

June 15, 1937.

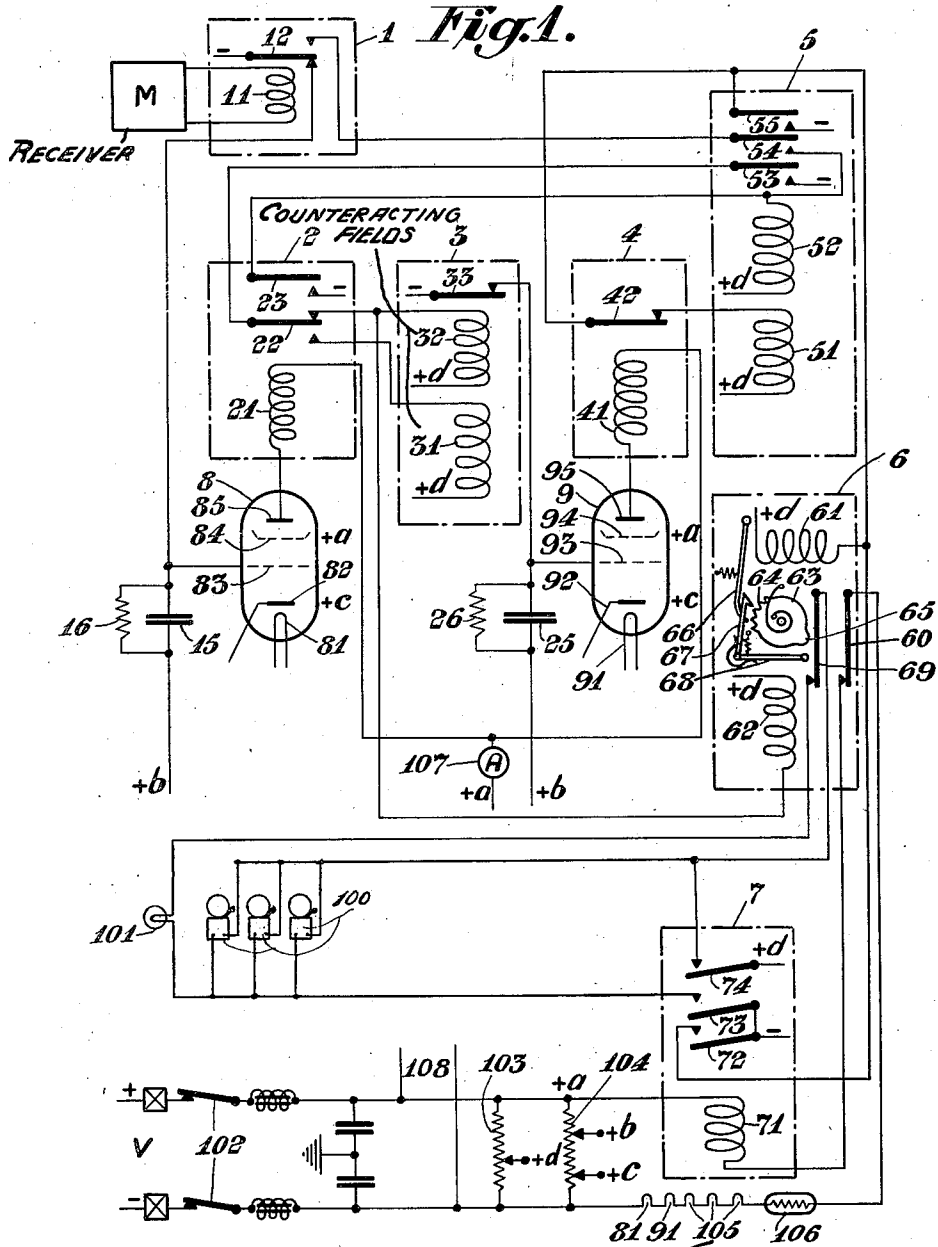
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2,083,849

ELECTRIC SELECTIVE SIGNAL RECEIVING APPARATUS

Filed Nov. 21, 1935

4 Sheets-Sheet 1



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Fig. 2.

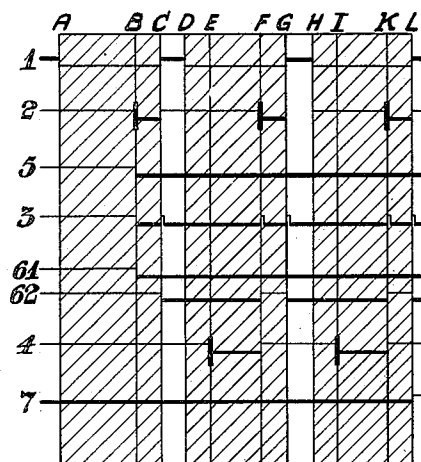


Fig. 3.

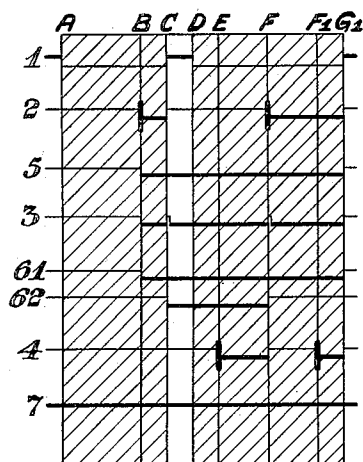
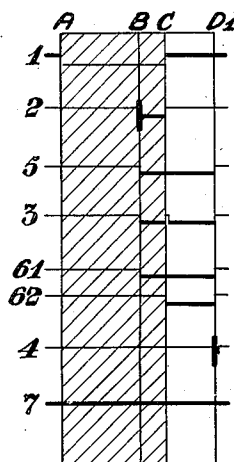


Fig. 4.



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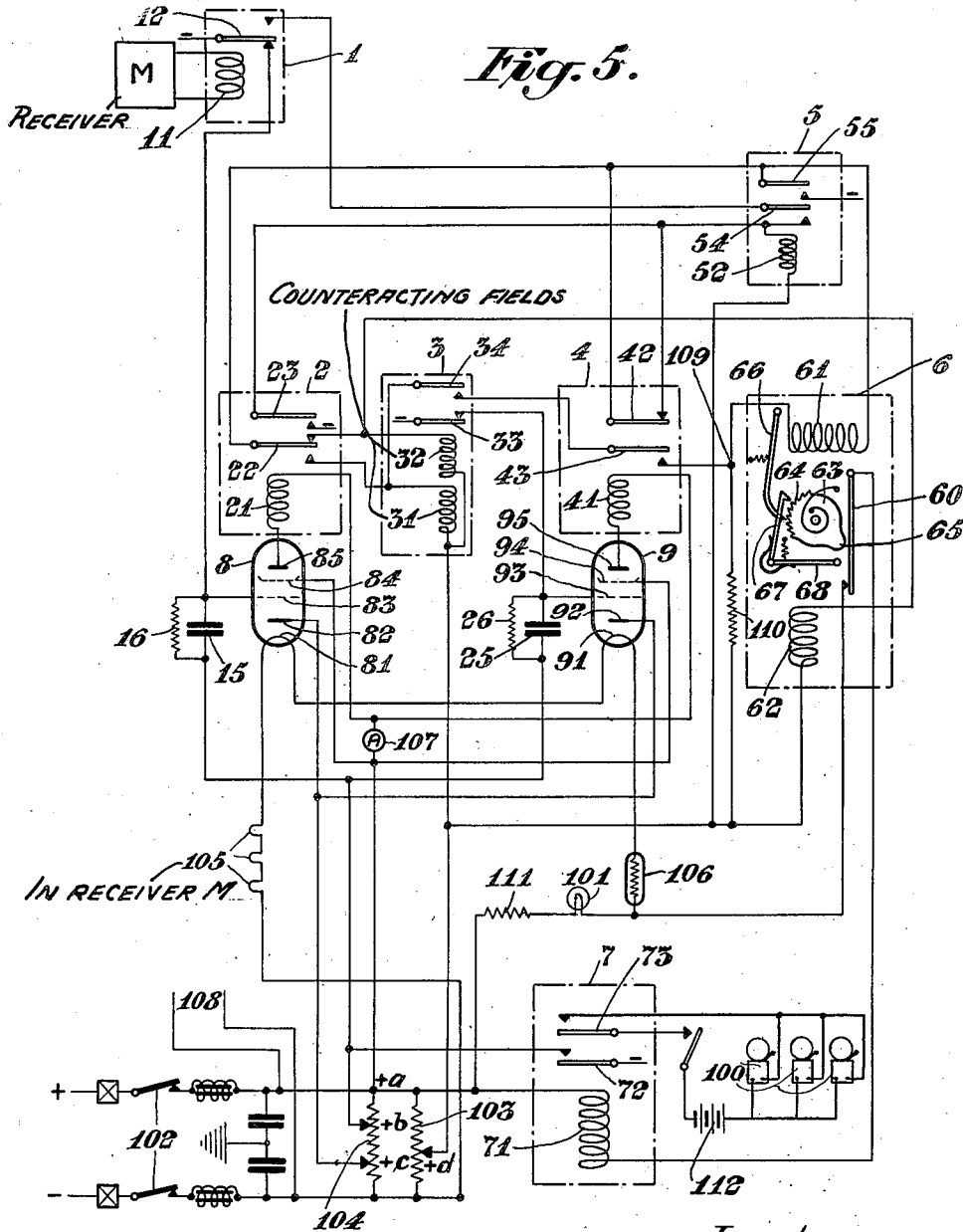
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4 Sheets-Sheet 3



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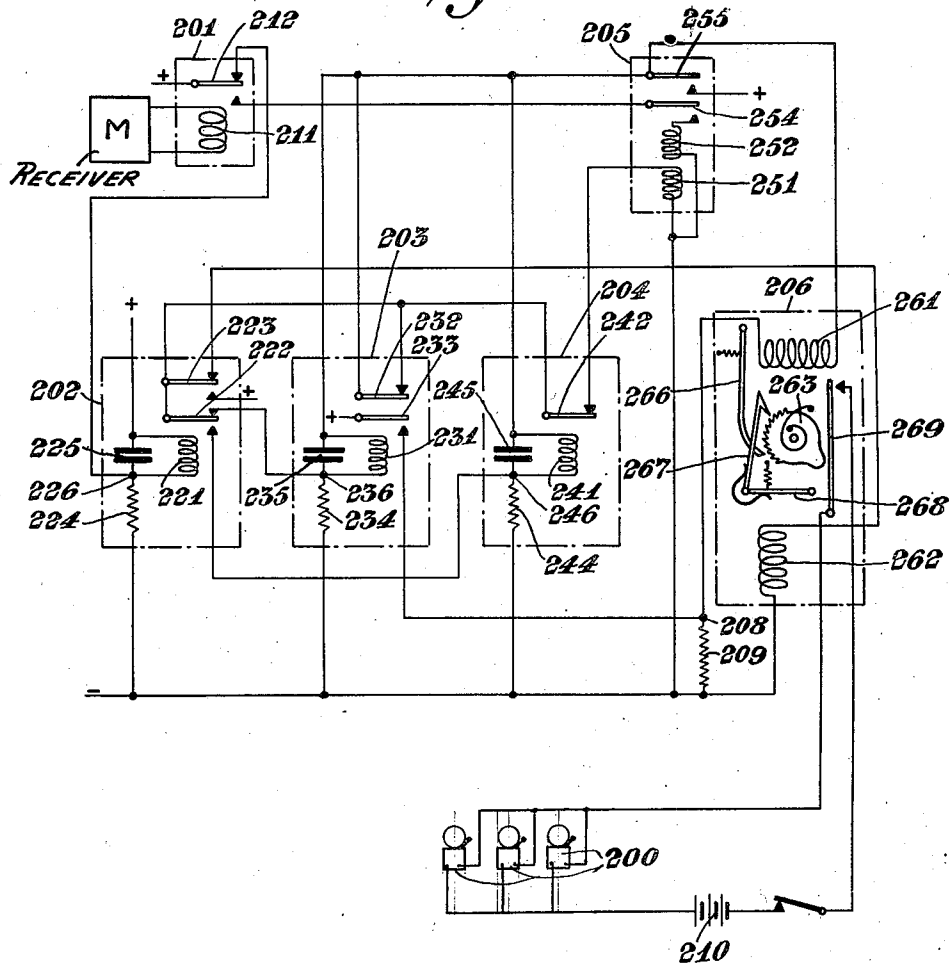
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Fig. 6.



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UNITED STATES PATENT OFFICE

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ELECTRIC SELECTIVE SIGNAL RECEIVING
APPARATUS

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3 Claims. (Cl. 177—353)

The present invention relates to an electric selective signal receiving apparatus which upon receiving a signal consisting of a certain predetermined number of partial signals or signal components of substantially equal duration, the length of which must lie between a certain minimum, and a certain maximum, and intervals, the length of which must not exceed a certain maximum duration, effects automatic indication, for instance actuation of an alarm bell or the like.

The invention is particularly concerned with an apparatus of this type which comprises a receiver having a receiving relay for receiving the signal components or dashes, and a counting device for counting the signal components and for effecting indication after counting a predetermined number of signal components, and a preparation and re-set device, such as a locking relay, for the counting device which relay is provided with a locking circuit so that after energization it will hold itself in energized or working position in which it maintains the counting device prepared for counting.

Between the signal receiving relay and the preparation and re-set device, or locking relay, there are connected a number of time measuring devices, each of which is adapted to actuate a contact means, such as a relay, associated with the same, after such time measuring device has been operating during a certain predetermined length of time.

One of said time measuring devices is a minimum time measuring device which serves to check that the signal components reach the predetermined minimum duration, this device being put in and out of operation by the signal receiving relay and serving, upon minimum duration of a dash being reached, through its contact means to cause the preparation and re-set device of the counting device to operate.

A time difference measuring device, which serves to check that the signal components do not exceed the predetermined maximum duration, and a space measuring device, which serves to control that the intervals or spaces between the signal components or dashes do not exceed the predetermined maximum duration, are adapted by means of their contact means to control the locking circuit of said preparation and re-set device in such manner that said locking circuit is opened, or is deenergized, when the contact means associated with either of said time measuring devices operates upon maximum duration of the dash, or upon maximum length of the space, being reached. The minimum time

measuring device through its contact means causes the time difference measuring device to start operation upon a dash reaching minimum duration, and stops operation of said device when the dash ceases, and then causes the space measuring device to operate, the contact means of which is actuated after the lapse of the maximum duration of the space and then remains in actuated position until the next dash has reached minimum duration.

In case the time difference allowed between minimum and maximum duration of the signal components is equal to the permissible maximum duration of the interval or space, the same time measuring device may serve to check the difference as well as the space, and in such case this combined time difference and space measuring device is connected to the minimum time measuring device in such manner that, when the dash terminates, the first named device is first put out of operation by the last-mentioned device, and then again caused to operate to measure the space.

It is the purpose of the present invention to provide a simplified signal receiving apparatus of this type which shall comprise the least possible number of parts, and in particular, to provide an apparatus in which, when signals, such as Morse-signals, are received which are of less duration than the permissible minimum duration of a signal component, only a single movable contact in the signal receiving relay operates, while the other parts and elements of the apparatus are left undisturbed.

With this purpose in view the present invention is broadly characterized by the signal receiving relay being provided with a single movable contact, and by the minimum time measuring device being connected to said signal receiving relay in such manner that said contact puts said device in operation at the commencement of a dash received and puts the same out of operation when the dash terminates, and that the preparation and re-set device is provided with a second locking circuit which is controlled by the said contact of the signal receiving relay in such manner that said locking circuit is closed while a dash is being received, and that an impulse circuit for the counting device is controlled by the contact means associated with the minimum time measuring device in such manner that said circuit is closed by said contact means when the minimum time measuring device is put out of operation owing to the dash terminating.

According to the invention the contact means

associated with the time measuring devices are always connected to the latter. By this arrangement the necessity is avoided of providing said contact means with special locking circuits, and of providing the relays of the apparatus with special contacts for closing and opening such locking circuits, whereby the number of movable contacts is decreased and the apparatus is simplified.

The accompanying drawings illustrate by way of example and diagrammatically a few constructional forms of the invention. Fig. 1 is a wiring diagram of a signal receiving apparatus according to the invention. Fig. 2 is a diagram illustrating the operation of the various parts of the apparatus illustrated in Fig. 1 when a correct signal is received. Fig. 3 is a diagram illustrating the function of the apparatus when a dash lasts too long, and Fig. 4 is a diagram illustrating the function when a space is too long. Fig. 5 is a wiring diagram of a slightly modified signal receiving apparatus, and Fig. 6 is a wiring diagram of a third constructional form.

The apparatus illustrated in Fig. 1 consists of a radio receiver, which may be a three valve receiver diagrammatically indicated at M, and a selector combined therewith. The entire apparatus is assumed to be connected to direct current mains carrying a voltage of 110 volts.

The drawings show all parts in the positions occupied when the apparatus is connected to the mains but no signal is received by the receiver.

The selector comprises in this case two time measuring devices and a counting device with associated relays. Connected in the anode circuit of the end valve of the receiver, through suitable amplifiers, if desired, is the winding 11 of a signal receiving relay 1 which is provided with a single change-over contact 12, and which is energized as long as no signal is received. The signal receiving relay may also consist of a polarized relay the energization of which is changed in a certain direction when a signal is received.

In the constructional form illustrated in Fig. 1 the time measuring devices consist of condensers 15 and 25 connected in parallel with large resistances 16 and 26, respectively, through which they are discharged when a potential impressed upon the same is removed.

One side of the condenser 15 which together with its discharge resistance 16 forms the minimum time measuring device, is connected to the lower contact of relay 1 and is normally connected to the negative terminal over the change-over contact 12. The same side of the condenser is also connected to a grid 83 of a valve 8 which latter is also provided with a cathode 82 indirectly heated by means of a filament 81, a screen grid 84, and an anode or plate 85. Connected in the anode or plate circuit of this valve is the winding 21 of the associated relay 2 which is provided with a change-over contact 22 and a normally open contact 23. The other side of the condenser 15 is connected to a tap +b of a voltage divider 104.

One side of the other condenser 25 which together with its discharge resistance 26 forms the combined time difference and space measuring device, is normally connected to the negative terminal over the normally closed contact 33 of a relay 3 which is provided with two windings 31 and 32. The same side of the condenser 25 is connected to a grid 93 of a valve 9 which latter is also provided with a cathode 92 indi-

rectly heated by means of a filament 91, a screen grid 94 and an anode or plate 95.

Connected in the anode or plate circuit of this valve 9 is the winding 41 of the associated relay 4 which is provided with a normally closed contact 42. The other side of the condenser 25 is connected to the tap +b of the voltage divider 104.

The anode circuits of both valves are connected to one another and, preferably through a milli-ampere-meter 107, to the voltage divider 104 at +a.

As above mentioned, when no signal is received, relay 1 is energized, and the negative terminal is thus connected to the lower contact so that the grid 83 of the valve 8 receives a negative potential, and therefore, no current can pass through the valve 8.

The upper contact of relay 1 is connected to a contact 54 in a locking circuit of a relay 5 which forms the preparation and re-set device, or locking relay, of the counting device, and which is provided with two windings 51 and 52 and three normally open contacts 53, 54 and 55.

The contact 53 is connected to the change-over contact 22 of relay 2 and, upon energization of the relay 5, closes a circuit either through the winding 31 or through the winding 32 of relay 3.

The windings 31 and 32 are so arranged that the fields produced counteract one another, so that the contact 33 of the relay 3 will be sure to close momentarily when the current is changed over from one of the windings to the other.

The contact 55 of relay 5 is connected to the contact 42 of relay 4, and also with a locking winding 61 of the counting device 6 and with a contact 72 of a relay 7.

In addition to the said locking winding 61, the counting device comprises a winding 62 which when energized effects movement of a ratchet wheel 63 which is provided with teeth 64 and a cam 65. The ratchet wheel 63 is actuated by a spring or the like which tends to maintain the wheel in a certain starting or initial position. When energized, the locking winding 61 attracts, against the action of a spring, a pivoted armature 66, which then allows a spring-actuated pawl 67 to engage the ratchet wheel 63. Said pawl 67 is pivoted to a spring-actuated armature 68 which is attracted by the winding 62 when the latter is energized.

The counting device has two normally closed contacts 69 and 70 which are opened when the ratchet wheel 63 has moved three steps.

The contact 69 is connected in the circuit of a signal lamp 101 and opens this circuit when the counting device arrives in the indication position.

The contact 70 is connected in the circuit of the winding 71 of a relay 7 and opens said circuit when the counting device arrives in the indication position. Said relay 7 is normally energized, and its contacts 72, 73 and 74 are then open. Upon deenergization of the winding 71 the contacts of the relay 7 are closed, and a number of alarm bells 100 which are connected to the contacts 73 and 74, are energized and start ringing.

The signal lamp 101, which is normally dark, and the circuit of which is opened by the contact 69 when the counting device has received and counted three correct dashes, is connected in parallel to the bells 100. The contact 72 of relay 7 serves to close a locking circuit through the locking winding 61 of the counting device 6 when

the signal receiving apparatus is moved to indication position.

As above mentioned, the entire receiving apparatus is supplied with current from direct current mains which may be the electric light mains of a vessel. A main circuit breaker 102 serves to switch on and off the entire signal receiving apparatus. The current to the various relays and the various voltages for the valves are taken out from the voltage dividers 103 and 104. The relay currents are taken out from the voltage divider 103 between the negative conductor and the tap +d, and the voltages for the valves 8 and 9 from the other voltage divider 104 at +a, +b and +c. Two voltage dividers are used to make the potentials of the valves independent of the closing and opening of the circuits of the relays.

The valves of the receiver M are indicated by their filaments 105 shown in the lower right-hand corner of Fig. 1, where the filaments 81 and 91 of the valves 8 and 9 are also shown. All filaments of the valves are connected in series with each other and with a self-regulating iron resistance 106 which serves the purpose of automatically maintaining the filament current constant.

Also in series with the filaments is the contact 60 of the counting device 6 and the winding 71 of relay 7.

If one of the filaments breaks, the winding 71 will immediately be deenergized, whereby the contacts 73, 74 are closed so that the alarm bells 100 start ringing, and the lamp 101 is lit.

The anode voltage of the valves of the receiver is taken out at 108.

The signal receiving apparatus above described makes an indication as soon as three signal components or dashes of correct duration and separated by correct intervals or spaces have been received in unbroken succession, but is always returned to starting or initial position if any dash is longer than the prescribed maximum duration, or shorter than the prescribed minimum duration, or if any space exceeds the prescribed maximum duration of the spaces.

The operation of the signal receiving apparatus will now be described. In the present case it is assumed that the dashes shall have a minimum duration of three seconds and a maximum duration of five seconds, and that the length of the spaces must not exceed two seconds. The operation of the relays and of the time measuring devices when a correct sequence of dashes is received, is illustrated in Fig. 2. The operation of the device when a dash has too long a duration, is illustrated in Fig. 3, and when a space is too long, in Fig. 4.

In Figs. 2, 3 and 4 the shaded surfaces denote the duration of the dashes received, the intermediate surfaces denote the spaces between the dashes, each of the horizontal narrow lines denotes a relay and indicates that its winding or windings are deenergized, the heavy horizontal lines denote the periods during which the respective relays are energized, and the heavy vertical lines denote when one of the condensers 15 and 25 has been discharged to such extent that the anode current in the corresponding valve is sufficient to cause the relay included in its anode circuit to close.

When a signal is received by the receiver M, at A in Fig. 2, the winding 11 is deenergized, and the change-over contact 12 moves to its upper position. The condenser 15 therefore begins to discharge through the resistance 16, and the

negative potential is gradually removed from the grid 83 of the valve 8. Through the valve 8 a gradually increasing current will flow which after three seconds, that is to say, when the dash has attained minimum duration, at B in Fig. 2, becomes so strong that relay 2 is energized and attracts its contacts 22 and 23.

When relay 2 closes, a circuit is closed from the negative conductor through the front contact 23 and the winding 52 to the tap +d on the voltage divider 103, and relay 5 becomes energized. Relay 5 closes its contacts 53, 54 and 55.

Contact 53 of relay 5 closes a circuit through the winding 31 of relay 3 which circuit was prepared by the energization of relay 2 causing contact 22 to move to its lower position. Relay 3 is thus energized through a circuit from the negative conductor through contact 53, contact 22 and winding 31 to the tap +d on the voltage divider 103.

Contact 54 of relay 5 closes a locking circuit through its winding 52 from the negative conductor through contact 12 of relay 1, contact 54 and winding 52 to the tap +d on the voltage divider 103. A locking circuit is also closed from the negative conductor through contact 55, contact 42 of relay 4, and winding 51 of relay 5 to the tap +d on the voltage divider 103. Relay 5 will afterwards be energized during the entire period of receiving the other dashes of the signal and during the spaces between the same, provided that all dashes and all spaces have correct duration.

The closing of relay 5 also causes a circuit to close from the negative conductor through contact 55 and the winding 61 of the counting device 6 to the tap +d on the voltage divider 103. This winding is energized and attracts the armature 66 against the action of its spring so that the pawl 67 is allowed to engage one of the teeth 64 on the ratchet wheel 63. The counting device is thus prepared for operation which action takes place as soon as the first dash ceases.

The relay 3 being energized, its contact 33 is opened so that the condenser 25 begins to discharge through the resistance 26 and the negative potential is gradually removed from the grid 93 of the valve 9. The period of discharge of the condenser 25 is so timed that after two seconds the potential on the grid 93 is sufficiently positive for the anode current through the valve to energize the winding 41 so that the armature 42 is attracted. However, if, as it is here assumed, the first dash ceases within the prescribed time, that is to say, after three but before five seconds from the beginning of the signal component at A in Fig. 2, the relay 4 will not be energized.

When the first dash ceases, at C in Fig. 2, the winding 11 of relay 1 is energized, and the change-over contact 12 is moved to its lower position. The grid 82 of valve 8 then receives negative potential, the condenser 15 is charged, and the relay 2 is deenergized, since the anode current ceases to flow through the valve 8. The contact 22 of relay 2 then moves from its lower position so that relay 3 is momentarily deenergized. The contact 33 of relay 3 is then momentarily closed so that the grid 93 of the valve 9 momentarily receives negative potential, and the condenser 25 is charged.

When the contact 22 has been closed in its upper position the winding 32 of relay 3 is energized through a circuit from the negative conductor through contact 53 of relay 5, contact 22

of relay 2, and the winding 32 to the tap +d of the voltage divider 103.

Simultaneously the circuit through the impulse or step winding 62 of the counting device 6 is closed, and said winding attracts its armature 68 so that the ratchet wheel 63 is moved one step.

The energization of relay 3 again opens its contact 33, and the condenser 25 again begins discharging through the resistance 26 for checking the length of the space. During the space, as long as the relay 4 is not energized, the relay 5 is maintained energized through the above-mentioned circuit from the negative conductor through contact 55, contact 42 of relay 4, and winding 51 to tap +d on the voltage divider 103.

If a second dash is received at D in Fig. 2, before the space has attained the prescribed maximum duration of two seconds, relay 1 is again deenergized and its contact 12 moves to its upper position. The condenser 15 commences discharging through the resistance 16, and the negative potential on the grid 33 is gradually changed to positive. Two seconds from the beginning of the space, at E in Fig. 2, the potential on the grid 93 of valve 9 has been raised so much that the anode current in said valve is strong enough to energize the winding 41 of relay 4 sufficiently for opening the contact 42. The current through the winding 51 of relay 5 is thus broken, but said relay is still energized since the winding 52 is now again supplied with current through contact 12 of relay 1 and contact 54 of relay 5.

When the second dash has attained minimum duration, at F in Fig. 2, the anode current through the valve 8 is strong enough to close relay 2. When the contact 22 moves from its upper position to its lower position, the relay 3 is momentarily deenergized so that its contact 33 closes, and the grid 93 of the valve 9 receives negative potential so that its anode current ceases, and therefore, relay 4 is deenergized. When relay 3 is again energized through its winding 31, the contact 33 is again opened, and the condenser 25 again commences discharging in order to check that the second dash does not exceed maximum duration.

If also the second dash ends within the prescribed time, at G in Fig. 2, the same operations are repeated as those above described in connection with the first dash, and the ratchet wheel 63 is moved a second step. When afterwards the third dash is received, the same operations take place as when the second dash was received, and if the third dash also ends within the prescribed length of time, the winding 62 of the counting device will be energized for the third time and moves the ratchet wheel 63 a third step. The cam 65 then opens the contacts 69 and 60, so that the current through the filaments of all valves in the receiving device and through the winding 71 of relay 7 is broken. When relay 7 deenergizes, its contacts 72, 73 and 74 close.

The contacts 73 and 74 close a circuit through the alarm bells 100 which start ringing. Since the contact 69 of the counting device is open, the signal lamp 101 will not be lit. The contact 72 closes a circuit through the locking winding 61 of the counting device 6 which prevents the counting device from returning to initial position when the other relays of the receiving device are deenergized. The alarm bells will therefore continue to ring until the operator opens the main circuit breaker 102 of the signal receiving apparatus.

For restoring the apparatus to normal position

after the bells 100 have commenced ringing, it is only necessary to open the main circuit breaker 102.

As above mentioned, the signal receiving apparatus is so constructed that if the signals are incorrect in any manner, it will immediately return to initial position. The operations which take place when various kinds of incorrect signals are received, will now be described.

If the first dash is too short, that is to say, if it ends before B in Fig. 2, the relay 1 will immediately be energized when the dash ends, and will therefore attract the contact 12, so that the discharge of the condenser 15 is interrupted, and said condenser as well as the grid 83 receive negative potential. Therefore, the anode current through the valve 8 will not attain such strength that the relay 2 closes. The apparatus will then again be in normal condition.

If the second or third dash is too short, and if it ceases after the relay 4 has become energized, that is to say, between E and F or between I and K in Fig. 2, the following operation takes place. When the dash ceases, the winding 11 of relay 1 is energized, the grid 83 is supplied with negative potential, and the condenser 15 is charged. Since the relay 2 has not yet been energized and, therefore, its contact 23 is open, and since relay 4 is energized and its contact 42 is open, and therefore, the circuit through the winding 51 of relay 5 is broken, the relay 5 will be deenergized when the contact 12 leaves its upper position and breaks the locking circuit through contact 54 and winding 52. When the relay 5 is deenergized, the relay 3 and the winding 62 will also be deenergized owing to the contact 53 being opened, and likewise, the winding 61 will be deenergized since the contact 55 opens. Owing to relay 3 being deenergized, the grid 93 of valve 9 again receives full negative potential, so that relay 4 is deenergized, and the apparatus is then again in normal condition.

If a dash, for instance the second dash, is too long, that is to say, if it lasts more than two seconds over the minimum duration, then relay 4 will be energized, as indicated at F₁ in Fig. 3, so that the contact 42 breaks the locking circuit through winding 51. When afterwards the dash ends, at G₁ in Fig. 3, and relay 1 is energized, contact 12 breaks the locking circuit through winding 52 and applies negative potential to grid 83 of valve 8 so that relay 2 is released and contact 23 breaks the circuit through winding 52, and relay 5 is deenergized.

When relay 5 deenergizes, the circuits through relay 3 and through winding 61 of the counting device are opened, so that said device is released and returned to normal position. The relay 3 being deenergized, its contact 33 closes and the grid 93 of the valve 9 is supplied with full negative potential, so that the anode current ceases and the relay 4 in the anode circuit is deenergized. The receiving apparatus is then again in normal condition.

If a space is too long, the relay 4 will be energized when two seconds have elapsed from the beginning of the space, as indicated at D₁ in Fig. 4. During the space, winding 51 of relay 5 is energized over the locking circuit through contact 42 of relay 4, and therefore, when said relay opens said contact 42, relay 5 will be deenergized, so that the circuits through the relay 3 and through the windings 61 and 62 of the counting device are broken. When relay 3 is deenergized, the grid 93 is again supplied with negative po-

tential, and the relay 4 is deenergized, after which all parts of the apparatus are again in normal condition.

If disturbing telegraphic messages or atmospheric disturbances are received by the receiver during a space, the receiving relay 1 will be momentarily deenergized, but this fact has no influence on the condenser 25 which continues to discharge during two seconds from the beginning of the space.

The apparatus above described is also arranged in such manner that if a filament in any of the valves in the apparatus burns out, the alarm bells will immediately start ringing. Simultaneously, however, the signal lamp 101 is lit which shows that there is a fault in the apparatus. As will be understood from a consideration of Fig. 1, if any of the filaments 81, 91, 105, or 106 breaks, the current through the winding 71 of relay 7 will be broken. The contacts of the relay then close, and the circuit is closed through the alarm bells 100, and also through the contact 69 of the counting device, which is assumed not to occupy indication position, to the signal lamp 101 which is lit.

The constructional form illustrated in Fig. 5 agrees on the whole with that above described, and the same reference numerals are therefore used to denote similar parts. The receiver M, relays 1, 2, 3, 4, and 5, counting device 6, condensers 15 and 25 and valves 8 and 9 are connected with one another in the same manner as above described in connection with Fig. 1, and are arranged in the same manner and have the same number of contacts, with the following exceptions:

Relay 5 is in this case provided with only one winding 52 which is connected, besides with the contact 23 of relay 2, with the locking circuit through contact 42 of relay 4 and contact 55 of relay 5. Said contact 55 is in this case connected with contact 22 of relay 2, and is also connected with the locking winding 61 of the counting device 6 in the same manner as in Fig. 1.

Besides the contact 55, relay 5 has only one further contact 54 which serves to close the second locking circuit for the relay 5 over contact 12 of relay 1 when deenergized, as in Fig. 1. It will be understood from this description that relay 5 of Fig. 5 will function in exactly the same manner as the corresponding relay 5 of Fig. 1.

Relay 3 is provided with an additional contact 34, and relay 4 is provided with an additional contact 43, which contacts serve to close a short-circuit for the locking winding 61 of the counting device 6 if a dash exceeds the maximum duration. As in the constructional form above described, relays 2, 3 and 5 are energized when a dash has reached minimum duration. When the permissible maximum duration of a dash is reached, relay 4 is operated, and a circuit is then closed from the negative terminal through closed contact 55, closed contact 22, closed contact 34, and closed contact 43 to point 109 and then through resistance 110 to tap +d on the voltage divider 103. The winding 61 is thus short-circuited, and the counting device 6 is immediately released. In this case, therefore, deenergization of winding 61 is effected at F1 in Fig. 3, and is not dependent upon relay 5 being first deenergized. Therefore, even if, when the dash terminates and the relay 2 deenergizes, its contact 22 should happen to close the circuit through the impulse or step winding 62 of the counting device 6 before relay 5 releases and opens contact 55, such energization of wind-

ing 62 will have no effect, since winding 61 is deenergized and has released armature 66.

During normal operation, however, for illustration of which the diagram shown in Fig. 2 will serve also in this case, when relay 4 is energized at the end of the permissible space period, at E in Fig. 2, relay 2 is not energized so that the above-mentioned short-circuit through contact 43 is not operative to deenergize winding 61, which action is not desired in this case. When, at F in Fig. 2, the dash has reached minimum duration and relay 2 is energized, relay 3 is momentarily deenergized by contact 22 moving from its upper position, so that contact 34 is opened and renders the above-mentioned short-circuit inoperative before contact 22 reaches its lower position, thus giving relay 4 time to release contact 43 and preventing the circuit from being closed by contact 22, which is not desired at this stage.

The counting device 6 has in this case only one normally closed contact 60 which is opened by the ratchet wheel 63 when the latter has moved three steps. Said contact 60 is connected in a circuit from the positive terminal through winding 71 of relay 7, contact 60, self-regulating iron resistance 106, filaments 91 and 81 of valves 9 and 8, and filaments 105 of the receiver valves, to the negative terminal. Shunted across winding 71 and contact 60 is a lamp 101 in series with a resistance 111 normally preventing the lamp from burning. When three correct signals have been received and the counting device 6 opens the contact 60, sufficient current will flow through the shunt to cause the lamp 101 to light, but if one of the filaments in the circuit burns out while contact 60 is closed, the lamp 101 will not be lit.

In either case relay 7 will be deenergized and close its contacts. In this case contact 72 serves to apply negative potential to the lower sides of condensers 15 and 25, thus putting the same and the valves 8 and 9 out of operation, while contact 73 closes a circuit through the alarm bells 100 and a battery 112. The bells will ring when relay 7 is deenergized, whether by the counting device 6 opening contact 60 or by the circuit being broken by one of the filaments burning out.

Fig. 6 shows a wiring diagram of a constructional form of the invention in which three time measuring devices are employed. Each of the time measuring devices consists of a condenser connected in parallel with a relay winding and in series with a resistance. Normally, or when the time measuring apparatus is not operative, the condenser and relay winding are short-circuited by means of a shunt connection, so that no current flows through the winding, but when the device is to operate the shunt connection is broken and potential is applied to the condenser and relay winding.

The drawings show all parts in the positions occupied when no signal is received by the receiver.

As in the constructional forms above described, M denotes the receiver to which the winding 211 of a signal receiving relay 201 is connected. This relay has a single movable contact 212 which in the position shown applies positive potential to point 226 between condenser 225 and resistance 224 of the minimum time measuring device 202, so that no current flows through winding 221 which is shunted across said condenser 225.

When a dash is received so that winding 211 attracts contact 212, the short-circuit of condenser 225 and winding 221 is removed, and cur-

rent begins to flow through the same. After the lapse of a period of time corresponding to the prescribed minimum duration of a dash, the condenser 225 has been charged to a potential sufficient to cause a strong enough current to flow through winding 221 to permit this winding to operate the contacts 222 and 223.

Contact 223 closes a circuit over contact 242 of the space measuring device 204 through winding 251 of the locking relay 205, which operates its contacts 254 and 255. Contact 254 closes a locking circuit for winding 252 of said relay 205 over contact 212 of relay 201. Contact 255 closes a locking circuit for winding 251 over contact 242 of the space measuring device 204 and contact 232 of the time difference measuring device 203. Contact 255 also closes a circuit through winding 261 of the counting device 206, which winding attracts armature 266 and thus prepares this device for operation.

Contact 255 also applies positive potential to the upper sides of condensers 235 and 245 of the time measuring devices 203 and 204. Contact 222 when operated, as above stated, breaks the short-circuit connection to point 236 between condenser 235 and resistance 234 of the time difference measuring device 203, but closes the short-circuit connection to point 246 between condenser 245 and resistance 244 of the space measuring device 204. No current will therefore flow through winding 241 of the last mentioned device.

Therefore, as soon as winding 221 of the minimum time measuring device 202 is energized, upon minimum duration of a dash being reached, the time difference measuring device 203 is put in operation and commences to check the difference between minimum and maximum duration, to control that the dash does not exceed the maximum duration permitted.

If the dash exceeds the prescribed maximum duration, the condenser 235 has been charged to a potential sufficient to cause a strong enough current to flow through winding 231 of the time difference measuring device 203 to permit said winding to operate the contacts 232 and 233.

Contact 233 closes a circuit from the positive terminal through said contact to point 208 between winding 261 and resistance 209, and through said resistance 209 to the negative terminal. Winding 261 is thus deenergized, so that the counting device 206 is no longer prepared for operation.

Contact 232 breaks the locking circuit through winding 251 of relay 205. When the dash ends and relay 261 and winding 221 are deenergized, contact 212 breaks the locking circuit through winding 252, and contact 223 breaks the original circuit through winding 251 of relay 205, which deenergizes, whereby winding 231 of the time difference measuring device 203 is also deenergized and the entire apparatus is returned to normal.

Contact 232 also breaks the impulse circuit for winding 262 of counting device 206, which circuit might otherwise be closed at contact 223, if the contacts of relay 205 have not been returned to normal before said contact 223 is returned to normal upon deenergization of winding 221. Said impulse circuit will be described here below.

If, on the other hand, the dash does not exceed maximum duration, winding 231 of the time difference measuring device 203 will not have time to operate its contacts before the dash ends.

In such case, when the dash ends, winding 211 of relay 201 is deenergized and contact 212 is returned to normal, thereby applying positive po-

tential to point 226 so that winding 221 of the minimum time measuring device 202 is deenergized and contacts 222 and 223 are returned to normal. Contact 223 closes the impulse circuit for winding 262 from the positive terminal through contact 255 of relay 205, contact 232 of the time difference measuring device 203, contact 223 of the minimum time measuring device 202, winding 262 of the counting device 206, to the negative terminal. Winding 262 attracts armature 266 with pawl 267 and moves the wheel 263 one step. The counting device 206 is of the same construction as that above described in connection with Figs. 1 and 5.

Contact 222 when returned to normal position, applies positive potential to point 236 whereby winding 231 is deenergized and the time difference measuring device 203 is put out of operation.

Simultaneously, the positive potential is removed from point 246, so that current is allowed to flow from the positive terminal over contact 255 to condenser 245 and winding 241 of the space measuring device 204, which is thus put in operation to measure the space.

After the lapse of the space period the condenser 245 has been charged to a potential sufficient to cause enough current to flow through winding 241, which becomes energized and opens contact 242, thereby breaking the locking circuit through winding 251 of relay 205.

If a second dash has not been received when contact 242 opens, so that relay 201 is still deenergized, the locking circuit through winding 252 of relay 205 is open at contact 212, and therefore, relay 205 will be deenergized as soon as contact 242 opens, thereby deenergizing winding 261 so that the counting device 206 is returned to normal. Deenergization of relay 205 also breaks the current to the space measuring device 204 which is returned to normal.

On the other hand, if, when contact 242 opens, a second dash is being received, relay 201 is energized and the locking circuit through winding 252 of relay 205 is closed by contact 212, so that relay 205 will remain energized in spite of the contact 242 being opened.

If such second dash does not last long enough for the minimum time measuring device 202 to operate, the locking circuit through winding 252 will be broken at contact 212 when the dash ends, and relay 205 will then be deenergized and the apparatus returned to normal, as above described.

If, however, the second dash reaches the prescribed minimum duration, the minimum time measuring device 202 will operate so that its winding 221 attracts contacts 222 and 223. Point 246 is thus connected over contact 222 to the positive terminal, so that condenser 245 and winding 241 are short-circuited, whereby the space measuring device 204 is put out of operation, and contact 242 is again closed in normal position. Simultaneously, positive potential is removed from point 236, so that the time difference measuring device 203 is again put in operation to check the maximum length of the dash, after which the operation proceeds in the manner above described.

When the prescribed number of correct dashes have been received and counted by the counting device 206, the latter effects indication. Said device may, of course, be connected to the alarm bell circuit in the same manner as above described and illustrated in Fig. 1 or Fig. 5. Diagrammatically, and for the purpose of illustration only, Fig. 75

6 shows the alarm bells 200 connected in a circuit including a battery 210 and a contact 269 which is closed by the wheel 253 of the counting device 296, when the correct sequence of dashes has been received.

Obviously, since the winding 61 of the counting device is energized simultaneously with relay 5, these two parts may be combined into one, in such manner that the winding 61, or 261, operates the contacts 53, 54, 55, or 254, 255, in which case the winding 61, or 261, should, of course, be connected in the manner above described in respect of the winding of relay 5, or 205.

It will readily be understood that the constructional forms illustrated in Figs. 1 and 5 may easily be modified in the manner above described in connection with Fig. 6, i. e. by using one time measuring device for checking the permissible difference between minimum and maximum duration, and another such device for checking the space, instead of a single such device—condenser 25, resistance 26, valve 9, and relay 4—with auxiliary relay 3, as above described in connection with Figs. 1 and 5.

It will be understood that the constructional forms of the invention above described and illustrated in the drawings are only to be regarded as examples, and that the details thereof may be modified in several various ways without departing from the principle of the invention.

I claim:

1. In a signal receiving apparatus of the character described, the combination of a receiver having a signal receiving relay provided with a single movable contact, a counting device for counting signals received and for effecting indication after receipt of a predetermined number of signal dashes, holding and re-set means for said counting device, a minimum time measuring device connected to said signal receiving relay in such manner as to be put in operation by said movable contact upon commencement of a signal dash received and to be put out of operation by said contact upon termination of the dash, contact means associated with and adapted to be operated by said device after a predetermined time of operation of said device and to be returned to normal position by said device being put out of operation, at least one further time measuring device connected to said contact means associated with said first mentioned time measuring device in such manner as to be put in operation and out of operation by said contact means, contact means associated with and adapted to be operated by said second time measuring device after a predetermined time of operation of said device, and to be returned to normal position by said device being put out of operation, a circuit for initially energizing said holding and re-set means for said counting device, said circuit being arranged to be closed by said contact means associated with said first-mentioned minimum time measuring device when operated by said device, a locking circuit for said holding and re-set means for said counting device arranged to be opened by said contact means associated with said second time measuring device upon said contact means being operated after a predetermined time of operation of said device, a second locking circuit for said holding and re-set means for said counting device arranged to be closed by said movable contact of said signal receiving relay while a signal dash is being received, and an impulse circuit for said counting device arranged to be closed

by said contact means of said first mentioned minimum time measuring device when returned to normal position by said minimum time measuring device being put out of operation upon termination of a dash.

2. In a signal receiving apparatus of the character described, the combination of a receiver having a signal receiving relay provided with a single movable contact, a counting device for counting signals received and for effecting indication after receipt of a predetermined number of signal dashes, holding and re-set means for said counting device, a minimum time measuring device connected to said signal receiving relay in such manner as to be put in operation by said movable contact upon commencement of a signal dash received and to be put out of operation by said contact upon termination of the dash, contact means associated with and adapted to be operated by said device after a predetermined time of operation of said device and to be returned to normal position by said device being put out of operation, at least one further time measuring device connected to said contact means associated with said first-mentioned time measuring device in such manner as to be put in operation and out of operation by said contact means, contact means associated with and adapted to be operated by said second time measuring device after a predetermined time of operation of said device, and to be returned to normal position by said device being put out of operation, a circuit for initially energizing said holding and re-set means for said counting device, said circuit being arranged to be closed by said contact means associated with said first mentioned minimum time measuring device when operated by said device, a locking circuit for said holding and re-set means for said counting device arranged to be opened by said contact means associated with said second time measuring device upon said contact means being operated after a predetermined time of operation of said device, a second locking circuit for said holding and re-set means for said counting device arranged to be closed by said movable contact of said signal receiving relay while a signal dash is being received, an impulse circuit for said counting device arranged to be closed by said contact means of said first-mentioned minimum time measuring device when returned to normal position by said minimum time measuring device being put out of operation upon termination of a dash and by said holding and re-set means, and a short-circuit connection for said holding and re-set means arranged to be closed by said contact means of said second time measuring device when in operated position.

3. In a signal receiving apparatus of the character described, the combination of a receiver having a signal receiving relay provided with a single movable contact, a counting device for counting signals received and for effecting indication after receipt of a predetermined number of signal dashes, holding and re-set means for said counting device, a minimum time measuring device connected to said signal receiving relay in such manner as to be put in operation by said movable contact upon commencement of a signal dash received and to be put out of operation by said contact upon termination of the dash, contact means associated with and adapted to be operated by said device after a predetermined time of operation of said device and to be returned to normal position by said device being put out of operation, at least one

5 further time measuring device connected to said
contact means associated with said first-men-
tioned time measuring device in such manner as
to be put in operation and out of operation by
said contact means, contact means associated
10 with and adapted to be operated by said second
time measuring device after a predetermined time
of operation of said device, and to be returned
to normal position by said device being put out
15 of operation, a circuit for initially energizing said
holding and re-set means for said counting device,
said circuit being arranged to be closed by said
contact means associated with said first-men-
tioned minimum time measuring device when op-
erated by said device, a locking circuit for said
holding and re-set means for said counting device
arranged to be opened by said contact means as-
sociated with said second time measuring device
upon said contact means being operated after a

predetermined time of operation of said device,
a second locking circuit for said holding and re-
set means for said counting device arranged to
be closed by said movable contact of said signal
receiving relay while a signal dash is being re- 5
ceived, an impulse circuit for said device arranged
to be closed by said contact means of said first-
mentioned minimum time measuring device when
returned to normal position by said minimum
time measuring device being put out of operation 10
upon termination of a dash and by said holding
and re-set means, said receiver and said time
measuring devices including electric valves hav-
ing filaments, a circuit including alarm-giving
means, a relay to close and open said circuit, and 15
a circuit including said valve filaments and said
relay and a contact in said counting device.

AXEL SIGURD LITSTRÖM.