Hence, as explained in a previous chapter, if the inductance is 100,000 centimeters (100 microhenries) and the capacity .001 microfarad, the wave length = $38 \sqrt{100,000 \times .001} = 38 \sqrt{100} = 380$ meters.

(5) An aerial whose fundamental wave length is 380 meters requires the insertion of a localized inductance at the base to radiate at 600 meters. To radiate a wave of 300 meters a short wave condenser, usually of .0005 microfarad capacity, is connected in series.

(6) Aerials may take various shapes or forms. Four types are generally recognized in commercial practice:

- (a) The vertical or fan aerial;
- (b) the umbrella aerial;
- (c) the inverted "L" flat top aerial;
- (d) the "T" flat top aerial.

Either the "T" or "L" shaped aerials are employed for ship use.

The vertical and umbrella aerials are used at a few high power stations, but the inverted "L" flat top is preferred by the Marconi Company both for ship to shore and long distance communication.

(7) Generally, the type of aerial adopted is the one most convenient to the space available although financial considerations may be the governing factor.

(8) Flat top aerials are used at the majority of stations for the reason that they prove just as effective as vertical aerials, with a smaller initial expense of erection.

(9) Some fundamental points to be considered in the design of an aerial follow:

- (a) The conductors must possess great tensile strength and good conductivity;
- (b) they should be spaced from two to three feet apart;
- (c) the wires must be thoroughly insulated at all points of support.

AERIAL INSULATORS

(1) Especial attention must be given to the insulation at the free end of a wireless telegraph aerial for, generally, the voltage there is greater than in any other part of the system.

(2) Aerial insulators must possess not only high specific resistance, but they must be of sufficient length to exceed the sparking distance of the voltage to which the aerial is charged.

Glazed porcelain possesses good insulating qualities, but the danger of breakage is considerable; the same statement applies to glass. Hard rubber rods have been used considerably for insulating the wires individually. Composition insulators such as moulded electrose, and others, are extensively employed.

Special insulators are employed to pass the lead-in wires through the deck, particularly if they extend through a steel deck.

DIRECTIONAL AERIALS

(1) It has been found that if the length of the flat top portion of an inverted "L" aerial exceeds the vertical portion, maximum radiation will take place in the direction opposite to the free end. A triangular looped type of aerial also will radiate with greatest intensity in the direction of its own plane. The directional properties of the flat top aerial were first noted by Marconi.

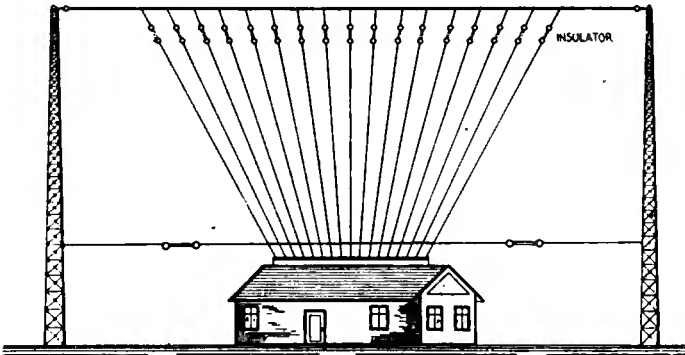


Figure 109

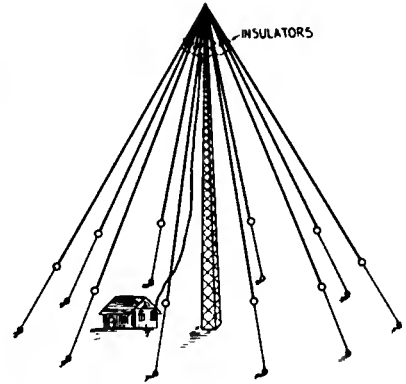


Figure 110

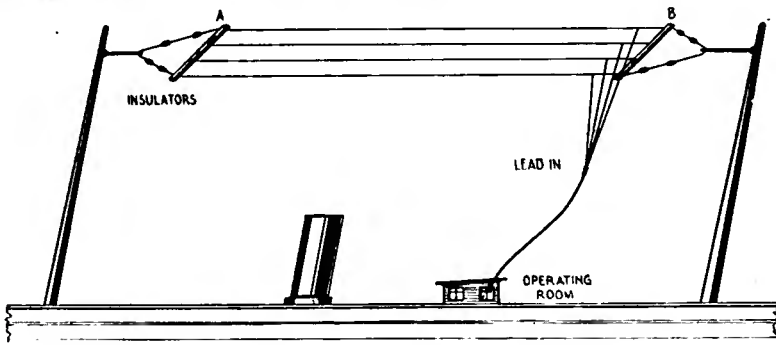


Figure 111

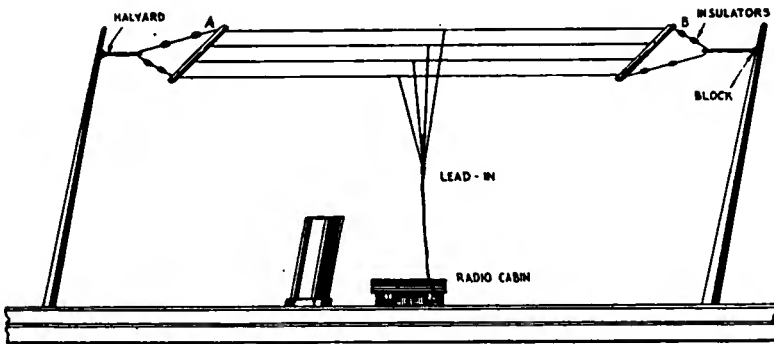


Figure 112

OBJECT OF THE DRAWINGS

- (1) Figure 109. To show the construction of the vertical or fan aerial.
- (2) Figure 110. To show the construction of the umbrella aerial.
- (3) Figure 111. To show the construction of the inverted "L" flat top aerial.
- (4) Figure 112. To show the construction of the "T" flat top aerial.

PRINCIPLE

The electric waves of wireless telegraphy are set into motion by causing an elevated conductor to oscillate at a radio frequency. The characteristic of the radiated wave is governed to a certain extent by the disposition and design of the aerial.

DESCRIPTION OF THE DRAWINGS

The vertical aerial in figure 109 consists of a fan or harp of copper or silicon bronze

wires supported vertically by a **wooden mast, steel tower, or any convenient structure** of sufficient height. The wires may or may not be joined at the top. All wires converge at the lower end where they enter the station house through a specially designed high voltage insulator.

The **umbrella aerial** shown in figure 110 receives its name from its general shape and similarity to an umbrella. A number of wires spread radially in several directions from a common center at the top of the mast. The lead-in wires are attached to the top wires of the ribs. The ribs of the umbrella are about two-thirds the height of the mast, but the guying out wires must be from 6 to 7 times the length of the downward wires.

The **inverted "L" flat top aerial** shown in figure 111 is employed almost universally for ship service. It consists of a number of parallel wires stretched between the wooden spreaders A, B. This is known as the **flat top portion** of the aerial. The vertical wires are attached to one end of the flat top from which they extend to the apparatus in the wireless cabin. These wires are known as the **lead-ins**.

The construction of the flat top portion of the aerial shown in figure 112 is the same as the type shown in figure 111 but the lead-in wires are attached to the center. This type is known as the **"T" aerial**.

SPECIAL REMARKS

(1) The umbrella aerial has been found of some value for portable military stations because the aerial wires can be used as guy supports for the mast, but beyond this, this type has little to recommend itself.

(2) The flat top aerials for ship's use generally consist of four wires spaced $2\frac{1}{2}$ to 3 feet apart. 2, 6, or 8 wires are employed in special cases.

(3) To change an inverted "L" aerial of given dimensions to one of the "T" type reduces the fundamental wave length approximately one third. Hence, if the fundamental wave length of an "L" aerial is too great for radiation at 600 meters, the lead-ins may be attached to the center of the flat top. This is the recognized practice of the Marconi Company today.

(4) A more favorable decrement is secured with the "T" aerial as compared to an "L" aerial of the same dimensions because larger amounts of inductance may be inserted at the base (of the aerial) for a given wave length. The radiated wave then possesses qualities affording greater selectivity, that is, freedom from interference at the receiving station.

OBJECT OF THE DRAWING

To show the practice of the American Marconi Company in respect to construction of ships' aerials.

DESCRIPTION OF THE DRAWING

The antenna consists of six wires equally spaced on spruce spreaders from 14 to 18 feet in length. Each wire consists of 7 strands of No. 18 silicon bronze wire. Each wire is insulated from the spreaders by 24" hard rubber or composition insulators.

The wooden spreader is insulated from the halyards by strop insulators made up of $\frac{5}{8}$ " Russian boat rope partially covered by rubber tubes. The space between the tube and the rope is filled with melted sulphur which, when it cools off, hardens and keeps out moisture. The strop insulators are attached to the spreaders and terminate in a heart shaped shackle to which galvanized iron halyard wires are attached for raising and lowering the aerial.

To prevent the spreaders from swaying, side stays are attached to the ends and fastened to the mast from 20 to 40 feet below the flat top. The stays are broken up by 24" hard rubber insulators to prevent leakage of the high voltage currents.

The lead-in wires are attached to a connecting lug mounted on a deck insulator. The strain is taken off this insulator by two 24" rod insulators attached to a screw eye in the deck as shown in the drawing.

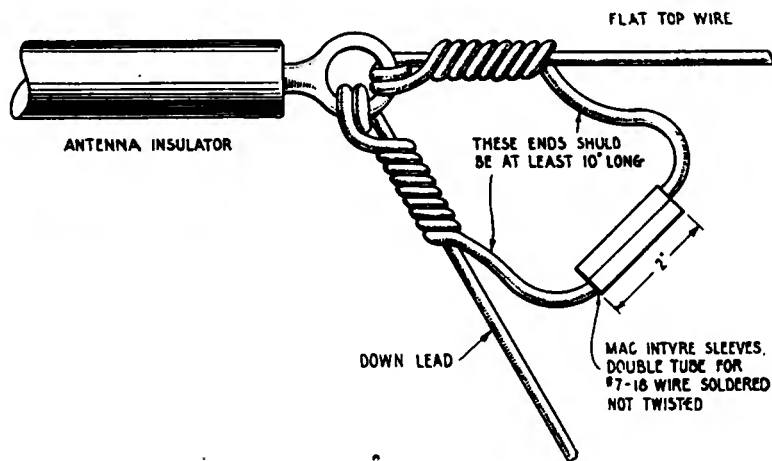


Figure 114

Figure 114—Showing how electric connection is made between the flat top wires and the lead-in wires according to the practice of the American Marconi Company. To solder silicon bronze wire anneals it and reduces its tensile strength. Hence, antenna joints subjected to considerable strain should not be soldered. In the above sketch, the mechanical strain is taken care of by twisting the wires as shown, but a thorough electric connection is effected by a MacIntyre sleeve connector in which the ends of the flat top wires and the lead-ins are soldered.

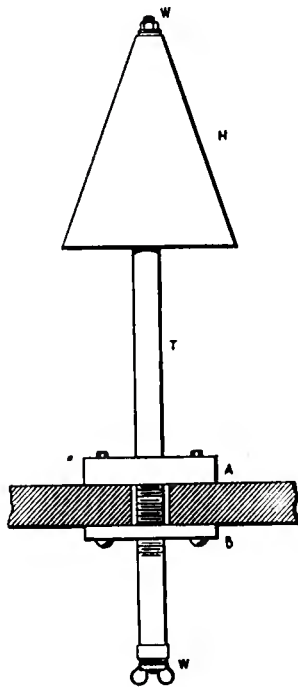


Figure 115

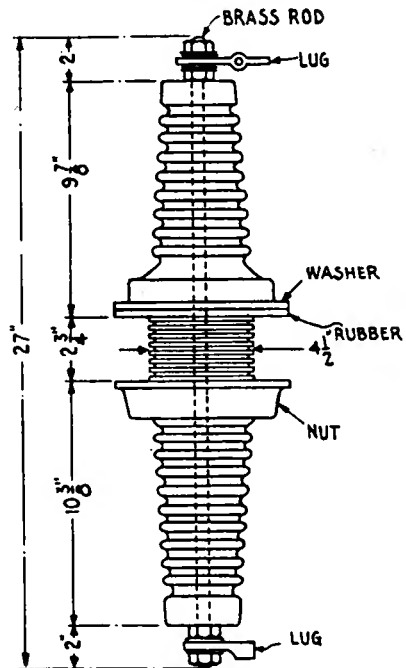


Figure 116

OBJECT OF THE DRAWINGS

(1) Figure 115. To show the general construction of the Bradfield type of deck insulator.

(2) Figure 116. To show the general construction of a special Electrose moulded insulator used by the American Marconi Company.

DESCRIPTION OF THE DRAWINGS

The deck insulator of figure 115 consists of a long hard rubber tube "T" about 2" in diameter which has a brass rod extending through it terminating at each end in a wire connecting lug W. The tube is threaded at the center to take the wooden blocks A, B, one of which is placed above the deck and the other underneath. After these blocks are drawn up tightly, they are held in place by wooden screws or lag bolts. To insure a water-tight joint a piece of canvas covered with white lead is placed under-

neath the blocks. A metal hood H fastened to the exposed end of the tube protects it from moisture.

The deck insulator shown in figure 116 is made of Electrose and has a heavy brass rod moulded securely into it which terminates at either end in a connecting lug. The outside of the insulator is threaded and after it is inserted in a hole cut in the deck a water-tight joint is made by taking up the collar R under which are placed rubber gaskets.

SPECIAL REMARKS

(1) Other types of deck insulators have been employed from time to time but the two just described are indicative of modern practice.

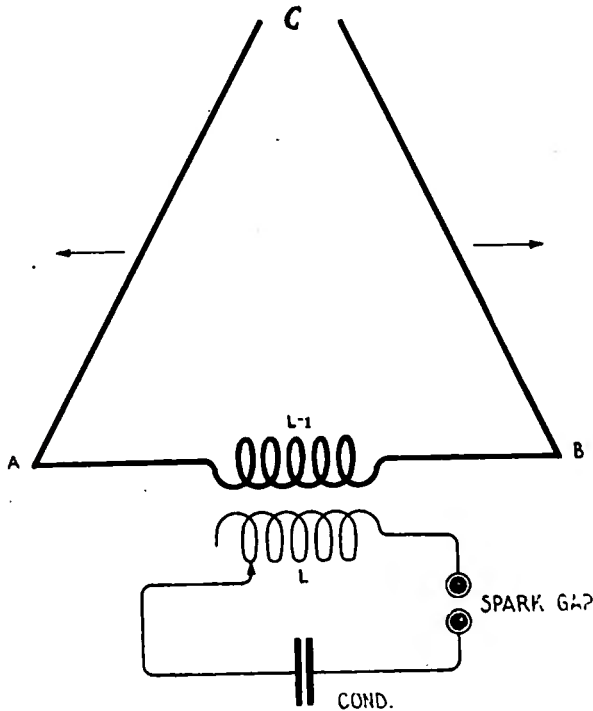


Figure 117

Figure 117—Showing the Bellini Tosi directional antennae. An aerial of triangular form A, B, C, is supported at the apex by a vertical mast (not shown). The two sides of the triangle A, C and B, C make an angle of 30 degrees with the vertical, and the third side is horizontal to the earth. The secondary winding of an oscillation transformer L-1 is inserted at the center. The circuit of the primary winding L includes the usual spark gap and condenser. When this circuit is set into oscillation, the aerial will radiate with the greatest intensity in the direction of its own plane, the radiation in a direction perpendicular to the triangle being zero. In any direction making an angle θ with the plane of the triangle the intensity of the radiation varies as the co-sine of the angle θ . The triangular aerial may be used for receiving purposes as well and if it be arranged so that it can be turned on its axis, the greatest strength of signal will be obtained when the plane of the antenna points in the direction of the wave front. In modified form these aeriels are employed in connection with the Marconi direction finder.



Military Preparedness

Signal Officers' Training Course*

A Wartime Instruction Series for Citizen
Soldiers Preparing for U. S. Army Service

ELEVENTH ARTICLE

By MAJOR J. ANDREW WHITE

Chief Signal Officer, Junior American Guard

Instruction in Garrison Visual Stations

THE alphabet and conventional signals with the flag should be thoroughly mastered by means of wand drill, instruction in which is to be given regularly at such time as prescribed by the company commander.

Signal parties should consist of four men, equipped with the necessary visual signal equipment for the operation of one station. The instructor selects the point where the station is to be established and gives the location of the station or stations with which communication is to be conducted.

At the command *open station*, the signal equipment is made ready for use.

One man is designated to record incoming messages and to call off the words of the message being sent.

A second man manipulates the sending equipment and reads and calls off incoming messages for the recorder.

A third man watches the distant station for breaks.

A fourth man is messenger.

The signal party is made familiar with the various duties by frequently changing about the four men to execute each other's tasks.

Outside or field work is conducted by sections, which may be divided into convenient squads of four, chiefs of sections and their assistants being the instructors. These units lend themselves readily to the use of the flag, heliograph, and lantern, as well as for convenience in camping.

*The articles in this series are abstracted from the complete volume, "Military Signal Corps Manual," by the same author.

Telegraphy

Ability to telegraph by means of the American Morse code is a most important qualification for members of the Signal Corps. Only those who have adaptability for operating and are sufficiently educated should be given this instruction.

The instruction should be conducted in classes, under the direction of the company commander, by competent noncommissioned officers, and, when practicable under the personal supervision of a commissioned officer. The buzzer is used for this instruction and the men classified according to ability and progress. Instruction indoors is to be continued until the operator is sufficiently advanced to work to advantage on field lines, that is, when he has acquired ability to send and receive about 15 words per minute under service conditions.

Instruments should be provided in company headquarters so that they are accessible to the members at all times, encouraging the ambitious to rapid progress. Opportunity should also be given to use typewriters when members have progressed sufficiently.

The standard instruction of the United States Army for telegraphy serves as an excellent guide and is given here for the information of all instructors.

The Morse code as used in the Signal Corps consists of seven elements: (1) the dot; (2) the dash; (3) the long dash; (4) the ordinary space; (5) the letter space; (6) the word space; and (7) the sentence space. It is important to remember that the value of the space in the code is as great as that of the dots and dashes. The complete code is shown in the accompanying plates.

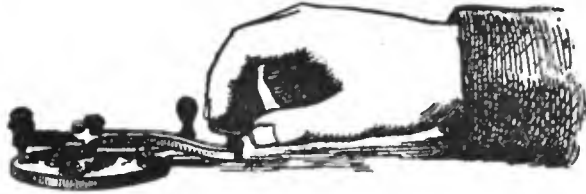
The arbitrary unit of time in this code, which, when written down becomes a unit of length, is technically termed the dot. An appreciable time is required for the production of signals by electricity, in the magnetization of the electromagnet, and in the movement of clockwork. The formation of a dot, therefore, necessarily involves time. Assuming, therefore, that—

- (1) the dot is the unit of time.
- (2) The dash is equal to two dots.
- (3) The long dash is equal to four dots.
- (4) The ordinary space between the elements of a letter is equal to one dot.
- (5) The letter space is equal to two dots.
- (6) The word space is equal to three dots.
- (7) The sentence space is equal to six dots.

The recruit will first thoroughly commit to memory the groups of signs representing the letters of the alphabet, the numerals, and the principal punctuation points, viz., the period, the comma, and the point of interrogation. The remaining characters can be learned afterwards, as they will be little needed by the beginner.

The most approved manner of grasping the key, and one which has been employed by some of the most successful, experienced, and rapid operators, is shown in the illustration. Curve the forefinger, but do not hold it rigid.

Let the thumb press slightly in an upward direction against the knob. Keep the wrist well above the table. No better general direction can be given than that the key will be grasped, held, and controlled with the same flexible but perfectly controlled muscular action of the fingers, wrist, and forearm with which the skilled penman holds his pen. Carefully avoid tapping upon the knob of the key; the raising spring should assist the upward motion of the key, but should never be permitted to control it.



Correct manner of grasping key in telegraphing

By constant drill, as hereinafter directed, the habit of making dots with regularity, uniformity and precision must first be acquired; then dashes, and lastly, in order, group of dots and dashes, letters and words. In commencing, the habit should at once be acquired of making dots like short, firm dashes. The recruit should learn to form the conventional characters accurately and perfectly; speed will come in good time, but only as a result of constant and persistent drill.

ELEMENTARY PRINCIPLES

As a basis for practice, the code may be regarded as comprising six elementary principles, viz.:

First principle—Associated dots.

I S H P 6

Second principle—Associated dashes.

M 5 ¶
 --- --- ---

Third principle—Isolated dots.

E

Fourth principle—Isolated dashes.

L or cipher T
 — —

Fifth principle—Dot followed by dash.

A

Sixth principle—Dash followed by dot.

N

The learner's first practice is upon these elementary principles.

Comma,	,	
Semicolon,	;	
Colon,	:	
Colon Dash,	:—	
Period,	.	
Interrogation,	?	
Exclamation,	!	
Dash,	—	
Hyphen,	-	
Pounds, ³	£	
Shillings, ³	/	
Dollars, ³	\$	
Capitalized Letter, ³		
Colon-Quotation,	: “	
Decimal Point,	’	
Paragraph,	¶	
Parenthesis, ³	()	
Underline, ³		
Quotation, ³	“	
Quotation within Quotation, ³	“ ”	

- (3) The *long dash* is equal to 4 dots ;
 (4) The *ordinary space* between the elements of a letter is equal to 1 dot ;
 (5) The *letter-space* is equal to 2 dots ;
 (6) The *word-space* is equal to 3 dots ;
 (7) The *sentence-space* is equal to 6 dots.

³ To be used before the characters to which it refers.

³ To be used before and after the words to which it refers.

Punctuation and miscellany

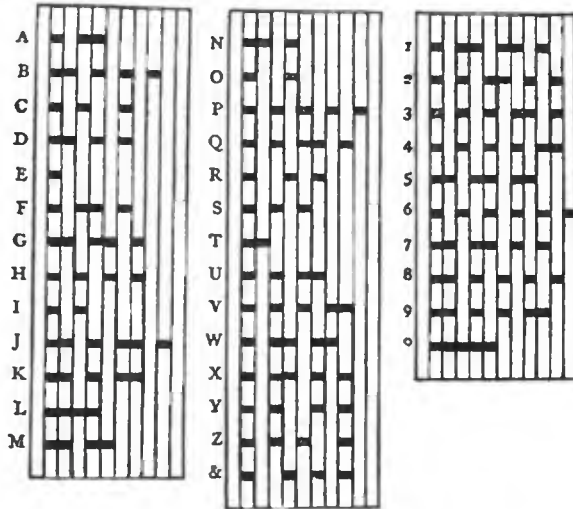
Make dots with the key at uniform and regular intervals, until they can be produced with the precision of a machine and of definite and uniform dimensions.

Next make dashes, first at the rate of about one per second, which speed may be increased by degrees, as skill is acquired by practice, to three per second. Make the space interval between successive dashes as short as possible. If the upward movement which forms the space be made full, it can not be made too quickly.

The third principle occurs but once, and needs no specific directions.

The fourth principle will be found somewhat more difficult to execute. The usual tendency is to make T too long and L too short. Theoretically, the cipher is one-half longer than L, but in fact it is always made the same,

as the practice has been found to occasion no inconvenience. Occurring alone or among other letters, it is translated as L, but when found among figures it is read as O.



Alphabet and numerals

The fifth principle forms the letter A. The usual tendency is to separate the two elements too much.

The dash followed by a dot (N) is usually found to be somewhat difficult. Time the movement by pronouncing the word ninety, sounding the first syllable fully. Guard especially against the usual tendency to separate the elements by too great a space.

Having become thoroughly familiar with the principles, the following exercises may with advantage be taken up in order:

E I S H P 6

These should be practiced repeatedly until the correct number of dots in each character can be certainly made at every trial. A habit once formed of making the wrong number, usually one or two too many in the case of H, P, and 6, is almost impossible to eradicate. Guard especially against the objectionable habit of shortening or clipping the final dot, a vice which leads to innumerable and vexatious errors and misreading of signals.

T M 5 ¶
 — — — —

The faults to guard against particularly in this exercise are shortening or elongating the terminal dash, and separating the successive dashes by too great a space interval.

A U V 4

The usual tendency to allow too much space between the dot and dash in the above letters may be overcome by forming them as by an elongation of the final dot in I, S, H, and P.

I A S U H V
 --- --- --- --- --- ---

Practice these characters in pairs, that the distinction between them may be more firmly impressed upon the mind.

N D B 8
 --- --- --- ---

The student who has mastered the sixth principle will find no difficulty with the above characters.

A F X ,
 --- --- --- ---

 W I
 --- ---

U Q 2 Period
 --- --- --- ---

 3

These are similar to preceding exercises, and present no new difficulties.

K J 9 7
 --- --- --- ---

J and K are usually considered the most difficult letters in the code. Avoid the tendency to separate J by a space into double N, and be careful that the dashes are of equal length. The numerals 7 and 9 require some care to insure correct spacing.

O R & C
 --- --- --- ---

 Z Y
 --- ---

These are termed the space letters, and the utmost care and diligent practice are necessary in order to form them accurately. The ability to transmit the spaced letters with absolute correctness is the test of a strictly first-class sender. The space should be just enough in excess of that ordinarily used between the elements of a letter to enable the letters intended to be made to be distinguished with certainty from I, S and H. The most usual tendency is to make the space too great, even in some cases as great as the space between letters. This is a most fruitful source of misapprehension and error, and too much pains cannot be taken to acquire and maintain correct habits in this particular.

Methods of Practice

In transmitting words containing groups of two or more spaced letters, careful operators are accustomed to slightly increase the spacing between successive letters of the group.

The receiving operator adds to the message after it is received the month and year and, after satisfying himself that the checked number of words corresponds, gives "R" followed by the call letter of his station and his own personal signal.* The operator then enters in the proper places at the head of the blank call letter of his own station, with his personal signal and the time the message was received.

Communications transmitted by telegraph or signals are always confidential and are revealed only to those officially entitled to receive them.

When several messages are to be sent in succession "end of message" signal is made after the signature of each, to be followed by the abbreviation "ahr," meaning "another," after which the sending of the next message is begun.

No message is considered sent until its receipt has been acknowledged by the receiving station.

Practice in transmission from miscellaneous manuscript is strongly recommended. The ability to read all kinds of copy—good, bad, and indifferent—correctly at sight is a most valuable one, and it is not difficult to acquire by attention and experience.

If the principles here laid down be firmly adhered to, the learner will find much reason for encouragement not only at the rapidity with which he will master what at first sight appears to be a very difficult undertaking, but the extreme accuracy with which he will be able to manipulate his instrument after a fair amount of practice.

This art can only be acquired by constant and persevering practice, keeping in mind the principles given above.

In learning to read by sound, it is advisable for two persons to practice together, taking turns at reading and writing, and each correcting the faults of the other. The sounds of the code characters must first be learned separately and then short words chosen, which must be written very slowly and distinctly and well spaced, the speed of manipulation being gradually increased as the student becomes more proficient in reading.

When the operator has made sufficient progress, he will be given instruction in checking messages, the conduct of offices, the care, adjustment, and repair of instruments.

Checking the Message

In preparing the "check" of the message, all words and figures written in the address, body of the message, and the signature will be counted. That is, count all words after *to* to the end of the signature. The word "sig." is sent merely to indicate that the signature follows, and is not counted in the check.

In counting the check of a message, all words, whether in plain English, code, or cipher, pronounceable or unpronounceable, or initial letters, will be counted each as one word. The abbreviations for the names of places, cities, towns, villages, States, Territories, and Provinces will be counted as if written in full. In the names of towns, counties, countries, or States all of the words will be counted.

Abbreviations of weights and measures in common use and cardinal points of the compass will be counted each as one word.

Figures, decimal points, and bars of division, and letters will be counted each separately as one word.

In ordinal numbers, the affixes st, d, nd, rd, and th will each be counted as one word.

* On military telegraph lines, short cables, and field lines the receipt of a message is acknowledged by the signal "OK."

Finding Your Way Across the Sea

A Practical Instruction Course in Navigation

By **CAPTAIN FRITZ E. UTTMARK**

CHAPTER V

(Copyright, 1918, *Wireless Press, Inc.*)

BEFORE we start with the Dead Reckoning problems, a chapter will be devoted to the important knowledge of the rule of the road, or how to handle the ship in order to avoid danger of collision. Every navigator should be thoroughly familiar with this. We have also included other helpful and important regulations.

RULES OF THE ROAD

Lights, Fog Signals, Whistles, Etc.

Regulation Lights Should be Exhibited from Sunset to Sunrise

Lights for an Ocean Steamer Under Way

On the starboard side a green light; on the port side a red light, and a white masthead light. The side lights are fitted with inboard screens projecting three feet forward of the light, so that they cannot be seen across the bows. They show from right ahead to two points abaft the beam on their respective sides. The size of the glasses must be six by six inches, and these lights must be visible for at least two miles on a clear night. The masthead light must be carried on or in front of the foremast, not less than 20 feet above the deck; but if the beam of the vessel exceeds twenty feet, it must be carried at a height above the hull of not less than such beam. It must show from right ahead to two points abaft the beam on each side, and must be seen for five miles on a clear night.

A steam vessel when under way may carry an after light of the same character as the masthead light described, which shall be fifteen feet higher than the masthead light.

Lights for a Sailing Vessel Under Way

The same character of side lights as prescribed for a steamer, but she shall carry no other lights.

Lights for a Towing Vessel

The side and masthead lights, and in addition an extra masthead light, six feet below the other, but in the same line. If towing more than one vessel, she shall carry an additional white light six feet below or above the others if the length of the tow, measuring from the stern of the towing vessel to the stern of the vessel being towed exceeds 600 feet. This third light must not be carried less than fourteen feet above the deck. The towing vessel may carry a small white light abaft the funnel or aftermast, for the vessel towed to steer by, but such light must not be visible forward of the beam.

Lights for a Vessel at Anchor

A vessel under 150 feet in length shall carry forward where it can be seen, at a height not more than twenty feet above the hull, a white light so con-

structed as to show a clear and unbroken light all around the horizon at a distance of at least one mile; but if the vessel exceeds 150 feet in length, she shall carry at a height of not less than twenty and not more than forty feet above the hull, such a light as just described, and at or near the stern of the vessel, another such light not less than fifteen feet lower than the forward light.

Fog Signals for a Steamer Underway

A prolonged blast of the steam whistle at intervals not to exceed two minutes.

Fog Signals for a Sailing Vessel Underway

When on the starboard tack one long blast of the fog horn; when on the port tack, two long blasts of the fog horn; when running with the wind abaft the beam, three blasts of the fog horn.

Fog Signal for a Steamer Towing Another

One long and two short blasts.

Fog Signals for a Vessel at Anchor

Ring the ship's bell rapidly for five seconds at intervals not to exceed one minute.

The Law About the Size of Running and Anchor Lights

The glass in the side lights shall not be less than 6 inches wide and 6 inches high. The glass globe of the anchor light shall be not less than 8 inches in diameter, which is equal to 24 inches in circumference. There is no law prescribed for the size of the masthead light, but it is provided that it must be of such character as to be visible for five miles on a clear night.

Lights and Shapes Shown by Vessels Not Under Command

A vessel which from any accident or cause is not under command shall show by night, well above the deck, where they can be seen all around the horizon for a distance of at least two miles, two red lights shown over one another, not less than six feet apart. By day, both sail and steam vessels not under command shall show two black balls or shapes, each two feet in diameter, one over the other, not less than six feet apart, and hoisted well above the deck where they may be seen all around the horizon.

Lights for a Vessel When Aground in a Fairway

A vessel aground at night on or near a fairway shall carry the prescribed anchor light or lights and two red lights where they can be best seen, in a vertical line one over the other, not less than six feet apart, and of such a character as to be visible all around the horizon at a distance of at least two miles. In the daytime, however, there shall be carried in a vertical line one over the other, not less than six feet apart, two black balls or shapes each two feet in diameter.

Signals for a Vessel Laying or Picking Up a Telegraph Cable

A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as a steam vessel's masthead light, and if a steam

vessel in lieu of that light, three lights in a vertical line one over the other not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light white, and they shall be of such a character as to be visible all around the horizon, at a distance of at least two miles. By day she shall carry in a vertical line, one over the other, not less than six feet apart, where they can best be seen, three shapes not less than two feet in diameter, of which the highest and lowest shall be globular in shape and red in color, and the middle one diamond in shape, and white. When such vessel is not making way through the water, she shall not carry side-lights, but when making way shall carry them.

Rules of the Road for Inland Waters

Inland water vessels are governed by the pilot rules prescribed for those waters. When ocean steam vessels enter pilotage waters, they are governed by the rules provided for said pilotage waters, and not by the rules of the road at sea. These rules may be had at the office or at the Local Inspectors.

Stem Light

A bright white light is carried in front of the stem by steamboats, tugs, and other mastless steam craft, navigating rivers and inland waters in general. This stem light must show from right ahead to two points abaft the beam on each side, and must be seen two miles.

Range Light

A seagoing steam vessel, when under way, may carry an additional white light similar to the masthead light. These two lights shall be so placed in line with the keel that one shall be at least fifteen feet higher than the other, and in such a position with reference to each other, that the lower light shall be forward of the upper one. The vertical distance between these two lights shall be less than the horizontal distance.

All steam vessels (except seagoing vessels and ferry boats) shall carry, in addition to the red and green side lights, a central range of two white lights; the after light being carried at an elevation at least fifteen feet above the light at the head of the vessel. The head light shall be so constructed as to show an unbroken light through twenty points of the compass, namely, from right ahead to two points abaft the beam on either side of the vessel, and the after light so as to show all around the horizon.

A vessel, when towing another vessel shall, in addition to its side lights, carry two bright white lights in a vertical line, one over the other, not less than three feet apart, and, when towing more than one vessel, shall carry an additional bright white light, three feet above or below such lights, if the length of the tow, measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds 600 feet. Each of these lights shall be of the same construction and character and shall be carried in the same position as the steamer's masthead light or the after range light.

Such steam vessels may carry a small white light abaft the funnel or aftermast, for the vessel towed to steer by, but such light shall not be visible forward of the beam.

What Should Be Done When Going Away from a Dock

Blow a prolonged blast of the steam whistle as a warning to other vessels under way in the vicinity.

What Should Be Done Upon Approaching a Bend In a River or Harbor

Blow a prolonged blast of the steam whistle as a warning to other boats that might happen to be coming the same way on the other side of the bend, and slow down engines until the bend is rounded.

In a Fog What Extra Precautions Should Be Taken?

Post a lookout, keep the whistle going, and slow down the engines. If making the land, keep the lead going.

Alarm Whistle

Four short blasts of the steam whistle.

Rule When Two Steamers Are Running In the Same Direction and the One Astern Desires to Pass the One Ahead.

Should the vessel astern desire to pass the one ahead on her right or starboard side, she shall give one short blast of the steam whistle, and if the vessel ahead answers with one blast, then the vessel astern shall put her helm to port, and pass the other.

On the other hand, should the vessel astern desire to pass on the left or port side of the vessel ahead, she shall give two short blasts of the steam whistle, and if the vessel ahead answers with two blasts, then the vessel astern shall put her helm to starboard and pass the other.

If the vessel ahead does not think it safe for the vessel astern to attempt to pass, she shall signify the same by giving several short and rapid blasts of the steam whistle (not less than four), and under no circumstances shall the vessel astern attempt to pass the vessel ahead until such time as it can be safely done, when the vessel ahead shall signify her willingness by blowing the proper passing signal to the vessel astern.

The vessel ahead shall in no way attempt to cross the bow or crowd upon the course of the passing vessel.

Cross Signaling

Answering one blast with two blasts, or answering two blasts with one blast. Upon receiving such cross signal, blow the alarm whistle consisting of four short blasts.

Rule for Vessels Meeting Obliquely

When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side, shall keep out of the way of the other.

The steamer which has the other on her own port side shall hold her course and speed, and the steamer which has the other on her own starboard side shall keep out of the way of the other by directing her course to starboard so as to cross the stern of the other, or if necessary, she shall slacken

her speed, or stop, or reverse. The steamer which has the other on her own port bow shall blow one blast to show her intention of crossing the bow of the other, holding her course and speed, and said signal shall be promptly answered by the other steamer by one short blast to show her intention to direct her course to starboard so as to cross the other's stern, or otherwise to keep clear. When this cannot be done, the danger signal of four short blasts shall be blown, and both steamers shall be stopped and backed, if necessary, until passing signals are made and agreed upon. This comes under the head of Rule 8.

Rule 9 provides that when two steamers approaching each other at right angles, or obliquely, the steamer having the other on her own starboard side may cross the bow of the other if it may be done without involving risk of collision.

If the steamers are within half a mile of each other, the steamer having the other on her own starboard side shall give as a signal of her intention to cross the bow of the other, two short and distinct blasts, and if this is agreed to, she shall proceed, but if not agreed to by the other steamer the latter shall sound the danger signal of four short blasts, and both steamers shall be stopped and backed if necessary until passing signals are agreed upon.

On What Side of the Channel Are Steamers to Keep?

All steamers must keep to the righthand or starboard side of the channel when it is possible to do so.

How Would You Signify Misunderstanding of Signals?

By several short, quick toots of the steam whistle—not less than four.

Rule When a Steam and a Sail Vessel Approach One Another

A steam vessel is always to keep out of the way of a sail vessel.

Rules for Sailing Vessels Approaching One Another

Risk of collision may be ascertained by watching the compass bearing of an approaching vessel, and if the bearing of same does not appreciably change, such risk should be considered to exist, and one of them shall keep out of the way, as follows:

- (a) A vessel running free shall keep out of the way of one close-hauled.
- (b) A vessel close-hauled on the port tack shall keep out of the way of a vessel close-hauled on the starboard tack.
- (c) When both are running free with the wind on different sides, the vessel having the wind on the port side shall keep out of the way of the other.
- (d) When both are running free with the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.
- (e) A vessel which has the wind aft shall keep out of the way of the other vessel.

Signal for a Pilot

At night, a white light flashed above the bulwarks for a minute or so at a time, or by day, the pilot signal S., or the Jack hoisted to the fore.

Signals of Distress

When a vessel is in distress and requires assistance from other vessels (or from the shore) the following signals should be displayed by her, either together or separately:

In the Daytime—A gun, or other explosive signal fired at intervals of about a minute.

The International Code Signal of Distress indicated by "N. C."

The Distant Signal, consisting of a square flag, having either above or below it a ball, or anything resembling a ball.

A continuous sounding with any fog signal apparatus.

In the Night Time—A gun or other explosive signal fired at intervals of about a minute.

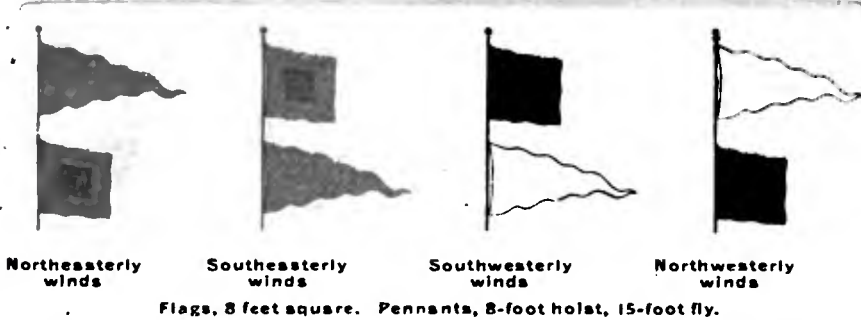
Flames on the vessel (as from a burning tar or oil barrel, etc.)

Rockets or shells, throwing stars of any color or description, fired one at a time at short intervals.

A continuous sounding with any fog signal apparatus. A blue light burned every few minutes.

SMALL CRAFT, STORM, AND HURRICANE WARNINGS

Storm



Small craft



Hurricane

In the illustrations above the color red is indicated by the shaded portions

Storm Warning Signals

Small Craft Warning—A red flag with a black center indicates that a storm of marked violence is expected. The pennants displayed with the flags indicate the direction of the wind; red, easterly; white, westerly. The pennant above the flag indicates that the wind is expected to blow from northerly quadrants; below, from southerly quadrants.

By night a red light indicates easterly winds, and a white light below a red light, westerly winds.

Hurricane Warning—Two red flags with black centers displayed one above the other, indicate the expected approach of a tropical hurricane, or one of those extremely severe and dangerous storms which occasionally originate in the West Indies or Gulf region and move northward along the Atlantic coastline.

Neither small craft nor hurricane warnings are displayed at night.

Life-Saving Signals

1. Upon discovery of a wreck by night, the life-saving force will burn a red pyrotechnic light, or a red rocket, signifying, "You are seen; assistance will be given as soon as possible."

2. A red flag waved on shore by day, or a red light, red rocket, or red Roman candle at night, will signify, "Haul away."

3. A white flag waved on shore by day, or a white light swung back and forth, or a white rocket or white Roman candle at night, will signify, "Slack away."

4. Two flags, a white and a red, waved at the same time on shore by day, or two lights, a white and red, slowly swung at the same time, or a blue pyrotechnic light burned by night, will signify, "Do not attempt to land in your own boats; it is impossible."

5. A man on shore beckoning by day, or two torches burning near together by night will signify, "This is the best place to land."

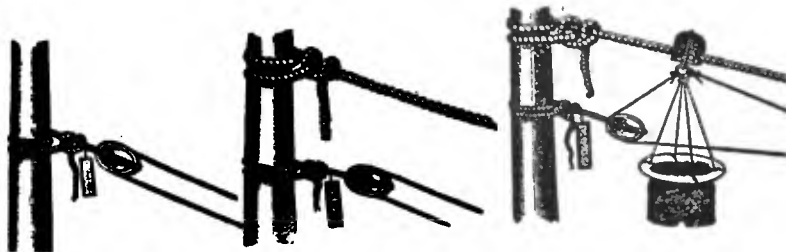


Fig. A—Tail block with endless line fastened to mast

Fig. B—Hawser made fast above the tail block

Fig. C—Showing manner of rigging a breeches buoy

Use of the Gun and Rocket Apparatus and Breeches Buoy

If your vessel is stranded and a shot with a small line is fired over it, get hold of the line and haul on board until you get a tail-block with an endless line rove through it; make the tail-block fast to the lower mast, well up, or in the event the masts are gone, to the best place to be found; cast off small shot line, see that rope in block runs freely and make a signal to shore (Fig. A).

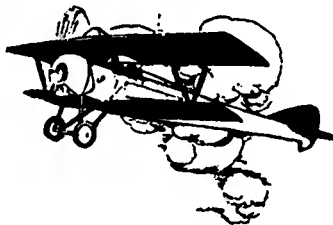
A hawser will be bent to the endless line on shore and hauled off to your ship by the life-saving crew. Make hawser fast about two feet above the tail-block and unbend hawser from endless line. See that rope in block runs freely and show signal to shore (Fig. B).

Life-savers on shore will then set hawser taut and by means of the endless line haul off to your ship a breeches buoy (Fig. C).

Let one man get clear into the breeches buoy, thrusting his legs through the breeches; make a signal to shore as before, and he will be hauled ashore by the life-savers and the empty buoy returned to the ship.

How to Become an Aviator

The Ninth Article of a Series for Wireless Men in the Service of the United States Government Giving the Elements of Aeroplane Design, Power, Equipment and Military Tactics



By **HENRY WOODHOUSE**

Author of "Text Book of Naval Aeronautics"

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OWING to the unusual conditions of wartime it is almost impossible to determine in advance what the outcome of plans will be one month hence. Thus, in the March issue it was announced for this series that the April installment would continue the study of aviation engines, dealing with carburetion and ignition. Demands upon the writer's time which have since arisen, however, made it impossible to complete the drawings for this subject before the magazine went to press, so the opportunity is taken to supply in this general article the answers to many questions which have been submitted by readers. These, in general, have been of the look-ahead type, from men who anticipate becoming flight officers and, as students of the magazine course, are curious to know the later conditions of flight training. It seems advisable to cover this subject in a general way at this juncture, if only for the reason that it will make the reader realize how important is careful study of the preliminary knowledge represented by this magazine course.

The most familiar question is that of physical qualification. The best answer to this is that the U. S. Army wants for its air service, men that are physically perfect. This is true of all nations, and, as long as the supply of perfect men lasts, the rigidity of examination is not likely to slacken. The medical tests for air pilots are thorough and skillful, little doubt remaining at the end of the examination of an applicant's fitness. Sight is tested, hearing, and sense of balance. The condition of the nervous system is accurately determined; digestion and respiration must be first class, and the circulatory system approved. Certain mental qualifications are also desired, a mind developed by a college education or its equivalent in experience being preferred.

For non-flying service, that is, the men behind the pilot, the physical requirements are not quite so drastic. The service rendered by these men and the distinctions of duty between both flying and non-flying crews of the Signal Corps will now be explained.

THE FLYING CREW

An aeroplane's flying crew is largely governed by the type of machine. Small machines of high power, designed either for strategic reconnaissance flights or pursuit at high speeds, carry but a single aviator. The two-seater, or most common, aeroplane carries an observer or gunner. Aircraft of the super-plane class carry from 3 to 15 men, comprising additional duties of navigator, gunner, engineer and radio operator.

THE NAVIGATOR

Military control and direction of pilot gunners, bombers, radio operator and engineers, as well as the navigation of the machine in flight, is the duty of the navigator, usually the senior officer of the crew.

THE PILOT

Management of the controls of the aeroplane while in flight is the duty of the pilot. He is also responsible for final inspection of the craft before the flight is begun, and for the careful completion of any repairs or alterations on the machine. Immediately upon return from a flight it is his duty to examine minutely all controls, lifting surfaces and braces and supervise all mechanical adjustments not included in shop work.

THE OBSERVER

Preparation of reconnaissance maps and reports, all observations and computations of flight navigation is the duty of the observer. In combat he directs the fire against enemy aeroplanes and, if on a bombing expedition, orders the use of explosive or incendiary bombs according to objective. He is also responsible for the efficiency of the personnel of the crew and the material.

MOTOR ENGINEER

Uninterrupted operation of the motor or motors in flight is the responsibility fixed on the motor engineer. At all times he performs, with the help of an assistant, any work necessary to insure the highest operating efficiency of the aeroplane's engines, and is responsible for all repairs other than those required to be made in the machine shop.

THE GUNNER

Expertness in the care and operation of machine guns and the construction and operation of explosive and incendiary bombs is required of the gunner. Range-finding, loading and releasing devices for bombs and barometer, telescope and air compressor must also be thoroughly mastered.

RADIO OPERATOR

Installation of apparatus, assembly and dismantling of radio equipment, thorough knowledge of all codes of army signaling are qualifications of the radio operator. In addition, he is responsible for all communications from the aeroplane and must be familiar with the operation of visual signaling devices, such as the Very pistol, rockets, smoke bombs, etc.

THE REPAIR CREW

Two non-commissioned officers and three privates, first class, are generally assigned to an aeroplane and are responsible for its care on the ground. In the case of small aeroplanes the repair crew may consist of only three men, but the general practice is a crew of five.

AVIATION MECHANICIAN

The chief of the repair crew is rated first class sergeant or sergeant, and in the U. S. Army is known as Aviation Mechanician. He is responsible for the condition of the aeroplane and its material while it is in the hangar; he supervises all adjustments, alterations, installations and repairs. All property issued for maintenance and all tools and accessories are in his charge, and he is responsible for the cleaning and preservation of the aeroplane.

ASSISTANT CHIEF OF CREW

Rated as a sergeant or a corporal, the assistant aids the chief and is required to be a qualified mechanic capable of discharging all duties of the chief of crew.

MECHANICIAN HELPERS

The three mechanician helpers, rated as privates, first class, are under the orders of the chief of crew and his assistant. They are required to assist in adjustments, alterations, removals, installations and repairs, to clean the motor and all parts of the aeroplane fusilage and surfaces, fittings and fixtures, wires and cables. It is their duty to keep the hangars clean at all times; to replace tools and equipment; to elevate the machine on chocks or jacks when in its stall and to cover the motor propellers and cockpit. Hauling gasoline, oil and other supplies and assisting in repair work are among their duties. When not employed about the machine they are required to be available for instruction or duty in the machine and repair shop.

INSTRUCTION IN FLYING

Candidates for instruction in aviation in the U. S. Army are selected from the following sources:

- Officers of the line of the Army,
- Enlisted men of the Aviation Section, Signal Corps,
- Civilian aviators, employed as Instructors,
- Civilian aviators, employed to perform flying duties and given the rank of Aviator, U. S. Army,
- Officers and enlisted men of the Signal Officers and Signal Enlisted Reserve Corps.

THE FLYING COURSE

The instruction is divided into definite stages comprising a complete flying course, as follows:

- (a) Preparatory.
- (b) Preliminary.
- (c) Elementary.
- (d) Advanced.

The preparatory instruction includes all the teaching up to the point where the pupil actually takes hold of the controls while the craft is in flight through the air. Preliminary training may be defined as the instruction up to the point where the student makes a flight alone, making quarter, half or full turns. Elementary training is the stage of instruction preliminary to the completion of pilot's tests. Advanced flying is the next step up to the qualification tests as a junior military aviator.

JUNIOR MILITARY AVIATOR TESTS

(a) Five figures-8 around pylons, keeping all parts of the machine inside of a circle, with radius of 300 feet.

(b) Climb out of a field 1,200x900 feet and attain 500 feet altitude, keeping all parts of the machine inside of the field during climb.

(c) Climb 3,000 feet, kill motor, spiral down, changing direction of spiral, that is from left to right and land within 150 feet of a previously designated mark.

(d) Land with dead motor in a field 800x100 feet, assuming the field to be surrounded by a 10-foot obstacle.

(e) From 500 feet altitude, land within 100 feet of a previously designated point, with a dead motor.

(f) Cross-country triangular flight of approximately 60 miles without landing.

(g) Straightaway cross-country flight, without landing, of about 90 miles.

FLYING BY DUAL CONTROL METHOD

THE AEROPLANE

A machine of moderate power and slow speed is used, with large surfaces for slow landing speed. Dual controls are provided, so that either instructor or student can control the craft.

FIRST STAGE

The student merely observes the operations of the instructor at the beginning. He is given the "feel" of the air and taught to gauge, by the air pressure against face and body, his speed and flotation for horizontal flight, climbing and banking. The machine's response to the controls are noted and their resistance to motion observed.

SECOND STAGE

Instruction is given in the operation and management of the controls. Horizontal flights are followed by broad, flat turns, quarter, half and full circles to right and left, simple, normal landings and float-offs and balancing the aeroplane in the air. Flight through unfavorable, disturbed air is next performed, including banking, climbing and gliding, moderate spiral glides and straight and spiral volplanes. Landings of various kinds are then taught, including normal, slow-speed, pancake and stall landings, and the landings in wind. The instructor gradually turns over the air controls to the student as the instruction progresses, and finally the power controls. Taxying, or maneuvering the machine on the ground, is also mastered before the student takes to the air alone.

FLYING ALONE

Detailed instructions as to the flight course and maneuvers to be performed, are given by the instructor before the student flies alone, and the altitude is also prescribed. The first flight alone is elementary, being restricted to horizontal flight, getaways and landings on a straight course. It is followed by adding circles to right and left, moderate climbs and straight glides. Figures eight are made with gradually decreasing radii and steeper banking; the turns are then combined with glides and advanced to spiral glides. From both straight and spiral glides, landings are then made with a dead motor. The instructor watches his pupil closely from an observation tower during these flights and corrects all faults observed at the completion of the flight.

FLIGHT INSTRUCTION BY SOLO METHOD

FIRST AEROPLANE

The first machine used for this method, practically one of self-training by progressive use of selected aeroplanes, is low powered with small lifting surfaces, in fact not intended for use off the ground. The speed of propeller revolution is limited by a stop on the engine throttle. The student first learns the manipulation of controls from the pilot's seat, that is, the rudder, elevators and balancing planes, or ailerons. He is then taught to "taxi" on the ground, using a straightaway course on a broad, flat and hard path, and to acquire skill in steering the machine on the ground.

SECOND AEROPLANE

The next machine is one of limited power but designed to lift off the ground for a height of about two feet, the lift being regulated by the throttle of the engine. The limitation of power causes the machine to sink gently back on the ground but permits the student to master the operation of the elevator. Hops up to 200 feet are made in this way and the handling of balancing planes is accurately learned. From then on the machine is regulated gradually until straightaway flight is made at heights up to 20 feet, several take-offs and landings being required with each flight.

THIRD AEROPLANE

The next machine is of an advanced type and in it flights are made at an altitude of 50 feet, at which very slight curves are taken along the course. Increasing altitudes are attained and these curves are gradually advanced to circles, with greater angle of banking for decreased radius or increased speed; these are mastered by barely perceptible degrees. Broad figures of eight follow and straight and spiral glides under throttled power advance to glides without power, or the volplane. Accuracy in landing on a mark and coming to rest over a mark are then attained.

Combination of Training Methods

Where time permits, the best training course is a combination of solo and dual methods, the former to give the student self-reliance and the dual control instruction to correct any errors acquired in training.

MILITARY AVIATOR COURSE

Advanced flying is begun with training designed to perfect judgment in landings and the volplane. Difficult conditions are then imposed, the flyer being taught to handle his machine near buildings, fences and all classes of obstructions, first on the ground and then in the air. He is trained to use and land over imaginary obstacles or over a specified height, indicated by a string stretched between two posts and marked by a pennant. He ascends from and descends into fields of restricted area, marked by chalk lines for safety.

High-powered machines and unfavorable weather are selected and sharp turns, steep banks, spiral glides and difficult landings are practiced. The instruction is mainly designed to give the pilot confidence in his abilities and to impress upon him caution and thoroughness.

The elementary observer's course follows. This consists of progressive flights at increasing altitudes and under varying conditions of visibility, from clear weather to foul. Visibility tests with naked eye and field glasses of various powers are made, followed by instruction flights in reconnaissance and navigation of the air. Short cross-country flights in preparation for junior military aviator tests are then in order.

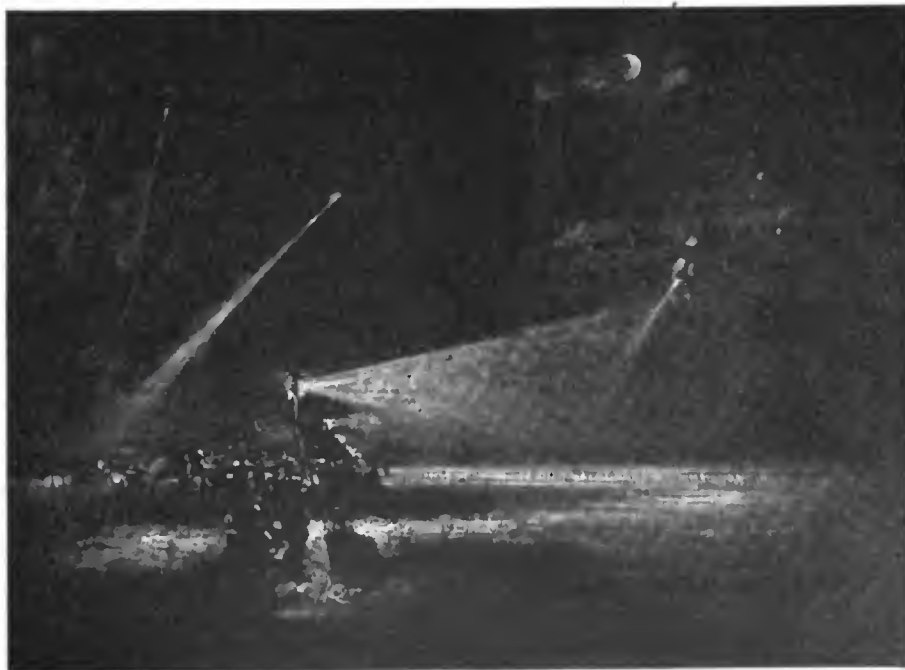
These tests complete the training as a military pilot; further development is acquired by training on various types up to super-planes and high speed pursuit planes. Expert aviators are required to attain a minimum altitude of 12,000 feet, remain in flight for four hours and cover 200 miles, cross-country.

ADVANCED FLYING

The advanced work is classified by the Training Department of the Army Aviation School into special phases as follows:

- Excessive use of controls
- Reduced power flights
- Flat glides
- Steep climb
- Banking up to 90°
- Fast landings and get-aways
- Landing across wind
- Stalls, side-slips, tail-slides, loops
- Bad weather ; rain
- Water flying
- Night flying
- Altitude flights ; duration flights ; cross-country flights
- Passenger carrying and low flying

The course of study and practical work embraces the elements of aeronautical engineering, use of meteorological and aeronautic instruments ; advanced meteorology ; practical reconnaissance ; spotting artillery fire ; bomb dropping ; principles of aerial combat ; wireless telegraphy ; gunnery ; strategic and tactical employment and administrative control of the air squadron.



This reproduction of a painting by Lieut. Farré of a bombardment by night shows powerful searchlights lighting up the ground of the field of aviation, thus permitting the machines to land safely

MILITARY AIRMEN



**MAJOR
FRANK PURDY LAHM**

Pioneer aeronaut has been associated with the Wright Brothers and is a prominent member of the Aero Club. He has also seen extensive service in the U. S. Army in connection with dirigible and spherical balloons and airplanes.

NO name is more familiar in connection with the early aeronautic work of the United States Government than that of Major Frank Purdy Lahm. From his father, Frank S. Lahm, he has doubtless inherited his talent for the science of aviation, and his fearlessness as a pilot. The elder Lahm was one of the founders of the Aero Club of America, and for many years the Dean of the air pilots of the Aero Club of France. As a special commissioner for the Aero Club of France he investigated the early claims of the Wright Brothers.

Major Lahm followed in his father's footsteps, and while stationed at West Point in 1906 arranged for the first balloon flight for members of the Aero Club. He continued to be very active in the interest of aeronautics in America. Accompanied by Major Hersey he won the first Gordon Bennett International Balloon Race held in Paris in 1906, bringing the trophy to America. The Lahm Trophy, for the pilot making the longest flight in America, was subsequently won by Allan R. Hawley who made the record flight from St. Louis of 1,172 miles.

In 1908 Major Lahm was selected by General James Allen, then in command of the Signal Corps of the U. S. Army, to be trained by Orville Wright to fly the Wright aeroplane, the first heavier than air machine purchased by the Government. The day following Wright's famous flight of one hour and two minutes, which established a world's record, Mr. Wright invited Major Lahm to accompany him on a voyage aloft. The major, dressed in boots and spurs, dismounted from his horse and climbed into the machine beside Mr. Wright, thus making the first passenger flight in America.

Major Lahm later operated the first dirigible balloon owned by the United States Army. After service in France he was stationed in the Philippines and later at North Island, San Diego, where he was engaged in training military aviators. He was later transferred to the United States Balloon School at Fort Omaha, Neb. He is one of the few aviators who hold all three of the certificates issued by the Aero Club of America; he has the Dirigible and Spherical Balloon Pilot's, and an Aviation certificate which was the second to be issued.

Signal Corps Has Opening For Many Electrical Men

They Are Required for Various Branches of Radio
Communication Work

THE Signal Corps, U. S. Army, has announced that it can use the services of a large number of men having electrical training.

They are needed especially in connection with the radio communication systems in use in the military service.

All classes of electrical men—wiremen, expert electricians, storage battery men, telegraph and wireless operators, and men with electrical engineering training and experience are wanted. The opportunity offered is exceptional because of the great interest and importance of this branch of the service, most aptly characterized as the nerve system of the army.

Men engaged in the radio division of the communication work in particular have an increasingly important part in the great intelligence system upon which army operations are almost totally dependent. The scope of this work requires men who will fall in general into three classes, depending on the character and amount of experience had by the individual; namely, radio operators, radio mechanics and field radio experts.

Application blanks for service in the radio work of the Signal Corps may be secured by addressing the Office of the Chief Signal Officer, Land Division, Training Section, Washington, D. C. Men of draft age may make application, and if qualified, will be inducted into the army, at their request, for service in this branch of the Signal Corps.

After enlistment or induction, all personnel will be sent to one of several radio schools for six weeks to three months of intensive training in one of the three general branches of the radio work for which their previous experience qualifies them.

Some of the personnel completing these courses will be commissioned, and the opportunity for advancement for all graduates will be dependent on the individual ability.

A Combination Set

This article describes a combination wireless telegraph and telephone set which, while it admits of a wide range of adjustment, is compact and more efficient than the average amateur set. In fact, with this set, communication was established between New York City and Port Washington, Long Island in broad daylight, using a simple three-electrode valve at the re-

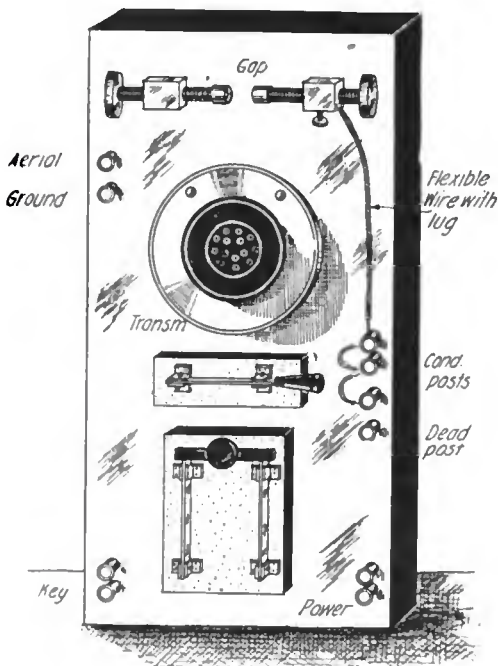


Figure 1—Combination set

ceiving station. As a wireless telephone set, it will transmit a fraction of a mile, provided a very short gap and low condenser capacity are employed.

The cabinet is made of any close-grained hard wood, preferably mahogany, but if bakelite is procurable, it will be more satisfactory. In Figure 1 the coil is placed in an upright position in a corner, with three sections of high tension condenser placed beside it, each section having a capacity of .001 microfarad. The individual sections consist of eleven glass plates, 2 inches by 5 inches, coated with tinfoil $1\frac{1}{4}$ by 4 inches. These are bound with tape, and while they may seem rather small, they have sufficient capacity for a 1 or 2-inch coil.

The spark gap is placed on the top of the panel and directly underneath it, an ordinary telephone transmitter. In order to cut this transmitter out of the circuit a single-pole, single-throw switch is shunted around it. At the bottom of the board a d. p. s. t. knife-switch controls the primary circuit. One end of each of the three high tension condensers are connected together, and to one terminal of the coil. The remaining three condenser terminals are connected to binding posts on the right side of the panel, to which connection is made from the right hand terminal of the spark gap by means of a flexible wire. The terminal is provided with a lug. The capacity of the condenser is varied by connecting one or more of the posts with the wire from the spark gap.

Heavy stranded wire or copper ribbon should by all means be employed for connecting up the circuits of radio-frequency. I have found automobile high tension cable ideal for a small set of this size.

In the diagram the aerial binding posts are placed at the upper left hand corner of the panel, the posts for the key at the lower left hand corner, and the source of power is connected to posts at the lower right hand corner.

To improve the appearance of the set two or three coats of black asphaltum varnish should be applied to the cabinet. The back should be made removable to permit of adjustment of the vibrator. Since the dimensions can vary consid-

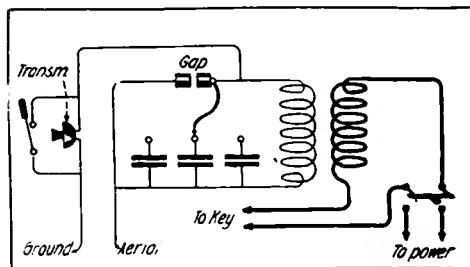
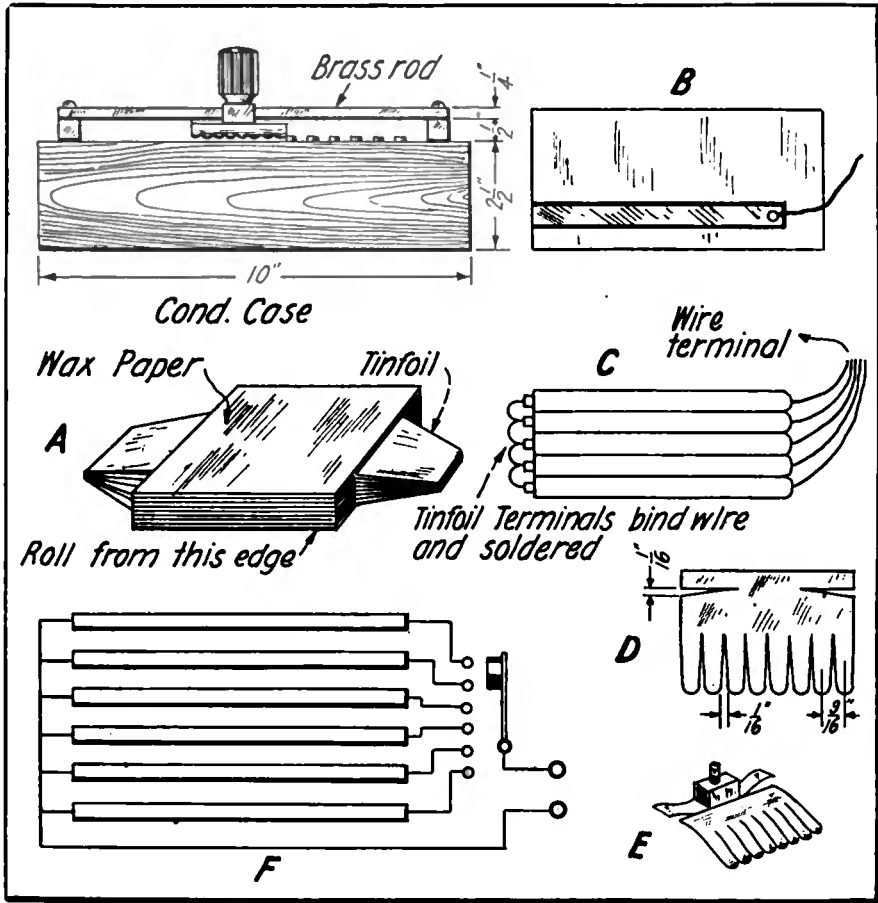


Figure 2—Circuit diagram

erably, none have been given in this article.

This apparatus will not act as a wireless telephone transmitter unless an arc is produced at the spark gap, and the gap must therefore be very short and must



Details of the adjustable fixed condenser

be shunted by the smallest possible capacity. In fact, it has been found advantageous to insert a series condenser in the antenna circuit to reduce the absorption of energy from the spark gap circuit. This will decrease the wavelength, but it will be much easier to obtain the arc at the gap which is strictly necessary for the manipulation of this apparatus. A diagram of connections is shown in Figure 2, in which the position of the transmitter is clearly shown.

J. W. HALLIGAN, *New York.*

Editorial Note.—Unless the antenna used with this set is exceedingly small, we are inclined to believe that even when used as a telegraph transmitter, better results would be obtained by the elimination of the ehunt condenser capacity, and in the event that this condenser is necessary in order to secure an oscillatory discharge, an oscillation transformer and a standard closed oscillation circuit would give the best results.

The Construction of an Adjustable Fixed Condenser

This is a description of a simple method of constructing an adjustable condenser which, although it will not entirely take the place of an air dielectric condenser, has sufficient fineness of variation of capacity to permit it to be used across the secondary winding of a receiving transformer.

The accompanying drawing shows the construction in detail and also the method of connecting up the apparatus. The condenser is made of wax paper and tinfoil. Connections are brought out from several sheets to the point of a multi-point switch which is constructed like the sliding rod of a receiving tuner.

To begin the construction, cut thirty-three pieces of wax paper, 3 inches by

3 inches, and eight pieces, $4\frac{1}{2}$ inches by $4\frac{1}{2}$ inches. Next cut twenty-six pieces of tinfoil, 2 inches by 3 inches. Make one condenser of five pieces of tinfoil and seven of three pieces of tinfoil. The units are assembled by laying one piece of paper on the tinfoil and so on. The tinfoil, it will be noted, laps $\frac{1}{2}$ inch over the wax paper at both ends.

After this is done the condensers are rolled from one side as shown at A. Two advantages are derived from this: (1) the condenser is compact; (2) on account of the thickness of the tinfoil, it is much easier to solder the connections.

After the rolled condenser is complete it should then be bound and a wire soldered to one of the tinfoil lugs. Next wrap the condenser in one of the large pieces of wax paper as indicated at B, leaving one of the lugs unwrapped. Bind the unwrapped lugs together with a wire and solder a lead to them.

A switch must now be constructed for connection with the various tap-offs. The blade of the switch, as will be noted, is of spring sheet brass, cut as shown at D. The size of the switch will vary according to the size of the contact in use.

The switch is soldered to the bottom of a square brass tube as shown at E. This tube is $\frac{1}{4}$ -inch square and $\frac{1}{2}$ -inch in length. A battery terminal is soldered to the top of the tube; this may be taken from an old dry cell. A hard rubber rod is next fitted as shown. The slider rod is a piece of brass, $\frac{1}{4}$ -inch by $\frac{1}{4}$ -inch, and 9 inches in length. The case is 10 inches in length, 5 inches in width and $2\frac{1}{2}$ inches in height. It may be made from any wood at hand. The two supports for the slider rods are $\frac{1}{2}$ -inch by 2 inches at the base and $\frac{1}{2}$ -inch at the top. It should be at least $\frac{1}{2}$ -inch in height. A complete diagram of connections is shown at F.

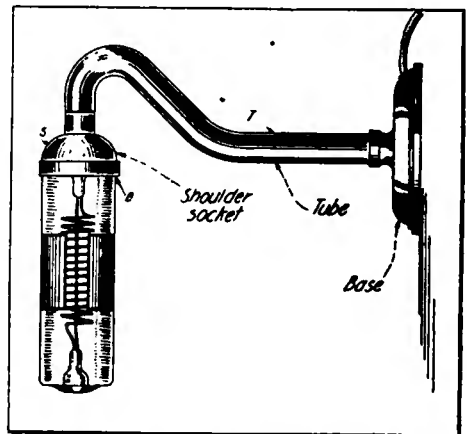
If required, a much larger condenser can be made along the same lines. It is, of course, understood that this condenser is only suitable for receiving apparatus and cannot be used in connection

with the transmitter, but it is a very handy piece of equipment at a receiving station because it permits tuning and adjustment which cannot be accomplished by an ordinary fixed condenser.

LLOYD WOLFE, *California.*

A Socket for a Tubular Vacuum Valve Bulb

This is a description of a socket for use with a tubular vacuum valve bulb that did good service in my station until war broke out. So far I have not noticed in THE WIRELESS AGE any reference to such a holder. As is well known, the ordinary tubular vacuum valve bulb is rather difficult to fasten in place during use, and, furthermore, the wires leading to the internal elements are apt to break off at any time because they are generally used to support the bulb.



Socket with tubular vacuum valve in place

After the wires have been led through the tube, T, the bulb should be drawn tight into the socket, S, by pulling tightly on the wires. It should then be held over a candle flame. The melted sealing wax is then poured around the bulb at B and allowed to cool. It will then be found that the bulb is thoroughly held in place and will withstand considerable strain before it will become free.

E. M., *New Jersey.*

A Digest of Electrical Progress

Effect of the War Upon Telegraph and Telephone Industries—Union of Power Companies—The Government's Searchlight Regiment—The Merits of The Metric System—The Telephone and the World War

Effect of the War Upon Telegraph and Telephone Industries

IN a recent issue of the "Electrical World" a writer reviews the effect of the war on our methods of communication. He declares that on the whole the wire and cable lines are carrying on "business as usual," but precedence is given to the immensely increased Government traffic. Telephone companies have been compelled to employ retired operators to take the places of those who have given their services to the Army and Navy. Additional women employees have been placed in operating, clerical, and supervisory positions formerly occupied by men. Through the use of automatic transmitters, messages may be dispatched by untrained clerks at a message speed greater than that obtained by the best Morse operators.

The writer mentions the extension of women's work into positions formerly held almost exclusively by men. He states that telephone companies have always had a large number of women employees, but in common with many other industries they have not been fully cognizant of the availability of women for positions requiring long and technical training. It is not generally known that the complicated mathematical operations involved in wire transmission and other problems are now worked out largely by women who specialized in mathematics at college. Continuing, the writer remarks:

The telegraph systems of the country have become more heavily loaded in at least two ways—(1) because of the growing need for quick communication which results from the large amount of wartime production, and (2) on account of the daily increasing delays in the mails, which, of course, enforces larger use of telegraphic messages. On the other hand, telegraphic traffic is cut down by the natural stimulus to economy which accompanies uncertain financial conditions and also by the increased urgency which in many instances necessitates telephonic communication, even at increased

cost. Just how these several factors will finally affect the general traffic load cannot be determined until detailed message reports are available, but it seems likely that a marked growth in telegraph business, and especially that of the "night letter" classification, will be found.

In spite of the careful plans laid down by commercial telephone companies, long distance telephony has suffered since the beginning of the war. On account of their value to the Government communication, so many of the trained operators have entered the Signal Corps and Naval Communication departments that the telephone companies are actually handicapped. Message service is made poorer than in the past, but this is probably accounted for by the fact that the lines are overcrowded due to the enormous pressure to which they have been subjected by war business. Telephone instruments have been called for in such large quantities that companies have been forced to refuse to extend many private installations. It has been necessary to inject into the service a large number of inexperienced girls and this naturally increases the confusion and delay even though superhuman efforts are being made by the companies to offset this.

Regarding the changes in the wireless telegraph field, the writer remarks:

War conditions have brought great changes in the commercial wireless-telegraph field . . . all commercial shore stations were closed by order of the President immediately after the United States entered the war. This put a stop to actual and anticipated international and overland radio traffic. Wireless outfits were permitted to remain in operation on shipboard as a matter of safety to passengers and cargos, but communication has been limited strictly to necessary position reports, warnings and similar maritime matters, all of which are sent in cipher. The Navy Department maintains a chain of land wireless stations along the shores of the country and has extended its services to comprehend essential commercial radio traffic, but since this must be entirely subordinated to governmental affairs the total number of private messages is extremely small.

In taking over the cargo ships, the Government has taken control of the operation of the radio apparatus. Hundreds of vessels are now entirely in the hands of the Naval radio service as regards the inspection and maintenance of their radio apparatus, and the supply of operators for them. Wireless companies have largely become manufacturers for the Army and Navy, and the development of new inventions is directed almost entirely toward their utility in war work.

Due to uncertainty in trans-Atlantic mails, the essential close co-operation between our Government and those of the European Allies and the diversion of long distance wireless stations for military uses, the traffic on the cables has mightily increased. Stringent censorship regulations have been adopted. To date nothing abnormal has been reported in the way of interruption because of the scarcity of enemy raiders left at large, and viewed in its entirety, the cable business seems to have suffered little change. Certain technical advances, including the use of selenium and other relays, have been made. No particularly sensational improvements have been announced.

Regarding the future of commercial radio, the writer remarks that "it seems to be dependent largely upon its general technical development, and consequently the present period of military domination must be looked upon as a necessary setback resulting from the availability of wireless communication as a weapon. When the great war is won and conditions are more normal again, the useful future of radio signaling will come into sight once more, and the newest of the communication arts should progress rapidly to its fullest development."

We disagree with the writer to some extent on the latter statement. We do not see that the war has in any way hindered the general technical development of radio, although naturally the increase of commercial stations has been effected. Numerous technical problems have been solved and inventions have been made that will permit commercial operation over greater distances than were heretofore considered possible. One of the good effects of the war has been the standardization of apparatus and the design of equipment, which is more flexible and better suited to commercial operation than that heretofore employed. The results which wireless radio engineers have gained through the construction of special apparatus for the requirements of the Government are bound to benefit the commercial side of the art. Opportunities are granted commercial companies to engage in research work such as never before, and at the close of this war, some of the inventions which will be made public will excel the dreams of those who are not in close touch with the situation.

Nothing has been left undone by our Government to put into service the best equipment available at this date, and whenever a rearrangement or re-design of the apparatus proved of ultimate benefit, changes were effected immediately. The thousands of wireless sets furnished to the Government and the experience of several thousand operators having charge of such equipment will stimulate and enhance the progress of the art in every possible way.

Union of Power Companies

AFTER joint conferences of the State Fuel Administrator Schwabacher and the California Railroad Commission, it was decided by the Pacific Coast Electric Company, the Great Western Power Company, the Sierra and San Francisco Power Company, and the Universal Electric and Gas Company, to operate their systems under one management. Under this plan, several stand-by plants can be shut down without endangering continuity of service. By operating only those centrally located stand-by plants whose efficiency is highest, a great saving of fuel will be effected and loads will be distributed so that the water storage in hydro-electric developments can be used to maximum advantage.

The combined systems furnish power over an area of about 40,000 square miles which is believed to be the largest area under the administration of a single management. The total generating capacity is about 3,771,600 kw. 240,000 kw. is generated by hydro-electric plants and the remainder by steam plants. A careful observer of the plan has recently commented in the "Electrical World" on the new arrangement as follows:

The consolidation of central California power systems for joint operation as a war measure is one of the long strides forward which are made from time to time in the West. It is not often, however, that so important a move is made literally overnight or is launched without precedent largely on faith that all concerned will do their part fairly. Much credit is due the several companies for the spirit shown in joining competitors without hesitation or limitation. The redistribution of load, it is understood, is to be made by one man, Mr. Downing, without let or hindrance, the determining factor always being the efficiency of the several systems considered as one unit and the minimum consumption of fuel.

One of the most important features of the move and one which there has not yet been time to work out in detail is the apportionment of income under the combined plan of operation. However, with all concerned in a

co-operative rather than a competitive attitude, it will be simply a matter of agreeing upon that plan which seems fairest to all. With the rainfall in California thus far the least in sixty-nine years, a plan which contemplates utilizing water storage more efficiently cannot impair the interests of stockholders. No man could be found who has better qualifications than Mr. Downing as "power dictator" for the California systems. Not only does his experience eminently qualify him to handle the complex problems of this work but he has the complete confidence of the several companies involved. The success of the plan under his administration may well establish a precedent that will be far-reaching in effect.

The Government's Searchlight Regiment

THE War Department is organizing a regiment of searchlight companies for special service in France. These units will be highly specialized and used for battle illumination and anti-aircraft protection. The companies will be armed and equipped as regular military units and will form part of the regular army organization. They will be called upon for extremely active work in the war zone and only those specially qualified for such work will receive consideration.

The plan is to obtain bright, young, intelligent, and ambitious men who possess a fundamental knowledge of mechanics and electricity, as well as trained and experienced electricians, gas engine operators, and machinists. The enlisted personnel will embrace men experienced in one or more of the following occupations: Electricians, gas-engine operators, machinists, motor-truck drivers, blacksmiths, horseshoers, mechanics and general all-around utility men.

Men must first enlist as privates and will be paid \$30 per month, together with food, clothing, medical attention, etc. Non-commissioned grades will be available at rates of pay from \$36 to \$96 per month. Further promotion is open to those of ability.

The work in which these young men will engage in the war zone embraces the following:

To discover and keep in touch with the movements of the enemy during the night.

To seek out and illuminate hostile objectives, so as to fire upon them.

To blind the enemy.

To periodically illuminate roads and possible hostile positions in the more distant foreground by the light.

To search the near foreground.

To support fire effect by illumination of hostile targets.

To disturb hostile works by alternate blinding and turning on the beam or by working the beam back and forth.

To blind opposing searchlights.

To support attacks in the foreground by throwing the beam in front of the advancing troops and screening their movements.

To reveal obstacles to their own artillery, which is thus enabled to destroy them.

To blind the enemy and disturb his forward march and firing capacity and confuse him by making him think his plans are discovered.

To facilitate the landing of aviators at night.

For anti-aircraft work and night-bombing defense.

Complete information may be obtained by writing directly to the Commanding Officer, Fifty-sixth United States Engineers, Washington Barracks, D. C.

The applicant must give (1) name, (2) address, (3) age, (4) married or single, (5) nationality, (6) whether he will enlist for the period of the war,

(7) brief statement of education, (8) present occupation, (9) experience, (10) name and address of present or former employer, (11) whether or not the applicant has been drafted.

In special cases, men of proper experience who already have been drafted in the service may be transferred.

The Merits of the Metric System

THE pros and cons of the metric system of weights and measures were discussed at the January 23rd meeting of the American Institute of Electrical Engineers section at Lynn, Mass. Among the speakers were L. D. Burlingame, Industrial Superintendent of the Brown & Sharpe Manufacturing Company; S. S. Dale, editor-in-chief of Textiles, and Professor A. E. Kennelly, of Harvard University. In the absence of Professor Adams, Professor Kennelly spoke twice, and he remarked that the adoption of the metric system is making some progress in the art of electrical engineering. He admitted that a complete change to the system would take time and cost money, but he urged that the United States, Great Britain, and Russia fall into line and adopt it as soon as convenient so that there would be an international system.

Mr. Burlingame contended that endless confusion would be caused in his business by the compulsory adoption of the metric system of measurements. Mr. Dale told of an amusing record of one day's training by a Chilean family. In Chile the attempt to standardize the metric system has been a long and baffling effort.

Mr. F. T. Cox, Chairman for the evening, advised all to continue to ponder over the merits and demerits of the system as pointed out by the debaters of the evening.

The Telephone and the World War

"THE Telephone and the World War," was the subject of a most interesting talk delivered before the members of the New York Electrical Society on January 24th by H. J. Carroll, of the New York Telephone Company. One of the instructive points upon which the speaker went into detail was the manner in which the barrage fire is regulated by men known as "linking officers" in the British Army. These officers push on after the infantry advance, laying wires, and then telephoning back to battery commanders the location of the enemy, at the same time advising the distance to which the fires should be shifted to be effective. To protect these wires all the warring armies maintain telephone patrols which constantly test, repair, and protect the line.

Men who possess abnormally acute olfactory senses are stationed as observers for approaching gas attacks. Upon scenting attack these men stationed at outposts telephone the alarm to the trenches permitting the soldiers to don their protective masks before the gas arrives. The speaker also described a very sensitive instrument for locating tunnelling and digging by the enemy hundreds of yards away. He spoke in detail about the use of the telephone in the field by the Russians, French, and Austrians; also he told how the Anzac troops had constructed at the Dardanelles a telephone central station the walls and ceiling of which were made entirely of sandbags. He stated that 12,000 competent telephone operators are employed by the American army in France with the special duty of handling Government messages throughout the United States. The entire organization of the Army under General Pershing is connected by telephone from sea ports to the front line trenches. He mentioned that the telephone had in some respects proved superior to the telegraph owing to the rapidity at which orders could be given.

Wireless Music For Wounded Soldiers

By Albert Marple

BEFORE a great while the boys of the U. S. Army in France who are injured while doing their "bit," will be persuaded to forget their aches and pains along with all the hardships of war, by strains of music, carried to them by wireless. It is planned that they will hear novels and poetry and news stories, the soldier boy who is too ill even for a little entertainment not being disturbed, for the entertainment will be distributed in individual doses by wireless telephone and phonograph.

Through the generosity of the Ebell Club of Los Angeles, the first set of this wireless phonograph has been purchased for \$1,000; it is to be donated at an early date to the American Base Hospital in France. The outfit will consist of a transmitting set, along with fifty portable or hospital receiving sets, for use on fifty different beds. By placing one of these sets between two beds and equipping it with two receivers, each receiving set may be made to bring joy and relief to a pair of our

wounded fighting men. The sets may be detached from any bed in a moment and carried for use to some other part of the room or building.

As a rule the conditions of the various patients in a hospital prevent the playing of a phonograph. The music, while beneficial to some, would be very irritating to others. This difficulty is overcome by the wireless phonograph.

The sending apparatus is located within a sound-tight room somewhere within the hospital and the attendant to operate the device has only to start the phonograph and throw a switch. From the phonograph the music travels by wire to the wireless telephone transmitter, from which it passes in the form of electrical waves to the sending aerial, going from this point out into space.

The receiving apparatus consists of a light, sensitive telephone receiver which is connected by a silk cord to a metal or wooden case three inches wide, six inches long and four inches

(Continued on page 593)



The wireless set showing phonograph and transmitter



Patient in hospital listening to music by wireless phone

Radio in the Navy

RADIO is a branch of Navy service about which there clings a glamour of mystery and romance which is fascinating to thousands of young Americans who are eager to take an active part in the sea engagements with German war vessels. And there is no more certain way to get under fire with the Navy than to enlist in the radio department.

There is room right now for one thousand more young, ambitious American youths in naval radio. Men who enlisted in other departments of the Navy are now transferring to radio in ever greater numbers.

A man who qualifies as a radio operator soon becomes the envy of the ship; his superior officers are dependent upon him and usually are eager to watch him send messages. In no other branch of the service is such an opportunity provided for experimental and research work and the exercise of initiative. In the case of those who are sent to the United States Naval Training Station, Great Lakes, Illinois, a course of several weeks is given the recruits, who then are sent to Harvard University for additional training. Yet even with these inducements and advantages recruiting offi-



Beginners at the Great Lakes Naval Training Station specialize on code practice, instruction being given in both Morse and Continental

cers cannot secure enough radio men.

The biggest radio training station in the country is at Great Lakes, Illinois, thirty miles north of Chicago. Captain William A. Moffett is commandant. The district is in charge of Lieutenant A. Hoyt Taylor, district communication superintendent, and includes sixteen stations. Radio gunner M. B. West is assistant communication superintendent. Lieut. L. C. Dent is in charge of the stations at Milwaukee, Wis.; Manitowoc, Wis.; Frankfort, Mich., and Ludington, Mich. Lieut. F. H. Mason, whose headquarters are at Cleveland, has charge of Detroit, Mich., and Buffalo, New York. Lieut. Mark Frazer is in charge of Calumet and Duluth and has headquarters at Minneapolis, Minn. All of these men are familiar figures to readers of *THE WIRELESS AGE*. Commodore C. G. Bowman, U.S.N. (Ret.) supervises the territory included by Mackinac, Alpena, Mich., Sheboygan, Drummond Island and Manistique, where his headquarters are located. All are under the supervision of Captain Moffett and Lieut. Taylor.

The Great Lakes station is equipped with a powerful transmitter which makes possible communication with either coast and the Darien station in the Panama Canal Zone. NAJ, a call familiar to all operators on the Great Lakes, is sounded before a daily report of storm warnings, and other necessary information is sent out.

Five hundred students, among whom are all the prospective aviators, attend the radio school daily at Great Lakes. The elementary course of instruction is given in three months to inexperienced radio students. Some of the men who have had some experience with amateur stations complete the course in considerably less than the allotted time. Upon finishing the work at Great Lakes, embryo radio operators are sent to Harvard University, where the Naval Reserve Radio School is located. Here they complete their training and from here they are detailed to ships on the high seas.

Psychology is used in conducting the radio courses. Students are taught



Captain William A. Moffett, commandant, under whose direction 500 students a day are prepared for sea service

to speed up in the Morse and Continental codes. A long row of tents adjacent to the radio station serves for the "schoolroom." A recruit's progress is indicated by the tent to which he is assigned. The boys usually have to start in the tent marked "0 to 5"; they soon pass into the "5 to 10" tent. When a student has arrived at the tent marked "20 to 25" his instructors know that he can send at a fairly good speed. When they have completed the courses at Great Lakes and at Harvard the recruits express a preference as to the type of sea service which they wish and then they are detailed to active duty on a battleship, a submarine, shore station, seaplane, or perhaps some merchant ship or transport. The operator's first watch is usually from midnight until 4 a. m. This gives him experience with a regular operator and soon he is allowed to handle a watch of his own.

On ship the radio operator is exempt from coaling duty and most of the other tasks which are considered burdensome by the youths who are



The classrooms are long rows of tents marked 0 to 5 progressively to 20 to 25, indicating the speed of the recruits in sending and receiving

anxious to fire a gun at the Germans.

On dreadnaughts he works four hours and then is given eight hours liberty, and in addition he is excused from duty every third day.

The strange thing about it all is that the Navy cannot get men rapidly enough to fill the seats left vacant in the schools when the recruits are sent out to the high seas.

Wireless Music for Wounded Soldiers

(Continued from page 590)

high. This case is connected by a tiny wire to the bed post or spring, which constitutes the receiving aerial. After being released by the sending aerial the sound waves travel through space until they are caught by the receiving capacity and transmitted from this by the tiny wire to the receiving cabinet, thence along the silk cord to the telephone receiver, which is held to the ear of the patient.

Another feature of this device is that the phonograph may be disconnected and stories and newspapers may

be read to the patients over the wireless telephone.

The transmitting apparatus connected to the phonograph and also to the telephone consists of a group of telephone transmitters arranged in a suitable casting. Being operated on low frequency the waves of this machine are not likely to interfere with or be troubled by the waves of high frequency systems. The system may be operated by a few dry cells, at a cost of not more than ten cents a day in connection with the largest hospital.

The Monthly Service Bulletin

of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Founded to promote the best interests of radio communication among wireless amateurs in America

J. ANDREW WHITE, Acting President GUGLIELMO MARCONI, President ALONZO FOGAL, JR., Secretary

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Headquarters, 25 Elm St., New York

AT a rough estimate over 50 per cent. of the former amateur experimenters within draft age have enrolled in the Government service. Many under twenty-one years of age have joined the U. S. Navy. Certain members of the association are employed as instructors in Government radio schools; others are assistants in Government research laboratories or are engaged in experimental work in the open field. We can recount three instances in which former amateur experimenters have been placed in charge of important radio development work, but it is necessary to state that they possessed qualifications other than those obtained through home experiments. However, the experience which they obtained as amateur telegraphists gave them an insight into the practical operation of wireless apparatus which otherwise would have required several months of practical training or experience. In other words, the Government received the benefit of the amateur's months of observation of the dispatch of commercial and Government wireless telegraph traffic. Hence, many were fitted at the start to undertake more advanced work.

On account of the confidential nature of the work in which many of the members of the Association are engaged, we are not permitted to speak

more in detail, but we have sufficient data on hand to assure us that the Association is well represented in the various Government departments.

* * *

THE U. S. Army needs practical wireless telegraphists, men who can operate equipment, locate trouble, and effect makeshift repairs. Mere theorists are non-essential.

One of the qualifications in certain branches of field signaling is knowledge of gasoline engines. Many former motor enthusiasts will have no difficulty in taking care of such equipment, but we are inclined to believe that others will have to spend many hours in the study of engine mechanisms. Not only must the mechanical features be understood but the electrical mechanism of gasoline engines will require most careful study.

Selected men who have not yet been assigned to cantonments should study the various types of ignition systems employed in connection with gasoline engines, such as the make and break system, the magneto, and the battery and coil system. They should learn how to time an engine, how to grind the valves, and how to adjust carbureters. Sleeve valve and poppet engines should be given consideration. Knowledge of the electric starting and

lighting systems will be of advantage to recruits in certain branches of the Government service.

* * *

WE would offer a word of advice to amateurs in Government or commercial radio schools on the subject of the use of technical terms and we would urge that they abandon certain habits and customs. Some have been accustomed to use technical expressions in such a loose manner that their statements under close analysis meant little or nothing. Often, in a Government examination paper, the examinee, although he had a right idea in mind, expressed himself so ungrammatically and his remarks fell so far short of the subject being explained, that he received a considerable reduction in marking.

In describing a piece of apparatus or the functioning of an electrical circuit, whether in the classroom or in a Government license examination office, let your descriptions and explanations be to the point. Use no unnecessary words or phrases. For example, as-

sume you are to describe a circuit diagram. First letter it carefully and explain the lettering. Next describe briefly the function of each part of the set in simple language and let your explanation be progressive, that is, do not jump from one part of the apparatus to another part not closely related, but explain the circuit progressively from its source. Punctuation and spelling are matters in which much private study could be effectively spent. In brief, avoid slipshodness in expression.

* * *

CONTRIBUTIONS from amateurs covering experiments or happenings in the pre-war period will be acceptable. We would be particularly pleased to hear from those who have done exceptionally long distance work. Experiments of interest or any unusual phenomenon encountered should be reported in these columns for the benefit of fellow members. The columns of this department are open for discussion of all matters relating to radio in which the experimenter may be interested.

A Simple Way to Make a Good Variometer

A serviceable variometer may be made in a simple manner as follows: Turn out a wooden ball of the dimensions shown in Figure 85 on page 104 of "How to Conduct a Radio Club" and wind it with fifty turns of No. 28 D. C. C. wire. The wire should be well shellaced and allowed to become perfectly dry and hard before use.

Next mount the ball on a shaft of $\frac{1}{4}$ -inch brass tubing, placing small fibre washers over the tubing next to the winding; then slip pieces of 5-16-inch brass tubing over each end to provide bearings.

Next completely cover the windings with plain cotton tape, winding it in and out through the opening in the center of the ball. Then wind a complete layer of "chalk line" or other hard smooth twine over the outside of the ball, fastening the ends slightly with bees-wax so that it is possible to pull out or unravel the

twine later. Then cover the twine with another layer of cotton tape wound in the same manner as before, and over this wind a layer of adhesive tape.

Over the adhesive tape wind on fifty more turns of No. 28 D. C. C. wire and give it one coat of very thin shellac. This completes the stationary winding.

Next prepare a small wooden box without top or bottom that will surround the ball, leaving a space of about $\frac{1}{4}$ inch at side and block in the corners so as to save wax. Be sure that the short pieces of 5-16-inch brass tubing are in place and extend through the sides of the box.

Place the box with the ball mounted inside on a pile of soft papers, weighting it down at the corners. Fill the space around the ball with melted common red sealing wax. While the wax is yet slightly soft, cut the adhesive tape and bend

(Continued on page 602)

From and For those who help themselves



FIRST PRIZE, TEN DOLLARS

New Type of Receiving Set with Desirable Features

IN looking over many articles on the construction of different types of receiving sets, it struck the author to given in figure 2. The drilling of the panel is important. Care should be taken to get the holes in their right

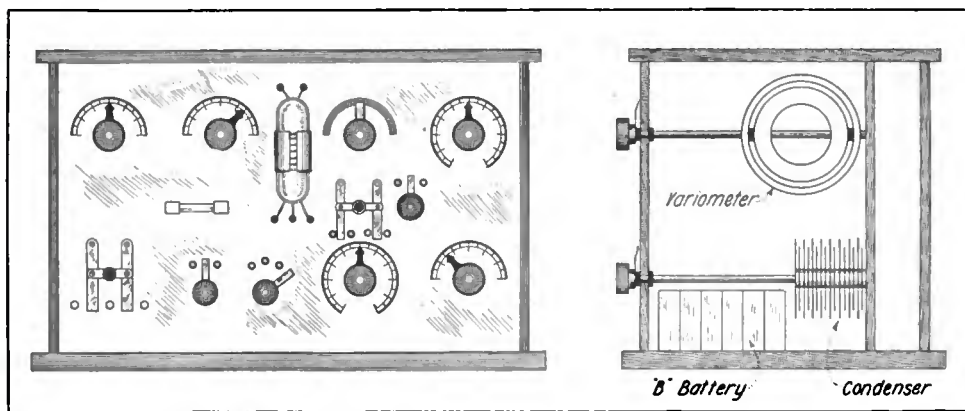


Figure 1

First prize article

Figure 5

design one combining as many as possible of the good points seen in them. The set to be described contains numerous desirable features. Among which may be mentioned the efficiency obtainable on either long or short waves. By use of several switches it can be very quickly changed to a *simple regenerative*, a *tuned regenerative*, or to a beat receiver. The crystal detector on the cabinet may be used to receive from nearby spark stations thereby increasing the life of the valve. The cabinet can also be used as a separate generator of oscillations for the production of beat currents.

The cabinet is shown completely in figure 1. The wooden parts may be finished in dark mahogany. Full dimensions for the construction are

positions. By following the dimensions given in detail in figure 3, no difficulty should be experienced. The diameter of the holes will be governed by the material the maker has on hand.

With regard to the panel, it is advisable to make it of $\frac{1}{4}$ " of polished hard rubber. Silver plated metal parts and hard rubber knobs mounted on it give a very fine appearance. The panel is set into the front of the cabinet in such a manner as to be easily removed. A double back is put on the cabinet on which are mounted all the elements of the oscillating circuits. This gives a more or less remote control of the tuning appliances thereby eliminating the undesirable feature of throwing the circuits out of tune when the hand is brought near. All leads

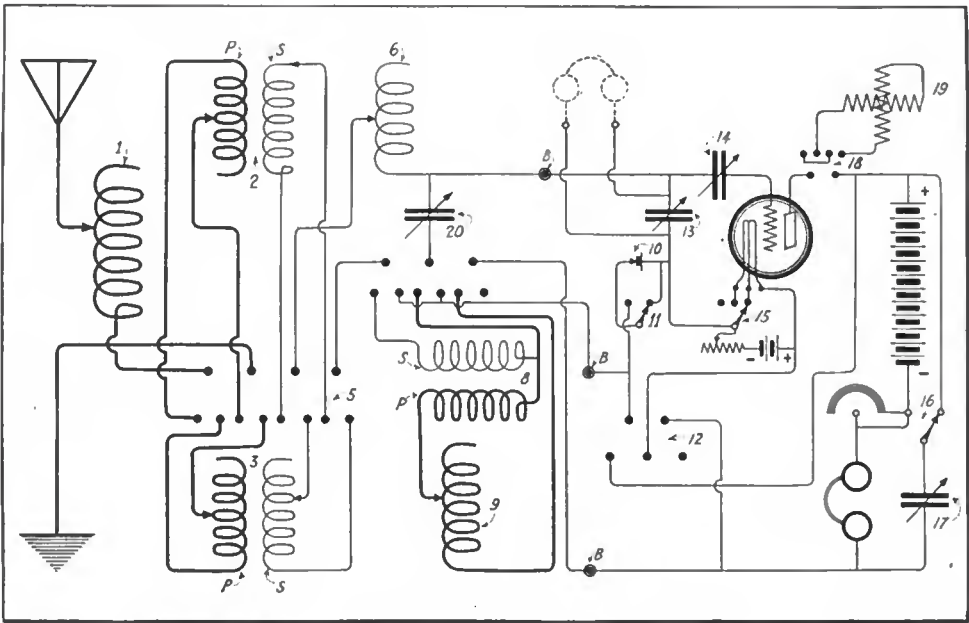


Figure 6.—First prize article

22 S. S. C. wire on a tube 4" in diameter; the secondary, 40 or 50 turns of No. 22 S. S. C. wire wound on a ball $3\frac{1}{2}$ " in diameter and so arranged that the coupling may be varied by rotating the ball within the primary.

Condensers 20, 13 and 14 each should have a maximum capacity of .0005 microfarads. Condenser 17 should have a maximum capacity of .002 microfarads.

Referring to figure 6, for the reception of undamped waves by the heterodyne, switches 5 and 7 are thrown to the left and switches 12 and 16 to the right. Then follow the usual procedure to make the circuits 9 and 17 oscillate. These are coupled to the secondary circuit through the radio frequency transformer, 8. The local oscillations are at a slightly different frequency than the incoming oscillations. When receiving with the simple regenerative circuit, switch 12 is thrown to the left and switch 7 to the right. by cutting in variometer 19 this circuit may be tuned for increased amplifications.

To receive with the crystal detector, switch 11 is thrown to the left and switch 7 to the right. The telephones are connected across condenser 13 on binding posts shown.

When receiving short waves, switch 5 is thrown to the right and the smaller

transformer substituted for 8. The long wave loose coupler 2 should be provided with suitable dead end switches for spark stations operating on wave lengths under 3,000 meters; otherwise a smaller one should be employed.

When the cabinet is used as a separate generator of undamped oscillations, the telephone connection should be shunted and in place of loose coupler, a smaller one should be used to force the radio frequent oscillations into the aerial circuit of the main receiving set.

The advantages of this set are obvious. Particular attention has been paid to the arranging of the apparatus in such a manner that the connections are as direct as possible. This, in a great measure, is conducive to the efficiency. If the details of construction are adhered to closely, a very efficient receiving set will result.

DONALD HASSELL, *Buffalo, N. Y.*

SECOND PRIZE, FIVE DOLLARS

An Automatic Code Sender for Beginners.

I HAVE constructed an automatic code sender which, I believe, will be of interest to readers of the WIRELESS AGE, who contemplate going into the Government service. The accompanying dia-

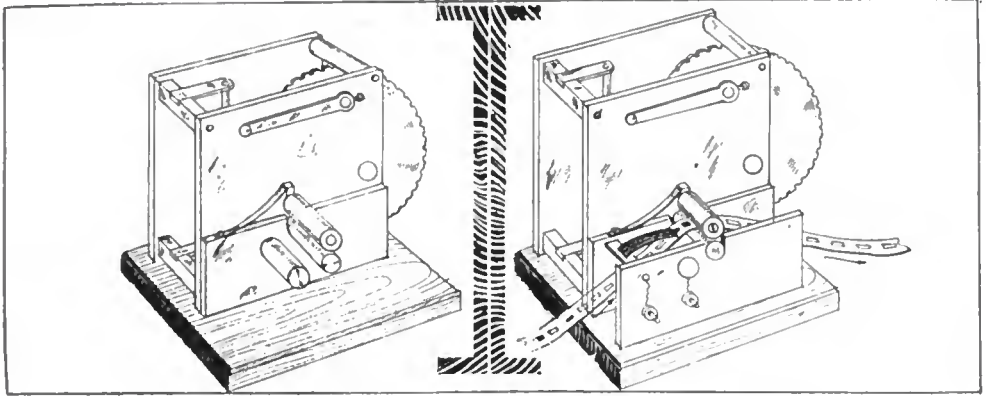


Figure 1

Second prize article

Figure 3

grams show the construction, in general, figure 1 being a detail of the rollers which feed the tape; figure 2, a detail of the tape plunger, and figure 3, the assembled instrument.

The first thing in the order of construction is the purchase of a phonograph motor, preferably one with a square frame. The one I employed was from a standard model B phonograph which is of very simple construction. Next, make the wooden parts. They should be made of hard wood. The base is made $\frac{3}{4}$ " in thickness and 3" square. A small bevel is cut around the top edge in order to improve the appearance. The motor is held to the base by means of switch H shown in figure 2. Two machine screws are passed through the holes 6 and 7. The complete dimensions are $4\frac{1}{2}$ " in length, $1\frac{1}{2}$ " in width and $\frac{1}{4}$ " in thickness, as shown at H, figure 2.

A hole $\frac{1}{2}$ " in diameter should be drilled at 1. A brass tube from $\frac{1}{4}$ " to $\frac{3}{4}$ " in diameter serves as the lower contact over which the tape moves. The motor shaft extends through a hole 5, figure 2, which is about $\frac{1}{2}$ " in diameter and $\frac{1}{2}$ " deep. The board, I, is the same size as H and has holes drilled the same size and in the same place as 1 and 5. A hole is drilled at 2 which takes the small machine screws for the brush. Two additional holes are drilled in 3 and 4 for the binding posts.

When these pieces have been completed, piece I should be fastened through the base with wood screws so as to leave a space of about $1\frac{1}{2}$ " as shown in figure 1. Previous to fastening the motor

in place take off the small tapered brass bushing at the end of the motor shaft. This ordinarily supports the disc. After you have removed the bushing, cover the motor with a rubber tape so that it will grip code tapes. The motor shaft is indicated at C, figure 1. A rubber roller which presses on the top of the motor shaft, C, is indicated at B, figure 1. These rollers are made of a piece of heavy rubber which may be cut from a hard rubber ball. They should be about $\frac{5}{8}$ " in length by $\frac{1}{2}$ " in diameter. A hole could be bored through the center into which is placed a metal bushing, so that it will turn readily.

Make the support for the roller as indicated at A in figure 2. This should be a piece of spring brass or some other elastic metal. This piece is about 2" in length, $\frac{1}{4}$ " in width, and it has an end projecting to one side which is $\frac{3}{4}$ " in length. This is bent down and a hole is drilled to take the bolt on which the roller turns. It is fastened by two nuts. When it is completed fasten it to the wooden support with a wood screw so that the roller comes directly on top of the motor shaft as shown in figure 1. The second support marked H should now be fastened so as to leave a space of $\frac{3}{4}$ " between it and the first one. Next make the brush shown at F in figure 2. It should be 1" in length, $\frac{1}{4}$ " in width, and $1-32$ " in thickness. Bore a hole as shown to fasten it to the wooden support. When completed, bend this piece at a right angle at the center. Next solder six No. 22 wires to the end. Each of these wires are approximately $1\frac{1}{4}$ " in

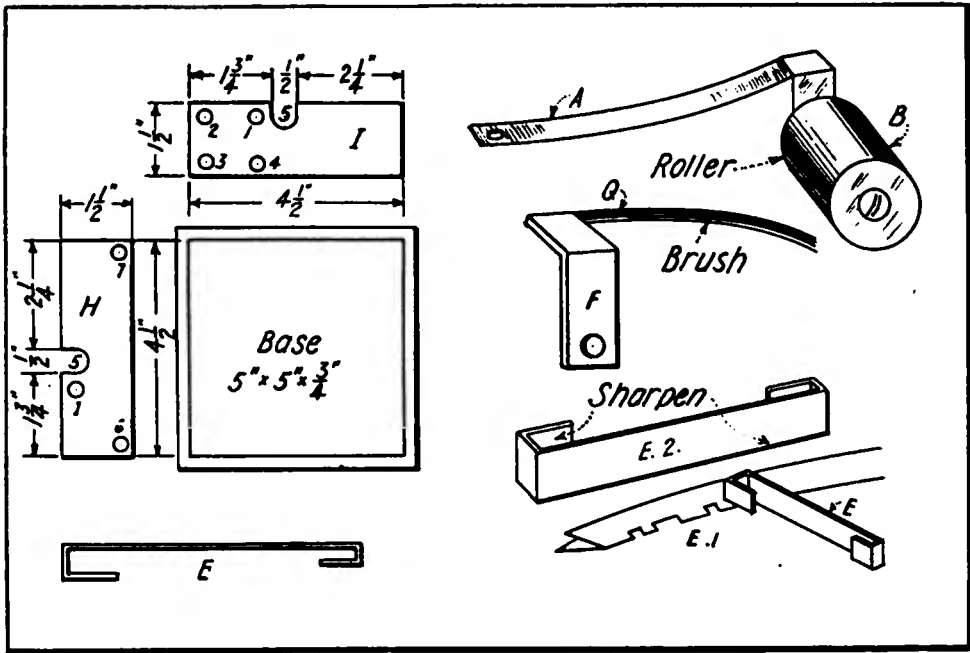


Figure 2—Second prize article

length. Care should be taken to lay them evenly side by side. They make contact with the brass tube, D, through the slots cut in the tape.

A small piece of wire makes connection between the brush and the binding post mounted below it, and another piece connecting the brass tube to the second binding post.

The tapes for this instrument are made by a special cutter as shown at E in figure 2. A small strip of hard metal $\frac{1}{4}$ " in width by $2\frac{1}{2}$ " in length is bent in the shape shown so that the inside of the large end measures 3-16" and the inside of the smaller end or dot measures 1-16".

The edges of both the dot and dash ends should be sharpened so as to make the cutting easy. Any paper suitable for the purpose can be employed, but I prefer the black paper which incloses the camera film. I have found it very tough and lasting. This should be cut into tapes about $\frac{3}{4}$ " in width. Just how the dots and dashes are cut is shown in the detail E-1, figure 2, where it will be observed that the tape is folded over and the dots and dashes cut out as shown. These slots may be cut very precisely by hitting the cutter with a small hammer.

Correct spacing of the letters is im-

portant. The space between the symbols of a letter is equal to one dot, between two letters is equal to three dots, or, in other words, the width of a dash. The space between two words is equal to five dots.

If this automatic code sender is constructed in accordance with my instructions, it will work satisfactorily and can be operated at a speed of from five to thirty-five words per minute. I would also suggest to the builder that in punching the tape he should use code words rather than ordinary words as better practice is obtained thereby.

Finally, I should mention that with the aid of this sender and the textbook, "Practical Wireless Telegraphy," any amateur should be able to obtain a first commercial license in from two to six months.

PETER M. HANSEN, *Chisholm, Minn.*

Try This In Your Spare Hours

Numerous combination detectors have been employed by amateurs in wireless telegraphy and many of them have contained a large variety of elements, but the one shown in the accompanying figures 1 and 2 in respect to the variety of

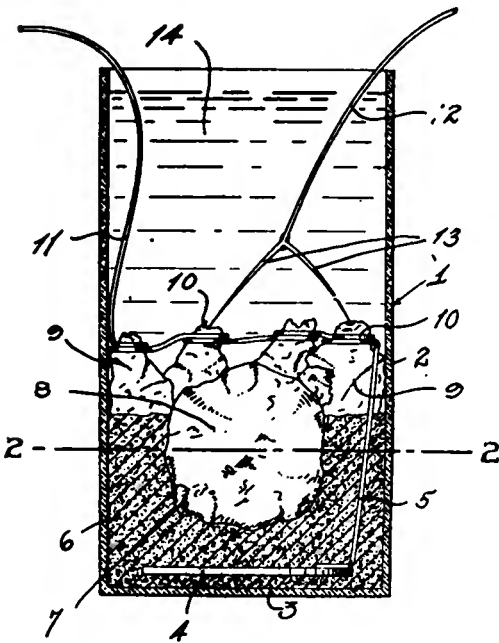


Figure 1—Detector with a variety of elements

elements employed exceeds anything which has so far passed our observation. Evidently, it combines all the good characteristics of well-known rectifiers. In addition, the principle of coherence has been adopted so that one obtains a coherer effect as well as rectification.

In figure 1, a suitable disk, 4, of copper is placed within the jar 1 near the bottom wall and has the wire, 5, which extends upwardly in the manner shown to a point midway between the upper and lower ends of the jar. A suitable filling of carborundum and iron filings, 6 (consisting of one part carborundum and one part iron filings), is placed in the bottom jar and surrounds the plate, 4. This

composition fills the jar to a point substantially one-third of its entire height above the bottom, 3, and is provided with a central pocket, 7, in which a suitable silicon crystal, 8, is seated, the upper end of which projects above the upper surface of the composition of iron filings and carborundum. The quantity of silicon is equal to one-half of the two-part mixture of carborundum and iron filings. The upper end of the container is surrounded by a plurality of crystals, 9, of galena, the points of which are disposed upwardly to provide necks around which the wire, 5, is clamped. After the detector has been assembled it is filled with paraffine.

If the experimenter is unable to supply the elements for this detector from his junk shop, he should take his prescription to the nearest drug store or chemical supply house which may be able to supply him with the necessary material! In brief, we have here a combination of metals which we are sure the average amateur has not thought of. We are much interested to learn by what series of experiments the proportionment of silicon to galena, galena to iron, and iron to carborundum was determined.

Preserving Aerial Ropes.

Radio experimenters frequently are annoyed by the breaking of their aerial ropes. Flexible steel cables are too expensive for the average experimenter. A splendid substitute is to buy the best sash cord and boil it in beef tallow for an hour or so. To procure the tallow it is generally necessary to buy beef fat and render out the tallow by heating it over a slow fire. Sometimes it is about as cheap to buy a bundle of genuine tallow candles and melt them. When a good pan of melted tallow is ready, the rope is coiled up and pressed down into the pan and allowed to remain over a slow fire for about an hour. The rope should be punched occasionally with a stick to keep it under the tallow and its position should be changed so that it will not become scorched. A rope thus impregnated will last for years in damp climates.

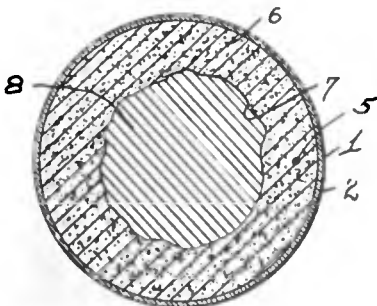


Figure 2

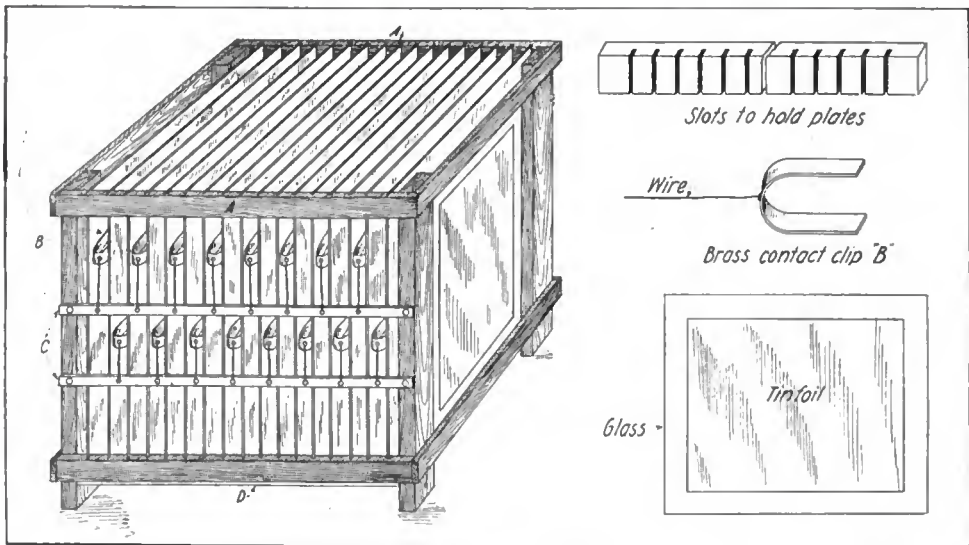


Figure 1

Figure 2—Top Figure 3—Center
Figure 4—Bottom

A Useful High Voltage Condenser

To amateurs who desire a high potential condenser with plates that can easily be removed without taking the entire unit apart, I offer the design indicated in figures 1, 2 and 3. If constructed as shown, it will present a neat appearance on a par with the remainder of the apparatus in the complete set.

As shown in figure 1, it consists mainly of a hardwood rack with slotted pieces, A, indicated in figure 2. The slot is made of sufficient width to take the plate with an intervening distance between slots of $\frac{1}{2}$ ". A

small strip, D, is screwed to A to hold the plate in position at the base.

The plates are coated on both sides with tinfoil, as shown in figure 4, and connections are made to them by the brass contact clip, B, indicated in figure 3. These are in turn connected to the copper strip, C, with binding posts located at each end for connection to the transformer. To prevent brush discharge, the plates should be coated with a good grade of beeswax.

It is evident that the condenser is readily accessible and of more than passable appearance.

A Simple Way to Make a Good Variometer

(Continued from page 595)

it back from the ball, pressing the soft wax back around the edges so as to insure proper clearance when the wax is hard.

As soon as the wax is cold, cut the outer layer of cotton tape, carefully unwind the layer if made of cord and then remove all tape. Give the stationary winding which is now held in place another coat of shellac. File a smooth notch in one side of the brass tube at a convenient place in the inside of the ball and run the terminals of the inner winding out through one end of the shaft and

mount a suitable knob and pointer on the other end. Then connect up the windings and mount as desired.

This variometer, used in connection with a secondary winding consisting of fifty turns of No. 28 D. C. C. wire wound on a form 3 inches in diameter without taps, will change the wave-length of a circuit from 150 to 500 meters and it is also suitable for use in the wing circuit of the regenerative set shown in the December, 1916, issue of the Bulletin of the National Amateur Wireless Association. M. B. WEST, Ohio.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

A. B., Orleans, Mass.:

Any attempt to calculate the effective height of the aerial you describe would be more or less conjectural. The form factor of the aerial can be calculated by the formula presented by Mr. Blatterman in the October, 1916, issue of *THE WIRELESS AGE*, and it may aid you in calculating the radiation characteristics of this aerial. The effective height of the flat top might in your case be considered as an average of the height taken at four to six different points along its entire length.

In the average case the receiving set will respond as well when installed on the second story of a house as if it were on the first floor, particularly if a flat top aerial is employed for receiving.

We cannot undertake to give you a scientific disquisition on the relative sensitiveness of the various types of detectors, but as you are probably aware the vacuum valve detector stands at the head of the list. The cerusite and galena rectifiers probably come next in the order of sensitiveness, followed by the carborundum rectifier. The natural wave-length of the aerial you describe is approximately 465 meters, and it makes no difference whether these wires are connected together at the extreme end or left open.

* * *

P. W., Westchester, Pa.:

Five K. W. transmitting sets are not supplied to the marine service of the Marconi Company. Wiring diagrams and constructional details of this apparatus are not open for publication.

Complete circuit diagrams of the auxiliary storage cell switchboard and connections appear in the book entitled "Practical Wireless Telegraphy."

* * *

A. B., East San Diego, Calif., inquires:

Ques.—(1) If we are permitted to do so after the War, we contemplate erection of an aerial 300 feet in length, 50 feet in height, consisting of four wires spread two feet apart. We intend to use a 1 kw. transformer and rotary spark gap. We are not within five miles of a Government station, and we would like to know (1) if our wave length will exceed 200 meters, and (2) if we would have to get a special permit or would have to reduce the length of the aerial.

Ans.—(1) The radiated wave will undoubtedly exceed 200 meters, and it is doubtful

whether or not the Government authorities will permit you to use a longer wave length. An aerial to radiate a 200 meter wave, should not be more than 120 feet in length.

Ques.—(2) We have an inductively coupled receiving transformer the primary of which is 24" in length, 6" in diameter wound with No. 19 wire. The secondary winding is 22" in length, 5" in diameter wound with No. 32 wire. What is the approximate wave length range of this tuner and how far should we be enabled to receive with a crystaloi detector? Could this receiving tuner be employed as an undamped wave tuner? We would much appreciate an answer to these questions.

Ans.—(2) If the secondary coil is shunted by a small condenser, the circuit will respond to waves up to 7,000 meters. The primary winding is rather coarse. Good results would be obtained with a winding of No. 24 S. S. C. wire and a much longer range of wave lengths would be obtained without the use of a loading coil. With the average amateur aerial, you would require some loading inductance in the primary circuit to reach the wave length of 7,000 meters.

We are unable to determine your range with the crystaloi detector, but inasmuch as the majority of long distance stations employ undamped oscillations, you would have to use some type of undamped wave receiver. Page 281 of "Practical Wireless Telegraphy" describes a beat receiver which will suit your requirements. Please be informed that amateurs are not permitted to construct wireless apparatus during the period of the War.

* * *

A. B. R., Moline, Ill., inquires:

Ques.—(1) The capacity of a condenser is often expressed in centimeters. How is this unit derived?

Ans.—(1) The capacity of spherical metallic bodies is found to vary as their radii. Hence the capacity may be expressed in centimeters of an equivalent sphere. In the electrostatic system of notation, a sphere of 1 centimeter radius has unit capacity. A microfarad is the equivalent of 900,000 centimeters capacity in the electrostatic system of units. A farad represents 900,000,000,000 centimeters.

You were enabled to hear the signals from spark stations on your crystal detector previous to the War because of the inequalities in the amplitude of the successive oscillations generated by the arc system. This gives the effect of damping and permits one to receive

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signals even with an ordinary crystal rectifier over distances up to 50 or 75 miles.

* * *

E. S., Hoboken, N. J., inquires:

Ques.—(1) Please explain how oscillating currents are produced by an electric arc.

Ans.—(1) The arc gap which is provided with special facilities for cooling electrodes is mounted in a chamber which is fed with hydrogen or illuminating gas. Generally a blow-out magnet is mounted at right angles to the arc. The electrodes are shunted by a condenser and inductance. Assume that the arc gap is open; the condenser connected in parallel to the gap will become charged to the voltage of the direct current supply. When the arc is struck, the voltage of the arc drops. Hence the condenser will discharge through the gap increasing its conductance and causing a still more rapid drop of voltage. When the stored up energy is exhausted, the current will decrease, and owing to the increase of resistance consequent upon the cooling of the gas, the voltage will rise. The condenser will again become charged and the cycle of events will then be repeated.

Replying to your second query, air condensers could be employed provided you had sufficient space for their erection. To obtain the capacity you desire you would require a condenser the surface of one side of which was 3960 square feet. Of course, the condenser could be made up of smaller sections, but nevertheless, it would take up an inordinate amount of space. We are speaking of condensers using air at atmospheric pressure. Compressed air condensers have been employed to some extent but they are cumbersome and difficult to keep airtight. Air at a pressure of 250 pounds is employed as the dielectric.

* * *

G. L. W., New York City, inquires:

Ques.—(1) In anticipation of future use of my wireless receiving set, I wish to have the design of a magnetic coupling coil between the grid and wing circuits of a vacuum valve; in other words, I want to use a tickler coil or small inductive coupler. Are there any special requirements in making this coupler, such as the size of the wire, the number of turns, etc., or is it simply necessary to have an equal amount of wire in each circuit?

Ans.—(1) There is nothing special in the design of these coils. For a long wave length tuner, a loose coupler of the dimensions ordinarily employed for tuners up to 3,000 meters will suffice. If the regenerative coupler is to be used with a short wave tuner, a small coupler such as employed for circuits up to 600 meters fulfills the requirements.

Ques.—(2) I contemplate linking this coupler magnetically with the exciter coil of my set which is wound to tune to a wave length from 200 to 2,500 meters. Would this require any special winding?

Ans.—(2) We do not fully understand the query. Do you intend to use a regenerative coil with a short wave length coupler? If so, the point is covered in the answer to No. 1.

E. S. M., Brooklyn, N. Y., asks:

Ques.—(1) How does the sensitiveness of the Fleming valve compare with that of the audion and the galena detectors?

Ans.—(1) When used in a special circuit, the Fleming valve is equal in sensitiveness to the audion. When used in the ordinary manner the Fleming valve is the most stable in operation of all.

Ques.—(2) Please tell me what my receiving range should be with the following, as shown in sketch:

Three loading coils 12 inches long of No. 20 wire; Murdock loading inductance; Murdock loose coupler; Murdock variable condenser, capacity 0.0005 Mfds.; Clapp-Eastman fixed condenser, capacity 0.003 Mfds.; galena detector; Marconi 2,000-ohm telephones; Aerial—length, 35 feet; number of wires, 6 of No. 14 B. & S. copper; distance apart, 3 feet; height at lead-in, 70 feet; height at other end, 65 feet; length of lead-in, 35 feet; direction of aerial, East and West; ground wire, connected to water pipe; length, 45 feet.

Ans.—(2) The natural wave length of your aerial is about 162 meters. This may be raised to 4,000 meters in the antenna circuit. The secondary of your receiving tuner, however, does not give the same range of wave lengths. Not knowing the value of inductance for the secondary circuit of the Murdock receiving tuner, we are unable to answer more definitely. The range of your apparatus is approximately 700 or 800 miles at night time; the daylight range is 80 or 90 miles at the most.

Ques.—(3) How much would it increase my receiving range if I were to use a Fleming valve instead of the galena detector?

Ans.—(3) Used in the ordinary manner, the Fleming valve will not increase the range.

Ques.—(4) Does the direction of the aerial make much difference in the receiving range of a set?

Ans.—(4) It makes very little difference except when the flat top portion of the aerial is very much longer than the vertical portion. Under these circumstances directional effects are experienced but not otherwise.

Ques.—(5) Upon what principle does the electrolytic interrupter work?

Ans.—(5) The electrolytic interrupter consists essentially of a plate of lead and a small wire electrode of thin platinum or German silver immersed in a dilute solution of sulphuric acid. The small electrode is generally covered with a glass or porcelain jacket, and is so arranged that more or less of it is exposed to the action of the liquid.

If this interrupter is connected in series with a source of direct current, using the platinum electrode as the anode and the lead plate as the cathode, gases are liberated by electrolysis; the oxygen so produced envelopes the platinum tip and practically insulates it from the solution, whereupon the circuit is interrupted. The circuit being interrupted, there is nothing to sustain the gas bubble, which immediately collapses and again makes the circuit. Thus a great number of breaks are produced per second. If the electrolytic



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interrupter is connected in series with the primary winding of the induction coil, the frequency of the spark produced depends upon the area of the platinum point exposed, the self-induction of the coil and the voltage. The average electrolytic interrupter requires at least 60 or 70 volts across it for satisfactory operation.

Book Reviews

RADIODYNAMICS. THE WIRELESS CONTROL OF TORPEDOES AND OTHER MECHANISMS. By *B. F. Miessner*.

The author presents in instructive fashion the most important material concerning the history, methods and apparatus of radiodynamics, the art of controlling distant mechanism without artificial connecting means. The subject matter has been treated in a manner that makes it intelligible to the general reader, without sacrificing the technical exactitude which makes scientific work of value to the trained engineer.

The chief recent developments in this new art have been of a military nature, and for this reason the volume is devoted for the most part to the torpedo-control application of radiodynamics. Beginning with the historical viewpoint of his subject, the author passes on to the wireless control of mechanism, electrostatic and combined induction and electromagnetic wave systems. He treats of the possible control methods for radiodynamics and then discusses the advent of the wirelessly controlled torpedo. A description is given of the work of the Hammond Radio Research Laboratory and a summary of recent developments in the art.

HOW TO MAKE LOW-PRESSURE TRANSFORMERS. By *Prof. F. E. Austin*.

This booklet will enable anyone to build a small transformer for experimental purposes at small cost, without the use of expensive tools or machinery, that may be connected with any house

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circuit where the pressure is 110 volts or less, and the frequency about 60 cycles. The small transformers, when connected with the ordinary alternating current house circuits, may be used to operate small electric lights, door bells, small arc lights, and direct current toy railroads, operating five or six loaded trains at one time.

The widespread popularity of this booklet has caused this, the third edition, to be published, and it has been greatly enlarged.

EXAMPLES IN ALTERNATING CURRENTS. VOL. I. *By Prof. F. E. Austin, B.S., E.E.*

The purpose of this book is to assist students who are pursuing courses in electrical engineering, to apply fundamental principles in engineering practice. While the book has been designed to assist the college student, it will be found valuable to those who are pursuing correspondence courses or who are attempting the study of alternating currents by themselves.

The writer states that he has found, as a result of an experience extending over a period of many years, that the average student requires a certain amount of *guidance*, in the solution of engineering problems that are presented to him, and it is the design of this work to furnish such guidance, and at the same time lessen the labor of the teacher.

One feature of the book is the insertion of various tables containing values of variable quantities met with in engineering practice, so arranged as to include a wide range of values, and to render evaluation convenient and rapid.

This is the second edition of the work, and contains additional features in the form of new cuts and subject matter.

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