

Aug. 14, 1934.

H. E. HUMPHRIES

1,970,455

ELECTRIC SELECTOR

Filed April 26, 1930

5 Sheets-Sheet 1

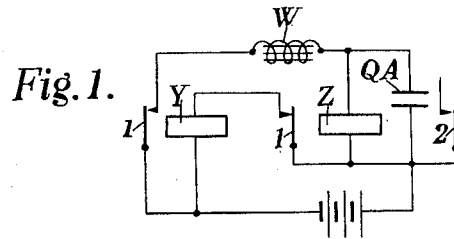


Fig. 2.

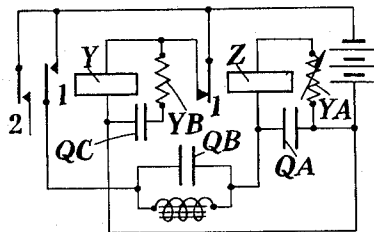
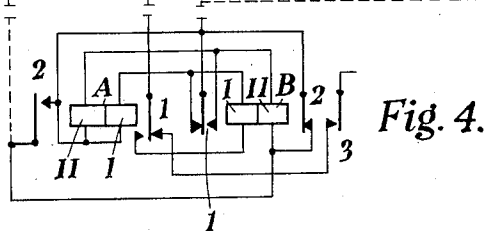
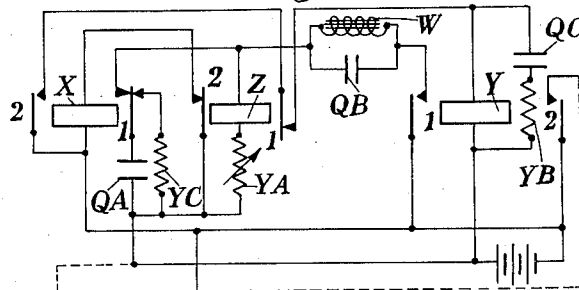


Fig. 3.



INVENTOR
Horace E. Humphries
BY
Richard E. Babcock
ATTORNEY

Aug. 14, 1934.

H. E. HUMPHRIES

1,970,455

ELECTRIC SELECTOR

Filed April 26, 1930

5 Sheets-Sheet 2

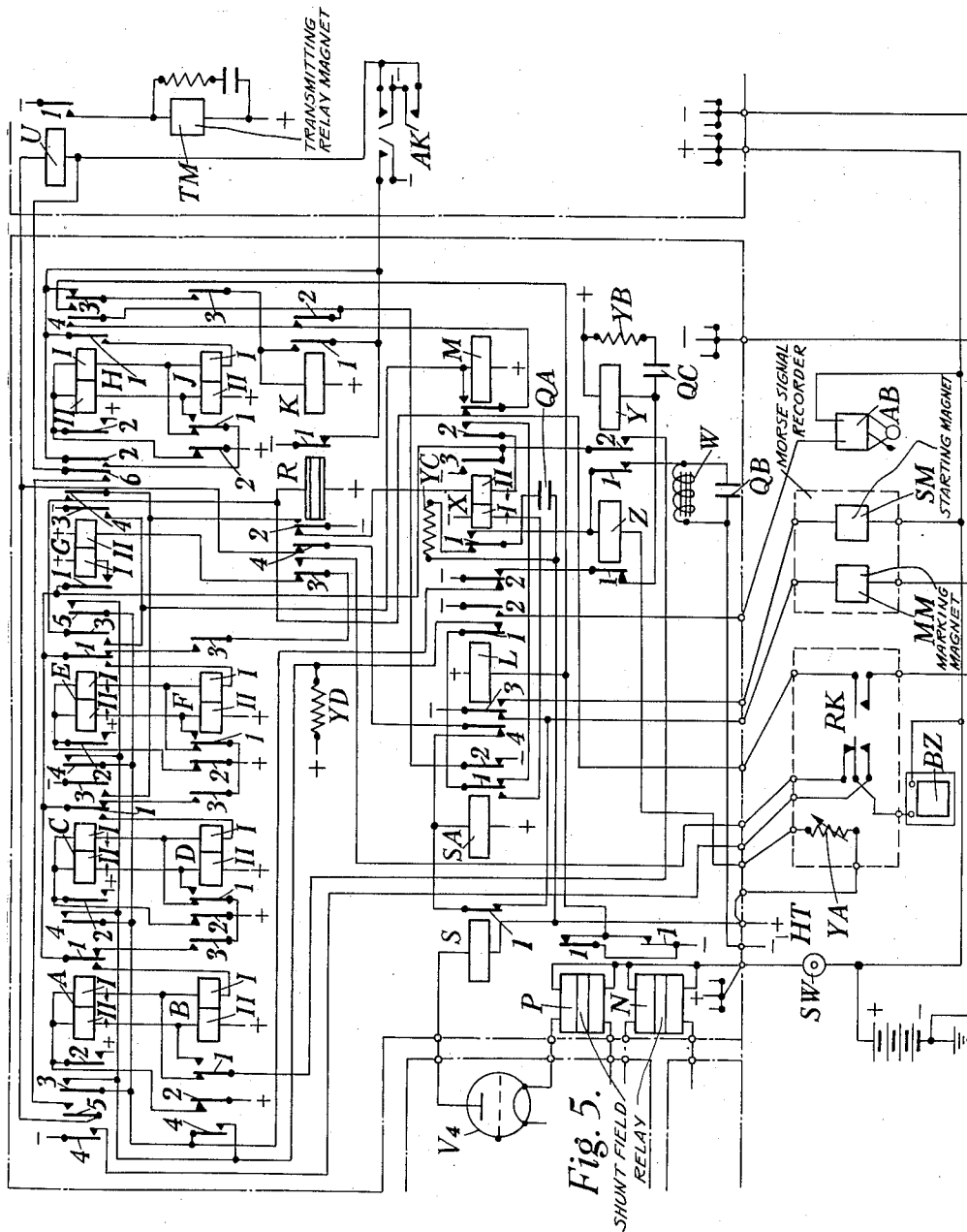


Fig. 5.

SHUNT FIELD
RELAY

INVENTOR
Horace E. Humphries
BY
Richard E. Babcock
ATTORNEY

Aug. 14, 1934.

H. E. HUMPHRIES

1,970,455

ELECTRIC SELECTOR

Filed April 26, 1930

5 Sheets-Sheet 3

Fig. 6.

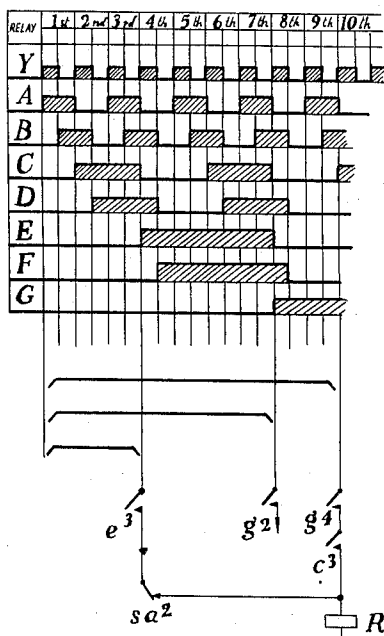
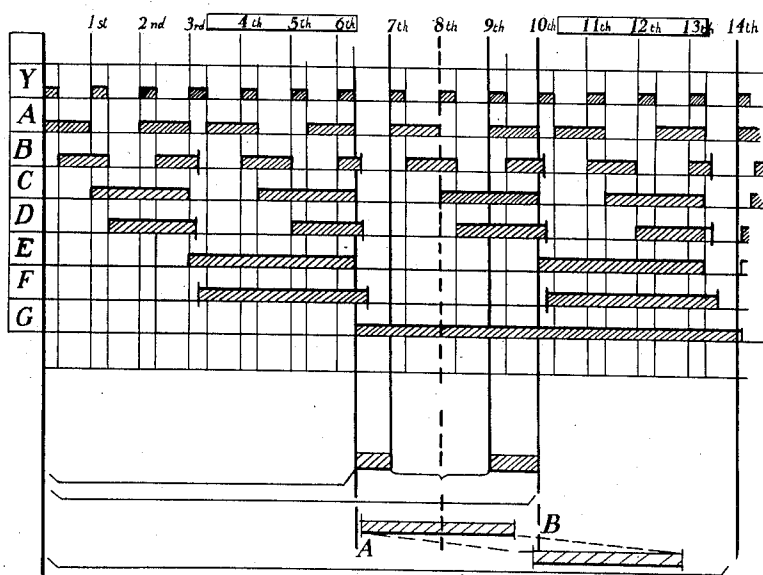


Fig. 8.



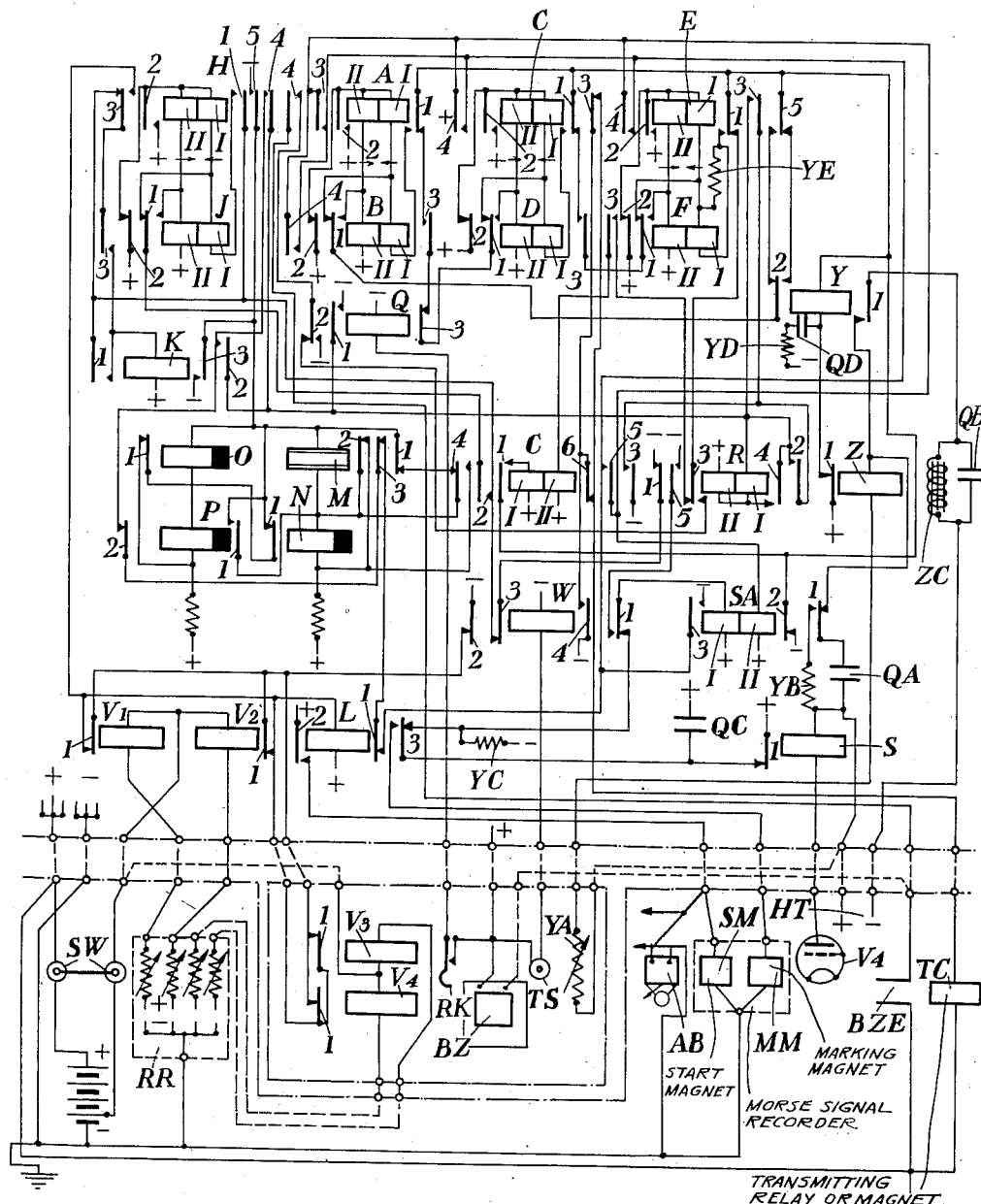
INVENTOR
Horace E. Humphries
 BY
Richard E. Babcock
 ATTORNEY

1,970,455

Filed April 26, 1930

5 Sheets-Sheet 4

Fig. 7.



TRANSMITTING
RELAY OR MAGNET

INVENTOR
Horace E. Humphries
BY
Richard E. Babcock
ATTORNEY

1,970,455

Filed April 26, 1930

5 Sheets-Sheet 5

INVENTOR
Horace E. Humphries
BY
Richard E. Babcock
ATTORNEY

UNITED STATES PATENT OFFICE

1,970,455

ELECTRIC SELECTOR

Horace Edgar Humphries, London, England, assignor to Siemens Brothers & Co., Limited, London, England, a British company

Application April 26, 1930, Serial No. 447,636
In Great Britain April 29, 1929

4 Claims. (Cl. 177—353)

This invention relates to electric selectors and more particularly to electric selectors operable by impulses of prescribed duration separated by breaks of prescribed duration.

Such selectors may be used, for example, in wireless telegraph systems to establish that an alarm signal is being received and to give thereupon an audible or visual signal or both.

The present wireless alarm signal laid down for marine purposes requires a sequence of three marks of four seconds each, separated by spaces of one second each. To meet the case that the timing of the signals in sending may be faulty, a tolerance is nevertheless permitted and the signals should be accepted provided a marking period is not less than $3\frac{1}{2}$ seconds and not more than $4\frac{1}{2}$ seconds and a space period is not less than $\frac{1}{2}$ second and not more than $1\frac{1}{2}$ seconds. The selector of the present invention is adapted to take into consideration such tolerances and will accept a mark as being permissible if it lies between the limits of $3\frac{1}{2}$ and $4\frac{1}{2}$ seconds and a space if it lies between $\frac{1}{2}$ second and $1\frac{1}{2}$ seconds.

For the timing of marks and spaces, the timing devices hitherto used have comprised cams which are coupled as required to constantly rotating members and which operate on contacts after a certain period of drive and relays provided with dashpots to the end that contacts are operated or released after a period of delay.

It is extremely desirable that any timing device used should be capable of very rapid restoration to normal after having timed an event, so as to be ready to time a succeeding event. A pendulum timing device would not fulfil these requirements by reason of its inherent momentum.

The present invention includes an improved form of timing device that can be re-set very rapidly to normal. The fundamental feature of the timing device is that it includes a periodically operated relay which is held operated temporarily by the discharge from a condenser. The relay may interrupt its own circuit on operating but preferably an additional relay is used to cause an interaction. To render the size of the condenser reasonable, the time of periodic operation of the relay is allowed to be small compared with the period to be measured and the operations of the relays are recorded. It is convenient to make the period of the operating cycle of the relay some sub-multiple of the periods to be measured, for instance, one half second.

It is very desirable for manufacturing and operating purposes that the effect of variation in

the air gap of the relay and variations of the load on the relay springs on the time of periodic operation should be diminished as far as possible. With this object in view, we arranged that the condenser whilst timing is taking place is steadily connected in parallel with the relay winding and the source of current for operating the relay is connected through a high impedance choke to the relay. If a relay is actually caused to operate by the discharge of a condenser and in due course releases as the discharge falls off, a variation of the relay air gap and/or the spring load has a very marked effect on the time the relay is operated, an increase in either of these factors resulting in a decrease of the operating time and vice versa.

The inclusion of the choke and the steady connection of the condenser has the effect that an increase of air gap or spring load delays the operation of the relay but allows of earlier release and vice versa so that the operating cycle is approximately constant for variations that may be expected in practice or occur from time to time. A resistance in place of a choke whilst not being so effective in this compensating action might conveniently be used.

To provide for the rapid restoration of the relay to normal when a timing operation ceases, the condenser is disconnected and discharged through a suitable resistance so that only the release lag of the relay, which is small, is concerned.

For recording the cycles of operation that take place whilst a signal is being timed a cycle recording device is provided and we prefer to use a set of relays which are controlled by the timing device. These relays are conveniently arranged in pairs, a pair executing a cycle of operation and release under the influence of control contacts. It can easily be arranged that a pair of relays executes one cycle for every two cycles of the preceding pair or in the case of the first pair, two cycles of the timing device.

The relay set establishes whether a mark has endured a time within the permissible limits, and if not, may prepare to close a circuit for immediate restoration. In the case of a jamming signal, we prefer to delay restoration of the selecting apparatus to normal until the signal ceases so that there is no possibility that a portion of the jamming signal is accepted as a permissible mark.

Beyond the cycle recorder the selecting apparatus includes a device for recording the receipt of permissible marks and when three such

marks in the case of a marine alarm signal have been received, an alarm circuit is closed.

We prefer again to employ relays for this purpose so that the complete apparatus can consist of relays.

Spaces may be timed by the timing device and cycle recorder and thereby it may be ascertained that a space does not exceed the permissible amount. On the other hand we may provide a separate timing device for spaces as will be hereinafter set out. That a space endures one fifth of a second in practice means only that some space has occurred between two marks, and no ascertainment is made of the actual duration beyond ascertaining that it does not exceed the prescribed limit, it being considered that the time taken for relays to release, settles that a space has, at all events, taken place. Space timing only takes place if a prescribed mark has been received as in certain prior forms of selecting devices.

The accompanying drawings will be referred to for the better carrying out of the invention. Fig. 1 illustrates a general form of the timing device for the periodic opening and closing of a circuit; Fig. 2 shows a control relay associated with the timing device; and Fig. 3 means for starting the timing device; Fig. 4 a portion of a cycle recording device. Fig. 5 shows selecting apparatus suitable for wireless alarm purposes. Fig. 6 a diagram for the better explanation of the operation of the apparatus in Fig. 5.

Further selecting apparatus is shown in Figs. 7 and 9 and Fig. 8 is explanatory of Fig. 7.

In the accompanying drawings the relays are each designated by a capital letter and each contact thereof by numerals. In the subsequent description each relay operating coil is referred to by the capital letter designating the relay, whilst to render the description concise and lucid each contact of the relay is referred to by its numeral prefixed by a small letter of the capital designating the relay, for example, referring to Fig. 1, relay Z has an operating coil to be designated Z and two contacts referred to as z1 and z2.

The relays and circuits in the figures are served from a common battery with the exception of the anode circuits of the thermionic tubes, such as V4 Figs. 5, 7 and 9 and in Figs. 5, 7 and 9 to avoid complication coils or contacts connected to positive or negative battery are marked by a + or - sign respectively, and it is to be understood that these connections lead to the marked common leads connected to the battery.

Referring to Fig. 1 relay Z has shunted across it a condenser QA, and in series with the paralleled relay and condenser is a choke W and contacts y1 of a control relay Y. When the battery is connected relay Y operates in a circuit from positive battery, contacts z1, coil of relay Y to negative battery. On the closure of contacts y1 the condenser QA charges up gradually by reason of the choke W, and the condenser in its uncharged state provides a shunt across the coil of relay Z and prevents its energization. The voltage across the condenser rises and the current in the coil of relay Z increases until the current is sufficient to operate the relay. When relay Z operates the operating circuit for relay Y is opened at contacts z1. When relay Y releases the circuit for the coil of relay Z is opened, but relay Z does not release at once as condenser QA discharges and maintains the relay operated for a short period. When relay Z releases the

circuit for the coil of relay Y is again closed at contacts z1 and relay Y re-operates and the cycle is repeated. Contacts z2 at each operation, or it may be release, of relay Z, close the circuit which is to be periodically opened or closed.

Whilst it is possible to cause relay Z to interrupt its own circuit when operated, and thus cause its periodic operation and release, it is preferable to cause the interruption by using an auxiliary relay which can then be provided with contacts to control the circuits which are to be periodically opened and closed, and the function of relay Z, which is timing, is not subject to the influence of spring sets additional to those required for the auxiliary relay.

Fig. 2 shows one way in which an auxiliary relay may be associated with relay Z. Condenser QC and resistance YB shunted across relay Y serve to quench sparks at contact z1. Condenser QB is also for spark quenching. The variable resistance YA is for the purpose of adjusting the frequency of beat of the relay combination; the greater the resistance inserted by YA the less is the frequency.

The operation of the relay combination is as follows:—On the closure of contacts z1, that is when relay Z releases or when the operating battery is connected, a circuit is closed for relay Y from positive battery, coil of relay Y, contacts z1, to negative battery. Relay Y operates and at contacts y1 a control circuit is made for relay Z from positive battery, variable resistance YA, coil of relay Z, choke W in parallel with condenser QB, to negative battery. The choke W and condenser QB particularly the former delay the rise of voltage across relay Z but in due course the voltage across the relay rises to a value sufficient to cause its operation. On the operation of relay Z contacts z1 open the previously traced circuit for relay Y at contacts y1. The relay Z however does not release immediately by reason of the charge in condenser QA dissipating itself through the relay and the variable resistance YA, the rate of discharge depending on the adjustment of resistance YA. When relay Z ultimately releases the previously traced circuit for relay Y is re-established and relay Y re-operates to recommence the cycle of operations.

As a guide to the characteristics of the relay combination, a combination having the following characteristics gave a beat period of approximately one half second:—

Relay Z—10,000 ohms resistance (D. C.).

Relay U—1,000 ohms resistance (D. C.).

Iron cored choke—3,000 ohms resistance (D. C.).

Capacity of QA—15 microfarads.

The relays were of the telephone type and the choke of the type known as an output choke in wireless receiving apparatus.

Condenser QB 0.1 microfarad. The spark quench YB and QC was made up by a 1 microfarad condenser and a ten ohm resistance: supply voltage 100.

In Fig. 3 a control relay X is shown which relay controls the starting and stopping of the cyclical operations. Assuming that the operating battery is normally disconnected, then when the battery is switched on relay X operates from positive battery, contacts z2 coil of relay X to negative battery. Relay X operates and at contact z1 disconnects the condenser QA from across the resistance YC and connects the former across the series circuit comprising the coil of relay Z and variable resistance YA. At contacts z2 the fol-

lowing circuit for relay Y is completed, positive battery, coil of relay Y, contacts $z1$, contacts $z2$ to negative battery.

Relay Y operates and a circuit for relay Z is closed from positive battery, variable resistance YA, and coil of relay Z, the condenser QA being in parallel with this series circuit over contacts $x1$, choke W, the condenser QB being in parallel therewith, contacts $y1$ to negative battery. The potential rise across relay Z is delayed directly by the condenser QA, whilst the potential rise in the whole of the circuit is delayed by the choke W.

Thus relay Z will not operate until the potential across the relay rise above a predetermined value, the relay being thus delayed in operation. When relay Z operates, the previously traced circuits for the coils of relays X and Y are opened at contacts $z2$ and $z1$ respectively, the relays releasing at the same time. With the release of relay Y the previously traced circuit for relay Z is opened at contacts $y1$, the release of contacts $x1$ disconnecting the condenser QA from across relay Z and connecting it to resistance YC through which resistance the charge in the condenser is quickly dissipated. By the removal of condenser QA from across relay Z the relay is allowed to release quickly. When relay Z releases the above traced circuit for relay X is again closed over contacts $z2$ and the cycle of operations is repeated. The operating lag given to relay Z is adjustable by the variation of resistance YA.

It will be appreciated by those skilled in the art that the auxiliary relay Y might be released by a differential winding the circuit of which is closed by a contact of relay Z when this relay operates.

For the recording of the number of beats or cyclical operations of the relays Y and Z, the multiplying relay combinations shown in Fig. 4 may be made use of. It comprises a pair of relays A and B each provided with two windings, and the pair is controlled by contacts $y2$ of a relay Y as shown in Fig. 3.

It should be understood that Figs. 1, 2, 3, illustrate only a limited number of circuit arrangements for the control of the timing devices, and that many modifications will suggest themselves to those versed in the art, for example, the control of the beat frequency may be provided for by the use of a variable condenser or by the variable resistance in series with the choke.

On the first closure of contacts $y2$, relay A is operated over its coil 1 in a circuit from positive battery, contacts $b2$, coil 1 of A, contacts $b1$ and $y2$ to negative. Relay A operates and at contacts $a2$ prepares a further circuit for itself. At contacts $a1$ a circuit is closed for coil 1 of relay B but the relay does not operate as the coil is yet short-circuited over contacts $y2$. On contacts $y2$ opening relay B operates over its coil 1 in series with coil 1 of relay A. Contacts $b1$ change over without effect at this stage. On the next closure of contacts $y2$ a holding circuit for relay B is made over its coil II and contacts $b1$ and $y2$. Current also flows through coil II of relay A, which coil is differential and opposes coil I. Relay A is consequently de-magnetized and releases, opening thereby its contacts $a1$ and $a2$ so that it stays released. When contacts $y2$ open, the holding circuit of relay B is opened and it releases. The next re-closure of contacts $y2$ cause the sequence of operations described, to be repeated.

It will be now clear that two complete opera-

tions of relay Y result in the operation of relay A, operation of B, release of A and release of B. The combination of relays A and B therefore, execute a complete cycle for every two cycles of relay Y. By means of control contacts $a1$ and $b3$ a further combination of relays may be controlled in the same manner as contacts $y2$ control relays A and B, the cyclical period of the further combination being double that of the relay pair A and B.

The explanation of the use of a pair of relays for giving a cyclical period which is double that of the period of a controlling contact is given here to lessen the explanations necessary in connection with the alarm device yet to be described.

Fig. 5 shows one form of selecting apparatus suitable for wireless alarm purposes. In Fig. 5 the alarm circuit is closed by a relay L.

The last valve V^4 of receiving apparatus is shown on the left and its plate or anode is connected to the positive terminal of a high tension supply HT through a relay S. The grid potential of the valve is normally sufficiently positive to allow sufficient current to flow to the plate so that relay S is maintained operated. It is arranged in known manner that sufficiently strong incoming signal causes the grid to assume negative potential whereby relay S releases and is only re-operated when the signal ceases.

Relays P and N are filament supply alarm relays of the consequent pole type, that is comprising two coils each one embracing an arm of a core forming a closed magnetic system it being necessary to energize both coils to produce similar magnetic effects in both arms before the armature is attracted. The circuit for each filament of the tubes such as V^4 passes through the filament and one coil of a relay such as P or N and thence to one side of the common battery and thence from a tapping off the common battery back to the filament. Thus one relay will serve two filaments and providing that both filament circuits are continuous a current will pass through both coils of the relay and it will remain operated. However if the current in one or both coils of the relay ceases indicating a discontinuance of the filament current, the relay will release and at its contacts, such as $p1$ and $n1$ or both, close an obvious circuit for relay L which latter relay at its contacts contacts $l2$ will close an obvious circuit for alarm bell AB, and at contacts $l3$ close an obvious circuit for magnet SM hereinafter referred to. Obviously a separate alarm relay might be used instead of using relay L.

The relays A to F form the cycle recording device relays J, H and K the sequence recording device. Relay M is operated when a mark is of the prescribed duration. Relay R serves to restore the apparatus to normal. Relays Y and Z form the timing device. Other parts will be referred to in the course of the following description. It will be assumed that the cyclical period of the relay pair Z and Y has been adjusted to one half second by means of the resistance YA.

If an alarm signal commences relay S releases on the first mark commencing. A circuit is then made from positive battery over contacts $l3$ and $s1$, coil of relay SA to negative battery, and the relay SA operates. Contacts $sa2$ open without effect at this stage and at contacts $sa1$ a circuit is made from positive battery over guard resistance YD, contacts $l1$ and $sa1$, coil I of relay X to negative battery. Relay X operates and at

contacts x_1 disconnects the resistance YC from across condenser QA, and connects the condenser QA across the series connection of relay Z and resistance YA. A circuit for relay Y is completed from positive battery, relay Y, contacts x_1 contacts x_2 to negative battery. At contacts x_3 a circuit is prepared for relays A, B—G, as hereinafter described.

Relay Y operates and completes a circuit for relay Z from positive battery HT, resistance YA, coil of relay Z, contacts y_1 , choke W, to negative battery HT, the condenser QA being connected in parallel with the relay Z and resistance YA over a circuit from positive battery HT and one side of resistance YA, condenser QA, contacts x_1 to one side of relay Z. Relay Z however owing to the choke W and the condenser QA does not operate immediately. A circuit is made for coil I of relay A from positive battery contacts b_2 , coil I of relay A, contacts b_1 , contacts y_2 and x_3 , to negative battery. Comparison with Fig. 4 will show that the circuit arrangements of the relays A and B are the same as in that figure.

Relay A operates and locks itself by positive battery over contacts a_2 , independent of contacts b_2 to the negative battery on contacts x_3 as previously traced.

At contacts a_1 a circuit is prepared for coil I of relay B but this relay cannot operate as it is short circuited as follows:—upper side of coil I of relay B, contacts b_1 , y_2 , contacts a_1 , to the bottom side of coil I of relay B. It will be seen that contacts a_3 are connected in parallel with contacts b_4 , c_4 , e_4 and g_5 the purpose of which will be hereinafter explained. Contacts a_4 prepare to operate the buzzer BZ under conditions hereinafter referred to, whereas contacts a_5 prepare the circuit for relay U, this circuit remaining open until relay G operates its contacts g_6 as will be subsequently described.

The operation of relay Z is delayed by the choke W and condenser QA, but in due course it operates and at contacts x_1 opens the previously traced circuit for relay Y which releases and at contacts y_1 opens the circuit for relay Z.

On the release of contacts y_2 the previously traced short circuit across coil I of relay B is removed, and relay B operates over this coil from the negative battery on contacts x_3 , over contacts a_1 and in series with coil I of relay A.

Contacts b_2 remove the operating positive battery from wire 1 of relay A and leave the continued operation of this relay dependent on its contacts a_2 . Contacts b_4 will be subsequently referred to. Contacts b_3 prepare a circuit for relays C and D. Contacts b_1 disconnect the original operating circuit for relay A and prepare for its release.

If the first mark persists after the relays A and B have operated relay X remains operated, and therefore when relay Z releases the circuit for relay Y is again closed over contacts x_2 and x_1 as previously described. Relay Y closes the circuit for relay Z over contacts y_1 .

When relay Y again operates a negative battery is connected over contacts x_3 , y_2 , b_1 coil II of relay A, contacts a_2 to positive battery. Relay B locks in parallel with coil II of relay A. The coil II of relay A is connected differentially to coil I and the energization of the former coil causes the relay to release. Relay A therefore releases and in doing so closes the following circuit positive battery contacts d_2 , coil I of relay C, contacts d_1 , b_3 , a_1 and x_3 to negative battery. Relay C therefore operates and at contacts c_3 prepares the op-

erating circuit for relay D over its coil I. Relay D cannot operate owing to the short circuit across its coil I over contacts d_1 , b_3 , a_1 and c_1 . The relay C locks over its coil I and coil I of relay D, contacts c_1 and x_3 to negative battery.

When relay Y releases upon relay Z operating the negative battery holding relay B from contacts x_3 is disconnected at contacts y_2 and relay B releases. The relay B in releasing opens the previously traced short circuit across coil I of relay D and this relay operates from negative battery, contacts x_3 , contacts c_1 , coils I of relay D and C, contacts c_2 to positive battery, and locks over this circuit.

If the mark still persists on the next operation of relay Y relay A is again operated followed by relay B, when relay Y releases, in the manner previously described. When relay A releases on the next operation of relay Y relay C is released by the energization of its coil II over the following circuit, negative battery contacts x_3 , a_1 , b_3 , d_1 , coil II of relay C, contacts c_2 to positive battery. Relay C releases whilst relay B is held from negative battery over contacts x_3 , y_2 , b_1 coil II of relay B, to positive battery, and relay D from negative battery over contacts x_3 , a_1 , b_3 , d_1 , coil II of relay D, to positive battery. When relay Y releases on the operation of relay Z the holding circuit for relay B is opened at contacts y_2 and relay B releases opening at contacts b_3 the holding circuit for relay D.

Before relay D releases however the following circuit for relay E is completed from negative battery contacts x_3 , c_1 , d_3 , f_1 , coil I of relay E, contacts f_2 , to positive battery. Relay E operates and locks over its contacts e_2 , coil I of relay E, coil I of relay F, contacts e_1 , and x_3 . Relay F cannot operate over its coil I as this coil is short circuited at this time over contacts e_1 , c_1 , d_3 , and f_1 . However when relay D falls back as previously described the short circuit is removed from coil I of relay F at contacts d_3 , and relay F operates and locks in series with coil I of relay E to the contacts x_3 as will now be understood.

When relay Y again operates relay A operates as previously described and on the release of relay Y relay B operates. On the next operation of relay Y relay A releases followed by the operation of relay C, relay B releasing on the release of relay Y allowing the operation of relay D. When relay Y again operates relay A operates followed by relay B on the release of relay Y. When relay Y releases relay A releases and causes the release of relay C. Relay C in releasing closes the following circuit for coil II of relay E, negative battery contacts x_3 , c_1 , d_3 , f_1 , coil II of relay E, contacts e_2 to positive. Relay E therefore releases and closes a circuit for coil II of relay G from positive battery, coil II of relay G, contacts g_3 , f_3 , e_1 , x_3 to negative battery. Relay G operates and locks over its coil I and contacts g_1 to the negative battery on contacts x_3 .

When relay Y releases, relay B releases followed by relays D and F the circuit of the latter relay being opened at contacts d_3 .

Reference to the accompanying Fig. 6 clearly shows the times at which the relays A to G are operated and unoperated when and after a mark has started. It will be seen that relay G is operated after seven cycles of the Z—Y relay combination, and if each cycle occupies one half second, three and one half seconds elapse before relay G operates as clearly shown.

The indications first, second and so on at the top of the chart indicate the ends of half seconds

elapsing from the commencement of cyclical operation of relay Y. It will be seen that the first release of relay B takes place the second time that relay Y releases as pointed out in connection with Fig. 4; also that relay C of a pair C and D is first operated when relay A is released whilst relay B is operated.

When $3\frac{1}{2}$ seconds have elapsed from the setting into operation of relay Y, that is to say, the lower limit of duration of a permissible mark has been received, relay Y has completed its seventh cycle. Relays B, D and F are operated and relays A, C and E are on the point of releasing.

When relay E releases which occurs on the next operation of relay Y, a circuit is made for relay G over back contacts $e1$ and front contacts $f3$. Relay G locks up over contacts $g1$.

Relay G on operating at contacts $g3$ closes an obvious circuit for relay M, whereas at contacts $g2$ a circuit is closed for coil I of relay H from positive battery, contacts $f2$, coil I of relay H, contacts $f1$, $g2$, $r1$, to negative battery. Relay H locks over its contacts $h2$ and relay J is prepared to operate over its coil I and contacts $h1$ as will now be understood.

Assume that the mark signal ceases before the maximum duration allowable, which is $4\frac{1}{2}$ seconds, is exceeded. It should be noted that just before 4 seconds have elapsed, the relays A to F are all at normal, as shown by Fig. 6 and the set starts once more into cyclical operation at the commencement of the fifth second.

Relay G operates when $3\frac{1}{2}$ seconds have elapsed and this relay in combination with relay C which operates once more a second later in the manner heretofore described, determines whether the maximum of the permissible mark has been exceeded. The mark signal having ceased as mentioned the grid of the tube V^4 assumes positive potential and relay S re-operates with the result that relay SA releases due to the opening of contacts $s1$. Since contact $m2$ is closed a circuit is made for coil II of relay X from positive battery, resistance YD, contacts $l1$, $sa1$, $m2$, coil II of relay X to negative battery. The coils I and II of relay X are differentially wound and on the closure of the circuit for coil II, the flux in the relay tends to reverse. The relay armature is repelled to normal and coil II is then short circuited by the negative battery on one side and a negative battery on the other side over contacts $x2$ and such of contacts $a3$, $b4$, $c4$, $e4$ and $g5$, as may be operated, contacts $l1$, $sa1$ and $m2$. At contacts $x2$ the circuit of Y is opened, also at $x1$ the condenser QA is disconnected from across the coil of relay Z and resistance YA and connected to the resistance YC through which resistance the condenser discharges. Contacts $x3$ open whereby any of the relays A—F at the time operated and relay G are released. On complete release the short circuit of coil II of X is removed, so that relay X re-operates from positive battery, resistance YD, contacts $l1$, $sa1$, $m2$, coil II of relay X, contacts $r2$ to negative battery. Although contacts $g3$ are now open, relay M is held operated over contacts $sa2$, $h4$ and $m1$, since relay H remains operated in series with coil I of relay J when contacts $g2$ open. When contacts $g2$ restore the short circuit across coil I of relay J is removed and relay J operates in series with coil I of relay H. Operation of X starts the timing device (relays Y and Z) into operation for the purpose of timing the space that is taking place.

The space between marks should not exceed $1\frac{1}{2}$ seconds, that is to say, the cycle recording relays

A—F which are set again into operation by closure of contacts $x3$ and $g2$ should not register the elapse of $1\frac{1}{2}$ seconds by the operation of relay E, before relay X is again released.

The space being assumed to be of permissible duration the cycle recording terminates due to the release of relay S on a fresh marking signal being received. This takes place by reason of relay SA then being operated. Contacts $sa1$ change over and connects in coil I of relay X, in place of coil II. The flux in the relay commences to fall and the relay is repelled to normal by the energization of its coil I, the re-operation of the relay being prevented by means of coil I being short circuited over the restored contacts $x2$ and contacts $a3$, $b4$, $c4$, $e4$ and $g5$ as may be operated as before described. By the opening of contacts $sa2$ relay M is released. The timing device, relays Y and Z, is thrown out of action by the opening of contacts $x1$ and $x2$.

When the operated relays in the cycle recorder have all been restored to normal by the opening of contacts $x3$ the short circuit across coil I of relay X (via contact $x2$) is removed and the relay re-operates, the timing device and the cycle recorder thereupon being set into operation to time the second mark. In the sequence recording device at this stage, relays H and J are operated in the circuit positive battery, contacts $h2$, coil I of H, coil I of J, contacts $h1$ and $r1$ to negative battery.

The operation of the cycle recorder are as described in connection with the first received mark up to the time that relay G operates and locks, which takes place after the elapse of $3\frac{1}{2}$ seconds. When relay G operates contact $g2$ closes and a circuit is made for coil II of relay H from positive over contacts $h2$, coil II of H, contacts $f1$, $g2$, $r1$ to negative. Coil II of H exercises an opposing action to that of coil I with the result that the relay releases and relay J is held in the circuit positive coil II of J, contacts $f1$, $g2$, $r1$ negative, although contacts $h2$ and $h1$ open. On the release of relay H relay K is operated over contacts $f3$, $h3$ and $r1$ and locks up to contacts $r1$ over contacts $k1$. Relay M is operated over contacts $g3$ as before.

The second mark ceases before $4\frac{1}{2}$ seconds have elapsed: relay S re-operates and relay SA then releases. Relay X is repelled to normal by the change over of contact $sa1$ to normal. Any relays of set A—G operated, are released by contacts $x3$ opening. On the release of relay G contacts $g2$ open, relay J is thereby released as the circuit of its holding coil II is cut.

Complete restoration of the cycle recording relays A—G allows relay X to re-operate over contacts $r2$, $m2$, $sa1$ and $l1$. Relay M is held over contacts $sa2$, $k2$ and $m1$.

The second space is then timed by the Y, Z combination and is assumed again to be less than $1\frac{1}{2}$ seconds. The third mark is also timed in the same way as the first and after $3\frac{1}{2}$ seconds, relay G operates with the result that relay H is operated as in the case of the first mark. The mark ceases before $4\frac{1}{2}$ seconds elapse whereupon relay S re-operates, relays SA and X release. Relay G as well as other relays of set A—F then operated, release. By the release of relay G, relay J, the circuit of which was prepared by the closure of contacts $h1$, operates as the short circuiting contacts $g2$ are now opened.

As contacts $k1$ are closed a circuit is made for relay L from positive over the coil of L operated contacts $h3$, $f3$ and $k1$. Relay L operates and

closes a circuit for an alarm bell AB at contacts 12. By contact 11 opening, any further operation of relay X is prevented. Contacts 13 change over and close a circuit for a starting magnet SM of a morse signal recorder and remove a short circuit from the marking magnet MM of the recorder. The recorder is provided in case after the alarm signal is given, a signal indicating the position of the calling ship is transmitted. Contact s1 in this case controls the marking of received dashes and dots.

Relay L when once operated remains operated until relay R is caused to operate. This may be done by means of the reset key RK. The operation of the key causes relay R to operate. The other relays at the time operated, are H, J, K, L and M: relays in the set A—G having been released by the opening of contact x3. On the operation of relay R relays H, J, K and L release due to the opening of contacts r1. Contacts r2 disconnect coil II of relay X and relay M is released when contacts h4 and k2 open. The release of L stops the recording action as contacts 13 change over. When key RK is restored, relay R releases and the whole apparatus is in a normal condition and ready for further use.

The operations taking place in the selecting apparatus if the marks or spaces are not of permissible value will now be described.

If the apparatus is at normal and a mark comes in, relay S releases, relay SA operates, thereby operating relay X. Relay X starts up the timing device (relays Y and Z). At contacts x3 a circuit is prepared for the relays A—G.

On the termination of the mark, relay X is released and by opening of contacts x3 any relays of the set A—G already operated, are released. Relay G only operates on the elapse of $3\frac{1}{2}$ seconds and operates relay H to signify that a mark which exceeds $3\frac{1}{2}$ seconds has been received. A mark of duration of less than $3\frac{1}{2}$ seconds is not recorded. Neither is relay M operated over contacts g3 and relay M causes the timing of the subsequent space. The result is that if a mark endures less than $3\frac{1}{2}$ seconds, the apparatus is restored at once to normal. Ordinary morse traffic would be dealt with in this manner.

If a jamming signal is received, that is to say, the received mark endures more than $4\frac{1}{2}$ seconds, the operation of the cycle recording device will have proceeded so far that relays G and C are both operated, which can be seen from inspection of Figs. 6, in the case when relay Y operates for the tenth time. A circuit is then made for relay R over contacts c3 and g4. The relay operates and locks itself at contacts r2 dependent on contacts g4. By contacts r1 operating, any of the relays H, J and K of the sequence switch recorder already operated are released.

Relay S remains operated whilst the jamming signal persists so that relays SA, X and G remain operated. Relays Y and Z continue to beat, exercising control on the cycle recorder, relays A—F.

If the jamming signal endures more than $7\frac{1}{2}$ seconds then on the expiration of $7\frac{1}{2}$ seconds, relay E is repelled to normal and a circuit is made over contacts x3, e1, f3, (relay F is operated) contacts r3 left hand normal contacts of key RK, buzzer BZ to battery. The circuit remains closed until relay F is released which takes place about a quarter of a second later. The buzzer BZ thus functions momentarily. Relay E is released and relay F is operated again when a further four seconds have elapsed and the

buzzer is again operated if the signal still persists.

On the signal ceasing, S re-operates and thereby relays SA, X, G, M and any operated relays of the set A—F are released as will now be understood without further detailed description. The opening of contacts g4 open the circuit of relay R. Relay R is provided with a copper sleeve to delay release until all other relays are at normal. If a correct mark or marks has or have been received and a subsequent intervening space is too long, the following occurs. Relay M is operated each time a permissible mark is received by contacts g3 and is held during the following space period over back contacts sa2, h4 or k2, m1, whilst the space persists. The space is timed by the operation of relays Y, Z, and the cycle recorder relays A—F. On the elapse of $1\frac{1}{2}$ seconds relay E operates for the first time signifying that the maximum allowable space has been exceeded. Relay E closes its contacts e3 and as relay SA is at the time released, a circuit is made for relay R over contacts sa2, h4 or k2, m1 and e3.

Relay R operates, releasing at contacts r1 the operated relays of the sequence recorder. At contacts r2 the circuit of relay X is opened so that the relays of the cycle recorder are released at contacts x3. Relay M releases on the opening of contacts h4 or k2 as the case may be as also does relay R when relay G releases. Relay R releases slowly to allow complete return to normal of the other relays.

If a second received mark or a third mark is too short, that is to say, does not endure for $3\frac{1}{2}$ seconds, and assuming that the previous mark or marks were of permissible duration and relays H and J or J and K were operated as previously described, relays G and M are not operated by the time the mark ceases so that on the release of relay SA, a circuit is made for relay R from negative battery over contacts sa2 and h4, or k2 and m1 coil of relay R to positive battery and relay R operates causing the immediate restoration of the apparatus to normal as previously described.

The apparatus if required may be adapted for transmitting an alarm signal. For this purpose the key AK, relay U and magnet (or relay) TM shown on the right of the drawing, are provided. The key AK is a two-position key and when thrown upwardly, three mark signals are sent with the permissible intervening spaces and then sending ceases. Thrown downwardly permissible marks and spaces are sent until the key is released. The transmitting magnet or relay TM is arranged to operate on wireless transmitting apparatus in such a way that a mark signal is sent when the magnet (or relay) is operated.

If key AK is thrown, whether upwardly or downwardly a circuit is closed from negative battery over the key contacts, coil of relay U, contacts r4, 14, relay SA to positive. The two relays are operated and at contact u1 the circuit of magnet TM is closed for the sending of a mark signal. Relay SA on operation causes the operation of relay X as in mark reception and the timing and cycle recording devices are set into operation. After $3\frac{1}{2}$ seconds relay G operates but relay A has released just previously. After a further half second has elapsed relay A re-operates and relay U is now short-circuited over contacts a5 and g6. The sending of the mark signal ceases. Relay SA being still operated the timing device and cycle recorder continue in operation.

When $4\frac{1}{2}$ seconds from the start have elapsed,

relay R (as in signal reception) is operated over contacts c3 and g4. At contacts r4 the circuit of relay SA is opened.

It will be assumed that key AK has been thrown upwardly. The release of relay SA results in release of relay X and the relay does not immediately re-operate as contacts r2 are operated. The operated relays of set A—G are released by the opening of contacts x3 but relay H which operated previously by reason of the operation of G remains held, despite the opening of contacts r1, since there is a holding circuit over the contacts of key AK. Relay J operates on the opening of contacts g2. Relay R itself is released when relays C and G have fallen back and on reclosure of contacts r4 relays SA and U are re-operated. The position at the moment is that a 4-second mark has been transmitted and a space of $\frac{1}{2}$ second has followed.

The operation described is repeated, a like mark and space being sent and a further mark of 4 seconds duration is sent. On the conclusion of such sending the condition is arrived at as in the reception of an alarm signal, that is to say, relay L is operated and by the opening of contacts l4 relays SA and U are cut out of circuit. The restoration of key AK results in the restoration of all parts to normal. If the key AK is thrown downwardly, then there is no holding circuit for the relays H—K when relay R operates so that both the cycle recorder and sequence recorder are restored to normal and operations re-commence again and again until the key AK is restored.

Fig. 7 shows selecting apparatus which through being slightly more complicated than that of Fig. 5 (which is illustrative of the main features of the invention) provides better safeguards against interference by signals which may occur whilst an alarm signal is being received. It also provides a tolerance beyond the prescribed duration of marks in that a mark is accepted provided it exceeds about 3.3 seconds and does not exceed 5 seconds. This tolerance is obtained by reversing the function of the control contact y2 of the cycle recorder as will be seen later.

Certain major differences between the arrangements of Figs. 5 and 7 may be noted here. Relay SA in Fig. 5 was operated by closure of contacts of relay S when the latter released. In Fig. 7 relay SA is released when relay S releases by reason of a short circuit imposed by relay S. By reason of the short circuit, relay SA is made slow to release without affecting its quickness to operate. Relay SA accordingly is less likely to release fully when a short mark or dot is received and start the timing device unnecessarily.

The timing of the spaces in Fig. 7 is carried out by an independent unit comprising the relays M, N, O and P, when it is started into operation on the cessation of a permissible mark. These relays when started execute a cycle of operation in a period of $1\frac{1}{2}$ seconds or preferably about 1.7 seconds to give a slight tolerance.

Relays V¹, V², V³ and V⁴, are filament supply relays individual to the four valves of a receiver diagrammatically indicated at RR. Release of a relay due to failure of a filament or cessation of supply, results in the closure of one of the corresponding contacts v¹₁, v²₁, v³₁, v⁴₁, whereby the alarm relay L is operated.

The relay X of Fig. 5 does not appear in Fig. 7 as the space timing is not done with the assistance of the cycle recorder.

Relay S is in the anode circuit of the last valve

V⁴ and normally operated. It releases on the receipt of a marking signal and re-operates when this ceases. Contact s1 is therefore normally open and relay SA is consequently operated in a circuit over its coil I, contacts w1, and guard resistance YC. Its contacts sa1 maintain the condenser QA disconnected from across relay Z and connected in a discharge path over resistance YB. It will be seen by inspection of Figs. 5 and 7 that the timing device used in Fig. 7 is the same, but the choke is designated ZC in place of W.

When a marking signal arrives relay S releases, and places over its contacts s1, and contacts l3, a short circuit across relay SA. Relay SA releases slowly and on release condenser QA is connected across relay Z and resistance YA over contacts sa1. Contacts sa2 in the released position close a circuit for relay Y, which circuit includes contacts z1. Relay Y operates and at contacts y1 closes a circuit for relay Z from positive battery HT, resistance YA, coil of relay Z, the condenser QA being in parallel with this circuit over contacts sa1, choke ZC to negative battery HT. At contacts y2 a circuit is closed for relay A from positive contacts b2, coil I of relay A, contacts b1, y2, e5, sa2 to negative. Interaction of relays Y and Z takes place. The period of the cycle of interaction is assumed to have been adjusted to be one half second. Fig. 8 shows by a chart the time at which relays are operated and released and the chart is of similar character to that shown in Fig. 6. The circuit arrangements of the set of relays A to F is the same as in Fig. 5 with the exception that the control circuit which includes contacts y2 also includes contacts e5 of relay E and therefore the general operation of the circuit will be fully understood without further detailed description, only a general recital being made.

On the first closure of contacts y2 relay A operates and relay B operates on the subsequent opening of contacts y2 in the manner similar to that previously described in connection with Fig. 5. Relay A is released on the second operation of relay Y, and relay C is consequently operated; relay D is operated on the second release of relay Y. On the fourth operation of relay Y relay A is released; the closure of back contacts a1 result in the release of relay C and on back contacts c1 closing, relay E is operated.

Contacts e5 which are in the circuit controlled by contacts y2 are changed over thus resulting in the opening of the previously described circuit for relay A. The immediate result of this, is that circuit changes that would otherwise take place when relay Y next released, take place immediately. Consequently relays B and D are released and relay F is operated. A further effect of the change over of contacts e5 is that events that before took place on the operation of relay Y, take place on the release as the moving contact of contacts e5 is disconnected from its back contact and the front contact of contacts y2, and is connected to its front contact and thus to the back contact of contacts y2. Reference to Fig. 8 will make this clear, and in particular, relay A will now be operated on the fourth release of relay Y and not on the fifth operation. There is actually a shift of the operation periods of the relays A and B by an amount equal to the release period of relay Y.

This relay A operates on the fourth release of relay Y and relay B operates on the fifth operation of that relay. On the fifth release of relay Y relay A releases and relay C operates

and on the sixth operation of relay Y relay B releases and relay D operates. On the sixth release of relay Y relay A re-operates followed by relay B on the seventh operation of relay Y. When relay Y releases for the seventh time relay A releases causing the release of relay C. Relay C on releasing causes the energization of coil II of relay E from positive contacts e2, coil II of relay E, contacts f1, d3, c1 and sa2 to negative. Relay E therefore releases and by the release of contacts e5 returning to normal the control exercised at the start by contacts y2 is restored. Furthermore the circuit made by released contacts y2 is now broken on the restoration of contacts e5 with the result that relays B, D and F release in turn. On the release of relay E before relay F releases a circuit was made for relay G over contacts sa2, e1, r3, f3 and coil I of G. Relay G operates and locks up over its contacts g1 and contacts sa2 before relay F is released, as before stated. Relay G at contacts g2 closes a circuit for relay H over its coil I in a circuit over contacts r1, w3, g2, f1, coil I of H, contacts j2. The circuit operations in the sequence recording relays H, J, K, is as described in connection with Fig. 5 and needs no further description.

Returning to the seventh release of relay Y, all the relays A to F become released as a result. Relay G having operated signifies that the received mark has endured sufficiently long. The next operation of relay Y results in the operation of relay A and the cycle recording or the interaction of relays Y and Z would proceed until relay Y operates for the tenth time, that is, five seconds from the start. However, as it is assumed that a permissible mark is being received, the interaction of relays Y and Z is stopped before five seconds have elapsed by the re-operation of relay S and re-operation of relay SA consequent on the opening of contacts s1.

When relay G operated, a circuit was prepared for relay M by the change over of contact g4 and the circuit was completed on the operation of contacts h5. The circuit is from positive battery, over guard resistance YF, contacts m2 and g4 in parallel, coil of relay M, contacts h5 to negative. Relay M operates and opens contacts m2 but relay N is still short-circuited over contacts g4.

When the mark signal being received, terminates, relay G is released by the opening of its locking circuit at contacts sa2.

Contacts g4 fall back, but as contacts m1 are open relay M is not short circuited. Relay M at contacts m2 removes the short circuit across relay N which then operates in series with M. Relay N operating, makes a circuit for relay O including guard resistance YG by opening contacts n1 and on relay O operating, relay P is brought into circuit by the opening of contacts o1. Relay P operating short circuits relay M at contacts p1 and the relay releases after a short interval. It is then further short-circuited over contacts g4 and m1 on the restoration of the latter. The release of M results in relay N being short-circuited at contacts m2 and in like fashion relays O and P are caused to release. From the time contacts g4 fall back, until the time relay P, after operation has been released, a period of just over 1½ seconds intervenes.

It may be noted that an exceptionally long release lag of relays M, N, O, P, is obtained by the combined effect of a short circuit and the fact that the relays have a sleeve or a copper slug.

It is assumed that the space after the mark

previously received, lasts less than 1½ seconds and the effect of a complete cycle of relays M—P will be described later. The succeeding mark causes the same operation as for the first mark and when relay G re-operates relay H is released leaving relay J held over its coil II and contacts f1, g2, w3 and r1. Relay K is then operated in a circuit over contacts h3, f3, w3 and r1 and locks up in a circuit over its contacts k1 to the said contacts w3 and r1. The release of relay G on the termination of the second mark starts relays M—P into cyclical operation and causes release of relay J by the opening of contacts g2.

A third permissible mark causes again the operations described for the first mark and on relay G operating relay H is re-operated. On the mark ceasing, relay J operates when contact g2 opens due to release of relay G. A circuit is now made for alarm relay L from positive battery over the coil of L, contacts h3, f3, k1, w3, r1 to negative. Relay L operates and closes at contacts l2 a circuit for the alarm bell AB. Contacts l3 open to prevent response of relay SA to further signals. Contacts l1 open to prevent restoration due to the space being too long. Contacts l2 also close a circuit for the start magnet SM of a recorder, if such be fitted, and contacts l3 connect in the marking magnet MM so as to place this under control of contacts s1 of relay S to receive any further signals.

To re-set the apparatus, the re-set key RK is pressed whereby relay Q is operated over an obvious circuit. The closure of contacts g1 causes operation of relay R over its coils I and II. Relay R at contacts r1 opens the circuit of relays H, J, K and L and they release. The relays A—G were released when the terminating space occurred by reason of the re-operation of relay SA. On the key RK being restored relays Q and R release in turn and the apparatus is at normal and ready for further use.

It may be noted here that when relay SA is operated at the end of a mark it is kept operated over its coil II until all the contacts a3, b4, e4, e4, and g5 are at normal, thus ensuring that the set of relays A—G are positively released at contacts sa2.

Consideration will now be given to the operations in the apparatus if a non-permissible mark or space is received.

If a first mark is too short, relays S and SA re-operate before relay G operates. No record of the mark is therefore made in the sequence recorder-relays H—K and relays Y and Z are set out of action and any relays in the set A—F released when relay SA re-operates.

If a mark signal exceeds 4½ seconds plus the tolerance i. e. 5 seconds in total, relay Y operates for the eleventh time and for the first time relays E and G are both in the operated condition.

A circuit is therefore made over contacts g3, e3 and coils I and II of relay R. The relay operates and contacts r2 and r4 close a circuit for holding the relay dependent on contacts g3 alone. At contacts r1 relay H is released.

Relay S and therefore SA remain released whilst the jamming signal persists and relay G remains operated and furthermore relays Y and Z interact so long as the signal persists.

On the expiration of about seven seconds relay A is operated and relay E being at the time released, a circuit is made over contacts sa2, e1, r3, g2, a4 for buzzer BZ and if desired other buzzers situated elsewhere, the connections thereto being indicated at BZE.

Relay A releases, half a second later opening the buzzer circuit and after a further half second has elapsed, relay A re-operates and the buzzer BZ again operates and for a period of half a second. When relay E operates again, the buzzer circuit is opened at contacts e1. The buzzer gives two short signals during release periods of relay E so long as the signal persists. On cessation of the signal, relay SA re-operates and all relays operated in set A—G are released and relay R releases on the opening of contacts g3.

If an intervening space is too long the following occurs. Relays M, N, O and P are set into action when the space starts and operate once and release in succession. As a mark has already been recorded, either relay H or relay K is operated. The space being too long, relay SA will not have released by the time a cycle of the relays M, N, O, P has been completed. A circuit is therefore made for relay R from negative battery over operated contacts sa3, contacts l1, m3, p2, h4 and/or k2, coils I and II of relay R to positive. Contact r1 releases the sequence recorder when R operates. The relays A—G were previously released. Contact r4 closes to delay release of Relay R when contacts h4 and k2 open to ensure complete release of relays H and K.

It may be noted that contact m3 prevents operation of R when relay SA operates at the termination of a permissible mark.

As aforementioned when an actual alarm signal is received relay SA releases when the mark subsequent to a correct space is received so that the circuit of R cannot be made at contacts sa3. At this time relay R will be operated and the circuit for R will be prepared over contacts sa3, l1, p2, k2 and coils I and II of relay R. Therefore if a mark terminates prematurely, that is, relay G does not operate and allows the operation of relay M indicating that the minimum permissible period for a mark has expired, relay SA will fall back and complete the above traced circuit for relay R at contacts sa3. Relay R will cause the release of the cycle recording device as previously described.

To transmit an alarm signal, the switch TS is closed to energize relay W. Relay W operates and at contacts w1 removes relay SA from control by relay S. Contacts w2 remove relay L from the control of the filament supply relays v¹ etc. The selecting apparatus is thus disassociated from the signal receiver and not subject to interference from the receiver.

Contacts w3 prevent the sequence recording relays operating. At contacts w4 and over the contacts g6 and c3 in parallel the relay TC which controls the transmission of marks by wireless sending apparatus is energized and a mark signal is sent out.

By the release of relay SA at contacts w1, the interaction of relays Y and Z is started as also cycle recording, just as if a mark were being received. On the ninth operation of relay Y (four seconds having elapsed) contact y2 closes and relay C is operated. Relay G is already operated by this time so that the circuit of relay TC is interrupted by both contacts g6 and c3 being opened. A space in the signal sending therefore ensues. On relay Y operating for the eleventh time, relay C releases and brings about operation of relay E. A circuit is now made over contacts g3 and e3 for relay R. The release of relay C results in re-closure of the circuit of the transmitting control relay TC, and relay R on operation at contacts r5 makes a circuit for relay SA

over its coil I and contacts w1. The operation of relay SA causes release of relays Y, Z and any relays operated in set A—G. On the release of relay G, the circuit of relay R is opened at contacts g3. Relay R releases and releases SA at contacts r5 so that the operation described is repeated. The sequence of four second marks and one second spaces continue until switch TS is restored.

In connection with signal reception it may be mentioned that although relay L is operated when a filament in the receiver fails and gives the bell alarm signal, yet it can be established that the signal is not due to an actual alarm signal having been received since on then pressing re-set key RK, the relay L will not be released as in the case of an actual alarm signal, as in the latter case the operation of key AK causes relay Q to operate and operate relay R which at contacts r1 disconnects the holding circuit for the relays H, J and K which relays at their contacts h3, j3, and k3 control the circuit of relay L as previously described.

Fig. 9 shows a further selecting apparatus. Compared with the apparatus of Fig. 7, the general working method is the same and as previously fully described with one difference that relay SA is not short-circuited on release of relay S but is caused to operate on the release of relay S over contacts s1, l3, and resistance YC. In that respect the arrangement is similar to Fig. 5. The purpose of short-circuiting relay SA in Fig. 7 to cause release was to render the working of the apparatus less liable to interference by short marks such as morse signals and to prevent unnecessary starting up of the timing and cycle recording devices. The relay SA is normally energized and its current consumption may be objected to.

In Fig. 9 the same object is achieved by arranging that relay Z is the first to operate on the reception of a mark. It will be remembered that relay Z does not operate until the condenser shunting it has charged up to the operating voltage of Z. In the case of a short mark, contacts sa1 may restore before relay Z operates.

Corresponding contact alterations have been made namely relay Y is now controlled by a make contact of relay Z and relay Z by a break contact of relay Y. When a mark is received relay S releases as before described and the following circuit for relay SA is closed, positive contacts s1, l3, coil of relay SA, resistance YC to negative, and at contacts sa1 performs the following circuit operations (a) disconnects the resistance YB from across the condenser QR (b) connects the condenser QR across relay Z and resistance YA, (c) closes the following circuit for relay Z from positive battery HT, resistance YA, coil of relay Z, contacts sa1, y1, choke ZC, to negative battery HT. At contacts sa2 the negative battery for holding the relays A—F is connected up, and at contacts sa3 the negative battery for the operation of relay R when an intervening space is too long is disconnected as before described in connection with Fig. 7. Contacts sa4 open a possible short circuit across relay SA prepared to be applied when any one of the relays A, B, C, E or G, operate their respective contacts a3, b4, c4, e4, g5, which circuit arrangement is provided so that when relay SA falls at the end of a permissible mark it is short circuited over any operated one of the said contacts and the contacts sa1.

It will also be noted that in contrast with Fig. 7

there are no contacts of relay E in series with contacts y2.

The originating circuit for relay G is now controlled by contacts a5, c3 and f3 the operation of this relay being substantially the same as the relay G in Fig. 7. In the holding circuit for relay G is an additional relay GA which when relay F operates is short-circuited by contacts f4. When relay F is subsequently released relay GA operates and contacts ga1 opening prevent release when relay F again operates.

The circuit for operating relay R if a mark exceeds the prescribed duration includes contacts ga2 and c5.

It is thought that a full description of the working is unnecessary in view of the similarity of the previously described example. As in the Fig. 7 arrangement, relay G controls the relays H, J, K to record permissible marks. Relays M, N, O, P time intervening spaces and cause operation of relay R if a space is too long or if a permissible space has ensued and the following mark is too short.

The periods at which relays A—F operate are as shown by the chart of Fig. 6. Relay G of Fig. 9 operates when contacts a5, c3 and f3 are closed, which as the chart shows, is after the elapse of three seconds from the setting into operation of relay Y. Actually it is somewhat more than three seconds after the mark commences, the amount depending on the release lag of relay S and the operating lags of relays SA and Z, but is still less than $3\frac{1}{2}$ seconds. Relay GA operates the first time relay F releases after relay G has been operated, namely, on the eighth release of relay Y. Relay GA having operated, a circuit for relay R is made when relay C reoperates, which takes place on the tenth operation of relay Y, that is after the expiry of $4\frac{1}{2}$ seconds plus the lags referred to.

If it is desired to delay the time at which relay R operates, contacts of relay D or E or F may be used in place of the contacts c5.

The selecting apparatus has been herein described as particularly suitable for marine wireless alarm signals, but of course, is capable of dealing with any other signal having prescribed marks and spaces.

As regards the sending of a signal, this may be caused to take place automatically on the occurrence of certain events, for example, outbreak of fire.

The intermittent operation of the buzzer BZ when a jamming signal is received indicates to the operator that the selector is held by a jamming signal and therefore is held against the reception of a regular or a distress signal. To release the apparatus switch TS could be thrown temporary operating relay W over an obvious circuit. At contacts w1 a circuit is closed from positive coil I of relay SA, contacts w1 and r5 to negative. Relay SA would operate and at contacts sa2 release relay G, which is locked over its coil II and contacts g1, and also release any of the relays A—F in the cycle recorder that may be operated. The release of relay G would release relay R as the locking circuit for this relay over contacts g3, r2 and r4 would be broken at the former contact.

If the jamming signal still persists after the restoration of switch TS the whole cycle of operations would be repeated until the buzzer BZ again intermittently operated.

What I claim as my invention and desire to secure by Letters Patent is:

1. Selective apparatus adapted to respond to signals consisting of a sequence of marks and intervening spaces of prescribed duration comprising a signal receiving means, a timing device for periodically opening and closing a circuit and having an energizing circuit to control its operation, control contacts controlled by the signal receiving means operative to close the energizing circuit of said timing device during the reception of a mark, a cycle recording means for recording the number of cycles of operation of said timing device during the reception of a mark and controlled by the periodic circuit of the timing device, a sequence recording device operated each time when the cycle recording device has ascertained that the timing device has been in operation for a period corresponding to the minimum prescribed period for a mark, releasing means whereby the cycle recording device causes restoration of the sequence recording device to its unoperated condition if a mark endures beyond the prescribed amount, control means associated with the sequence recording device operative to close an alarm circuit when a prescribed succession of marks of allowable duration have been received, means for determining whether a space intervening between marks exceeds the allowable duration, a signal transmitting device, manually controlled means for disassociating the said signal receiving means from the timing device and operatively associating the signal transmitting device with the apparatus to transmit a signal, means for starting the timing device simultaneously with the transmitting device in the sending of a mark signal, means under the control of the cycle recording device for stopping the transmitting device after the cycle recording device is in an operative condition corresponding to the reception of a prescribed mark, and means for subsequently stopping the operation of the timing device and consequently the cycle recording device after the elapse of a period corresponding to a permissible space and causing restoration thereof to normal with subsequent re-starting.

2. Selective apparatus adapted to respond to signals consisting of a sequence of marks and intervening spaces of prescribed duration comprising a signal receiving means, a timing device for periodically opening and closing a circuit and having an energizing circuit to control its operation, control contacts controlled by the signal receiving means operative to close the energizing circuit of said timing device during the reception of a mark, a cycle recording means for recording the number of cycles of operation of said timing device during the reception of a mark and controlled by the periodic circuit of the timing device, a sequence recording device operated each time when the cycle recording device has ascertained that the timing device has been in operation for a period corresponding to the minimum prescribed period for a mark, releasing means whereby the cycle recording device causes restoration of the sequence recording device to its unoperated condition if a mark endures beyond the prescribed amount, control means associated with the sequence recording device operative to close an alarm circuit when a prescribed succession of marks of allowable duration have been received, means for determining whether a space intervening between marks exceeds the allowable duration, a signal transmitting device comprising a transmitting relay with apparatus to transmit a signal, a manually operated switch, a control relay controlled by said switch, contacts of said

control relay which when the relay is in an operated condition close a circuit for the transmitting relay and prevent the signal receiving means from controlling the timing device, said 5 contacts starting the timing device into operation, means in the cycle recording device situated in the circuit of the transmitting relay and operating to open said circuit on the expiration of a period corresponding to a prescribed permissible 10 mark, terminating means whereby the releasing means operating on signal reception upon a mark exceeding the allowable duration controls jointly with said control relay a circuit for terminating the operation of the timing device and cycle 15 recording device and restores same to the non-operating condition, the said terminating means ceasing to operate on said devices being restored.

3. Selective apparatus adapted to respond to signals consisting of a sequence of marks and 20 intervening spaces of prescribed duration comprising a signal receiving means, a timing device for periodically opening and closing a circuit and having an energizing circuit to control its operation, control contacts controlled by the signal 25 receiving means operative to close the energizing circuit of said timing device during the reception of a mark, a cycle recording means for recording the number of cycles of operation of said timing device during the reception of a mark and controlled by the periodic circuit of the timing de- 30 vice, a sequence recording device operated each time when the cycle recording device has ascertained that the timing device has been in operation for a period corresponding to the minimum prescribed period for a mark, releasing means 80 whereby the cycle recording device causes restoration of the sequence recording device to its unoperated condition if a mark endures beyond the prescribed amount, control means associated with the sequence recording device operative to close 85 an alarm circuit when a prescribed succession of marks of allowable duration have been received, means for determining whether a space intervening between marks exceeds the allowable duration, and means operative to give a periodic signal dur- 90 ing such time as elapses after the permissible prescribed duration of a mark has been reached.

4. Selective apparatus according to claim 3, wherein the means operative to give a periodic 95 signal comprises a relay, a circuit therefor controlled by contacts associated with the cycle recording device and operated when a mark has exceeded the permissible value, a locking circuit for said relay, such locking circuit being kept closed 100 so long as the mark continues, a signal circuit, contacts therein closed when said relay operates, and further contacts therein which under the control of the cycle recording device are periodically closed and opened whilst the mark continues. 105

HORACE EDGAR HUMPHRIES. 105

35 110

40 115

45 120

50 125

55 130

60 135

65 140

70 145

75 150