New Operating Switch.

A new operating switch for use with Mark II. sets has been designed, and a model constructed in "Vernon" during the year. The new design is much smaller, lighter, and cheaper than the existing design. It also requires less adjustment and operates with a very much smaller current. It is not arranged to "break" the leads to the receiving instruments but simply to short-circuit them, and this short-circuiting is done over a line contact 4 or 5 inches in length, so that the contact resistance to oscillating currents is reduced to a minimum. This point is likely to become more important in the future than it has been in the past owing to the probability of more persistent waves being used in the aerial for transmitting purposes.

Plate No. VIII. shows two views of the new operating switch, and it will be noted that only a single small solenoid "O" is used in the switch. In order to ensure that the switch will "make" before the magnetic key "makes," and "break" after the magnetic key "breaks," it is proposed to control the operating switch from the tail contact of the Morse key in a similar manner to that outlined in G and T Order, No. G. 4906/12 of July 1st, 1912, for the protecting switch.

Fig. 6.

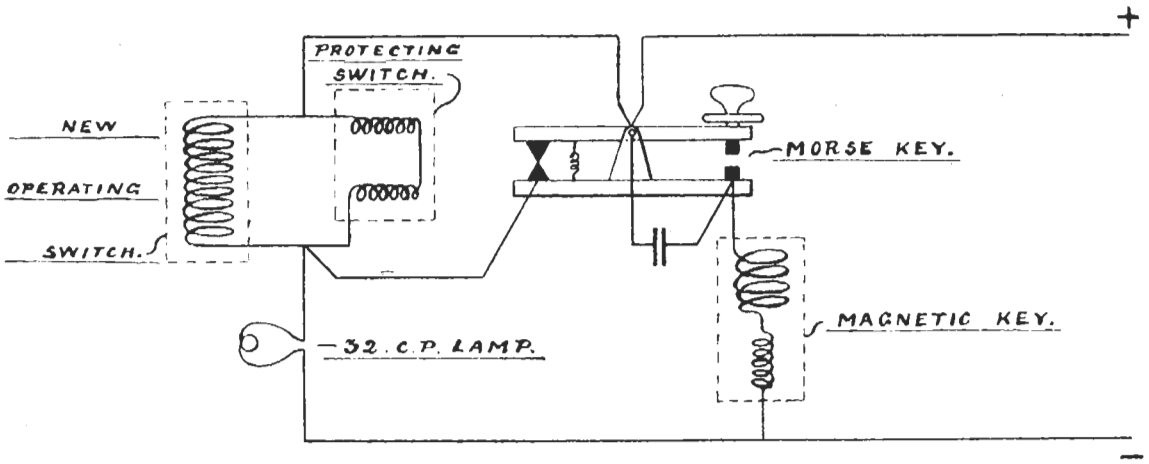
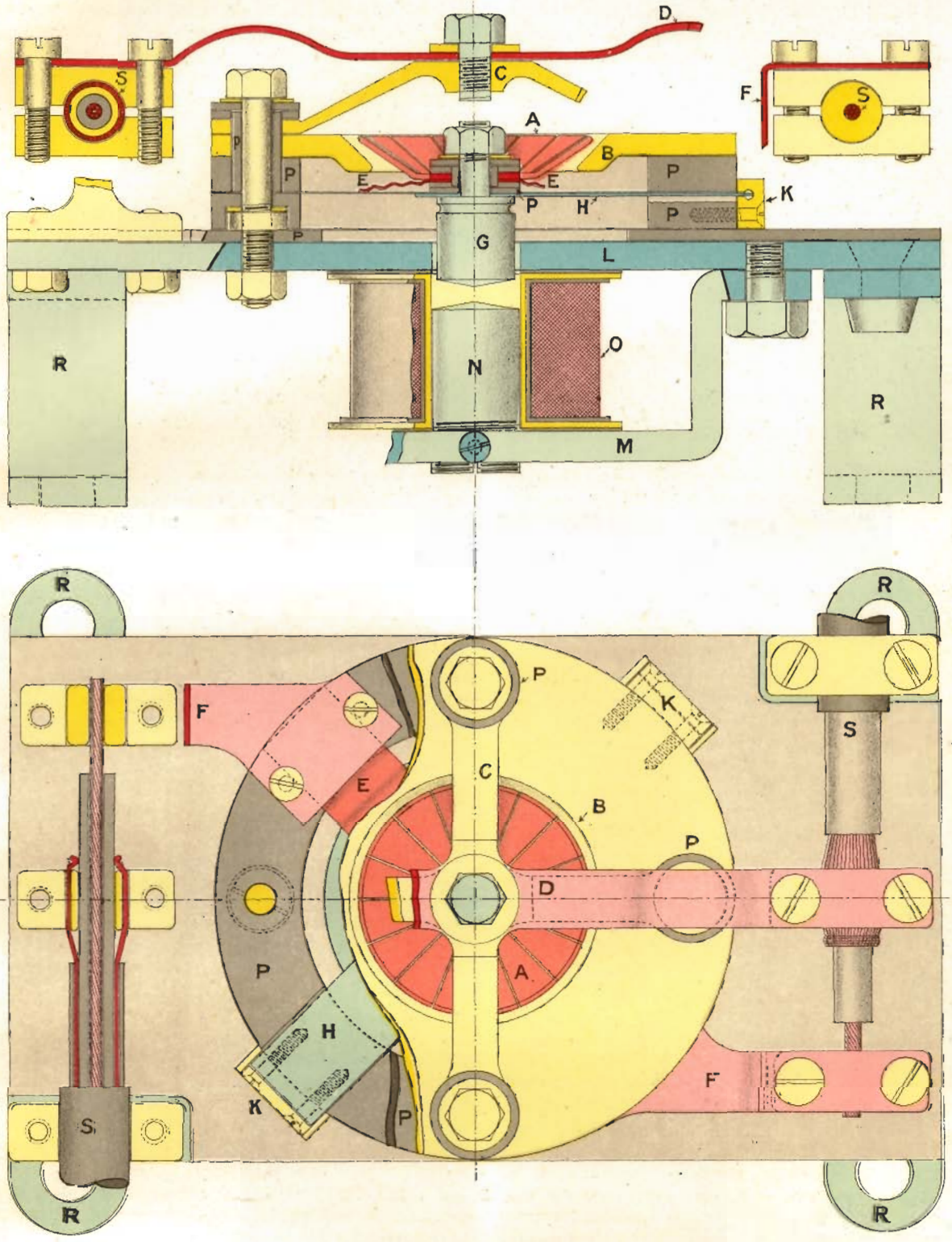


Fig. 6 illustrates the proposed new scheme of connections both for the operating switch, protecting switch, and magnetic key. It will be noted that the protecting switch coils and the new operating switch coil are connected in parallel, and are actuated by the current through a 32-C.P. lamp whenever the Morse key is depressed. For satisfactory working it will, of course, be necessary to arrange that the resistance of the protecting switch coils are commensurate with that of the new operating switch, and this will probably be the case if 220-volt shunt-protecting switch coils are used. The bobbin of the sample operating switch has a resistance of about 110 ohms, and 0·3 of an ampère is required to actuate the switch. However, the matter of the precise resistances of the coils and the candle-power of the lamp have not yet been finally settled.

Referring to the plate, one part of the concentric cable runs to the aerial and earth fitting, whilst the other part runs to the receiving instruments. In the switch the outer cores of the two parts of the concentric cable are permanently connected together through the copper strap "D," whilst the inner cores are also permanently connected together by the two copper strips "F," and the thin flexible sheet of copper "E." When the switch is depressed a short-circuit is established between "E" and "D" through the special contact piece "A." This contact piece "A" is made in a cup-shaped form with radial slots cut in it so as to make it springy. It makes contact around the whole of its circumference with the fixed brass contact "B." In order to ensure that the high frequency current will distribute itself fairly equally around this circular contact, the current is led into "B" from "D" by means of a brass casting "C" which has four

NEW OPERATING SWITCH.



REFERENCE.

A	MOVING SPRING CONTACT.
B	FIXED CONTACT PLATE.
C	CASTING CONNECTING "B" TO "D".
D	STRIP CONNECTING OUTERS OF C.C.CABLE.
E	FLEXIBLE CONNECTION FROM "A".
F	CONNECTION FROM "E" TO INNERS OF C.C.CABLE.
G	MOVING ARMATURE.
H	STEEL SPRING SUPPORTING "G" & "A".
K	SUPPORTS TO "H".
L	STEEL BASE PLATE.
M	STEEL YOKE.
N	STEEL CORE.
O	BOBBIN.
P	INSULATION.
R	SECURING BRACKETS.
S	CONCENTRIC CABLE PATT. Nº 751.

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To face page 24.

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radial arms so that the current should divide equally between these four arms. The moving contact "A" is in metallic contact with the thin flexible copper strip "E," and these two, together with a suitable insulating bush "P," and cylindrical iron armature "G" are all mounted on a flat steel spring "H." This spring "H" is of tempered steel about 5 inches long, $\frac{5}{8}$ of an inch wide, and $\frac{1}{32}$ of an inch thick. It is supported at both ends in special bearing blocks "K." These bearing blocks, whilst being arranged so as not to allow any side or end motion to the spring, yet do not grip it tightly so that when the iron core "N" attracts the iron armature "G" the steel spring "H" bends at the centre, and thus the moving contact "A" is made to touch the fixed contact "B." The magnetic circuit is completed through the iron yoke "M" and the steel base plate "L." The air gap between "N" and "G" is arranged to be about $\frac{1}{8}$ of an inch maximum, and $\frac{1}{32}$ of an inch minimum, thus allowing $\frac{3}{32}$ of an inch movement. It will be noted that the ends of the iron core "N," and the moving armature "G," are turned slightly conical so that the apexes of the cones are opposite each other. This is to ensure that the magnetic pull will always tend to keep the centre line of "G" in line with the centre line of "N," and so counteract any tendency to side-pull which may arise, due to inequalities of the air gap between "L" and "G." As stated the contact "A" and flexible connection "E" are insulated from the steel parts "H" and "G," so that even if "G" should accidentally come into contact with the bobbin or the core "N" it would not give rise to a short circuit. The switch has very few parts liable to wear since the movement in the bearing blocks "K" is extremely small, so that it is anticipated that the switch will operate for very long periods of time without any attention. The switch is arranged to be bolted to the underside of the deck over by means of the securing brackets "R," "R," so that the bottom view on the plate shows how the switch would appear on the deck over when looked at from underneath.

New Magnetic Key.

A new magnetic key has been designed and a first model made in "Vernon" with the object of securing the following advantages over the existing design :—

(1) The parts to be more readily get-at-able for purposes of adjustment and renewal ; (2) To use less direct current and therefore reduce the troubles which are sometimes experienced due to sparking at the Morse key ; (3) To be lighter, smaller, and cheaper than the existing design.

Plate No. IX. illustrates the new design of key, and it will be seen that the contacts are arranged below instead of above the bobbin. This has the advantage that globules of copper thrown off from the contact surfaces fall to the bottom of the case and not on to the bobbin or bearings. The magnetic yoke "A" is built up of steel plates about $\frac{1}{16}$ of an inch in thickness riveted together, the plates being varnished before being assembled. It is found that this construction reduces the eddy currents sufficiently to enable the key to be worked quite quickly so that it is unnecessary to build up the yoke of thin laminations as previously used. The core and moving armature "G" are turned out of solid steel, but six narrow radial saw cuts are made in them to reduce eddy currents. The bobbin "B" is wound on a brass former, and, in the case of the 100-volt key already made, this bobbin has a resistance of 18 ohms, and a resistance of about 40 ohms is used in series with it, so that the maximum current taken is about 1·7 ampères. For the 220-volt key a higher resistance bobbin will be used, and the current will be proportionately less. "C" represents the terminal block for the bobbin connections.

The steel armature "G" is $1\frac{3}{16}$ inches in diameter and the hole in the magnetic yoke, through which it moves, is $1\frac{1}{4}$ inches in diameter, thus giving a circumferencial air-gap of $\frac{1}{32}$ of an inch. This air-gap is uniform all round the circumference and the armature does not touch the yoke in any position. The spindle of the key slides in two gunmetal bearings, and the total travel of the spindle is about $\frac{1}{4}$ of an inch. The minimum air-gap between the armature and the magnet core is about $\frac{3}{32}$, or $\frac{1}{8}$ of an inch, and the maximum air-gap is $\frac{1}{4}$ of an inch more than this. In the new key it is quite easy to correctly measure the air-gap at any time since the length of armature visible below the magnet yoke is always exactly the same as the length of air-gap inside the bobbin. This is an important advantage of the new design of key since in the existing design it is somewhat difficult to correctly measure the air-gap although the satisfactory working of the key depends largely on the adjustment of this.

The main contact fingers "H" and auxiliary contact fingers "K" are very similar to the contact fingers used on the existing key, but the method of mounting them is different from the existing method. The main fingers "H" are mounted on a rocking bearing so that the pressure automatically tends to adjust itself equally between the two contact surfaces, and if for any reason these fingers get out of adjustment they tend to pull themselves into adjustment again. Also both the main fingers "H" and the auxiliary fingers "K" are insulated by means of a Pertinax bush and washers from the spindle so that no part of the spindle or framwork becomes electrically charged. The upper portion of the spindle has a flat surface machined on it corresponding with a flat surface on the bearing gap which prevents any possibility of the spindle turning. Also the insulating washers on the spindle are arranged to prevent the contact fingers from turning with regard to the spindle.

It is expected that the same "key resistances" as used at present will continue to be used and the concentric cables "D," "D" are shown running to these resistances. The main concentric cable, Patt. No. 273, is indicated by "E." All of these cables are connected to their corresponding contacts by copper straps "F." The cable clamps on the ends of these straps are not connected to the base at all but clamped directly on the cable above the base. A sheet of micanite insulation "L" is fixed to the base to prevent any possibility of short circuits, although the connecting straps "F" are so stiff that very little movement will be possible.

The fixed contacts are quite different to those in the existing key, and as will be seen from the plate there are four contacts all exactly similar, each one being adjustable independently of the others. A separate illustration is given on the plate of one of these fixed contacts with its holder. From this it will be seen that the contact is mounted on a steel stud, which is screwed to the casting forming the back of the key. On the steel stud, and insulated from it by a suitable bush and washers is a cylindrical piece of brass " M " referred to as the " contact holder," with the hole in it drilled eccentrically with regard to the circumference. Over this brass contact holder the main copper contact " N " fits. This contact is in the form of a thick copper tube, and it is prevented from turning by a set-screw (not shown in the plate). Should that portion of the contact which is in use become worn it is a simple matter at any time to slacken the set-screw and turn the tube " N " through a portion of a circle, thus bringing a new surface into action. It will be noticed that this can be done without moving the brass contact holder " M," and therefore without disturbing the adjustment of the key. If, however, it is required to alter the adjustment of any one contact holder, the steel nut can be slackened and then the contact holder " M " is free to turn, and being mounted eccentrically the act of turning it reduces or increases the " beat " of the key as regards that particular contact. It will be seen that it is a very simple matter to adjust or replace any one contact, and this can be done without disturbing the others.

It will be noted that no condenser or resistances are shown in the plate. It is not proposed to supply any condenser with the key since, owing to the small current it requires, the present Morse key condenser will be large enough without using any additional condenser in the key. Also it is not proposed to use any shunt resistance across the bobbin of the key, since a practical test has not revealed any advantage in this arrangement with the new key. However, as previously stated, a series resistance will be used, and it is proposed to mount this resistance in a separate ventilated case. In the existing key, where the resistances are mounted in the case of the key itself, it is necessary to ventilate the case in order to cool the resistances. This, of course, prevents the key being as silent in operation as it would be if the cover were not ventilated, and in the new key it is not proposed to ventilate the cover, but on the contrary to make it as sound-tight as possible.

The plate does not illustrate any " safety contacts," but these will probably be fitted in a somewhat similar manner to that used in the existing key.

The data given for this key should not be regarded as final, since, although the first model has been made and works very satisfactorily, it has not yet been thoroughly tested, and the design is therefore subject to modification in detail.

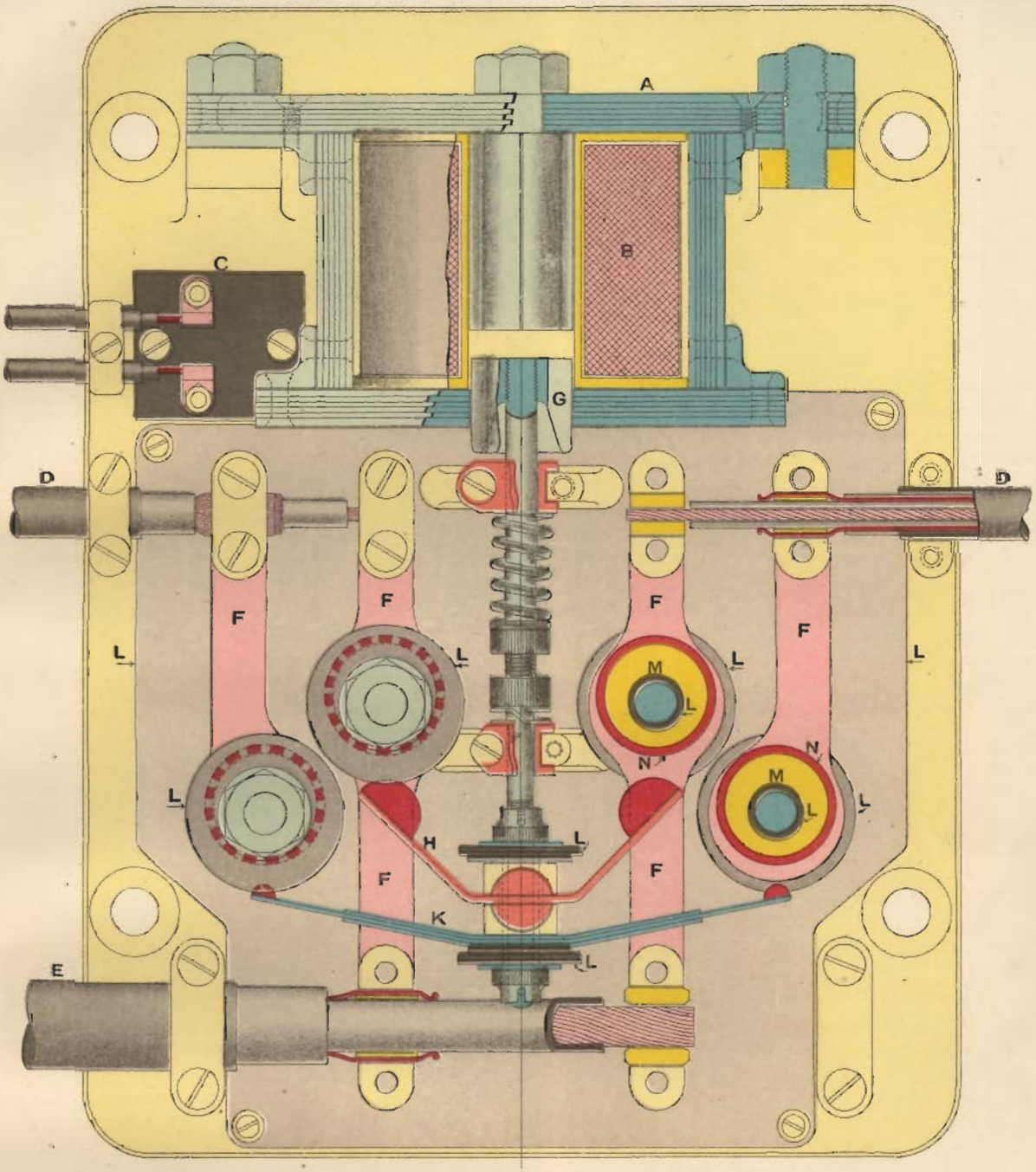
New Hand-operating Key.

Objections have been raised in regard to the existing pattern of hand-operating key as used with Mark I*. and Destroyer sets in that (1) the moving parts of this key are rather large and heavy, (2) it is necessary to work with a rather large beat, and (3) considerable pressure must be exerted in order to overcome the three spring contacts, all of which work against the pressure of the hand whilst the key is being depressed. For these reasons it is stated that fast signalling cannot be obtained with the key, and that it is somewhat tiring to use for long messages.

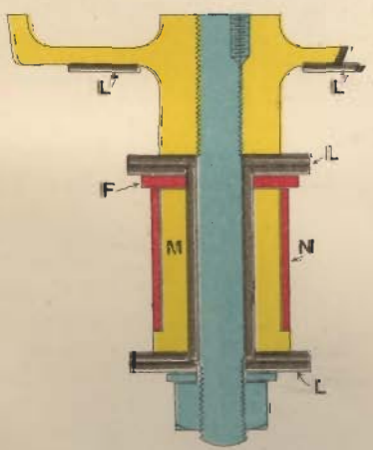
In order to overcome these objections it was suggested some time ago that a magnetic attachment should be supplied for fitting to the key so as to practically convert the key into a magnetic key. A small Morse key would then be supplied for use as a transmitting key, this small key being simply used to control the current to the solenoids of the above-mentioned magnetic attachment. Such a device was made in " Vernon," and consisted of a pair of solenoids with iron core, moving armature and levers, the whole being mounted in a box designed to fit underneath the existing hand-operating key. A hole was drilled in the base of the hand-operating key, and in this hole a lever was arranged connecting the magnetic armature to the hand-operating key, so that whenever the armature was attracted by the solenoids, the key was depressed. This device worked satisfactorily, but it was not proceeded with since, in the meantime, a new design of key was suggested to overcome the difficulties in a simpler and cheaper manner. Plate No. X. illustrates this new hand-operating key, and it is proposed in future to purchase and fit this new design of key in place of the existing design. It is also proposed to purchase additional fittings which can be supplied to ships which already have the existing hand-operating key, to enable them to easily convert their existing key to the new pattern by substituting these fittings for some of the existing ones. Full instructions for carrying out this alteration will be supplied with the additional fittings.

Referring to the plate, it will be seen that the moving portion of the key is practically identical with the moving portion of the Mark II. Morse key. At the back of the key, however, is fitted a flat horizontal phosphor-bronze spring some 2 inches long, fixed at one end, and at the other end carrying two " gold-silver " contacts C 1 and B. The contact C 1 is riveted or sweated to the spring, whilst the contact B is insulated from the spring by a suitable insulating bush, and is only in metallic contact with a light flexible connecting strip " F," which serves to connect this contact B to a neighbouring terminal. Underneath this contact B is the corresponding contact B 1, which is fixed to the base of the key, and is connected by a connection underneath the board to a second terminal. Above the contact C 1 is a corresponding fixed contact C, which is connected to the inner core of the concentric cable D, which runs to the earth-ring fitting. The outer core of this concentric cable is connected to the fixed end of the flat phosphor-bronze spring.

NEW MAGNETIC KEY.



SECTION THRO' CONTACT HOLDER

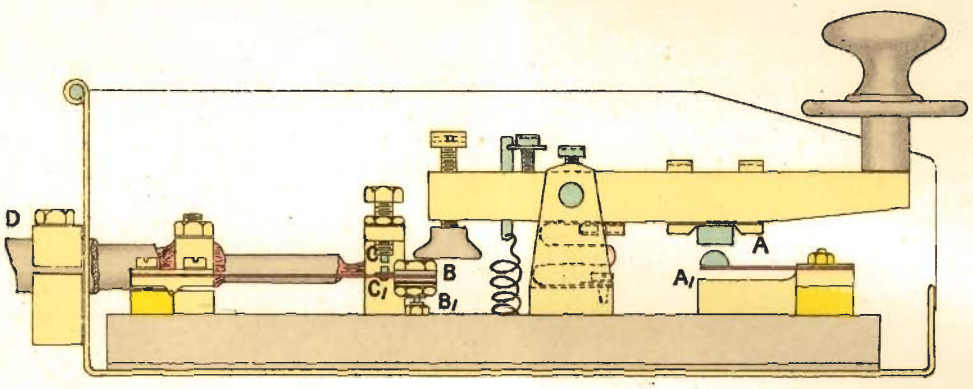


REFERENCE.

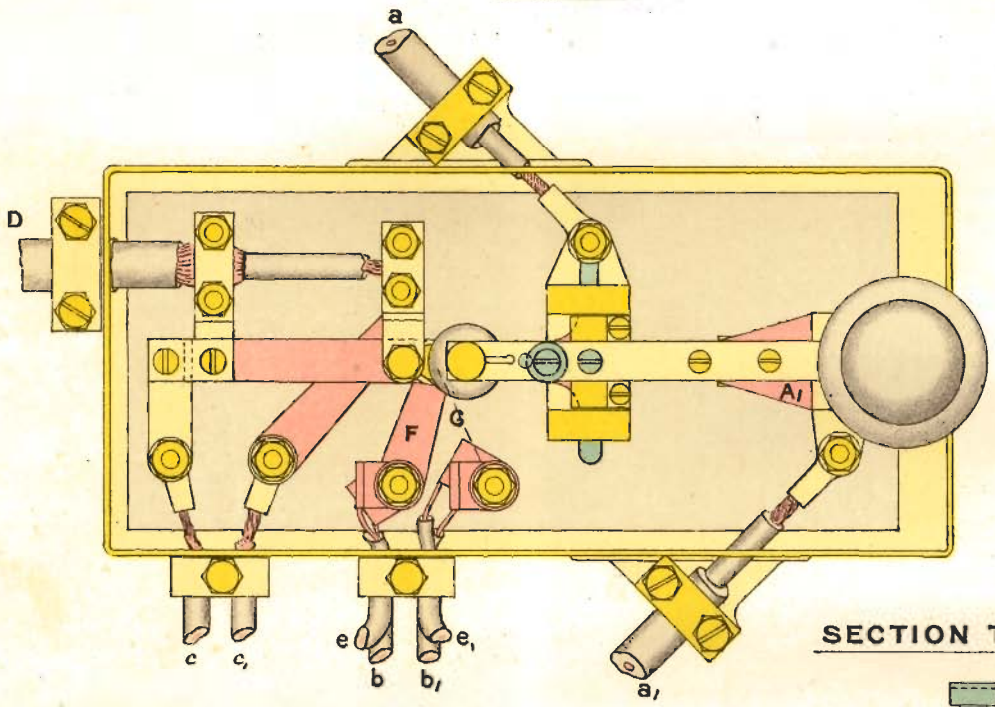
A	MAGNET FRAME
B	BOBBIN
C	TERMINAL BLOCK FOR BOBBIN CONNECTIONS
D	CONCENTRIC CABLE PATT. Nº 751
E	" " " " 273
F	CONNECTING STRIPS
G	MOVING ARMATURE
H	MAIN CONTACT (WITH ROCKING BEARING)
K	AUXILIARY CONTACT
L	INSULATION
M	CONTACT HOLDER (ADJUSTABLE)
N	CONTACTS (REMOVABLE)

NEW HAND OPERATING KEY.

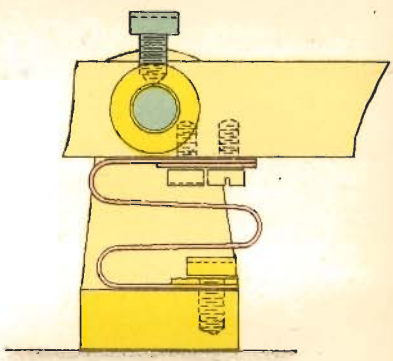
ELEVATION.



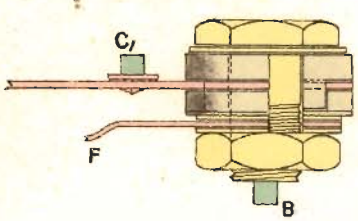
PLAN.



SECTION THRO' PIVOT.



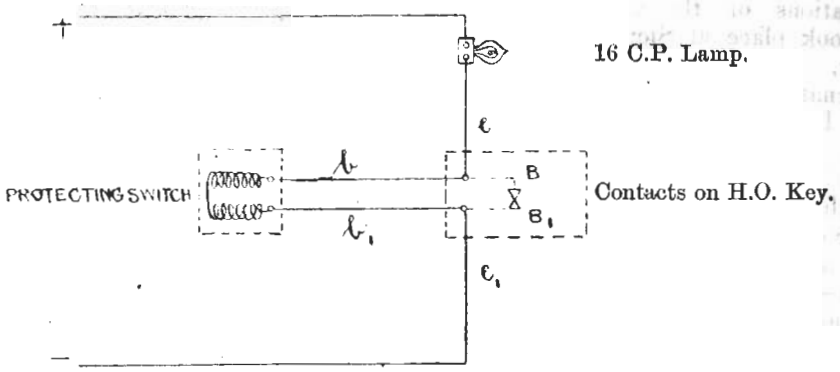
DETAILS OF CONTACTS B & C1



REFERENCE.

A A1	MAIN CONTACTS (SILVER.)	c c1	LEADS TO RECEIVING INSTRUMENTS.
a a1	MAIN A.C. LEADS.	D	CABLE TO EARTH RING FITTING.
B B1	PRO. SWITCH CONTACTS (GOLD-SILVER.)	e e1	LEADS TO D.C. SUPPLY THRO' LAMP.
b b1	" " LEADS.	F	FLEXIBLE CONNECTION TO "B".
C C1	AERIAL & E. CONTACTS (GOLD-SILVER.)	G	CONNECTION UNDER BASE TO "B1".

FIG. 7.

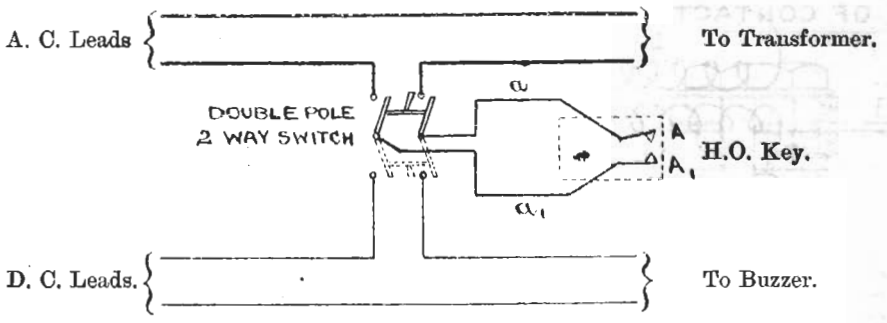


This latter spring tends normally to lift the contacts up so that C is in contact with C 1, but B is not in contact with B 1. However, a red-fibre finger, mounted on the ends of the screw which is used to adjust the beat of the main key, is in contact with the end of the flat phosphor-bronze spring, and the ordinary steel spiral spring of the key has sufficient power to overcome the action of this flat spring and so keep the two contacts B and B 1 in contact with each other, whilst keeping the contact between C and C 1 broken. If therefore one depresses the handle of the key the first result is to break the contact between B and B 1 ; the manner in which these two contacts are connected to the protecting switch is illustrated diagrammatically in Fig. 7, the reference letters corresponding to those letters used in the plate. It will be seen that so long as the contacts B and B 1 are touching each other no current flows through the protecting switch, but immediately the contact is broken between B and B 1 the protecting switch coils are energised. This method of actuating the protecting switch has already been explained in G. and T. Order G. 4906/12, July 1, 1912.

The first operation of the key is, therefore, to cause the protecting switch to "break." Immediately after the contact between B and B 1 is broken the contact is made between C and C 1, the clearance between these two being always a very small amount. The effect of C 1 touching C is of course to connect together the inner and outer cores of the concentric cable D. The third operation of the key is to make the main contact between A and A 1 in the usual manner. It will be noted that the flat phosphor-bronze spring only moves a very small amount, and that after the contact C is touching C 1 it ceases to move and remains at rest, whilst the main arm of the key completes the remainder of the beat. Owing to the very small clearance between C and C 1 it is possible to work with quite a small beat on the key. The flat spring can be adjusted by means of two screws at its fixed end, and it should be so adjusted that its tendency to move upwards is just overpowered by the steel spiral spring pulling downwards. It will be seen that at the moment of making the main contact A, A 1, the whole of the pressure exerted by the hand is usefully employed at this contact, and is not distributed amongst three contacts, as is the case with the existing hand-operating key. The contact A 1 is identical with the existing contact on both the hand-operating and Morse keys. The brass support for this contact has, however, been carried out underneath the spring, so that those who prefer a fixed contact can easily pack the spring underneath, and so fix it.

It is also proposed to fit a very thin flexible spring loop to carry the main current from the bearing to the arm of the key so that this current will not have to pass through the steel hinge of the key.

FIG. 8.



Another defect of the existing hand-operating key is that buzzer and protecting switch are both worked from the same contact, and since the moving part of the buzzer is very light it frequently makes contact more quickly than the protecting switch "breaks." In the new key it is proposed to use the main contacts A—A 1 whether "buzzer" or "power" is being used, so that the protecting switch, being operated by B, B 1, will always work quickly enough. To do this it will be necessary to supply a double-pole two-way switch which will enable the leads a—a_1 from the key to be switched either into one of the A.C. or one of the D.C. leads. This is made clear by Fig. 8.

It is proposed to designate this key in the Rate Book and Gunner's Establishment "Key, Type II.," and the switch "Switch, Power-Buzzer, Type II.

The Goldschmidt High-Frequency Alternator.

Demonstrations of the working of a high-frequency alternator invented by Professor Goldschmidt took place at Slough on the 4th and 8th July 1912, and were attended by Naval representatives.

This alternator generates high-frequency currents directly and produces a continuous wave in the aerial. It is a decided advance on other known similar machines that have been tried up to the present. They have the disadvantage of extremely small clearances, in the neighbourhood of $\frac{1}{1000}$th of an inch, between the rotating part and the stationary parts. Also, they run at an extremely high speed and have very small pole pieces, the pole pitch being about $\frac{1}{4}$ of an inch. In the Goldschmidt machine, the pole pitch is increased and the speed reduced, and the current generated at a comparatively low-frequency (11,500 cycles per second in the case of the machine witnessed). The required high-frequency is obtained by connecting up to the rotor and stator windings a number of carefully tuned resonating circuits which increase the frequency by successive stages through 23,000 and 34,500, up to 46,000 cycles per second, which is applied directly to the aerial, and therefore causes a wave of about 6,500 metres to be radiated.

Both the rotor and stator of the machines are very finely laminated, the iron used being about as thick as a sheet of thin foreign note-paper. This fine lamination is necessary on account of the very high-frequencies employed.

Signalling is done by a key in the exciting circuit.

When a direct current is used to excite the machine continuous waves are produced; when an alternating current is used to excite the machine, signals having an extremely clear and pure note are produced. If a telephone transmitter is put into the exciting circuit, speech is reproduced at the receiving end, there is perfect definition, and entire absence of stray noises and distortion.

The machine inspected had a nominal output of 7 K.W. with a speed of 10,000 R.P.M. The power in the aerial was not easily measured, and although it was estimated to be about 6 K.W., it is very possible that it was not more than about 3 K.W.

Four machines of 150 K.W. are under construction and are to be installed in a station at Berlin and in a similar one being erected in America. These two stations are to work to one another.

For Naval purposes the system is not considered at present likely to be of much use. Firstly, the very high speeds necessary would mean mounting the machines on gimbles, and even then they would probably give trouble at sea; secondly, the system does not readily lend itself to the transmission of several different wave-lengths; and thirdly, the system is not practicable for any but very long wave-lengths, as with short waves excessive speed, small clearances, minute pole pieces, or else a very large number of resonant circuits, each one of which would have to be very carefully tuned, would be required.

Another disadvantage of the system is that any variation of the speed of the machine means an alteration in wave-length and tuning, and, unless all resonant circuits are re-adjusted, a considerable loss in output as well.