May 24, 1955 R. J. MARMORSTONE 2,709,250

ALARM AND ANNUNCIATOR SYSTEM

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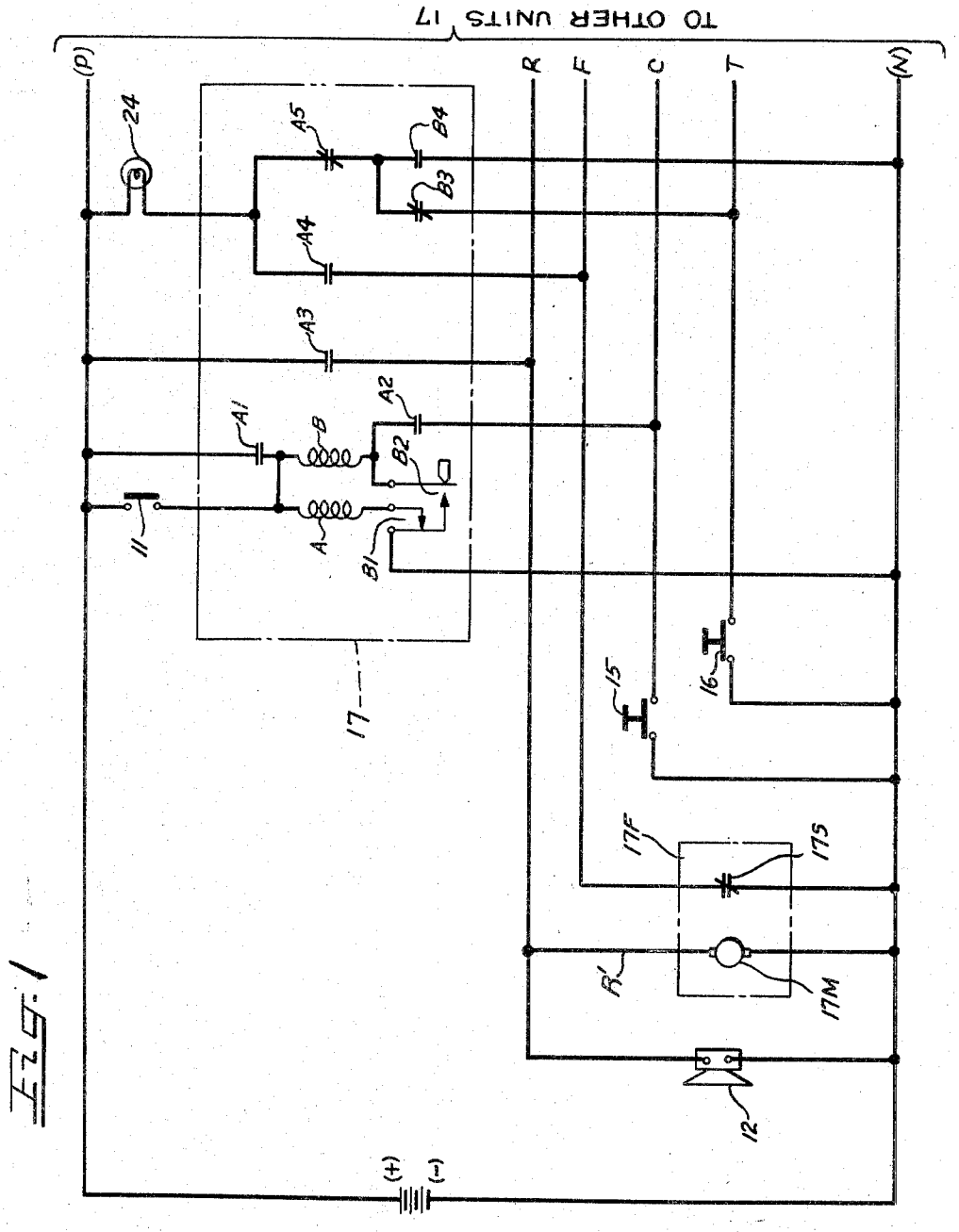


FIG. 1

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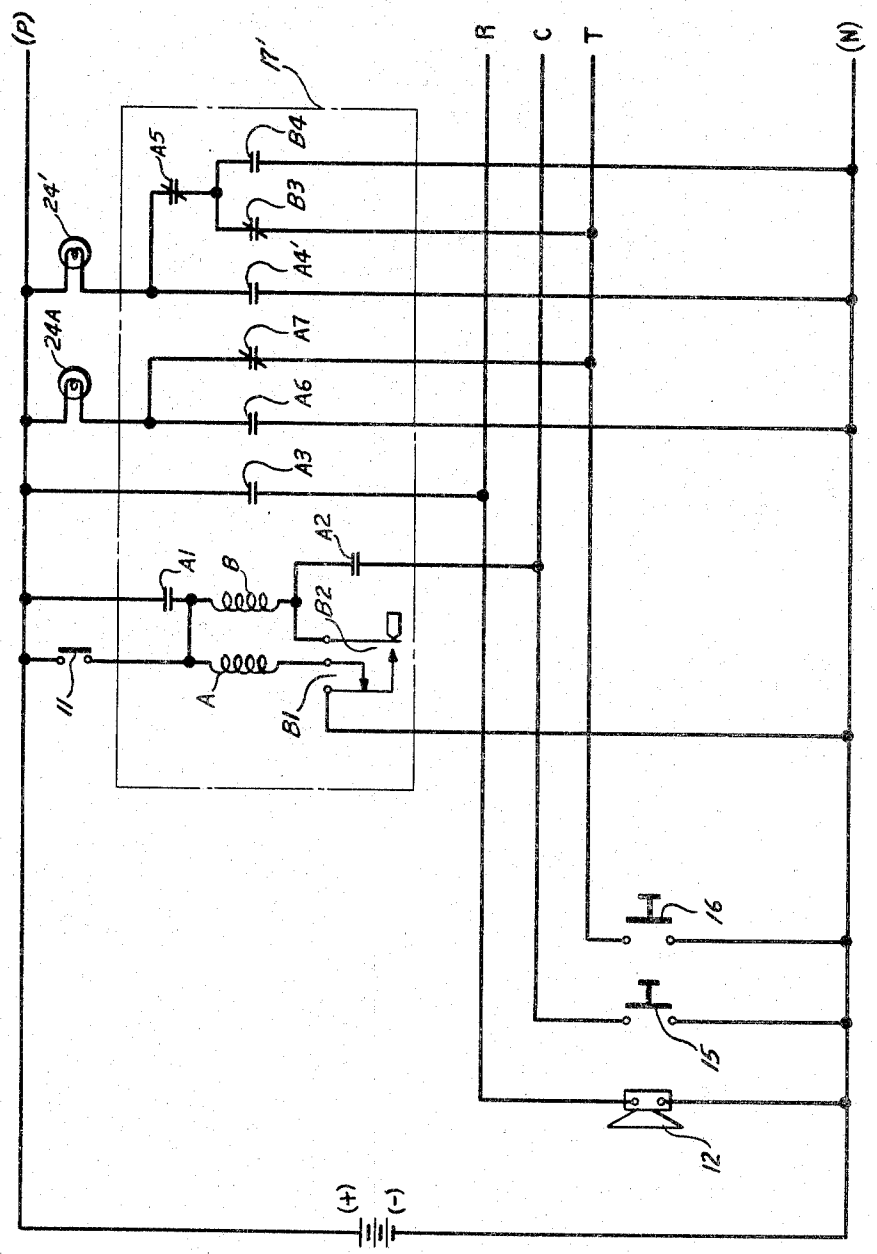


Fig. 2

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2,709,250

ALARM AND ANNUNCIATOR SYSTEM

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6 Claims. (Cl. 340—213)

This invention relates to electric alarm systems for power plants, chemical process plants and other plants wherein protection is required for a great number of machines or process elements such as electric circuit breakers, machine bearings, fluid treatment tanks and the like.

Large amounts of electric energy have been consumed in earlier alarm systems of this type. This was so mainly when the system used, for each apparatus to be protected, a versatile relay unit comprising a plurality of relay coils energized in different cycles to announce different conditions such as alert, acknowledged alarm, return to normal, testing of annunciators, etc. Such consumption of electric energy is sometimes a cause for complaint because of its cost; and more seriously, it may impair the safety of an alarm system, when the system utilizes direct current from a storage battery, as is usual for instance in power plants.

Therefore it is a primary object of this invention to provide a low drain, high versatility alarm system for plants of the type mentioned.

A further important object is to provide an inexpensive relay unit for such a system. More particularly, it is an object to effect the required variations of the control program with a minimum of relay coils and relay switches in each relay unit. Another pertinent object is to standardize the arrangement of such coils and switches so that basic elements, applicable in various alarm systems, can be used in systems of the present type.

These objects have been achieved by means of a circuit system which comprises, in addition to the basically required positive and negative busses, at least two auxiliary bus wires, one of which carries electric current from any of the relay units to an audible annunciator, while the other provides a normally open circuit for the control of each relay unit, as will be explained hereinafter.

Still other auxiliary busses may form a part of the new and improved system, for the purpose of providing a sequence of flashing and steady illuminations in an alarm lamp associated with each relay unit and for the further purpose of testing such alarm lamps, or sometimes for the purpose of cutting a variety of alarm lamps into and out of the alarm program, during different phases thereof.

A most important feature of the new, improved relay unit is that it provides two relay coils selectively energizable through a continuity transfer switch system of the make-before-break type. It is by means of this switch system, in combination with more conventional alarm elements, that versatile low drain operation is allowed in a simple and economical manner.

The description of two preferred embodiments of the new circuit, which follows, will specify certain details, and further details will be illustrated in the drawing appended hereto. Considerable variations are possible as to such details, within the scope of this invention. This scope will be defined in the claims set forth at the end of this specification.

In the drawing:

Figure 1 is a schematic wiring diagram of a first embodiment of this invention.

Figure 2 is a similar diagram of a second embodiment, modified as to the visual annunciators.

Referring first to Figure 1:

The alarm system comprises a plurality of signal contacts or field switches, one of which is shown at 11. Each signal contact is normally open for low-drain operation, and is closed under predetermined conditions by well known thermostatic means, liquid level, flow or pressure responsive means, or equivalent apparatus (not shown). The alarm system, when excited by and from any one signal contact 11, is expected to cause a common, plantwide annunciator unit, such as a strong horn 12, to operate and thereby to alert practically the entire plant personnel to the existing danger condition. It is further expected simultaneously to energize an alarm light unit 24, associated with the contact 11 and installed in a central control room. This serves to indicate the exact source of trouble.

In the system of Figure 1 the light unit 24 is advantageously constructed in form of a so-called back-lighted name plate, suitably imprinted to identify the circuit breaker, machine, tank or other process unit associated with the corresponding switch 11. While only two switch and lamp arrangements 11, 24 are shown, a typical alarm system in accordance herewith usually comprises several dozens, hundreds or sometimes thousands of such arrangements.

At a suitable location, usually in the central control room, a push-button 15 is provided, to enable the control room operator or superintendent to acknowledge the alerting signal sounded by the horn, that is, to silence the horn and thereby to eliminate unnecessary disturbance of plant personnel, while still preserving a visual alarm in the control room to identify the location of the acknowledged but as yet unremedied trouble. It is also desirable, in a versatile system, to distinguish this acknowledged visual alarm from the original alerting visual alarm. For this purpose the push-button 15 and associated controls according to the present system are expected to modify the energization of the lamp 24. When normal conditions are re-established in the field, the signal contact 11 returns to normal position and the lamps 24 are advantageously de-energized, in the interest of low-drain operation.

This program of alarm operations, which is known by itself, is here achieved with particular economy, both as to first cost and operating cost. At the same time the new system insures a particularly high degree of safety, which is a feature of prime importance for an alarm system.

The system comprises an electric storage battery with a positive terminal P and a negative terminal N. The horn 12 and the various lamp units 24 are energized by currents from P to N; and these currents are controlled by relay units 17, one of which is associated with each signal contact 11 and corresponding lamp unit 24. In the form of Figure 1 the relay units 17 cooperate further with a flasher relay 17–F which is provided in parallel with the horn 12 and in common with the entire set of relay units 17.

A first auxiliary bus wire R, common to all relay units 17, has the horn 12 interposed thereon; the other terminal of the horn being connected with the negative terminal N. A branch R′ of the R bus has a flasher motor 17–M interposed thereon, within the flasher relay 17–F; the other terminal of the flasher motor being connected with the negative bus N. In this manner, simultaneous operation of the horn and flasher motor is achieved.

A second auxiliary bus or control wire C is provided, common to all relay units 17. Interposed on this bus C is a normally open acknowledgment switch, operable by

the acknowledgment push-button 15. The other terminal of this push-button switch is connected with the negative bus N. Thus the bus wire C is normally de-energized but capable of being momentarily energized by depression of the acknowledgment push-button 15, when wire C is connected with the positive bus P through suitable switch and load arrangements in any one of the relay units 17. This control arrangement is important for the achievement of economical low drain operation, as will be described presently.

At this point however, it may first be noted that there is also provided a third auxiliary bus F, having interposed thereon a flasher switch 17–S in the flasher relay 17–F, the other side of the switch 17–S being connected with the negative terminal N.

Still further there is provided a test bus T connected to the negative terminal N through a normally open test push-button 16.

Each relay unit 17 contains two relay coils, shown at A and B respectively. One terminal of each coil A, B is connected to one battery terminal or line P, either through the signal contact 11 or through a normally open seal-in switch A–1, controlled by the A coil. The opposite side of each coil A, B is connected to the other battery terminal or line N, through a continuity transfer switch B–1, B–2 of the make-before-break type, controlled by the B coil; one coil A being so connected through the normally closed part B–1 of this switch, while the other coil B is so connected through the normally open part B–2 of this switch. Additionally a normally open switch A–2, controlled by the A–coil, is connected on the one hand between the B coil and the switch B–2 and on the other hand to the C bus.

The remaining circuitry is rather simple. A normally open switch A–3 controlled by the A coil is provided in each relay unit 17 and is connected between the P and R busses, in order to energize the horn 12 and flasher motor 17–M at the proper time. A system of double throw switches A–4, A–5 and B3, B–4 is provided in each relay unit 17 for the control of the lamp unit 24. One terminal of this lamp unit is connected to the P bus; the other terminal of the lamp unit 24 is connected to the common terminal of the double throw switch A–4, A–5 controlled by the A coil. The normally open part A–4 of this double throw switch is connected with the F bus leading to the flasher switch 17–S. The normally closed part A–5 of said double throw switch is connected with the common terminal of the second double throw switch B–3, B–4 controlled by the B coil. The normally open part B–4 of that switch is connected with the negative terminal N while the normally closed part B–3 is connected to the test bus T.

In operation, so long as all signal contacts 11 are in their normal open position, all circuits of the entire system are dead and all load devices de-energized, thereby safeguarding zero drain of electric energy from the battery through the external circuit system.

Upon the occurrence of abnormal conditions in the actuating apparatus of any one signal contact 11 that contact closes, at least momentarily, thereby energizing the corresponding A coil through the normally closed part B–1 of the continuity transfer device B–1, B–2. The energization of the coil A through the signal contact 11 may be only momentary, depending upon the operation of the actuating apparatus, but the coil A immediately seals in through the seal-in switch A–1. As a result, the A coil cannot be de-energized except by subsequent opening of the continuity transfer switch element B–1.

The energization and sealing in of the A coil closes the normally open switch A–3, thereby establishing a circuit from the positive terminal P through A–3 and R and the horn 12 to the negative terminal N. The horn 12 begins to sound. Simultaneously a circuit is also made from the positive terminal P through A–3, R, R', 17–M to N, starting the flasher motor. Still another circuit is made from the positive terminal P through the lamp unit 24, switch element A–4, bus F and flasher switch 17–S to the negative terminal N. Flashing of the signal lamps 24 starts, simultaneously with the sounding of the horn.

Up to this time the second relay coil B was de-energized. Now, when the control room operator hears the horn and when he has noted the source of the trouble by inspection of the series of lamp units 24, he will normally depress the acknowledgment push-button 15 for a moment. This establishes a momentary circuit from the positive terminal P through the signal contact 11 and/or seal-in switch A–1 and further through the coil B, switch A–2 (closed by coil A), control bus C and momentarily closed switch 15 to the negative terminal N. This energizes the coil B and thereby operates the make-before-break continuity transfer switch B–1, B–2, with the following effect:

Momentarily both B–1 and B–2 are closed; so that the energization of the B coil occurs both through the switch B–2 and the switch A–2, the latter still being closed by the coil A. It can thus be said that the circuit system comprising the coils A, B and switches B–1, B–2 and A–2 constitutes a seal-in before seal-out arrangement for the coils B and A respectively. During a very short interval upon the depression of the acknowledgment push-button 15 both coils A and B are energized; immediately thereafter coil A is de-energized and only B is energized.

Expressed otherwise: momentary triggering of the B coil, sufficient for seal-in thereof at B–2, is obtained by the switches 15 and A–2. It is followed rather than preceded or paralleled by the sealing out of the A coil at B–1, by means of the known make-before-break construction of the switch B–1, B–2.

For the alarm program the energization of the B coil and de-energization of the A coil has the effect that the switch A–3 is opened, silencing the horn and stopping the flasher; the switch A–4, A–5 is reversed, connecting the lamps to the switch B–3, B–4 instead of the F bus; and the switch B–3, B–4 is reversed, connecting the lamps 24 between the P and N busses. Flashing of the lamps terminates and is followed by a steady bright illumination.

In the foregoing description it has been assumed that the signal contact 11 is and remains in closed condition at the time when the acknowledgment push-button 15 is depressed. The energization of the B coil is then effected and maintained through the signal contact 11. It could not be maintained through the seal-in switch A–1, which opens when coil A is de-energized.

Assuming, on the other hand, that the signal contact 11 is open when the acknowledgment push-button 15 is depressed, the effect is that both coils A and B are de-energized; that is, a normal condition is re-established. If the open condition of the signal contact 11 is due only to fluctuations of the controlling apparatus and if accordingly the signal contact 11 closes again after a short time, a new alarm is started; resulting in renewed sounding of the horn and flashing of the lamp unit.

Usually however there is no such resetting to normal condition by depressing of the acknowledgment push-button, and no such restarting of the alarm, since the signal contact 11, as mentioned, is likely to be in closed condition by the time that the alert signal is acknowledged.

Likewise it is possible and desirable in many instances to re-establish normal conditions of the system automatically by the reopening of the signal contact 11, and the present system provides for this purpose. The reopening of the signal contact de-energizes the B coil, thereby reversing the switches B–1, B–2 and B–3, B–4 again.

At this time the reversal of the switches B–1 and B–2, regardless of sequence thereof, has no effect, both switches 11 and A–1 being open.

On the other hand the reversal of the switch B–3, B–4 breaks the circuit from the positive terminal P through the lamp units 24, closed switch A–5 and switch B–4 to the negative terminal N, thereby extinguishing the lamps. The lamps are now connected to the test bus T through

the normally closed switch B–3, for occasional testing by the push-button 16.

The modified system of Figure 2 utilizes, as may be noted from the drawing, the same seal-in before seal-out arrangement A, B, B–1, B–2, A–2 as has been described above. It also energizes the horn 12 through the same bus R as has been explained. The system is modified however with respect to the lamp unit.

The back-lighted name plate and flasher arrangement as described above is preferable mainly in two instances: (1) in central control rooms where there is a great multiplicity of alarms in a relatively small space and where the attendant must read some definite legend in order to interpret the appearance of an alarm light properly, and (2) in graphic panels where a lettered name plate forms an integral part of a flow diagram symbol and where the use of more than one lamp unit, for the representation of one field apparatus, would be confusing. On the other hand, a combination of two or more bullseye light elements has the advantage of compactness coupled with excellent visibility over a wide range of distances and viewing angles. Whenever such considerations are controlling the system of Figure 2 will be found preferable.

This system uses the same buses P, R, C, T and N as described above. It further uses relay units 17′ comprising the same seal-in before seal-out system and bus R energization system as described above. There may be used a red signal lamp 24′ of the bullseye type, connected in much the same manner as is the lamp 24 described above, except that the switch A–4′ is connected to the lamp on the one hand and to the negative terminal N on the other. Usually it is then desirable to add a white signal lamp 24–A of the bullseye type, connected on the one hand to the positive terminal P and on the other to the common terminal of a double throw switch A–6, A–7, the normally open part of this switch, A–6, being connected to the negative terminal N and the normally closed part A–7 to the test bus T.

As a result, both signal lamps are off during normal conditions. Both are on during the alert. The red lamp alone is on during the acknowledged alarm. Both lamps are on during a test. The operation of the horn is the same as before.

A system according to Figure 1, equipped with all of the bus wires shown, may have different annunciator and relay systems connected thereto. Some of these annunciator and relay systems may be those shown in Figure 1 while others may be those shown in Figure 2. There will be no mutual interference or feed-back.

Still further modifications no doubt will occur to persons skilled in the art upon a study of this disclosure.

I claim:

1. In an alarm system for the protection of a series of devices, a corresponding series of signal switches; a corresponding series of alarm relay units; at least one annunciator specially associated with each unit; a common annunciator associated with the entire series of units; a normally open acknowledgment switch common to all of said units; a pair of energizing voltage terminals associated with the entire series of unit; each unit comprising: a make-before-break type switch, a first relay coil and a second relay coil; one terminal of each of said coils being connected to one of said terminals through the corresponding signal switch, the other terminal of the first coil being connected to the other energizing voltage terminal through the normally closed part of the make-before-break type switch, the second coil controlling said make-before-break type switch, and the other terminal of the second coil being connected to said other energizing voltage terminal through the normally open part of the make-before-break type switch and in parallel therewith, through a normally open switch and said acknowledgment switch in series therewith, said latter normally open switch being controlled by the first coil; switch means in each unit controlled by said relay coils for de-energizing the specially associated annunciator when the acknowledgment switch has been closed and the associated signal switch is open, to produce a first announcement of the common annunciator and respective specially associated annunciator, by a change in the state of energization of the respective first coils, when the respective signal switches close, and to produce a different announcement of the respective specially associated annunciators while stopping said first announcement of the common annunciator upon operation of said acknowledgment switch.

2. An alarm system as described in claim 1 wherein both coils of each relay unit have their first mentioned terminals connected to said one energizing voltage terminal through two switches in parallel, one of said parallel switches being said associated signal switch and the other being automatically actuated by the associated first coil.

3. An alarm system as described in claim 1 wherein said switch means of each unit comprises, in circuit with the respective annunciator, first relay coil annunciator control contacts in two branch circuits leading to one of said energizing voltage terminals, said branch circuits including means to produce different operations of the respective annunciators, means for rendering said respective branch circuits operative respectively before and after operation of the acknowledgment switch.

4. An alarm system as described in claim 3 wherein at least some of said specially associated annunciators are lamps, a flasher switch connected in common with one of said two branch circuits of each annunciator unit, said first relay coil contacts in one of said branches of each annunciator unit being normally closed contacts and the first relay coil contacts in the other associated branch circuit being normally opened contacts, means connecting each of said lamps to said energizing voltage terminals through a series circuit of said normally opened first relay coil contacts in said associated one branch and said flasher type switch, and said other associated branch shunting said flasher type switch and connecting the associated lamp to said energizing voltage terminals through a series circuit of normally closed first relay coil contacts and normally open second relay coil contacts.

5. An alarm system as described in claim 3 wherein the specially associated annunciator in each unit comprises a pair of lamps, one of said lamps being in one of said associated branch circuits and the other lamp being in the other of said associated branch circuits, said first relay coil contacts in one of said branches being normally closed, said first relay coil contacts in the other branch circuit being normally opened to energize the alarm lamp when an abnormal condition exists, normally open contacts of said second relay coil connecting the normally closed first relay coil contacts in said one branch circuit to said energizing voltage terminals, so that the alarm light in that branch circuit is energized when the first coil is in its normal position and the second coil is in its abnormal position, additional normally open contacts of said first relay coil shunting said normally closed first relay coil contacts and said normally open second relay coil contacts in said one branch to energize the alarm lamp therein when the first relay coil is in its abnormal position.

6. A low drain alarm system comprising a pair of energizing voltage terminal, first and second normally de-energized branch circuits connected between said energizing voltage terminals, a first normally de-energized relay coil in said first branch circuit and a second normally de-energized coil in the second branch circuit, a normally open condition-responsive signal switch means connected in series with said relay coils of both branch circuits and adapted to close upon existence of an abnormal condition, normally open contacts of said first relay coil in series with said second relay coil in said second branch circuit and a normally opened acknowledgment switch in series with said last-mentioned normally opened contacts in said second branch circuit which

energize said second relay coil when said first relay coil is energized and the normally open acknowledgment switch is momentarily closed, make-before-break switch contacts including normally closed contacts in series with said first relay coil in said first branch circuit for effecting energization of that coil upon closing of the associated signal switch, and normally open contacts connected in shunt with said normally open first relay contacts and said normally open acknowledgment switch of said second branch circuit, said normally open contacts of said make-before-break contacts arranged to be closed upon energization of said second relay and said normally closed contacts of said pair arranged to open following closing of the last-mentioned make-before-break contacts, means for providing a first signal announcement responsive to the energization of said first relay coil, and means for providing a second signal announcement responsive to the energization of said second relay coil.

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