

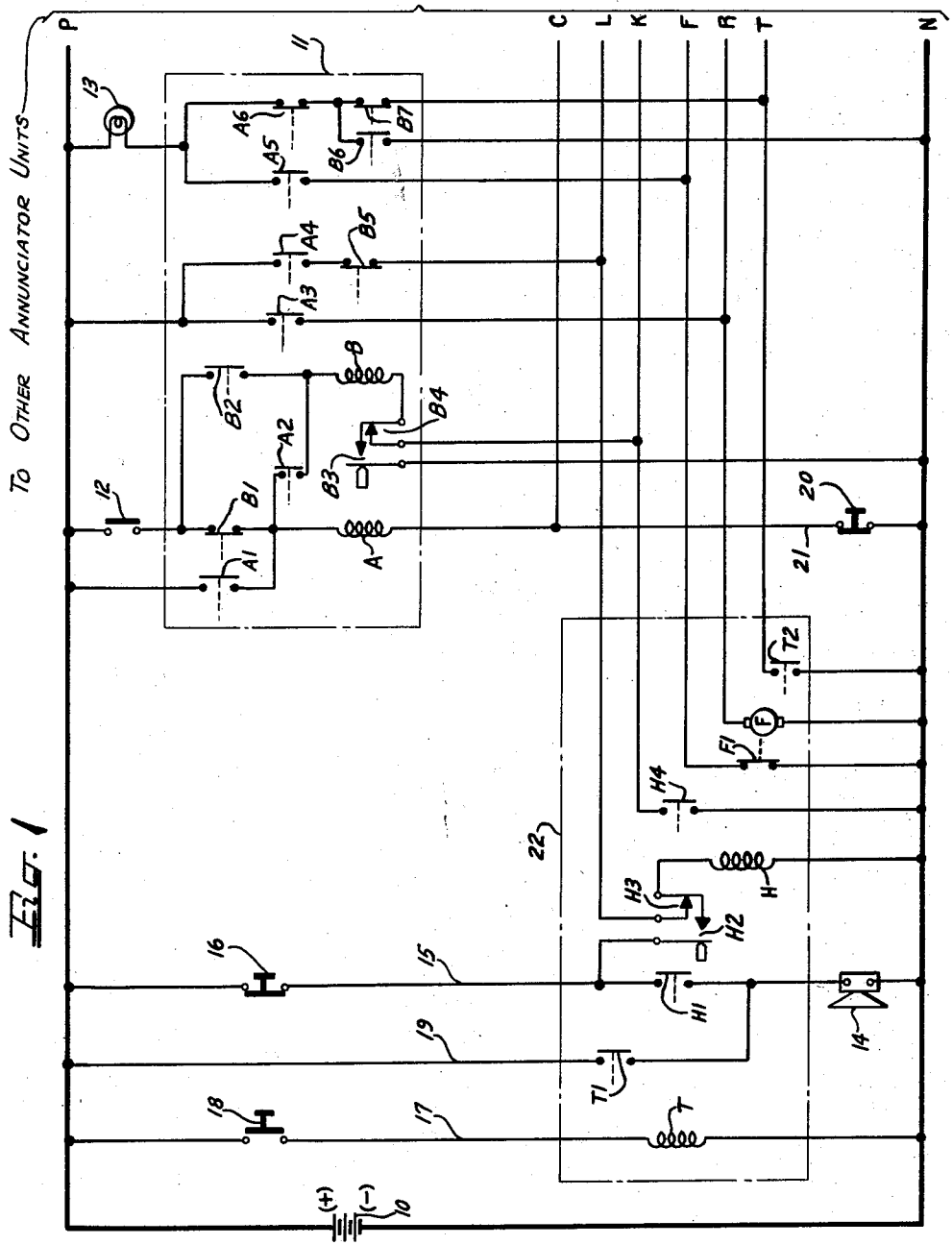
June 28, 1955

R. J. MARMORSTONE
ANNUNCIATOR AND ALARM SYSTEM

2,712,129

Filed Dec. 11, 1952

4 Sheets-Sheet 1



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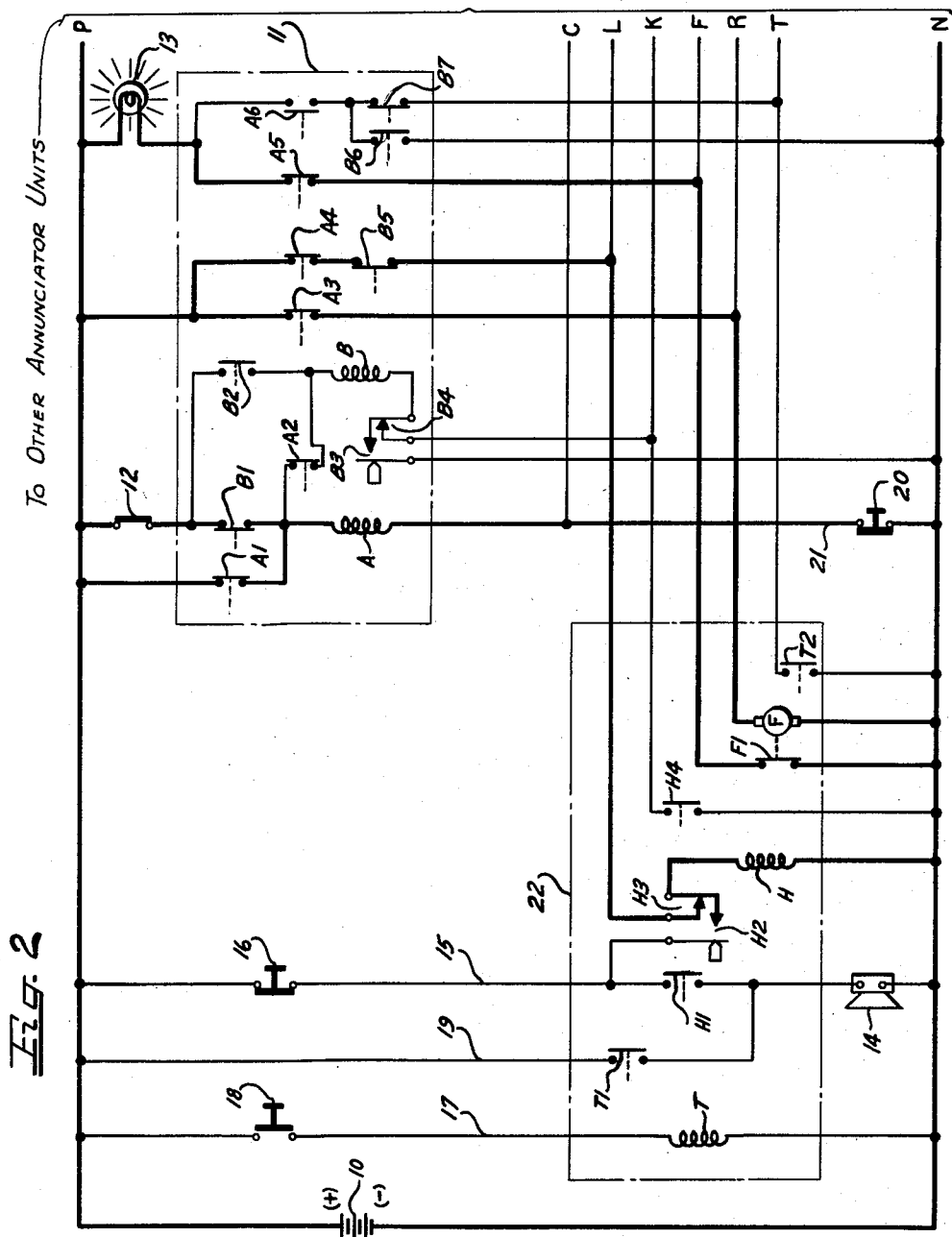
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4 Sheets-Sheet 2



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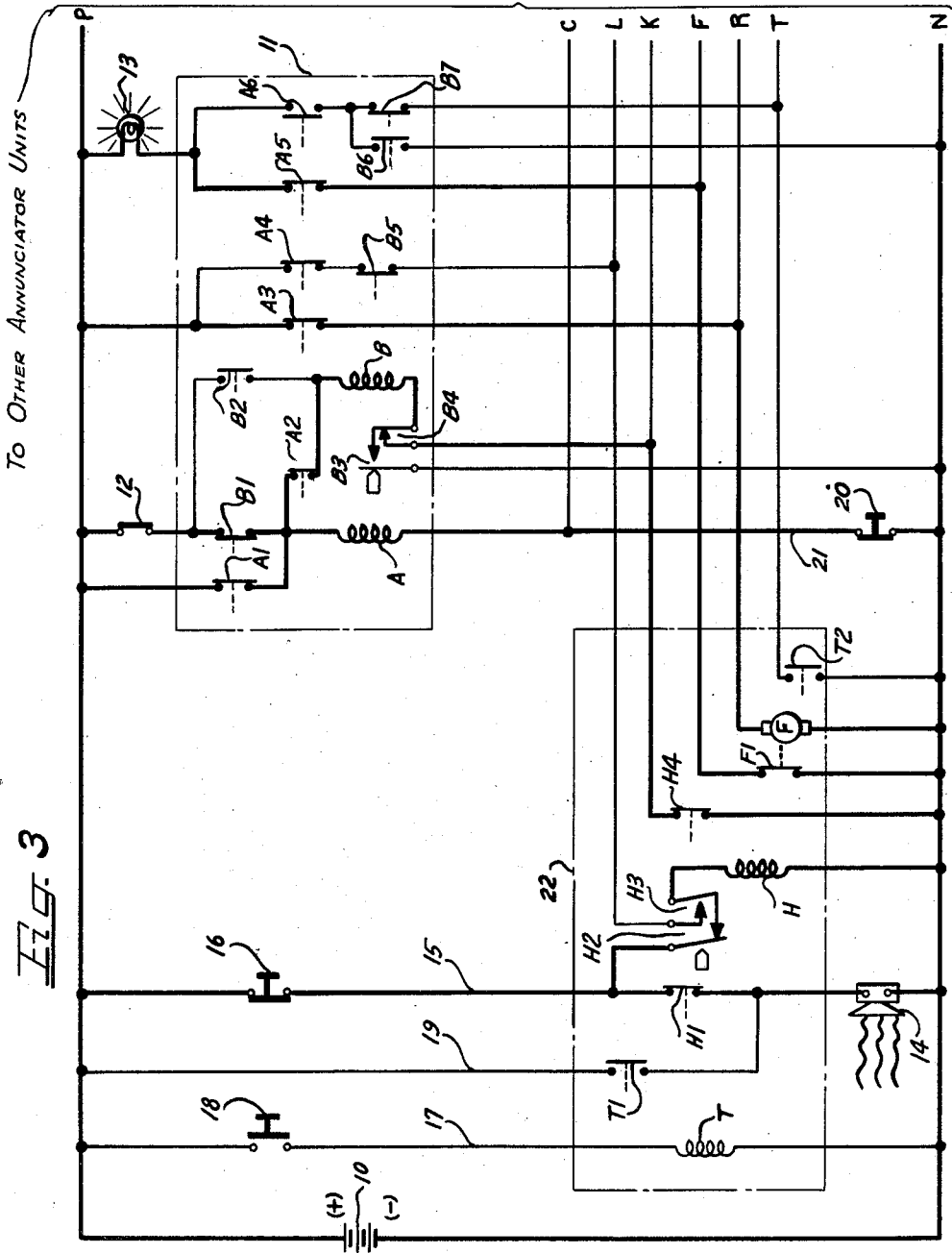
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4 Sheets-Sheet 3



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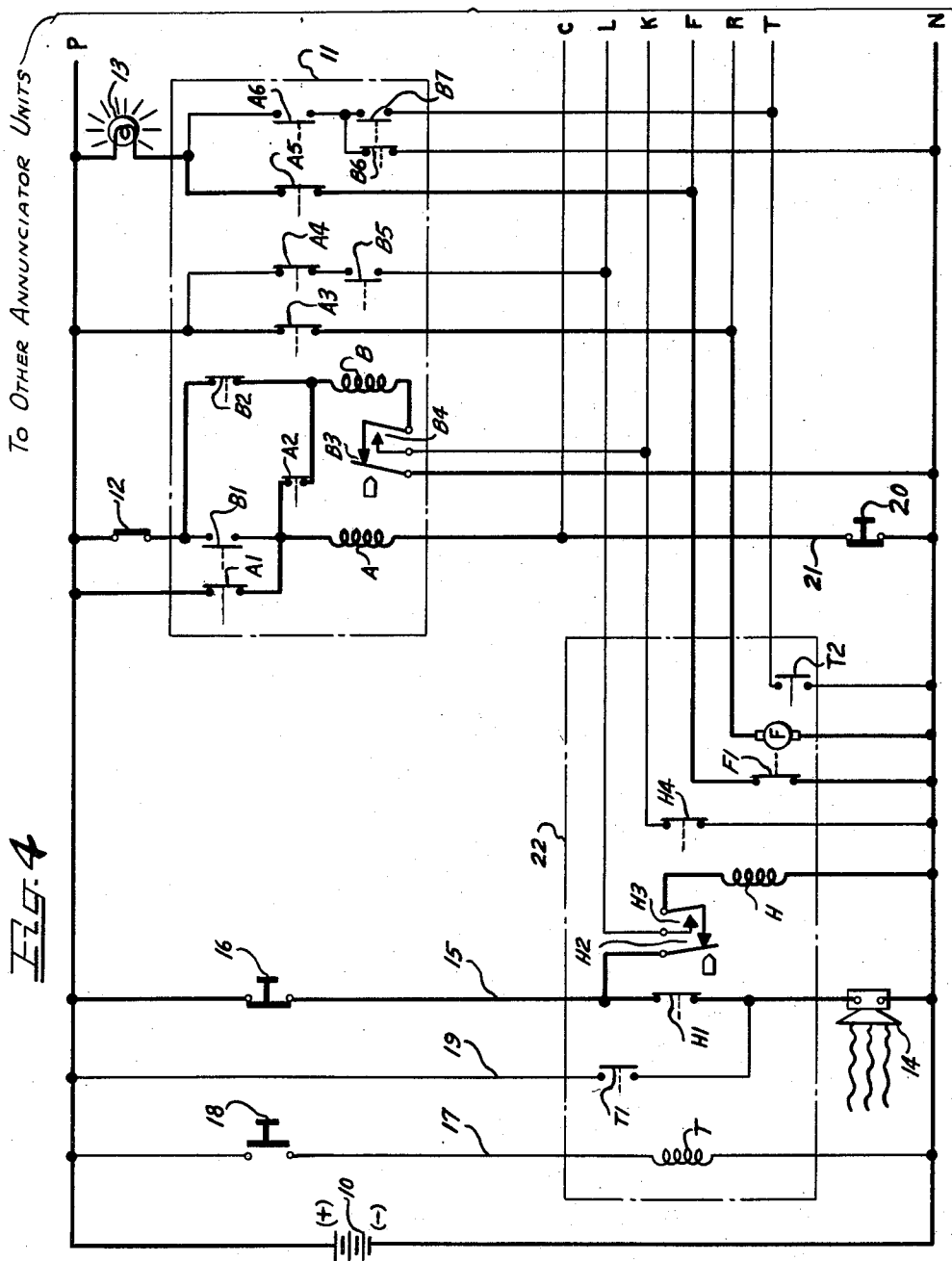
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Fig. 4



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ANNUNCIATOR AND ALARM SYSTEM

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10 Claims. (Cl. 340—213)

This invention relates to an electric alarm system for the supervision of a plurality of apparatuses and more particularly to an alarm system of the kind wherein each of the apparatuses is provided with an annunciator whereas an alarm circuit is common to all the annunciators so as to be actuable by any one of them. In such alarm systems each of the annunciators comprises a normally open signal switch which is closeable in response to a deviation from the normal condition in the apparatus to which the particular annunciator is coordinated.

It is an object of this invention to provide an electric alarm system of the kind referred to which, while relatively simple in construction, is extremely reliable and inexpensive in operation. In particular, it is an object of the invention to construct the alarm system in such a manner that there is no drain from the source of electric power during the normal condition of the system.

It is another object of the invention to provide an alarm system of the kind referred to wherein each of the annunciator units contains two alarm relays which interact with each other and with a master relay coordinated to the common alarm signal in such a manner that those three relays in their co-action control the duration of an energizing pulse so as to terminate that pulse when a certain sequence of operations of the three relays has been completed.

In connection with an alarm system of the kind just mentioned it is an object to provide a switch mechanism adapted to be triggered by the master relay, one part of the switch mechanism being arranged in series with a contact controlled by the first alarm relay and another part of the switch mechanism in series with a contact controlled by the second alarm relay, thereby to provide a temporarily closed path for the above mentioned energizing pulse to the master relay which becomes broken upon said second alarm relay becoming energized.

It is a further object of the invention to provide in an alarm system of the kind referred to a contact controlled by one of the two alarm relays in a circuit controlled by the other of these two alarm relays and further a contact controlled by the above mentioned master relay so that the first named alarm relay becomes operative only after the second named alarm relay and also the master relay have become energized.

It is a further object of the invention to provide an electric alarm system of the kind referred to in which the individual signal which is coordinated to each individual annunciator is adapted to display signals of different kinds depending on whether the signal has been put into operation in consequence of a deviation from the normal condition in the apparatus supervised by the particular annunciator or has been reset manually. Preferably the individual alarm signal is in the form of a signal lamp alternatively connectable into two circuits, of which one contains a motor-operable flasher

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switch and a normally open contact controlled by one of the two alarm relays of the annunciator and of which the other contains a normally closed contact controlled by the same alarm relay as the just mentioned contact in series with the flasher switch and a normally open contact controlled by the other of the two alarm relays.

Other objects and advantages of this invention will appear as the description proceeds, reference being had to the accompanying drawings, in which:

Fig. 1 shows a circuit diagram of one form of the invention, all elements of the circuit being shown in the positions they assume if the apparatuses supervised by the alarm system are in normal condition;

Figs. 2 to 4 show different phases in the operation of the alarm system of Fig. 1, those portions of the circuit which are active during the particular phase illustrated in each figure being indicated by heavy lines.

Referring first to Fig. 1, the reference numeral 10 denotes a source of direct current, such as a 125-volt battery, to which there are connected a positive lead (P) and a negative lead (N). For each of the apparatuses to be supervised by the alarm system there is provided an individual annunciator unit 11 comprising two alarm relay coils A and B, each of these relay coils controlling a plurality of contact switches, which in the following will be called "contacts" for short. The contacts operable by either of the relay coils A and B by either of two other relay coils H and T, the two latter belonging to a master control unit 22, are indicated by the same reference letter as is used for the coordinated relay coil but this reference letter is followed by an index number, e. g. A1 or B1. There are six contacts A1, A2, . . . to A6 coordinated to the relay coil A. Two of these six contacts, namely the contacts A5 and A6, form together a double throw switch. The contacts A1, A2, A3, A4 and A5 are normally open; only the contact A6 is normally closed. Seven contact switches B1, B2, . . . to B7 are actuable by the relay coil B, of which the contacts B2, B3 and B6 are normally open. The contacts B1, B4, B5 and B7 are normally closed. The normally closed contacts B3 and B4 are united as a make-before-break continuity transfer contact device. This type of contact device operates in such a manner that the contact B4 stays closed for a few milliseconds during which time the normally open contact B3 closes.

Coordinated to each individual annunciator unit 11 are a signal switch 12 responsive to changes of some selected condition in the connected apparatus, which condition may be one of mechanical physical or chemical nature, e. g. a change of level, pressure, temperature, acidity, etc., and at least one signal lamp 13.

The relays A and B and their contacts A1 to A6 and B1 to B7 are connected in the manner shown to eight common leads or buses, of which two are the positive lead (P) and the negative lead (N), and the other six are denoted by the reference letters C, L, K, F, R and T.

A single individual annunciator unit 11 is detailed in the drawings but it is to be understood that any desired number of annunciator units, up to hundreds and even thousands, may be used in parallel arrangement relative to the above mentioned common leads (P), C, L, K, F, R, T, and (N), and that all these annunciator units may be identical to the illustrated device 11 with its associated signal switch and lamp 12, 13.

Common to all the individual annunciator unit systems 11, 12, 13 is a master alarm relay possessing a coil H and four contact switches H1, H2, H3, and H4. Of these four contacts, the contacts H2 and H3 are in the form of a make-before-break continuity transfer device of the kind above described with reference to the contacts B3 and B4. Between the contact H1 and the nega-

tive lead (N) there is interposed an acoustical alarm 14, such as a horn, and into a connecting lead 15 between the contact switch H1 and the positive lead (P) there is inserted a normally closed push button switch 16 for manually silencing the acoustical alarm 14.

Inserted into a lead 17 extending between the positive and the negative leads (P) and (N) is the coil T of a testing relay which is arranged in series with a normally open push button test switch 18. The testing relay coil T controls two normally open contacts T1 and T2. The contact T1 is arranged in series with the acoustical alarm 14 by means of a lead 19 connected to the lead (P). The contact T2 is connected between the negative lead (N) and the bus T which, in turn, is connected to the contact B7 of each second alarm relay B. Mechanically coupled with a flasher motor F is a rotatable switch F1 electrically connected at its one side to the negative lead (N) and at its other side through the bus F to the contact A5 of each alarm relay A.

A normally closed push button switch 20 is inserted into a lead 21 extending from the negative lead (N) to the bus C and thereby to each alarm relay coil A. This switch 20 serves in a manner to be described later as a reset button for the signal lamps 13 and their controls.

The just described positions of the various contacts of the system of the invention are the positions these contacts assume when in none of the supervised apparatuses there exists a condition to which the alarm system is supposed to respond by an alarm signal. Fig. 1 shows that for this condition none of the various circuits of the system is energized. Accordingly, there is no drain at all from the battery 10 during the normal condition of the system.

If an abnormal condition occurs in any of the apparatuses supervised by the alarm system so that the signal switch 12 coordinated to that particular apparatus closes, the elements of the individual annunciator unit 11 coordinated to that apparatus and the elements of the master unit 22 common to all the individual annunciator units 11 shift in the following manner from the positions shown in Fig. 1 to the positions shown in Fig. 2, in which they establish the circuits marked in Fig. 2 by heavy lines: Closing of the signal switch 12 finds all the relays A, B, H and T initially unenergized and, in particular, finds the contact B1 closed. Consequently, a circuit is temporarily established extending from (P), over 12, B1, coil A, and the push button switch 20 to (N). This circuit energizes the coil A and the energized coil A causes the contact A1 to close and thereby to establish a holding circuit for the coil A. With the coil A energized, the contacts A2, A3, A4, and A5 close.

Of the now closed contacts A2, A3, A4 and A5 the contact A2 remains ineffective for the time being, no uninterrupted current path being closed as yet by said contact A2.

In contrast to the contact A2, the now closed contact A3 is in an uninterrupted circuit, namely in the circuit leading from (P) through A3, the bus R, and the flasher motor F to the negative lead (N). Therefore, the motor F starts working, operating the flasher switch F1 to open and close intermittently, thereby causing the signal lamp 13 to flash through bus F and contact A5.

Through the now closed contact switch A4 and the still closed contact switch B5 there exists a circuit extending from the lead (P) through the bus L, the normally closed master continuity transfer contact H3, and the relay coil H to the negative lead (N). This circuit energizes the coil H with the effect that the positions of all the H-contacts become reversed as compared with their initial positions. The contact H1 becoming thus closed, the horn 14 is in a closed circuit extending from (P) through 16, 15, H1 and 14 to (N) and, therefore, starts sounding (Fig. 3).

The contacts H2 and H3 being of the above mentioned make-before-break continuity transfer type, the contact H3

opens only after a positive period of time, such as one or two milliseconds, after the cutting-in of the relay coil H into a circuit (P), 16, 15, H2, H, (N) which is independent of the alarm relay 11. This continuity transfer is provided to make sure that the coil H remains sealed-in through the contact H2 before the above described path through A4 and B5 breaks due to opening of the contacts H3 and B5.

By reason of the energization of the coil H, also the contact H4 changes its position so as to become closed. From Fig. 3 it will be seen that the closing of the contact H4 brings into play the alarm relay B over a circuit extending from (P) through A1, A2, B, B4 and H4 to (N). The contact B1 opens, so that possible fluttering of the signal switch 12 has no influence on the coil A since the latter is locked in by the contact A1. B2 closes, thus establishing a by-pass to the contacts A1 and A2 for a purpose to be described later. Of the two contacts B3 and B4 of the make-before-break switch B3, B4, the contact B3 closes while B4 is still closed for a few milliseconds after the cutting-in of the coil B into circuit (P), A1, A2, B, B3 (N) which is independent of the master relay 22.

Thus it will be seen that, when both the contacts A4 and B5 are still closed (Fig. 2), there is a pulse started to the coil H reaching this coil via the bus L. This pulse is transferred to line 15, in order that it may safely persist at least until the neutral feed for the B relay has been established through the contact H4, that is until both relay coils H and B have been rendered effective. Thus, the cutting in of coils H, B is positively based on the completion of the above described particular sequence of operations and not on a time constant, such as that of an R—C or other time constant network used in some prior art alarm devices.

As will best be seen from Fig. 4, the opening of the contact B4 breaks the circuit through the closed contact H4, whereas the opening of the contact B5 terminates the positive feed to the H coil.

The contacts B6 and B7 are reversed in their positions without consequence upon the circuit since the contact A6 is open at this time.

When the circuit is in the condition shown by Fig. 4, the acoustical alarm 14 sounds and that optical signal 13 which belongs to the particular annunciator unit 11 shown in Fig. 4 also operates. Since the purpose of the acoustical signal 14 is only to call the attention of the attendant to the fact that there has occurred an irregularity somewhere in the plant supervised by the alarm system and there should be a fresh warning each time another of the various apparatuses goes out of order, it is desirable that the acoustical signal 14 be silenced as soon as its sounding has been recognized by the attendant. This is achieved by momentarily depressing manually the push button switch 16. This breaks the circuit through the relay H2 H and thereby through the contact H1 and horn 14. Permitting the push button 16 to return to its normally closed position will not re-establish the circuit for actuating the horn 14 since H2 remains open, H de-energized and H1 open until a new pulse arrives over the bus L. While the particular signal switch 12 whose closing caused the sounding of the horn 14 is still closed and will remain closed until such time when the condition in the apparatus coordinated to that particular switch 12 will have returned to normal, the circuits for and through the horn 14 remain broken at B5, H2 and H1. (Only if another signal switch 12 would move into the closed position and thereby start in another of the annunciators the cycle of operations above described in connection with the illustrated annunciator 11, there would then be again established a positive feed to the H relay through the corresponding contact B5, and the horn 14 would sound again. While thus the horn 14 is silenced, the aforementioned optical signal 13 continues

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flashing, thereby indicating the particular apparatus that went out of order.

To be able to reset the optical signal 13 for a new actuation after the irregularity that caused the acoustical alarm 14 and the optical signal 13 to go into action has been logged by the attendant, the lamp reset button 20 is provided. Depressing this button will deenergize the relay coil A of the annunciator unit 11 (and through bus C of all the other annunciator units). Since all the A contacts thereby return to the normal position shown in Fig. 1, also the contacts A5 and A6 change their position so that the previously existing circuit containing the switch F is interrupted and a new circuit for the optical signal 13 is established, extending from (P) through 13, A6 and B6 to (N). Thus, those annunciator units whose signal contacts 12 are closed will continue to display an optical signal which, however, is now not a flashing but a steady signal. Due to the mutual triggering of otherwise independent alarm and master relays 11, 22, the push-buttons 16, 20 can safely and effectually be operated in any desired sequence.

The relay B remains energized through the previously mentioned by-pass contact B2 regardless of A2 opening.

It is only when the signal switch 12 belonging to an energized signal lamp 13 returns to its normal position, shown in Fig. 1, that also the relay coil B becomes deenergized, the contact B6 opens and thus the signal lamp 13 goes out entirely.

It will be noted that the return of the signal contact 12 to its normal position causes all elements of the coordinated annunciator unit 11 to automatically return to their normal positions.

It will be apparent that the horn 14 is actuated by each signal switch 12 which moves into closed position, provided the horn is silent at this time. If an abnormalcy occurs in a second apparatus while the horn is still sounding in consequence of a previously occurred abnormalcy in another apparatus, the pressing of the push button switch 16 will silence the horn 14 regardless of the fact that there had been irregularities in two of the supervised apparatuses. However, the signal lamps 13 of the annunciators coordinated to both these apparatuses will display flashing signals, which flashing signals will change to steady optical signals upon operation of the reset button 20.

By means of the test push button 18 the acoustical signal 14 as well as the optical signals 13 of all the annunciator units can be tested. Closing manually the normally open push button 18 energizes the test relay coil T so that the two contacts T1 and T2 controlled by this coil close; contact T1 closes the circuit for the horn 14, and contact T2 the circuit for the signal lamps 13 of all the annunciator units 11. Thus, the horn 14 sounds and all the signal lamps 13 of the system display steady visual signals.

While I have shown in the drawings one particular embodiment of my invention, I desire it to be understood that various changes, modifications and re-arrangements of the elements of the circuit shown and described may be made without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In an electric alarm system for the supervision of a plurality of apparatuses each provided with an annunciator unit, an alarm circuit including a master relay common to all said annunciator units and arranged to be actuated by any one of said annunciator units, each of said annunciator units comprising a signal switch operable in response to a deviation from the normal condition in the apparatus to which the particular annunciator is coordinated and a first alarm relay controlled by said signal switch and a second alarm relay, said two alarm relays having each coil controlling a plurality of contacts, said second alarm relay coil being arranged in a circuit containing a contact controlled by said first alarm relay coil and a contact controlled by said master relay coil so as

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to become operative only after said first alarm relay as well as said master relay coil have become energized.

2. In an electric alarm system for the supervision of a plurality of apparatuses each provided with an annunciator circuit, a common master relay having an energization circuit extending through each annunciator circuit, each of said annunciator circuits comprising a signal switch operable in response to a deviation from the normal condition of the associated apparatus and a relay circuit, said relay circuit comprising a first alarm relay which is actuated by the associated signal switch, the energization circuit of said master relay which extends through said annunciator units including groups of contacts of said first and second relays connected in parallel and arranged to establish an energization circuit to said master relay coil upon the initial alarm actuation of said first relay and to disestablish the energization circuit through the annunciator units when said second relay is de-energized, said relay circuit also including a second relay having an energization circuit containing contacts controlled by said first relay and by said master relay which actuate said second relay when said master relay is actuated by said first relay, a holding branch circuit for said master relay, circuit disconnect means responsive to operation of said second relay for disconnecting the master relay from said annunciator circuits and connecting the same to a holding branch circuit for holding the master relay in said actuated state, acknowledgment switch means for breaking said holding circuit, and audible alarm means responsive to the energization of said master relay for sounding an audible alarm.

3. In an electric alarm system for the supervision of a plurality of apparatuses each provided with individual annunciator circuits, a common alarm circuit including a master relay having a first energization circuit including parallel sub-branches extending through each of said individual annunciator circuits, a condition-responsive signal switch for controlling the operation of said first relay, said first and second relays having contacts in said sub-branches of the energization circuit of said master relay and arranged to establish said energization circuit of said master relay when said first relay is operated in response to an alarm position of the associated signal switch and to disestablish the energization circuit through the associated annunciator circuit when said second relay is actuated, said master relay having contacts which actuate said second relay when said master relay is actuated by said first relay, said master relay having a make-before-break continuity transfer switch providing a normally closed contact path in series with said parallel sub-branches of said annunciator circuits and a normally opened contact path leading to a holding branch which parallels said sub-branches of said annunciator circuits, said make-before-break continuity transfer switch upon the actuation of said master relay transferring connection of said master relay from said parallel sub-branches to said holding branch circuit, and switch means for breaking said holding circuit.

4. In an electrical alarm system for the supervision of a plurality of apparatuses each provided with an annunciator circuit, a common alarm circuit including a master relay common to all of said annunciator circuits so as to be actuated by any one of said annunciator circuits, each of said annunciator circuits comprising a signal switch operable in response to a deviation from the normal condition in the apparatus to which the particular annunciator circuit is coordinated and a first and second relay, said two relays controlling a plurality of contacts, contacts controlled by said first and second relays controlling the initial operation of said master relay, said second relay arranged in a circuit containing contacts controlled by said master relay and said first relay so as to become operative only after said first relay as well as said master relay have become actuated, and switch mechanism triggered by said master relay and being in series

with said master relay and with said contacts controlled by said first and second relays for temporarily establishing an energization circuit to said master relay when a first relay is initially actuated, said contacts controlled by said second relay in said energization circuit of said master relay operating to break said energization circuit when said second relay is actuated following the actuation of said first relay and said master relay, and means for producing a signal announcement controlled by said master relay.

5. The alarm system of claim 4 wherein said switch mechanism is a make-before-break continuity transfer switch which disconnects the master relay from the energization circuit extending through said annunciator circuits and connects the coil to a holding circuit which is independent of said annunciator circuits when the master relay is initially energized, and acknowledgment switch means for breaking said holding circuit.

6. In an electrical alarm system for the supervision of a plurality of apparatuses each provided with an annunciator circuit, a common alarm circuit including a master relay common to all of said annunciator circuits so as to be actuated by any one of said annunciator circuits, each of said annunciator circuits comprising a signal switch operable in response to a deviation from the normal condition in the apparatus to which the particular annunciator circuit is coordinated and a first and second relay, said two relays controlling a plurality of contacts, contacts controlled by said first and second relays controlling the initial operation of said master relay, said second relay arranged in a circuit containing contacts controlled by said master relay and said first relay so as to become operative only after said first relay as well as said master relay have become actuated, each annunciator unit additionally including a normally closed section of a make-before-break continuity transfer switch which section is in circuit with said contacts controlled by said master relay, a normally open section of said make-before-break continuity transfer switch connected to a holding circuit which by-passes said contacts controlled by said master relay, said normally open section of said latter make-before-break continuity transfer switch controlled by the associated second relay and arranged to close upon the actuation of said second relay which follows the actuation of said first relay and said master relay, annunciator means for producing a first and a second signal announcement, the contacts of said first and second relay arranged in circuit with said annunciator means for effecting said first announcement when said first relay is initially actuated and for providing said second announcement when said first relay is returned to its normal position and said second relay remains in its initial actuated position, and resetting means for actuating said first relay to its normal position without affecting said second relay.

7. In an electric alarm system for the supervision of a plurality of apparatuses each provided with an annunciator circuit, each of said annunciator circuits comprising a signal switch operable in response to a deviation from the normal condition in the apparatus to which the particular annunciator circuit is related, a signal lamp, a motor operable flasher switch, a first and second alarm relay, said relays both operated in response to said operation of said signal switch, a manually operable switch arranged to return said first relay to its normal position, said signal lamp being alternatively connectable into two circuits, one of said two circuits containing said flasher switch and normally open contacts controlled by said first alarm relay for causing said signal lamp to display a flashing signal upon initial operation of said first relay and the second of said two circuits containing a normally closed set of contacts controlled by said first relay and a normally open contact controlled by said second relay for causing said signal lamp to display a steady signal upon operation of said manually operable switch.

8. In an electric alarm system for the supervision of

a plurality of apparatuses each provided with an annunciator circuit, an alarm circuit including a master relay common to all of said annunciator circuits so as to be actuable by any one of said annunciator circuits, each of said annunciator circuits comprising a normally open signal switch closeable in response to a deviation from the normal position in the apparatus to which the particular annunciator is coordinated and a first and a second relay, said first relay connected in series with said signal switch so as to be energized upon the closing thereof, said master relay being in circuit with contacts of said first relay which are arranged to energize said master relay upon the energization of said first relay, said second relay arranged in a circuit containing contacts controlled by said master relay so as to become operative only after said first relay as well as said master relay have become energized, means for holding the energization of said master relay independently of the position of the signal switch, means for holding the energization of the first relay independent of the position of the signal switch, means for holding the energization of said second relay so long as the signal switch is closed, a first alarm device actuated upon the energization of said master relay, a manually operable acknowledgment switch for deenergizing said master relay separately from the other relays, means for providing a first and a second condition-indicating signal controlled by said first and second relays, said last-mentioned means providing a first signal indication when said first relay is energized and providing another signal indication when said second relay is energized and said first relay is de-energized, and reset switch means for de-energizing said first relay independently of said second relay.

9. An annunciator system comprising a common alarm, a number of annunciator circuits associated respectively with respective mechanisms to be monitored, each of said annunciator circuits including a pair of relays and a signal switch, a source of energizing potential, means connecting said first relays in circuit with the associated signal switch and said source of energizing potential, means connecting said master relay to said source of energizing potential through a number of parallel branches each comprising contacts of said first and second relay arranged to couple said source of energizing voltage to said master relay for a time interval which begins when the first relay is initially actuated by said signal switch and terminates when said second relay is actuated, means connecting each second relay to said source of energizing potential through contacts of said master control relay and contacts of the associated first relay arranged to actuate the second relay following the actuation of said first relay and said master relay, and alarm means controlled by said master relay.

10. Annunciator apparatus comprising a group of annunciator circuits for indicating the condition of respective variables, each of said annunciator circuits including a first and a second relay and a signal switch, each of said first relays being controlled by the associated signal switch, a common alarm device, a master relay for controlling said common alarm device, contacts of said master relay arranged to energize the audible alarm while the master relay is energized, means connecting said master relay to a source of energizing potential through two parallel branches, one of the branches comprising a holding circuit including holding contacts controlled by the master relay in series with a normally closed acknowledgment switch, the other branch circuit including a series of parallel sub-branches each including normally closed contacts of one of said first relays in series with a set of contacts of the associated second relay, the contacts in said sub-branches arranged to establish said other branch circuit when the first relay is operated by said signal switch in response to an abnormal condition of the associated variable and to disestablish said branch circuit through the corresponding sub-branch when the

associated second relay is initially operated, means for initially operating each of said second relays comprising contacts of said master relay in series with contacts of said first relay which actuate said second relay when said master relay is energized and said first relay is initially operated by said signal switch, and said contacts controlled by said master relay in said first and second branches of said energization circuit comprising a make-before-break continuity transfer switch arrangement wherein the master relay is transferred from connection with said first branch circuit to said second holding branch circuit upon energization of said master relay.

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