May 10, 1938. Y. WATANABE 2,116,990

SELECTOR APPARATUS

Filed Dec. 27, 1935 2 Sheets-Sheet 1

Fig. 1.

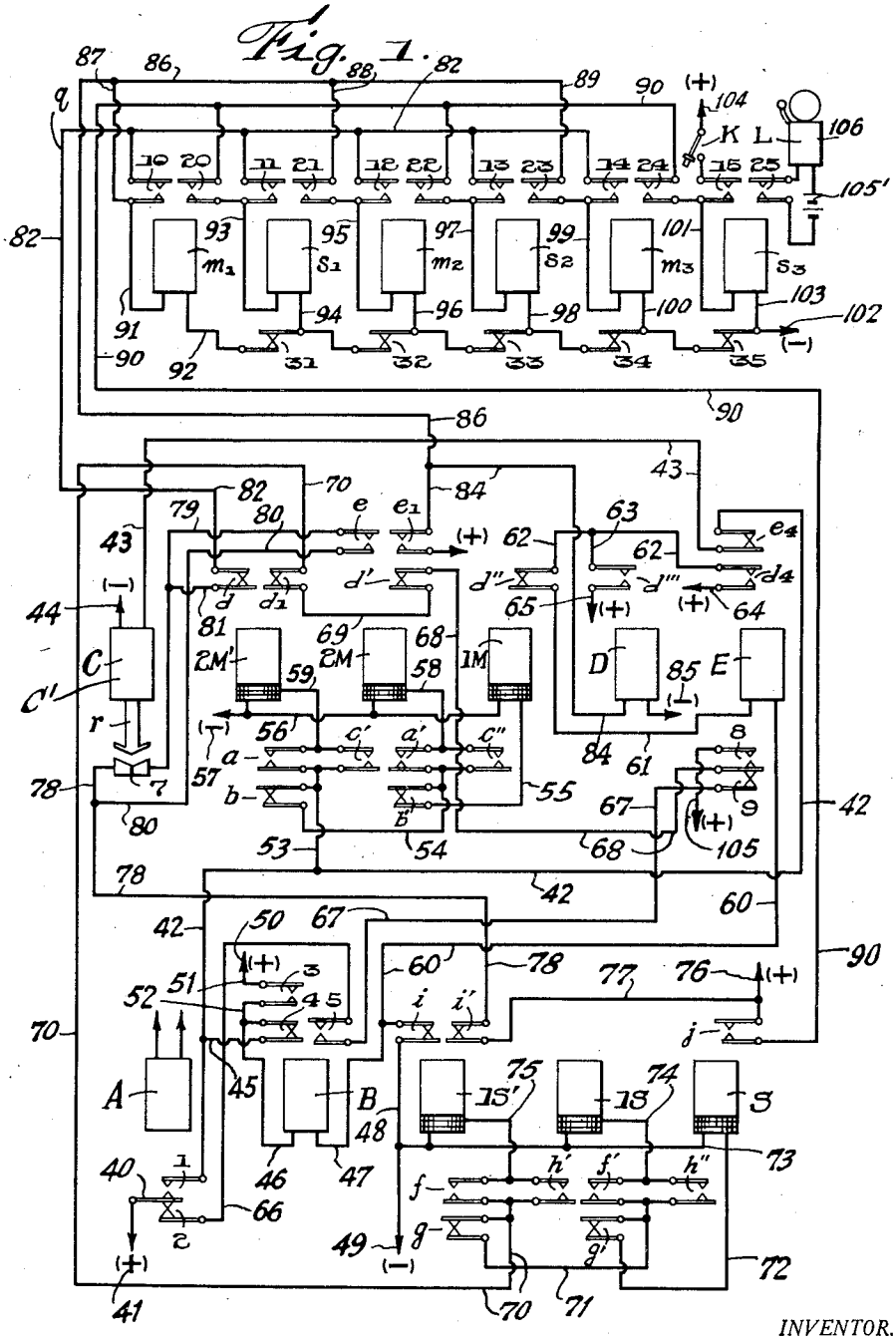

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Fig. 2.

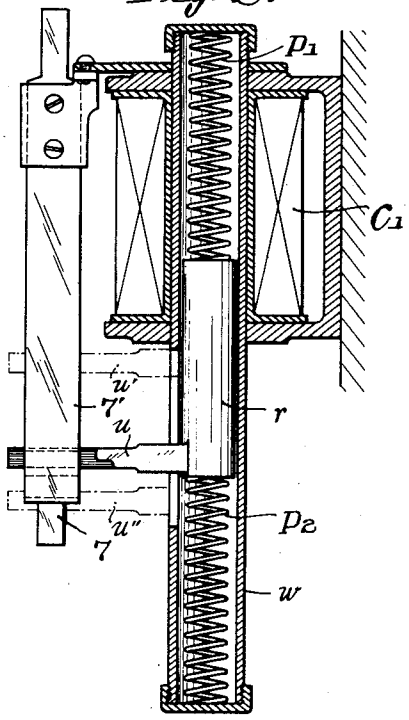


Fig. 3.

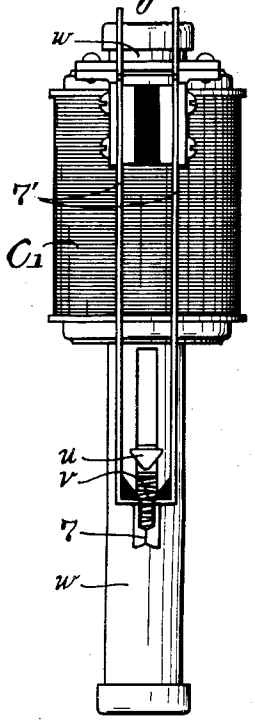
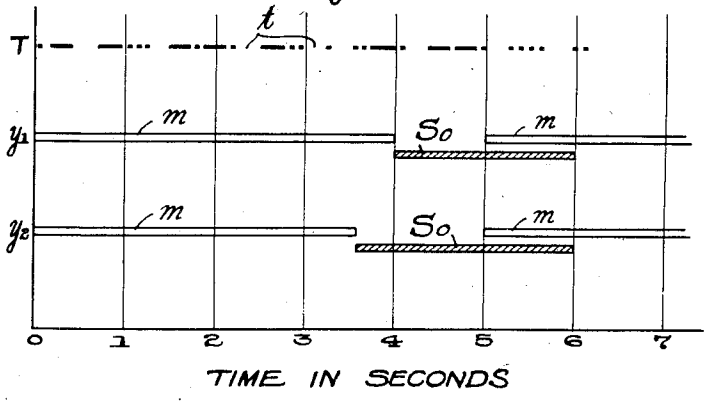


Fig. 4.



TIME IN SECONDS

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UNITED STATES PATENT OFFICE

2,116,990

SELECTOR APPARATUS

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Application December 27, 1935, Serial No. 56,321
In Japan March 27, 1935

1 Claim. (Cl. 177—353)

This invention relates to a system of receiving a low speed repeating signal consisting of an alarming part composed of any desired number of "signal" relays and "space" relays alternately arranged which are operated successively to correspond to the repetition of the regular signal and space till finally an alarm circuit is completed; a "signal" relay system consisting of several delayed action relays combined in such a manner as to be operated successively in response to a signal lasting a certain time; and a relay system comprising several delayed action relays combined so as to be operated successively for a certain time interval or space between signals, characterized by wholly operating the alarming relay system for only a warning signal consisting of a certain number of the regular signals and spaces, starting the operation of said system over again in case of the irregularity in the time duration of the "signal" current and the time interruption of it or the time space in the above warning signal; continuing the operation of the "space" relay system once when started, even upon arrival of a signal and stopping such operation only when the above incoming signal has lasted a certain time. The object thereof is to receive a warning signal accurately by preventing the operation of the "space" relay system from being disturbed by the arrival of another ordinary signal, for example, a signal according to Morse code, in the regular "space" time and thus saving said warning signal from being interferred with by such code signal. The "warning signal" as it is termed in the present invention is such an electric signal that, for example, signals lasting a pretty long time alternate with certain time intervals, and in a working example evplained later an alarm is operated when electric signals each lasting 3–5 seconds are repeated three times at intrevals of one-half to one and one-half seconds. Generally an electric signal or impulse of about four seconds duration is transmitted continuously twelve times at intervals of about 1 second and any three of the signal impulses will be registered by the receiving system of this invention, whereupon an alarm rings.

Referring to the appended drawings,

Figure 1 is a wiring diagram of the alarm signal receiving system according to the present invention;

Figure 2 is a sectional side view of an electric relay used in this system;

Figure 3 is a front view of the same and

Figure 4 is a diagram showing the relation between the duration of the signal impulses as received and the starting and stopping periods of the space relays.

In the drawings, 1M, 2M, and 2M′ are relays operated by incoming electric signals, each having a delayed action, that is, the first-mentioned relay has a delayed action of 1 second; and the last two have delayed action each of 2 seconds, while the delayed action of a "space" relay S operated in the absence of an incoming signal impulse is ½ second. The "space" relays 1S and 1S′ operate their respective contacts at the interval of 1 second.

A is an instantaneous relay at the receiving end and is adapted for closing a contact 1 when an electric current flows through it by the arrival of an electric signalling impulse and also closing a contact 2 in the absence of a signal impulse. B, D and E too are instantaneous relays. The relays m_1, s_1, m_2, s_2, m_3 and s_3 operate successively at the first regular impulse and regular space, the second regular impulse and space, and the third regular impulse and space, each being of instantaneous type for resetting the previously operated relay and also holding its own operation.

Their number is determined according to the requirements of the special care. The last relay s_3 is adapted for completing the circuit of an alarm L by its operation.

When this receiving system is not operated, the contact of each relay maintains the condition as shown in the drawings, but makes an opening and closing movement instantaneously or within a certain time limit when in energized condition.

C is a relay which when energized opens its contact 1 for a moment. Figures 2 and 3 show its construction. A core r is mounted in a sleeve w of non-magnetic material. This core has its both ends engaged by springs P_1 and P_2 and is provided at its lower end with an arm projecting through a slot w' formed in the sleeve. A solenoid winding or coil C_1 surrounds the upper end of sleeve w. When the core is energized the core r is attracted so as to compress the spring P_1 and the arm u is moved to the position indicated by u'. If the current is cut off, the core will drop down and running over the original position by its inertia and pressing the spring P_2, will reach the position u'', where it enters the V-shaped space v formed by two contact springs 1′ to push open the contact 1 for a moment and then is returned to its original position by the spring P_2.

Now, if this system receives an incoming elec-

tric signalling wave or current, firstly the relay A is operated to close its contact 1 and thus complete the following three circuits.

(1) A circuit from the positive pole to the negative pole of an electric source (not shown) by way of the contacts 1, *b* and *b'* and the relay 1M. This circuit leads from terminal or pole 41, through wire 40, circuit closer 1, wire 42, wire 53, circuit closer *b*, wire 54, circuit closer *b'*, wire 55, winding of relay 1M and wire 56 to negative terminal 57. This energizes the relay 1M, the circuit closer *c''* is closed and the circuit closer *d''* is opened. It will be noted that there is no holding circuit for the relay 1M and that it has a delayed action of one second.

(2) A circuit from the positive pole to the negative pole through the contacts 1 and 4, the relay B and contact *i*. As the relay B operates here, its contact 3 is closed to continue its operation and accordingly maintain the contact 5 in a closed condition. Tracing these circuits, the current will flow from the positive terminal 41 through wire 40, circuit closer 1, wire 42, wire 45, circuit closer 4, wire 46, winding of relay B, wire 47, circuit closer *i*, and wire 48 to negative terminal 49. This energizes the relay B, opens the circuit closer 4 and closes the circuit closers 3 and 5. The holding circuit for the relay B is now established from the positive terminal 50, circuit closer 3, wire 52, wire 46, and through the winding of relay B as before.

(3) A circuit leading to the relay C through 1 and *e4* from the positive pole and accordingly said relay C lifts the core *r*. This circuit is traced from the terminal 41 through wire 40, circuit closer 1, wire 42, circuit closer *e4*, wire 43, winding C' to negative terminal 44. If the relay 1M is energized for a full second, it opens the contact *d''* and closes *c''*, thus completing the following circuit.

(4) A circuit leading from the positive pole to the negative pole through 1, *b* and *c''* and the second relay 2M in the following manner. From positive terminal 41, wire 40, circuit closer 1, wire 42, wire 53, circuit closer *b*, wire 54, circuit closer *c''*, wire 58, winding of relay 2M to the negative terminal 57. If the signalling impulse lasts 3 seconds and accordingly said relay 2M is energized for 2 seconds, it causes the following actions.

(5) The contact *a'* of the relay 2M is closed and the contact *b'* is opened to cut off the current of the relay 1M, so that the contact *c''* and *d''* of the relay 1M are opened and closed respectively. However, the operation of the relay 2M is continued by the contact *a'* in place of the contact *c''*. This happens because the current flows as before to the wire 54 but now flows through the holding circuit closer *a'* from whence it passes as before over the wire 58, through the relay 2M and to the negative terminal 57.

(6) The contact *c'* is closed to energize the last relay 2M'. This is done in the following manner, current flows as before to the wire 53 and from that wire through circuit closer *c'*, wire 59 and winding of relay 2M' to negative terminal 57.

(7) The contact *e* is closed to short-circuit the contact 7 of the relay C.

(8) The contact e_1 is closed to energize and operate the first "mark" relay m_1 of the alarming part, while the contacts 10 and 20 are closed, so that the operation of the said relay m_1 is maintained by the said contact 10. The circuits here run from the positive terminal through the circuit closer e_1, wire 84, wire 86, wire 87, wire 91, winding of relay m_1, wire 92, circuit closers 31, 32, 33, 34 and 35 to negative terminal 102. As the circuit closer 10 is closed current will flow from positive terminal 76 through wire 77, circuit closer *i'*, wire 78, contacts 7, wire 79, wire 81, circuit closer *d*, wire 82, circuit closer 10 and wire 91 to and through the winding of relay m_2 as before thus establishing a holding circuit for this relay.

(9) Further, the relay D is energized by the closed contact e_1 of the relay 2M to close is contact *d'''*, thus energizing the relay E through the contacts *d''* and *i* and operating it to close the contacts 8 and d_4 and open the contacts 9 and e_4. The operation of the relay E is maintained by the closed contact d_4. The circuits are as follows. The circuit for relay D runs from the positive terminal through circuit closer e_1, wire 84, winding of relay D and to negative terminal 85. Now current flows from positive terminal 65 through circuit closer *d'''*, wire 63, wire 62, circuit closer *d''*, wire 61, winding of relay E, wire 60, circuit closer *i*, and wire 48 to negative terminal 49. The closing of the circuit closer d_4 by relay E establishes a holding circuit from positive terminal 64, circuit closer d_4, wire 62, circuit closer *d''* and wire 61 to and through the winding of the relay E and thence back to the negative terminal 49 as before. Energization of relay E opens the circuit closer e_4.

(10) By the opening of the contact e_4 the current of the relay C is cut off to reset its core *r* and open the contact 7 temporarily. However, the contact 7 being short-circuited by the contact *e* as described above, the above operation gives no effect upon other circuits.

When the signal impulse is of the regular length, namely 3–5 seconds, the relay 2M' does not act on the circuit closers *a*, *b*, *d* and *d'*. When said mark ends and the relay A becomes deenergized to open the contact 1, the relays 2M and 2M' will be deenergized, while the relays B, E and m_1 remain energized through the action of their holding circuits. The cessation of the signal impulse is followed by a space and the following changes in the condition of the apparatus occurs.

(11) The first "space" relay S is energized through the contacts 8, *d'*, d_1, *g* and *g'* from the positive pole. This circuit starts from the positive terminal and passes through circuit closer 8, wire 68, circuit closer *d'*, wire 69, circuit closer d_1, wire 70, circuit closer *g*, wire 71, circuit closer *g'*, wire 72, winding of the relay S, wire 73 and wire 48 to negative terminal 49. Once the space time operation has begun, the opening of the contact 2 by the arrival of the next impulse has no effect upon its circuit. However, owing to the closing of the contact 1 the relay 1M is reenergized to open *d''* 1 second later, namely the time of delayed action of said relay 1M and the relay E is deenergized because the circuit closer *d''* is opened and the holding circuit through relay E is broken. This opens the contact 8, whereupon the circuit of the relay S is broken and the relay S is deenergized.

Now, one half second later, namely the time of delayed action of the relay S the following two actions take place.

(12) The contact *j* is closed and the "space" relay s_1 is energized by the contact 20 of the relay m_1 of the alarming part and thus is operated, on one hand closing the contacts 11 and 21, so that said relay s_1 is held by said contact

11 and on the other hand opening the contact 31 to cut off the circuit of the previously-operated relay m_1 and deenergize this relay. This is accomplished in the following manner. Current flows from positive terminal 76, circuit closer j, wire 90, circuit closer 20, wire 93, winding of relay s_1, wire 94, circuit closer 32, wire 96, circuit closer 33, wire 98, circuit closer 34, wire 100, circuit closer 35 and to negative terminal 102. The energization of relay s_1 opens contact 31 and thus the circuit through relay m_1 is broken and that relay is deenergized thus opening the circuit closer 20. The circuit closer 11 is, however, closed and a holding circuit is established from the relay s_1 through the wire 82 from the positive terminal 76 over the same circuit as closed the holding circuit for relay m_1.

(13) Further, the contact h'' of the relay S is closed to energize the second relay 1S. This circuit passes from the positive terminal 41 through circuit closer 2, wire 66, circuit closer 5, wire 67, circuit closer 9, wire 68, circuit closer d', wire 69, circuit closer d_1, wire 70, circuit g, wire 71, circuit closer h'', wire 74, winding of relay 1S, wire 73 and wire 48 to negative terminal 49. The energization of relay 1S closes the circuit closer f' and thus establishes a holding circuit from the positive terminal 41 as before to the wire 71 and then through circuit closer f', wire 74, the winding of relay 1S and to the negative contact 49 as before. The energization of the relay 1S also opens the circuit closer g' and thus breaks the circuit through the relay S and deenergizes this relay so that the circuit closers j and h'' open. The energization of the relay 1S also closes the circuit closer h' in preparation for closing a circuit through the circuit closer 1S'.

It will now be seen that, in the bank of relays which ultimately control the signalling circuit, the relay m_1 is cut out and that the relay s_1, being held energized by its holding circuit, holds the circuit closer 21 closed in preparation for the energization of the relay m_2.

If the next regular signal impulse arrives during the regular time after the beginning of the space, the contact 1 is closed as described above to energize the relay 1M and then a second after the second relay 2M. Also, the contact d'' is opened to cut off the circuits of the relays E, S and 1S. Then, 2 seconds later, the relay 2M is operated to open the contact b' and consequently the relay 1M is reset and also it energizes the relay m_2 of the alarming part by means of the closed contact e_1, which relay m_2 holds itself by its contact 12. The relay s_1 is deenergized by the open contact 32. The circuits here follow the same course as described for the energization of relay m_1 except that from the wire 86 current flows through the wire 85, circuit closer 21, wire 95, winding of relay m_2, wire 96 and as before to the negative terminal 103. Upon energization of the relay m_2, the circuit closer 32 is opened which cuts out the relay s_1. Also the circuit closer 18 is closed to establish a holding circuit for the relay m_2 and the circuit closer 22 is closed in preparation for establishing a circuit through relay s_2. Upon termination of this second signal impulse the relay S is energized as before and this starts a train of operations which eventually deenergizes relay m_2 and energizes relay s_2. It is not thought necessary to trace the circuits here because they can be traced by following the circuits for relays m_1 and s_1.

The abovementioned operation is repeated, shifting the operation of the relays of the alarming part successively every time till the last relay s_3 operates, when by its contact 25 the circuit of the alarm L is closed and the operation of the said relay is continued by the contact 15. Also, the current of the previously-operated relay is cut off at the circuit closer 35 which is opened by energization of the relay s_3, the circuit closers 15 and 25 being closed. It will be noted that, independently of the remaining of the apparatus a holding circuit may be maintained through the relay s_3, since, if the switch K be closed current will flow from the positive terminal 104, switch K, circuit closer 15, wire 101, winding of relay s_3 and wire 103 to the negative terminal 103. The alarm circuit proper passes from the current source 105' through the series connected bell 106 and circuit closer 25 back to the source 105 so long as the relay s_3 is energized.

There will now be considered those deviations from normal signalling operations such as impulses of less lengths than three seconds and of greater lengths than five sections, it being remembered that the delayed action of the relay 1M is arranged for one second and the relays 2M and 2M' each have a delayed action of two seconds. If the signal impulse fails to reach three seconds of duration, the relay 2M will not operate and consequently the operation dependent on relay 2M above described for any of the relays m_1, m_2 and m_3 cannot take place since this relay 2M' will not be effectively energized for the terminal bank of relays. When, however, the received signal impulse lasts for three seconds the relay 2M operates as described above and the circuit of the first space relay S is brought to a condition open at only the contact d' of the relay 2M, and accordingly if the signal impulse discontinues in 3 seconds and said contact d' is closed, the said relay S starts the operation. If the signal impulse does not last 3 seconds and the contact 1 is opened, the relay 2M is deenergized and does not reach the time limit, so that the contact e remains in an open condition and the relay C is deenergized to open its contact 7 and cut off the circuit of the line q leading to the alarming part, thus deenergizing the relays m_1 s_1, etc. kept in an operative condition by their holding circuits provided any exist in such condition that they have been energized and their holding circuits established. If the signal impulse time exceeds the longest regular time interval, namely 5 seconds, the contact of the relay 2M' operates after the operation stated in (10) and opens the contact d, thus cutting off the circuit of the line q and releasing the operation of the relays of the alarming part as stated before.

Figure 4 shows a relation between the periods of starting and stopping the operation of the "space" relay for the lengths of the regular signal and the space. In y_1 the lengths of the signal m and time space are 4 and 1 seconds respectively. In y_2 they are 3½ and 1½ seconds respectively. In the former, the "space" relay S begins to be energized every 4 seconds as shown at S_0 and a circuit leading to the "space" relay is cut off every 6 seconds by the opening of the contact d' of the relay 2M. The latter case may be easily understood from the above explanation.

The "space" relay mechanism thus starts its operation with the commencement of the space time and operates the relays S, 1S and 1S' successively at the predetermined time limits, ½, 1 and 2½ seconds. On the other hand, if a signal impulse arrives during the progress of these op-

erations of the relay system, said "space" relay is reset, only when said signal impulse still lasts one second after it begins. Therefore, if a signal impulse begins after the "space" lasted more than 1½ seconds, the time limit of the third "space" relay 1S' comes before the relay 1M reaches its time limit, so that the contact *i'* of the relay 1S' connected with the line *q* is opened to cut off the holding circuit of the relay m_1, s_1, etc. If a signal lasts more than 5 seconds, the relay 2M' operates similarly to open the contact *d* and cut off the same holding circuit.

If there be considered the possibility of an interference by the ordinary speed signal such as is used in transmitting messages, it is obvious that the one superposing its regular alarm signal impulse has no effect whatever upon the operation of the relay A. Also, since in the "space" time every word of the ordinary Morse code has a duration of less than 1 second on an average as shown in Figure 4, T, it includes several spaces *t* and the relay A opens and closes the contact every time, but after all does no more than cut or keep the current of the relay 1M.

In the present invention, the alarm is not operated by an interference or noise, nor does any extraneous signal impulse arriving in the "space" time hinder the progress of the operation of the "space" relay mechanism. The alarm is operated only when the regular alarm signal impulse and space are repeated certain times. Otherwise, the already operated part of the apparatus constituting this invention is restored to normal condition.

I claim:

In a signal receiving apparatus, a master impulse receiving relay having a normally closed circuit closer and a normally open circuit closer, a control relay, circuit connections between said normally open circuit closer and the control relay including a normally closed circuit closer, a set of primary delayed action relays including a first primary relay and a plurality of successive primary relays including second and third primary relays, said plurality of relays including normally closed circuit closers each associated with a respective relay to open upon energization thereof, said last mentioned circuit closers being connected in series between the normally open circuit closer of the master relay and the first primary relay, each of said primary relays except the last including a normally open circuit closer closed by the energization of the respective relay to establish a circuit through the next succeeding relay, means actuated by the energization of each of the plurality of primary relays to establish a holding circuit through the energized relay, a pair of supplemental relays including first and second supplemental relays, means to establish a circuit through the first of said supplemental relays including a normally open circuit closer associated with the second of the primary relays and closed upon energization thereof, said first supplemental relay including a circuit closer in series connection to the winding of the second supplemental relay, said series connection including a normally closed circuit closer opened during energization of the first primary relay, means to establish a holding circuit through the second supplemental relay and including a normally open circuit closer closed upon energization of the second supplemental relay, a series of delayed action space relays including a first space relay and a plurality of other space relays, said plurality of space relays including normally closed circuit closers each associated with a respective relay to open upon energization thereof, said last mentioned circuit closers being connected in series between the normally closed circuit closer of the master relay and the first space relay, said connection including in series a normally open circuit closer closed by energization of the control relay and normally closed circuit closers opened respectively by energization of the second supplemental relay and the second and third primary relays, each of said space relays except the last including a normally open circuit closer closed by energization of the respective relay to establish a circuit through the next succeeding relay, means actuated by the energization of each of the plurality of space relays to establish a holding circuit through the respective space relay, the circuit of the second supplemental relay including a normally closed circuit closer opened by energization of the third space relay, a set of alternately arranged secondary impulse and space relays, a branch from the circuit of the first supplemental relay to the first relay of the secondary set, a normally open circuit closer for each relay of said secondary set, each of the last mentioned circuit closers except the last being connected in series to the next succeeding relay of the set, said last mentioned circuit closers except the last of the set being connected in multiple, a normally open circuit closer closed by the energization of the first relay of the first space set, means to establish holding circuits in the secondary relays each including a normally open circuit closer closed by the energization of the respective relay, each of said secondary relays except the first including a normally closed circuit closer opened by the energization of the respective relay, said last circuit closers being arranged in series and having the relays connected in multiple thereto, and an alarm device including the first mentioned circuit closer of the last relay of the secondary set, an alarm and a current source connected in series.

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