This is a continuation-in-part of application Serial No. 414,704, filed March 8, 1954 by Albert F. Sperry and Robert J. Marmorstone on an "Alarm and Annunciator System," now abandoned.

This invention relates to annunciator systems and more particularly to an annunciator system which includes relay apparatus usable with either normally closed or normally open signal contacts.

 Annunciator systems usually comprise a condition-responsive element, such as a thermocouple or the like, associated with each test point or variable to be monitored and which includes a pair of cooperating electrical contacts which open or close when the associated test point or variable is normal and which respectively close or open when the associated test point or variable is abnormal. Each set of signal contacts or condition-responsive contacts are associated with relay circuitry which in turn control various audible and visual alarm annunciator units. Where a large number of test points are involved, such as is common in power plants and other large industrial installations, the various relay circuits directly controlled by the signal circuits are tied into common busses wherever possible and brought to a central indicating and control panel where, by means of indicating lights or the like, an operator may monitor the various test points from a central location and may perform various control operations with respect thereto.

For example, it is common to include on such control panel a separate light for each test point which lights up when the associated test point becomes abnormal and an audible alarm common to all of the test points which is sounded the instant any test point becomes abnormal. Therefore, it will be appreciated that attention to a particular part of the control panel which indicates the location of the abnormality. An acknowledge push button is generally provided which de-energizes the audible alarm so that the alarm may be operated by the initiation of other abnormal conditions for other test points in the system.

Certain industrial applications, for example, power plant applications, prefer to utilize normally open signal contacts to minimize drain on the battery system used for energizing the annunciator circuits; on the other hand, many chemical and other industries prefer to utilize normally closed alarm contacts where the circuit in which the contacts are located draw current in their normal position. Hereinbefore, the relay apparatus which controlled the visual and audible annunciator units were variously designed for signal contacts having normally open and normally closed contacts, respectively. In accordance with this invention, the same relay apparatus produces identical operation of the visual and audible annunciator units when used with normally open or normally closed contacts. This results in standardization of the components making up the annunciator system.

The foregoing and other features of the invention will be understood more clearly upon a study of the description which follows with reference to the drawings appended hereto. It should be understood that a number of specific features are here described and illustrated as being preferred for certain purposes, which may be omitted without deviating from the broader aspects of the invention.

In the drawings:

FIG. 1 is a schematic diagram of one embodiment of the invention;
FIG. 2 is a modified form of the embodiment of FIG. 1; and
FIGS. 3 and 4 are across the line diagrams of a third embodiment of the invention with different jumper connections to adapt the same relay apparatus for use on normally open and normally closed contacts.

Referring first to FIG. 1: A panel or cabinet 10 is provided to interconnect a series of signal switches 11A, 11B, etc., with a corresponding series of visual alarm annunciators 24A, 24B, etc., forming part of an alarm light cabinet or panel 25, preferably close to or even integral with the basic panel or cabinet 10. Each signal switch 11A, 11B, etc., is suitably incorporated in or associated with a machine or field unit to be protected by the alarm system, by well known thermostatic means, liquid pressure responsive means or equivalent apparatus (not shown).

An important feature of the present system is that any one, more or all of the signal switches 11A, 11B, can be normally open or closed and that nevertheless no modification whatsoever is required in the structure and arrangement of the entire panel or cabinet 10, including the bus wires, plug-in sockets, plug-in relay devices and other elements thereof. The only pertinent requirement is that connections 20-30A, 20-9B, etc., must be plugged into socket terminals 20-11 or 20-9 provided on the panel 10, depending on whether the corresponding alarm light cooperates with the normally open or normally closed signal switch 11A, 11B, etc.

At a suitable location, usually at a central point in the plant, an audible alarm device such as a loud horn 12 is provided in order to alert practically the entire plant personnel whenever and any one of the signal switches 11A, 11B, etc., changes from its normal (open or closed) to its abnormal (closed or open) position. By means of the three relay construction of the plug-in unit, each horn operation is initiated in the starting or alerting phase of each alarm program, and also in a return alarm or all-clear sounding phase thereof, regardless whether the alarm initiating signal switch 11A, 11B, etc., is normally open or normally closed; no modification of the wire system whatsoever being required and utilized in this connection.

At or near said central location there is also provided a push-button station 13 in order to allow the plant superintendent to acknowledge the alarm alert and silence the horn, and also suitably to modify the other visual alarm announcements, caused by the alerting phase, as soon as the alert has been noted and remedial action started. For such and related purposes the push-button station contains a push button 15, the interconnections of which will best be explained hereinafter. It may be noted at this point that the same push button also serves to reset the system in its normal position when a return alarm has been sounded and visually indicated, which last-mentioned sounding and visual indication is occasioned by the return of the alarm initiating signal switch 11A' or 11B', etc., into its normal (closed or open) position.

Thus the complete alarm program according to the present system, which can be caused by any of the normally open or normally closed signal switches 11A, 11B' moving into abnormal and then back to normal position, comprises the following phases:

(1) A signal switch 11A', 11B', etc., moves into abnormal position; this causes transmission of audible alerting signals to the plant and control station through the horn 12 and of a corresponding visual alerting signal to the control station through the corresponding light unit 24A; the preferred visual indication of this phase being flashing of this light unit (alert or alerting phase).
(2) The superintendent acknowledges the alert by depressing the push button 15; this causes transmission of a primary alarm modifying signal to the plant by silencing the horn 12 and transmission of a primary alarm modifying signal to the control station by modification of the annunciator 24A, which at this time preferably becomes steadily illuminated (acknowledged condition).

(3) The signal switch responsible for the original alert moves back to normal position; this causes transmission of a new audible or all-clear signal to the plant through the horn 12 and to the control station through the aforementioned alarm light unit which begins to flash again (return alert).

(4) The superintendent depresses the push button 15 again, which at this time transmits final reset signals, different from those caused by the first depression of the push button. The horn is silenced again and the aforementioned alarm light unit at this time is extinguished (reset or normal position).

For the detailed circuit analysis which follows, it may be assumed that the signal switch 11A is normally open and that the signal switch 11B is normally closed.

The signal switch 11A is interconnected with its corresponding light unit 24A by a relay plug-in device 17A. Switch 11B is similarly interconnected by a relay unit 17B. These relay plug-in units 17A, 17B, etc., are identical with one another in every respect, as shown, although their starting switches 11A, 11B operate in manners basically opposite to one another as mentioned.

Eight bus wires are shown within the panel or control box 10. In addition, there is provided a hot wire H which need be not connected to the other relay plug-in units 17A, 17B, etc., and which accordingly is shown outside the panel, thereby limiting the system of bus wires installed on the panel. This system comprises: a lamp control wire R; a light flashing wire F; a lamp test wire T; an acknowledgment and reset control wire C; and a neutral wire N. These bus wires C, R, F, T and N are the only bus wires installed within the cabinet which are utilized in the operation to be described hereinafter. In the interests of standardization, which is a slighted simplified system or group of systems to be described hereinafter, there are also shown bus wires K, FR and RR, on the control panel, which can be disregarded for present purposes. However, it is preferred to interconnect them with the corresponding terminals on the plug-in sockets, in manner identical with that described hereinafter.

As is shown in FIGURE 2: the material and labor involved in such standardization being insignificant in cost and conducive to much greater simplicity and safety in mass production and mass testing.

For the flashing operation mentioned above, there is provided a flasher switch 17S interposed between the neutral wire N and the light flashing wire F, and operated by a flasher motor 17M which is connected in parallel with the horn 12, between the neutral wire N and the horn wire R. A flasher relay 17Y is formed by this flasher switch and flasher motor and it is usually sufficient to provide a single flasher relay of this kind for a very large number of individual alarm relay units 17A, 17B, etc., cooperating therewith.

The reset and acknowledgment control wire C is connected with the hot wire H through its push button 15 which is normally closed, thereby normally making this control wire the source of electric current for the entire system, together with the neutral wire N.

Coming now to the details of the branch circuits interconnecting the foregoing major parts of the alarm system, and referring particularly to the branch circuits associated with the normally open signal switch 11A:

The relay or plug-in unit 17A has eleven connector plugs, inserted in corresponding connector socket terminals, all of which are schematically shown at X-1 to X-11. Connected with these plugs the unit 17A has three relay coils A', B', and C', each of which has one terminal connected with the neutral wire N by the plug X4.

The other terminal of the coil A' is connected by the plug X10 with one side of the signal switch 11A', the other side of which is connected with the hot wire H. A terminal Y-10A is interposed on this connection, between the plug X10 and the switch 11A', and similar terminals Y-10B, Y-10C, etc., are provided for the similar plugs X10 of the other relay units 17', etc. The entire series of relay through the interconnection with the coil A' is incorporated in a single compact terminal unit X, such as an insulating strip with suitable binding posts or the like, which preferably is located in the back of the cabinet 10 at a conveniently accessible point in order to facilitate installation, interconnection with different locations in the field, maintenance and checking.

The control wire C, through the connector plug X3, is connected with three circuits, two of which have shunts. One of these circuits leads to the free terminal of the coil B' and has a normally open switch B1' interposed thereon, and a normally closed switch A1' interconnected. The circuits mentioned lead to the horn wire R and has interposed thereon normally open switches B2' and C1' in series. The last of the three circuits mentioned leads to the free terminal of the coil C' and has the normally open switch A2' thereon and the normally open switch C2' on a shunt around A2'.

It will be understood that all switches identified as A1', A2', etc., are located within the plug-in unit 17A' and controlled by the coil A', and correspondingly all switches identified as B1', C1', etc., are similarly located and controlled by the corresponding coils B', C', etc.

Connections to and from the lamp unit 24A are made through the aforementioned jack 20-9A which can be inserted either in a corresponding socket terminal of a socket 20-9 or in a socket 20-11; said sockets being interconnected with corresponding terminals X9 and X11 on the plug-in unit 17A'. Two alternative connections are thus provided, one of which is used in the present case where the signal switch 11A' is normally open, while the other is utilized in connection with the normally closed switch 11B'. The sockets 20-9 and 20-10 are used in connection with the normally open signal switches 11A'; etc., and their corresponding relay units 17A'; etc., whereas the sockets 20-10 and 20-11 are used with the normally closed signal circuits.

In either case connections are made so that if desired, a single lamp, with a backlighted nameplate in front, can distinctively and clearly indicate the several states or phases of any alarm initiated by the corresponding switch and relating to a clearly identified plant unit.

For these purposes the lamp terminal plug X9 connected with the corresponding lamp through the socket 20-9 has two primary branches connected therewith in the relay plug-in unit 17A', containing respectively normally open and normally closed portions A3' and A4' of a double-throw switch. The normally open portion A3' in turn has two branches within the unit 17A' containing respectively normally open and normally closed portions B3' and B4' of another double-throw switch. The latter portions are connected respectively through the connector X7 with the flasher bus F and through the connector X4 with the neutral wire N. The normally closed portion A4' of the first mentioned double-throw switch has another pair of branches in the relay unit, containing respectively the normally open and normally closed parts C3', C4' of still another double-throw switch, connected respectively through the plugs X7 and X5 with the flashing wire F and the testing wire T.

The interconnection of the common terminal X9 with the corresponding lamp 24A could theoretically be obtained by a terminal strip arrangement similar to that
shown at Y for the corresponding signal switch corrections. However, there is a practical difference between
the signal switch and signal lamp connections. The former inherently require individual hook-up arrangement with
remote field stations, whereas the latter are desirably unitized in a compact panel or a lamp bezel adjacent the
panel 10, and it is frequently desirable to establish, separate and re-establish connections between the relay and
lamp panels 10, 25, for testing and other purposes. It is for this reason that the use of jack or plug connectors
20-9A, etc., is preferred at this point. It will also be noted that the corresponding sockets 20-9, 20-11 are inter-
changeable with corresponding sockets shown in the co-pending application Serial No. 312,821.

The system of branch circuits in the unit 17A, connected with the switch 11A' and lamp 24A, is completed by a circuit and shunt around the same connected with the free terminal of the coil 1C. Said circuit contains the normally open switch 2A' while the shunt contains the normally open switch 2C'. Connection is thus made to the acknowledgment and reset control wire C, through the terminal X3.

The horn 12 and control switch 15 as well as a lamp termed 1I, to be described hereinafter, are desirably connected with the wiring of the panel 10 in manners similar to that used for the connections of the signal switches 11A', 11B', etc., that is, through a terminal strip W' arranged to facilitate individual field connections of permanent nature, as indicated for instance at WN', WR' for the horn 12.

The details of the alternate lamp circuit and its terminal X1I, connected with the normally closed signal switch 11B' and corresponding lamp 24B, will be described hereinafter. At the present point it may be noted that the panel is 10, in addition to the bus wires described above, a row of identical plug-in devices 17A', etc., of the lamp plug-in sockets 20-9, 20-11, the flasher relay 17F, a pair of terminal strip units W and Y for connection with the alarm equipment 12, 15, 16 and the signal equipment 11A', 11B' respectively, and of course a series of plug-in sockets, diagrammatically shown at X1, etc., for the plug-in relay units 17A', 17B', etc.

**OPERATION WITH NORMALLY OPEN SIGNAL SWITCHES**

The signal switches 11A', etc., as mentioned are normally open. The corresponding jacks 20-9A, etc., as mentioned are inserted in the sockets 20-9.

The corresponding lamp units 24A, etc., are normally "off." The plant-wide audible annunciator 12 of course is normally "off."

In the relay units 17A', etc., the coils A' are connected and disconnected through the signal switches 11A'; the coils B' are normally energized through normally closed switches A1' and self holding through switches B1'; and the coils C' are connectable through normally open switches A2' and self holding through switches C2'; the circuits of connecting and self-holding switches A1', B1', A2' and C2' being controlled by the push button 15.

Accordingly it will be seen that as a result of the normal open condition of the signal switch 11A', the coil A' is normally de-energized; the coil B' is normally de-energized through A1'; and the coil C' is normally de-energized.

As a further result it will be seen that the bus wires R and F are normally de-energized, all connections thereof being at least one normally open switch C1', A3' and C3'. Thus neither horn actuation nor flashing of lamp 24A, etc., occurs normally. Nor is lamp 24A steadily illuminated in the normal position, the remaining connections thereof being open at B4' and 16 respectively.

Upon the occurrence of an abnormal condition in the protected plant unit or machine, the signal switch 11A' closes. This energizes the coil A', this in turn closes the switch A2' thereby energizing the coil C'. The energized coil B' remains energized at B1'. Thus all coils A', B' and C' are now energized. Due to the closing of the switch C1' and the switch B2', the horn wire R is energized and the horn 12 begins to sound. In parallel there with the flasher motor 17M begins to operate. The switches B3' and A3' connecting the lamp 24A with the flashing bus wire F are now closed, and the lamp 24A begins flashing (a steady illumination of lamp 24B, etc., may simultaneously exist in connection with another signal switch 11B', etc., but no interference will occur, the flashing connections and steady illuminating connections of the lamps being made through separate wires F and N and separate relay switches as described).

Acknowledgment of the alarm, by momentarily depresssion of the push button switch 15, momentarily de-energizes the control bus C and thereby the plugs X3. This results in momentary de-energization of the coils A' and C'. The coil B' remains de-energized, its self-holding switch B' having opened and its starting switch A1' being held open by the energized coil A'. The coil C' is promptly re-energized upon release of the push button 15, through the switch A2' which is held closed by the coil A'. Thus the coils A' and C' are energized during the acknowledged alarm condition. The horn sounding and flashing connections are eliminated thereby as described, whereas the lamp 24A is now connected to the neutral wire N through the switches A3' and B4' and to the hot wire H through the reclosed acknowledgment switch 15. Thus during the acknowledged alarm condition further disturbance of the plant personnel by sounding of the horn is avoided whereas the lamp 24A continues to indicate the existence and exact location of a danger condition.

When that condition has been removed, the signal switch 11A' opens again thereby de-energizing the coil A' again. This re-energizes the coil B' through the normally closed switch A1', while the coil C' remains energized through the seal-in switch C2'. Thus the return alarm position which now follows is characterized by de-energization of the coil A' and energization of the coils B' and C'. The one bulb F and flasher relay 17F are connected again, as before; the horn sounds and the lamp 24A shows a return alert or all-clear signal for the unit previously alerted, while the previous steady illumination of the lamp 24A is broken at B4'.

Renewed operation of the push button 15 again momentarily de-energizes the coils B' and C'. This time the coil B' is re-energized through the normally closed switch A1' while the coil C' still is de-energized at A2'. Thus the normal position of the system, wherein only the coil B' is energized, is re-established and all annunciators are "off."

It will thus be seen that the sequence of operations described up to this point can be summarized as follows:

**Operation With Normally Open Signal Switches**

<table>
<thead>
<tr>
<th>Photo</th>
<th>A'</th>
<th>B'</th>
<th>C'</th>
<th>24A</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>Flashing..</td>
<td>E</td>
</tr>
<tr>
<td>Acknowledged Alarm</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Flashing..</td>
<td>E</td>
</tr>
<tr>
<td>Return Alert</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Off..</td>
<td>D</td>
</tr>
<tr>
<td>Reset (Normal)</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Off..</td>
<td>D</td>
</tr>
</tbody>
</table>

It will be understood that in this chart the letter D signifies "de-energized" while the letter E signifies "energized."

**OPERATION WITH NORMALLY CLOSED SIGNAL SWITCHES**

As noted above, the lamps 24B, etc., to be used with normally closed switches 11B', etc., are plugged in at 20-11 rather than 20-9. As a result, they utilize the lamp connections originating at the plug X-11 while the horn connections remain the same as described above.

The plug X-11 has connected therewith, within the
relay unit 17A', and identically in the unit 17B' utilized in the present instance, two circuit branches having interposed therein the normally closed and normally open portions A5' and A6' of a double-throw switch controlled by the coil A'. The branch A5' in turn has two branches having interposed therein the normally open and normally closed sides C5' and C6' of a double-throw switch operated by the coil C', connected respectively through plugs X-7 and X-4 with the flashing and neutral wires F, N. The other branch A6' has two branches with the normally open and normally closed sides B5', B6' of a double-throw switch controlled by the coil B'; connected respectively through the terminals X-7 and X-5 with the flashing and test wires F, T. It may be noted that the connections are substantially the reverse of those shown at X-9. Thus it will be understood without further detailed analysis of the corresponding circuits that with the present method of plugging in at 20–11 and without change as to the horn 12, there is obtained the following:

**Operation With Normally Closed Signal Switches**

<table>
<thead>
<tr>
<th>Phase</th>
<th>A'</th>
<th>B'</th>
<th>C'</th>
<th>24A</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Flashing...</td>
<td>E</td>
</tr>
<tr>
<td>Acknowledged Alarm</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Flashing...</td>
<td>E</td>
</tr>
<tr>
<td>Return Alert</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Flashing...</td>
<td>E</td>
</tr>
<tr>
<td>Reset (Normal)</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>Flashing...</td>
<td>E</td>
</tr>
</tbody>
</table>

Testing of the different lamps 24A, 24B, etc., whether connected at 20–9 or 20–11, is conveniently effected by depression of the push button 16, which as shown is interposed between the neutral wire N and the test wire T. If such depression of the push button occurs during the other or energized condition of the lamps, such as the normal position of the system, it energizes the lamps 24A connected at 20–9, through the switches C4' which in this method of interconnection are normally closed. It likewise connects the lamp 24B plugged in at 20–11 through the switches B6', which in this latter condition are normally closed. Thus there is provided a convenient single testing operation, regardless of the other variations of announcements as described.

**The Modification of Figure 3**

The jack 20–9A, 20–9B, etc., can be replaced by the poles of single-pole double-throw switches 20SA, 20SB, etc., preferably of the toggle switch type, so that it is not even necessary to modify the insertion of jacks and corresponding cords when changing over from normally open to normally closed arrangements as at 11A', 11B'. In this modification it is merely necessary to provide on or near the panel 10 a double-throw switch 20SA, etc., for each annunciator light 24A, and to interconnect the common leg or permanently connected terminal of each switch 20SA, etc., with the respective light 24A, etc. (in the same manner as the sockets 20–9 or 20–11 are connected therewith by the jacks 20–9A, etc., in figure 1). The sockets 20–9, 20–11 can be omitted; the wires C–9, C–11 from the relay plug-in terminals X–9, X–11 can be connected with the alternate legs or terminals of the corresponding switches 20SA, etc., with or without terminal strips 20–9A, 20–11A interposed, depending on whether the switches are on or away from the panel 10.

**The Modification of Figures 3 and 4**

In the embodiment of FIGS. 3 and 4, the same plug-in unit is utilized with normally open or normally closed field contacts. However, the number of relays and the number of contacts per relay are reduced over the embodiment shown in FIGS. 1 and 2. Further, in the modification of FIGS. 3 and 4, the alarm light 24A remains fixed in the circuit when operating from normally closed or normally open field switches. Instead of relocating the alarm light when changing from normally open to normally closed signal switches, or vice versa, the jumper lead JL connected to the No. 8 plug-in terminal of the plug-in unit 17a is relocated from its position in connection with the H supply line where normally open field switches contacts are utilized to the normally closed supply line (see FIG. 4) when used with normally closed field contacts. No other changes are required.

The same plug-in unit is usable with either normally open or normally closed signal switch contacts in the embodiment of FIGS. 3 and 4, because of the particular arrangement of the signal contacts in the circuit, and because of the connection of the addition of a series resistor R in the A relay coil circuit between the N and H supply lines. In this embodiment, the field contacts, whether normally open or normally closed, are connected between the H supply line and the terminal of the resistor R supply line and the terminal of the resistor R which is remote from the resistor terminal connected to the N supply line. The resistor R and the field switch contacts are therefore always in series across the supply line. When the jumper lead JL is connected to the H supply line as shown in FIG. 3, where normally open field switch contacts are used, the relay coil is in parallel with the field switch contacts so that the A relay coil is de-energized upon the initiation of an abnormal condition. On the other hand, where the jumper lead JL is connected with the N supply line as in the normally closed field switch arrangement of FIG. 4, the A relay coil is in series with the field contacts so that the opening of the field contacts in response to an abnormal condition of a variable also results in the de-energization of the A relay. The identical annunciating sequence therefore exists whether the system is connected with normally opened or normally closed field switch contacts.

Refer now to FIG. 3 for a more complete description of the circuitry. As there shown, each relay plug-in unit 17a has only two relays, namely an alarm relay A and an acknowledgment relay B. The alarm relay A is connected in a circuit extending from the N supply line through a current limiting resistor R, the No. 2 plug connector of the relay unit 17a, the relay coil A, the No. 8 plug connector of the relay unit 17a, through the jumper lead JL connected with the H power line. The field contacts 11A' have one terminal connected to the H supply line and the other terminal connected in the line leading to the No. 2 plug-in terminal of the plug-in relay unit 17a. The field contacts 11B' are connected in shunt with the A relay coil so that upon the existence of an abnormal condition of the variable which controls the field contacts, the field contacts will close shunting out the A relay coil from the supply line. The resultant de-energization of the A relay results in the energization of the horn 12 and the flashing on indication of the alarm light 24A.

The energization circuit of the horn 12 can be traced from the N supply line, through the horn 12, the common R bus, the No. 6 plug-in terminal of a relay unit 17a, the normally open but then closed contacts B2 of the acknowledge relay coil B, the then closed normally closed contacts A2 of the alarm relay, the No. 3 plug-in terminal of the relay unit 17a, the common acknowledge bus C, and through the normally closed acknowledge push button switch 15 leading to the H supply line. The expression "normally closed or open" relay contacts means that the relay contacts have these respective conditions when the associated relay is de-energized.

The energization circuit of the alarm light 24A can be traced from the N supply line through the interupter contact 17mf of the flasher unit 17f, common flasher bus F, the No. 7 plug-in terminal of the relay unit 17a, the normally closed contacts A–5, the then closed normally open contacts B2, the then closed plug-in terminal of the relay unit 17a, the alarm light 24A, the common acknowledge bus C, and through the then normally closed acknowledge push button switch 15 leading to the H.
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supply line. The flasher contacts 17mf are active because the flasher motor 17m is connected in parallel with the horn between the N supply line and the common horn bus R.

The energization circuit of the acknowledge relay B can be traced from the N supply line, the No. 4 plug-in terminal of the relay unit 17A, the acknowledge relay coil B-1, the No. 3 plug-in terminal of the relay unit 17a, the common acknowledge bus C, and through the normally closed push button switch 15 leading to the H supply line.

When the operator is attracted by the sounding of the horn 12, he depresses the acknowledge push button 15 which breaks the holding circuit of the B relay to de-energize the same. Release of the acknowledge push button 15 does not result in the re-energization of the acknowledge relay B because the normally opened contacts A1 in parallel with the B relay holding contacts B1 are open due to the de-energized condition of the A relay.

The de-energization of the B relay changes the flashing indication of the alarm light 24A to a steady-on condition and de-energizes the audible alarm 12. The latter occurs because the aforementioned normally open contacts B2 are then opened which interrupts the energization circuit of the audible alarm 12.

The alarm light 24A is in a steady-on condition because of the establishment of an energization circuit extending from the N supply line through the No. 4 plug-in terminal of relay unit 17A, the then closed normally closed contacts A7, the then closed normally closed contacts B5, the alarm light 24A, the common acknowledge bus C and through the then closed acknowledge push button switch 15 leading to the H supply line. The circuit between the flasher bus F and the series circuit of normally open contacts B4 which connects with the flasher bus through the then closed normally closed contacts A5.

Upon return to normal of the variable involved, the field contacts 11A will open thereby re-energizing the alarm relay in the shunt circuit including the field contacts open.

The re-energization of the A relay effects the re-energization of the B relay as the normally open contacts A1 close. The B relay then seals in through its holding contacts B1. The audible alarm 12 is not sounded at this time because the normally closed contacts A2 have opened. The alarm light 24A is extinguished because of the opening of contacts A7 and B5 in one of the alternate energization circuit branches of the alarm light 24A. The other branch of the energization circuit of the alarm light 24A is energized because of the opening of normally closed contacts A5.

To test the operation of the alarm light 24A, the test push button 16 is depressed which if the alarm light 24A is in operating condition will energize through a circuit extending from the N supply line, the push button 16, the common test bus T, the No. 5 plug-in terminal of the relay unit 17A, the then closed contacts A4 (normal operation is assumed), the then closed contacts B4, the No. 1 plug-in terminal of the relay unit 17A, the alarm light 24A, the common acknowledge bus C, and through the then closed acknowledge push button switch 15 leading to the H supply line.

The circuit shown will give an alarm also upon failure of either the A or B relay coils. Since the A relay coil is normally energized, failure of this coil will result in an audible alarm since the circuit operates identically as if the normally opened field contacts have closed. One of these circuit branches effects an alarm when the A relay coil is energized. This branch includes a series circuit of normally closed contacts B3 and normally open contacts A3 which shunt the normally open contacts B2 and the normally closed contacts A2 in the energization circuit of the audible alarm 12. With the A relay energized, failure of the B relay will result in the energization of the audible alarm because of the establishment of this new branch circuit upon the closing of the normally closed contacts B3 in series with the then closed normally open contacts A3.

Failure of the B relay during energization of the A relay will also result in the flashing of the alarm light 24A due to the establishment of an energization circuit therefor extending from the N supply line, the interrupter contact 17mf of the flasher motor unit, the common flasher bus F, the No. 7 plug-in terminal of the relay plug-in unit 17A, the then closed normally open contacts A6, the normally closed contacts B5, the alarm light 24A, the common acknowledgment bus C and through the normally closed push button switch 15 leading to the H supply line.

As previously stated, it is unnecessary to review the operation of the annunciator circuit when used with normally closed field contacts because in the latter situation opening of the field contacts during an abnormal condition results in the de-energization of the alarm relay A since the field contacts are then in series with the A relay coil due to the relocation of the jumper lead JL.

The relay apparatus thus operates in the same manner whether normally open or normally closed contacts are used.

It should be understood that numerous variations may be made in the circuitry above described without departing from the spirit of the invention.

I claim:

1. Annunciator apparatus for monitoring a series of field stations, a signal switch for each field station adapted to assume a normal and an abnormal position, respective annunciator means associated with said signal switches for indicating the position of the corresponding signal switch, manually operable control switch means for modifying the indication of said annunciator means, relay control apparatus for each signal switch and associated annunciator means, each relay control apparatus having signal switch connecting terminal means adapted for selective connection to signal switches having normally closed or normally open contacts, a first set of annunciator connecting wires leading from said respective relay control apparatuses, a second set of annunciator connecting wires leading from said respective relay control apparatuses, means for selectively connecting said respective annunciator means to one or the other of said sets of annunciator connecting wires depending on whether said signal switch connecting terminal means are connected to normally open or normally closed signal switches, means including means interconnecting said first set of annunciator connecting wires with their associated relay control apparatus for providing a given sequence of respective annunciator indications on the associated annunciator means during the following sequence of operation of a normally closed signal switch and said control switch means:

   (a) opening of such signal switch,
   (b) manual operation of said control switch means,
   (c) closing of said signal switch, and
   (d) manual operation of said control switch means,
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(c) opening of said signal switch, and then
(d) manual operation of said control switch means.
2. Apparatus as described in claim 1 wherein said se-
lective connecting means comprise a number of double-
throw switch contacts respectively connected with the
corresponding annunciator means and adapted to make
alternate connection with said terminals of the associated
pair of connecting terminals.
3. Apparatus as described in claim 1 wherein said con-
necting terminals and selective connecting means are co-
operating plug and socket connectors whereby the an-
nunciator means associated with each signal switch may
be selectively connected with either terminal of the asso-
ciated pair of connecting terminals.
4. Apparatus as described in claim 1 wherein each re-
lay control apparatus comprises three separately ener-
gizable and de-energizable multi-pole relays of the two
position type, and circuit means interconnecting said re-
lays and their associated contacts with said signal switch,
control switch means and annunciator means for pro-
viding at least four different indications whether the sig-
nal switch is normally open or normally closed.
5. Apparatus as described in claim 4 wherein there is
provided means for energizing a pair of the relays to
provide one of the four indications; means for energizing
one of the relays to provide a subsequent indication;
means for energizing all three relays to provide the next
subsequent indication; and means for energizing another
pair of relays for the fourth indication.
6. Apparatus as described in claim 5 wherein the con-

trol switch means is connected in common with all of
said relays.
7. Apparatus as described in claim 5 wherein said
thrce relays are so connected that successive reversals
of the corresponding signal switch and intermediate op-

erations of the control switch means provide the follow-
ing sequence:

A B C
E E E
ED E

where A, B and C are the three relay coils, the A relay
coil being arranged to respond directly to a change in
position of the associated signal switch, D means de-
energized, and E means energized.
8. Apparatus as described in claim 5 wherein said
thrce relays are so connected as to provide the following
sequence when connected to one of said types of signal
switches:

A B C
E E E
ED E

by initial reversal of the corresponding signal switch,
subsequent momentary operation of the control switch
means, subsequent return of the signal switch to the
original position and final momentary operation of the
control switch means, respectively; A, B and C meaning
the three relay coils, D meaning de-energized, and E
meaning energized.
9. In an annunciator system, an alarm relay and an
energization circuit for said alarm relay in which signal
contacts are to be interposed for controlling the ener-
gization and de-energization of the alarm relay, second
and third control relays and respective energization cir-
cuits therefor, annunciator means and an energization
circuit therefor, acknowledge switch means and contacts
of said alarm relay in the energization circuit of said
second and third relays and adapted to de-energize said
second relay upon actuation of said acknowledge switch
means when the alarm relay is in one of its positions and
adapted to de-energize the third relay when the alarm
relay is in the other one of its positions, the energization
circuit of said annunciator means having two alternate
branches each containing contacts of all three relays, one
of said branches being arranged for operation with nor-


mally closed signal contacts and the other branch being
arranged for operation with normally open signal con-
tacts, and terminal means for selectively connecting said

apparatus means in either one of said branch circuits.
10. In an annunciator system comprising a set of signal
contacts adapted to assume opposite positions when the
associated variable is normal and abnormal, respecti-
vely, and an alarm relay and an energization circuit therefor
in which said signal contacts are interposed for controlling
the energization and de-energization of the alarm relay,
second and third control relays and means for holding
the same in one of their states of operation, respective
energization circuits for said second and third relays,
said alarm relay having a set of contacts in the energiza-
tion circuit of said second relay which operate the same
into its holding position when the alarm relay is in one
of its positions, the alarm relay having contacts in the
energization circuit of the third relay which operates the
third relay into its holding position when the alarm relay
is in the opposite position, annunciator means and an
energization circuit therefor, the energization circuit of
said annunciator means having two main branches in
which the annunciator means may be selectively inter-
persed, each of said branches including contacts of said
alarm relay and said second relay arranged to energize
said annunciator means when the alarm relay is actuated
to one of its positions and also having other contacts of
said alarm relay and contacts of said third relay arranged
to energize the annunciator means when said alarm relay
is actuated to the other one of its positions, one of said
main branches having contacts of said second relay
arranged in a circuit which modifies the signal of the
 annunciator means when the second relay is in its non-
holding position, and the other main branch circuit includ-
ing contacts of said third relay which are arranged to
modify the signal of the annunciator means when the third
relay is in its non-holding position, and acknowledge
switch control means in the energization circuits of said
second and third relays and arranged to actuate said relays
momentarily to their non-holding positions.

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