

Nov. 17, 1942.

V. DURBIN

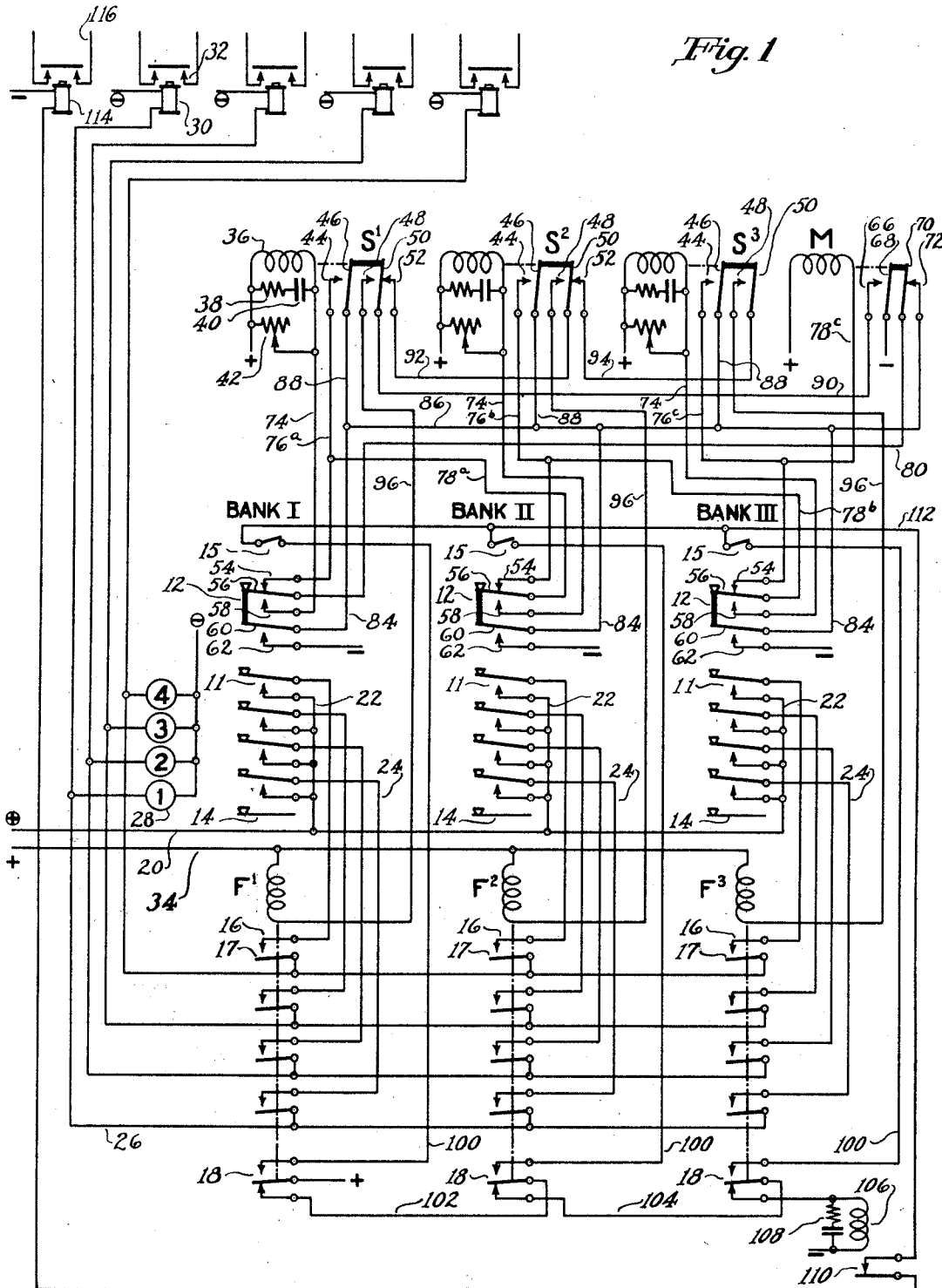
2,302,535

PAGING SYSTEM

Filed April 5, 1940

3 Sheets-Sheet 1

Fig. 1



Witness
Paul F. Bryant

Inventor
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by his attorney
Fish, Hildreth, Lang & Penney

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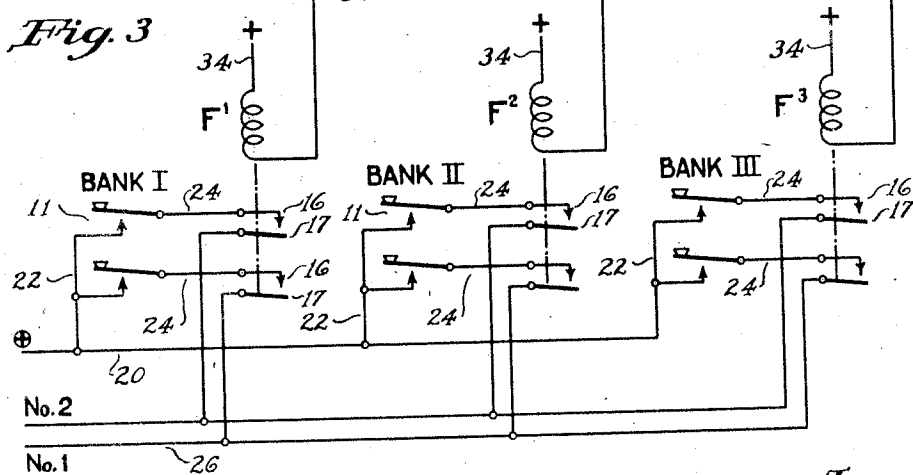
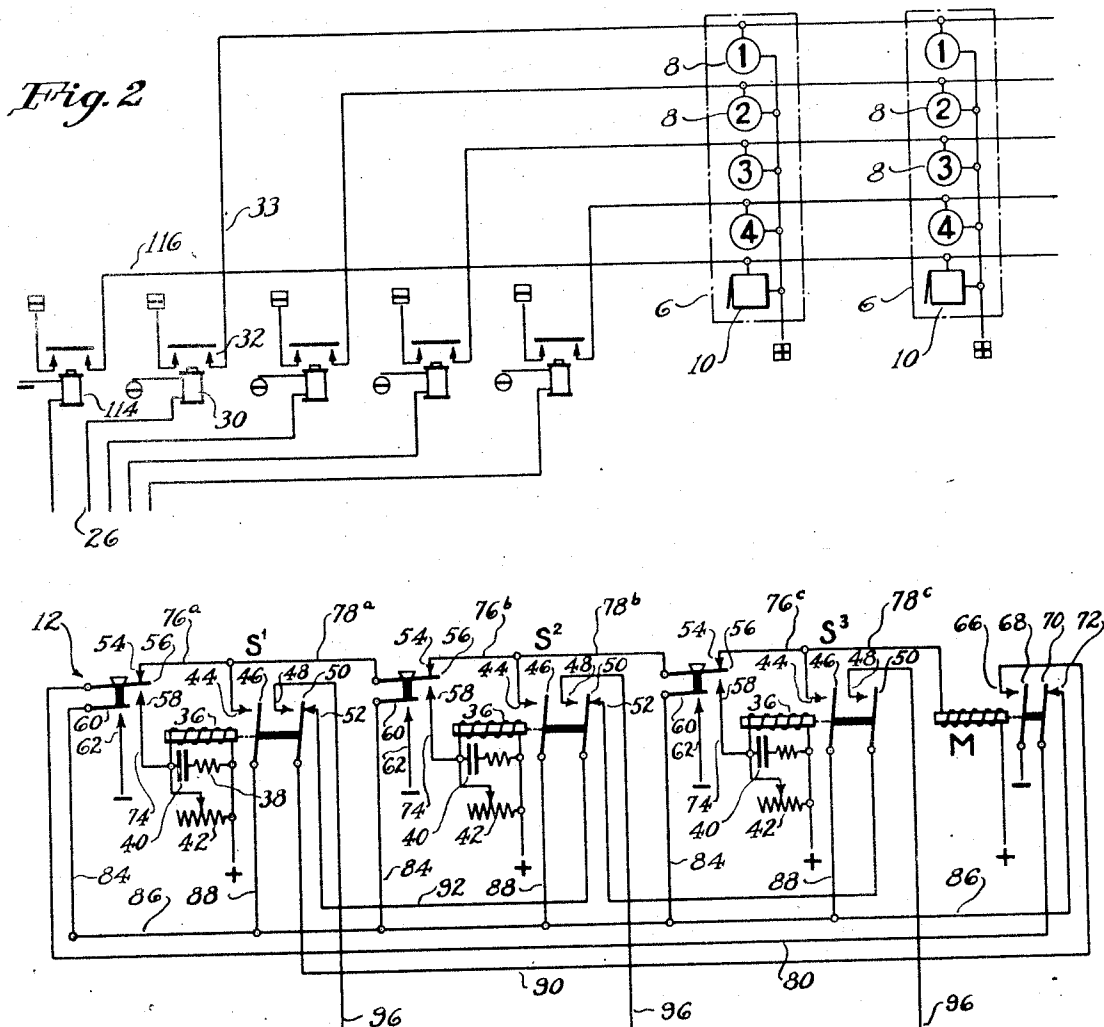
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PAGING SYSTEM

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3 Sheets-Sheet 2



Witness

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3 Sheets-Sheet 3

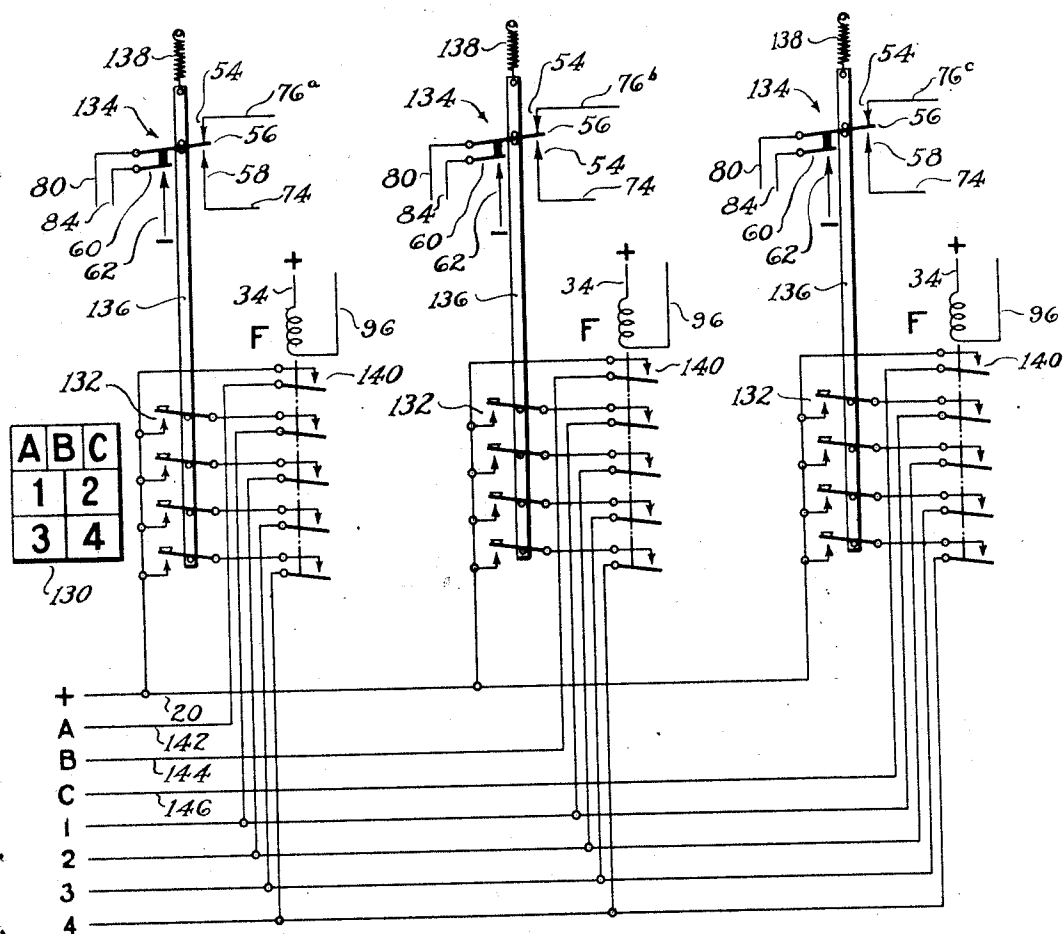


Fig. 4

Witness

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UNITED STATES PATENT OFFICE

2,302,535

PAGING SYSTEM

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Application April 5, 1940, Serial No. 327,975

11 Claims. (Cl. 177—353)

The present invention relates to paging systems and more particularly to systems of the general type disclosed in the Lichter Patent 1,780,791 and the Baker Patent 1,795,536.

The systems disclosed in the Lichter and Baker patents comprise a series of banks of calling keys which, through suitable flasher means, are sequentially connected with annunciator circuits whereby the annunciator cyclically displays the signals set up on the several banks. A disadvantage of these systems is that an inactive bank, that is, a bank on which no call is set up, assumes control of its proportionate part of the cycle. Thus in a six-bank system, if calls are set up on only two banks, the annunciator will be dark for at least two-thirds of each cycle. In my Patent No. 2,052,999 I have illustrated a system in which this disadvantage is overcome, the specific embodiment of said invention involving a mechanical flasher which is operated at low speed with respect to an active bank and at high speed with respect to an inactive bank.

In accordance with the present invention, means are provided for causing the control of the flasher devices to advance over any bank or banks on which no calls are set up, so that the signals set up on active banks are displayed cyclically, and without the delay periods characteristic of the systems described in the Lichter and Baker patents. The invention is similar to that of my prior patent, but embodies important improvements, particularly in the use of simple and relatively inexpensive apparatus, in the freedom from moving parts, and in the certainty and flexibility of the control. In the preferred form of the invention the control is effected electrically through a series of sequence relays, each under the control of an activating switch or start switch. These relays are operated successively only for those banks in which the activating means are in active position. Accordingly, signals may be set up on any one or several of the banks and the control is such as to place the annunciator only under the influence thereof, whereby all active signals are flashed in rapid succession, without any effect by the inactive banks on the annunciator.

Other features of the invention comprise certain novel features of construction and combinations and arrangements of parts arranged for flashing signals according either to the Baker method (numbers only) or the Lichter method (letter and number combinations), but in each case without delay periods due to inactive banks.

Another feature of the invention comprises an audible signal control useful with any type of sequential paging system, hereinafter to be more particularly described.

In the accompanying drawings Fig. 1 is a

diagram of a system in which the signals are given by number combinations as in the Baker patent and embodying the features of the present invention to avoid delay periods due to inactive banks: Fig. 2 is a diagram of the annunciator circuits for the system of Fig. 1; Fig. 3 is a simplified diagram with some of the elements rearranged to assist in the explanation of the operation of the system of Fig. 1; and Fig. 4 is a simplified diagram of a system to display letter and number signals of the type described in the Lichter patent and likewise embodying the feature of avoiding dark periods due to inactive banks.

The invention is illustrated in Figs. 1 to 3 as embodied in a doctor's paging system of a type to give indications similar to those of the construction disclosed in the Baker Patent No. 1,795,536. There is provided a plurality of annunciators 6, each having a number of lamps 8 with characteristic symbols illustrated here as numerals 1 to 4. Each annunciator is also provided with an audible signal device 10.

The system also includes a call board provided with a plurality of banks of call switches, each bank having a switch for each annunciator symbol. In the system herein described three banks of switches are illustrated at I, II and III, and the individual call switches are shown at 11. A start switch or activating switch 12, to be later described in detail, is provided for each bank. The call board construction may be as described in the Baker Patent 1,963,346, in which the switches after being depressed are held latched in closed position. Each bank also has a stop key 14 by which the start switch and any call switches may be released. Each bank is also provided with an audible signal switch 15.

The annunciators may comprise any number of lamps with any suitable characters, and the buttons for the call switches are provided with corresponding symbols. In one form, each bank has ten switches numbered from 1 to 0, and each doctor is assigned a call number consisting of three digits. The calls for three doctors may be set up on the separate banks of switches and are displayed in succession on the annunciator. To avoid complication of the diagram, the annunciators and banks of call switches are shown as comprising only four characters.

Associated with each bank is a flasher relay (F¹, F² and F³ for the banks I, II and III, respectively), the flasher relays being adapted for successive energization to illuminate the annunciator signals corresponding to closed call switches on the call board. Each flasher relay has a plurality of pairs of contacts 16, 17 corresponding in number to the number of call buttons of the bank, and a set of audible signal control contacts 18.

The call switches are connected in series with corresponding flasher relay contacts of the same bank. The connections are traced as follows: A bus 20 designated by a plus sign in a circle is connected through leads 22 with the fixed contacts of all the call switches of the several banks. The movable contact of each switch is connected by a wire 24 with the corresponding flasher contact 16 of the same bank. All similar movable contacts 17 of the flasher relay are connected together; thus the movable contacts corresponding to number 1 are connected to a bus 26 which in turn is connected to a pilot lamp 28 on the call board, and also to a power relay 30 which in turn is connected to the other side of the source, as indicated by a minus sign in a circle. Similarly, the other contacts of the several flasher relays are connected to busses leading to properly numbered pilot lamps and to similar power relays. The power relays, when energized, close contacts indicated at 32 connected with annunciator circuits 33 which run to the proper annunciator lamps. The sources of energy for the annunciator circuits are indicated by plus and minus signs in squares.

The means whereby the flasher relays are energized will now be described: Each relay is connected at one terminal to a bus 34 which is connected to one side of a source of energy indicated by an unenclosed plus sign. For reasons which will presently become apparent, the flasher relays and control circuits therefor are energized by direct current, and the sources are indicated by unenclosed plus and minus signs. Either alternating or direct current may be used for the sources which are represented by plus and minus signs in circles and squares. In any case the signs have no significance as to polarity and simply indicate the terminals of the sources.

The flasher relays are controlled by a chain of three sequence relays S' , S^2 and S^3 . Since the sequence relays are substantially identical, a description of one only will suffice. The relay S' comprises a winding 36 shunted by a resistor 38 and a condenser 40, and also shunted by a variable resistor 42, forming a time constant circuit to determine a period of slow release of the relay. The relay has a pair of contacts 44, 46 which are open when the relay is de-energized and an independent set of three contacts 48, 50 and 52. When the relay is de-energized, contact 50 makes on 52 and when the relay is energized, it breaks contact with 52 and makes on 48. Relays S^2 and S^3 are identical and corresponding parts are similarly numbered, except that the back contact 52 is omitted from relay S^3 .

Each start switch 12 comprises a set of three contacts 54, 56 and 58 and a set of two contacts 60 and 62. When the switch is up, contact 54 makes on 56, and when the switch is manually depressed, contact 56 makes on 58 and 60 makes on 62.

There is also provided an impulsing relay or master relay M having two pairs of contacts 68, 69 and 70, 72, the former being open and the latter closed when the relay is de-energized.

One side of each winding of the sequence relays and the master relay is connected to the positive terminal of the direct current source. The other side of each sequence relay is connected by a wire 74 with the contact 58 of its own start switch. The upper contact 54 of the first start switch is connected by a wire 76^a with the contact 44 of its corresponding sequence relay, and exactly similar connections for the other start switches and sequence relays are indicated at 76^b

and 76^c. A connection 78^a is made from the wire 76^a to the movable contact 56 of the second start switch, a connection 78^b is made from the wire 76^b to the movable contact 56 of the third start switch, a connection 78^c is made from 76^c to the winding of the master relay, and a connection 80 is made from contact 70 of the master relay to the movable contact 56 of the first start switch.

To assist in tracing the connections, a simplified diagram is given in Fig. 3. The parts are here rearranged by placing each start switch adjacent to its sequence relay and also by changing the arrangement of the call switch and flasher relay contacts to shorten the connections. Fig. 3 is electrically identical to Fig. 1 (except that the call switches are fewer in number) and all connections are similarly numbered, so that Fig. 3 may be hereinafter referred to for the description of the sequence relay operation.

The lowermost fixed contact 62 of each start switch is connected to the negative terminal of the direct current source. The movable contacts 60 of the several switches are connected by wires 84 with a sequence relay control bus 86. The movable contacts 46 of the several sequence relays are connected by wires 88 to the control bus. The bus is connected at one end to contact 72 of the master relay.

Contact 68 of the master relay is connected to the negative terminal of the direct current source, and contact 66 is connected by a wire 90 with the movable contact 50 of the first sequence relay S' . Contact 52 of S' is connected to contact 50 of S^2 by a wire 92, and contact 52 of S^2 is connected to contact 50 of S^3 by a wire 94.

Contacts 48 of the several sequence relays are connected by wires 96 with the terminals of the corresponding flasher relays. The first flasher relay F' is energized whenever its corresponding sequence relay is energized, if the master relay is also energized at the same time. This may be seen by tracing a circuit from the positive bus 34 through flasher relay F' to wire 96, contacts 48, 50 of relay S' , wire 90 and contacts 66, 68 of the master relay to the negative terminal of the source. Flasher relay F^2 is energized when its sequence relay S^2 and the master relay M are energized, but only under the additional condition that the preceding sequence relay S' is de-energized, since the circuit from F^2 to connection 90 must be traced through contacts 48, 50 of S^2 , wire 92 and contacts 52, 50 of S' . Likewise relay F^3 can be energized only when relay S^3 and master relay M are energized and the preceding sequence relays S' and S^2 are de-energized.

A description of the audible signal controls will be deferred until the operation of the parts thus far described has been explained.

Operation of visible signals

When no start switch is depressed, which is the condition illustrated in the diagrams, all relays are de-energized and no indications are given on the annunciators. Assume now that a call is set up on each bank of call switches and that all three start switches are depressed. For the sake of definiteness, it may be assumed that switch 1 of bank I, switch 2 of bank II, and switches 1 and 2 of bank III are closed. Negative potential is now applied through contacts 62, 60 of any or all of the start switches and through wires 84 to the bus 86. An impulsing circuit may now be continued through contacts 72, 70 of the master relay, wire 80, contacts 56, 58 of the start

switch of bank I, and winding 36 of sequence relay S' to the positive terminal of the direct current source. This relay is immediately energized, thus closing contacts 44, 46. At the same time contact 50 closes on 48, which leads through the wire 96 to the flasher relay F', but the flasher relay is not immediately energized because the circuit is open at contacts 66, 68 of the master relay. Closure of contact 46 on 44 applies negative potential from the bus 86 through wire 88 and said contacts to wire 78^a which leads to the movable contact 56 of the start switch of bank II, and an impulse is thus transmitted through 56, 58 to energize relay S². Energization of S² likewise closes its contacts 44, 46, thereby closing an energizing circuit through wires 78^b and contacts 56, 58 of the third start switch to relay S³. Finally, energization of relay S³ closes its contacts 44, 46 and establishes an energizing circuit through 78^c for the winding of the master relay M. Thus all four relays are energized successively. The successive energization of these relays occurs very rapidly.

The energization of the master relay opens contacts 70, 72 and thus opens the previously traced circuit through which the relay S' was energized. The relay, however, does not de-energize immediately because of the relatively large time constant afforded by the shunt circuits 38, 40 and 42. While the contacts of relay S' are thus held up, the previously described conditions for energization of flasher F' are satisfied, namely, simultaneous energization of relay S' and master relay M. This energizing circuit for F' may be traced from the negative terminal of the source through contacts 68, 66 of the master relay, wire 90, closed contacts 50, 48 of relay S', wire 96 and winding F' to the positive bus 34. Relays S², S³ and M are held energized because negative potential applied to the bus 86 through closed contacts 60, 62 of the several start switches is still fed to the windings of each of these relays through contacts 46, 44 of the preceding relay and the connections 78.

Flasher relay F' being thus energized, all of its contacts are closed and the power relay circuits corresponding to closed call-board switches are energized. Thus, in the example which has been assumed, circuits corresponding to number 1 are energized and number 1 is displayed on the proper pilot lamp and on all of the annunciators.

After a time determined by the time constant of the winding of relay S' and its shunt circuits, the relay becomes sufficiently de-energized to drop its contacts. This disconnects flasher relay F' at contacts 48, 50, whereupon the relay is de-energized and the annunciator indications are extinguished. Furthermore, opening of contacts 44, 46 of relay S' opens the holding circuit for relay S², thereby allowing the latter to de-energize slowly through its timing circuit. An energizing circuit for flasher relay F² is now traced from the negative terminal of the source through contacts 68, 66 of the master relay, wire 90, contacts 50, 52 of relay S', wire 92, contacts 50, 48 of relay S², wire 96 and flasher F² to the positive bus 34. Relays S³ and M remain energized through contacts 44, 46 of the relays S² and S³, respectively. In the interval of slow de-energization of relay S², the flasher relay F² remains energized and thus causes annunciator signal numbered 2 to be displayed, this having been set up on the proper switch of bank II.

After relay S² has been de-energized sufficiently to drop its contacts, relay S³ assumes con-

trol in exactly similar manner so that flasher relay F³ is energized to display the characters 1 and 2 which have been set up on bank III of the call board. Finally, relay S³ de-energizes, thereby opening the circuit of flasher F³, and also opening its contacts 44, 46 through which the master relay has been held energized during the whole cycle. The master relay then drops its contacts. As soon as contacts 70, 72 of the master relay are closed, the sequence relays and the master relay are again energized in rapid succession, following which the relays de-energize slowly and in succession to control the operations of the flasher relays.

It has been found satisfactory to flash at about forty-five times a minute, so that each flash lasts for somewhat over a second. The duration of the flashes is determined by the settings of the resistors 42, and these may be set to give flashes of substantially any desired length.

The operation above described, wherein characters are set up on each bank, may be considered the normal operation of the system, in that the flasher relays operate successively and give visible indications exactly like those displayed by the system of the Baker Patent 1,795,536. However, if all three of the start switches are not depressed, the present system operates to flash signals from the active banks without the delay period which is characteristic of the system of the Baker patent. This may be seen by assuming that a call is set up on bank I and the start switch for bank I only is depressed. In such a case, relay S' is energized exactly as previously described. However, relays S² and S³ are not energized. Immediately upon energization of S', a circuit for energizing the master relay is traced from the negative terminal through closed contacts 62, 60 of the first start switch, bus 86, contacts 46, 44 of relay S', wire 78^a, contacts 56, 54 of the second start switch, wire 76^b, wire 78^b, contacts 56, 54 of the third start switch, wire 76^c, wire 78^c and relay winding M to the positive terminal. The energizing impulse may be therefore considered as advancing past relays S² and S³. The energization of the master relay opens the energizing circuit for S', thereby permitting the latter to de-energize slowly, and when the de-energization has progressed sufficiently to drop the contacts, the energizing circuit from the master relay is again opened. At no time is it possible to energize either of the other cycle relays or to establish a connection to the flasher relays F² and F³. Under such conditions the sequence relay S' and the master relay are simply energized and de-energized successively. The signals set up on bank I are therefore displayed almost continuously, except for the short interval of time in which the relay S' is de-energized. This de-energization of relay S' gives a flashing signal which is very effective in attracting attention.

From the description thus far, it will be seen that the flasher relays operate only for those banks in which the start switches are depressed; thus if a call were set up on bank II or bank III, the corresponding cycle and flasher relays would be operated, but the cycle and flasher relays of other banks would be inactive. Likewise, two calls may be set up on two banks and these will be flashed in immediate succession without being affected by the inactivity of the third bank. In any event, the impulse initiated by closure of master relay contacts 66, 68 passes through the operating devices of any active bank or banks

and advances over any inactive bank or banks. In this embodiment of the invention, an active bank refers to one in which the start switch is depressed.

It will be noted that a bank for which the start switch is depressed will control an interval even though no call switch for that bank is closed. It is thus possible to provide an interval in which no signal is displayed but ordinarily the system will not be operated in that fashion.

The keys may be arranged in any number of banks, with any suitable number of keys in each bank. Usually, the banks are three or more in number, and there are ten keys in each bank numbered from 1 to 0. A call preferably consists of a three-digit number with the digits in ascending order, such as 123, 679, 480, etc., as described in the Baker patent.

Audible signals

The manually operated audible signal switches 15, one for each bank, and the contact groups 18 of the flasher relays have already been mentioned. The purpose is to give an audible signal, when desired, during the flash of any visible signal and this feature is ordinarily used to indicate an emergency call.

As shown in Fig. 1, each contact group 18 comprises a middle movable contact and upper and lower fixed contacts. One terminal of each switch 15 is connected to the upper contact of its corresponding group 18 by a wire 100. The movable contact of the first group 18, corresponding to bank I, is connected to the positive terminal of the direct current source. The lower fixed contact is connected to the movable contact of the next group by wire 102, and the lower contact of said group is connected to the middle contact of the next group by wire 104. The lower contact of the final group is connected to one terminal of an audible signal relay 106, the other terminal of which is connected to the negative terminal of the direct current source. The relay 106 is shunted by a time constant circuit 108 comprising a resistor and a condenser. When all the flasher relays are de-energized, the audible signal relay 106 remains continuously energized, thus holding its contacts 110 closed.

One terminal of each of the audible signal switches 15 is connected to a bus 112, leading through the contacts 110 to an audible signal power relay 114, which in turn is connected to the negative side of the direct current source. The relay 114 is similar to the relays 30 and has contacts for operating the audible signals 10 through a circuit 116. It will be seen that when the audible signal switches 15 are left open, the power relay 114 is not energized, regardless of the operations of the flasher relays.

Assuming now that the audible signal switch 15 for the bank I only is closed, then when the flasher relay F' is energized, under the conditions previously described, the movable contact of group 18 of this relay leaves the lower fixed contact and engages the upper contact. The energizing circuit for the audible signal relay 110 is thus opened, but the relay remains energized for a short time because of the time constant circuit 108. An energizing circuit for the power relay 114 is now traced through the middle and upper contacts of group 18, wire 100, closed switch 15 of bank I and bus 112. The energization of the power relay 114 closes its contacts and operates the audible signals of all annunciators. Shortly thereafter the audible signal relay 75

106 de-energizes through its circuit 108 and drops the contacts 110. When the flasher relay F' is de-energized the audible signal relay 106 picks up again, thus closing its contacts 110, but no audible signal is given at that time because the energizing circuit for the power relay is broken.

The operation of the audible signal controls for the other banks is similar and need not be described in detail. The audible signal switches 15 of more than one bank may be closed, in which case an audible signal will be given upon the activation of each bank for which a switch 15 is closed.

The audible signal controls above described are particularly arranged for use with audible signal devices of the solenoid type, in which a single stroke is given upon closure of the main audible signal circuit 116. If audible signal devices of the buzzer type are employed, the relay 106 and its contacts may be omitted. An energizing circuit for the power relay 114 would then be traced directly through the contact groups 18, a closed audible signal switch 15, and bus 112, whenever the flasher relay corresponding to such a closed audible signal switch should be energized. However, some difficulty might be encountered if audible signal devices of the solenoid type were used with such a simplified circuit. Such signal devices are rather slow acting and might not be de-energized with sufficient rapidity in the relatively short interval between operations of successive flasher relays, in which case the audible signal would be lost. This might happen if the audible signal switches for all active banks were closed. Consequently, the circuit above described is preferably provided. Upon energization of any flasher relay, the audible signal is immediately sounded if the corresponding switch 15 is closed. The time constant of the relay 106 is long enough to insure only that the contacts 110 shall remain closed for a sufficient time to transmit the energizing impulse to the power relay 114, after which the contacts 110 are permitted to open, thereby restoring the audible signal devices to their original condition. The time constant determined by the circuit 108 may be made considerably shorter than the time constants for the sequence relays so that de-energization of the audible signal devices will be assured before the flasher relay of an active bank becomes de-energized.

System of Fig. 4

The system illustrated in Fig. 4 is arranged to give signals of the type described in the Lichter Patent 1,780,711. Each annunciator has signals of two groups, for example, letters A to D and numbers 1 to 16. A call consists of the combination of a letter and a number. By this arrangement the calling capacity is increased since several numbers may be displayed with each letter. There are as many banks of calling keys as there are letters and each bank has a key for each number. In the Lichter system the letters A, B, C, etc., are displayed automatically in sequence, and as each letter is displayed the numbers set up on the corresponding bank are displayed therewith. According to the present invention, as shown in Fig. 4, the same general results are obtained except that inactive banks are skipped over, that is, no time is taken by banks in which no number keys are set.

The system of Fig. 4 is similar to that of Figs. 1 to 3, except that some changes are made to permit activation of a bank by operation of any

number key therein and without the use of a manual start switch; also the number keys are independently releasable to permit cancellation of a call while still allowing other calls set up on the same bank to be displayed in their proper sequence.

For simplification, only three banks are shown in Fig. 4, each comprising four keys numbered from 1 to 4. Each annunciator 130 has the signal lamps A, B, C, 1, 2, 3 and 4. Each key has contacts 132, correspondingly numbered contacts of the several banks being connected through appropriate relay circuits with the corresponding annunciator signals. Each bank has a start switch 134, electrically identical with the start switches 12 of the system previously described, but operated automatically through a sliding bar 136. The bar is moved to close the start switch when one or more number keys of the bank are depressed, and is restored to inactive position by a spring 138 when all keys of the bank are released.

The sequence relays, the master relay and the electrical connections to the start switches are exactly as in Fig. 3, these connections being omitted from Fig. 4. The flasher relays F¹, F² and F³ are also similar to those of Fig. 3, each having a pair of contacts in series with correspondingly numbered key contacts of the bank. The flasher relays each have additional contacts 140, connected at one side to the bus 20 and at the other side to circuits (142, 144, 146) for energizing the respective letter signals. Thus the contacts 140 of relay F¹ control energization of the letter A, the similar contacts of relay F² control energization of letter B, etc. The relay connections to the annunciators are omitted from Fig. 4.

Audible signal switches may be provided to operate in the same manner as in the system previously described.

As an example, it may be assumed that doctors A1, A3, C1, C2 and C4 are to be called. Keys 1 and 3 of the first bank and keys 1, 2 and 4 of the third bank are depressed. The annunciator first displays the letter A together with numbers 1 and 3, and then displays the letter C together with numbers 1, 2 and 4, this sequence being repeated at a rate determined by the time constants of the relay circuits, and without any B indication. If it is now desired to call a B doctor, say B4, key 4 in the second bank is depressed, and the annunciator indication B4 enters into the sequence between the A and C indications. Any call may be canceled simply by releasing the corresponding key, while still permitting other calls set up on the same bank to be displayed; thus if key 1 of the A bank is released, the call A3 will continue to be displayed in its proper sequence. When all keys of a previously active bank are released, the start switch for that bank is opened, and the bank no longer has any control over the system. If one bank only is active, its letter and number indications will be displayed practically continuously, except for the short flashing intervals caused by the timing operations of the relays.

As in the first system described, the system may be extended to any number of banks, with any number of keys in each bank.

Having thus described the invention, I claim:

1. A sequence control system comprising a plurality of sequence relays having individual output means associated therewith and controlled thereby, manual activating means for each sequence relay, an impulse device, means operated by any

of said activating means for actuating the impulse device, means operated by an impulse generated by the impulse device for energizing in succession only those sequence relays for which the manual activating means have been operated, a timing circuit for each sequence relay to determine a period of slow de-energization thereof during which its output means is operative, connections to cause slow sequential de-energization of the relays which have been previously energized in a cycle of variable length depending on the number of such activated relays, and means controlled by the last of said relays to operate the impulse device to initiate a new cycle, whereby said selected relays are separately and sequentially in control of their output means in substantially continuous succession.

2. A sequence control system comprising a plurality of sequence relays having individual output means associated therewith and controlled thereby, manual activating means for each sequence relay, an impulse device, means operated by any of said activating means for actuating the impulse device, means operated by an impulse generated by the impulse device for energizing in succession only those sequence relays for which the manual activating means have been operated, a timing circuit for each sequence relay to determine a period of slow de-energization thereof during which its output means is operative, connections controlled upon completion of de-energization of a relay to initiate de-energization of the next succeeding energized relay, and means controlled by the last of said activated relays to operate the impulse device to initiate a new cycle of operation, whereby said selected relays are separately and sequentially in control of their output means in substantially continuous succession.

3. A sequence control system comprising a plurality of sequence relays each having a timing circuit to determine a period of slow de-energization thereof during which each relay is in control of individual output means associated therewith, a start switch for each relay, an impulse relay, means operated by the impulse relay to establish energizing circuits for only those sequence relays for which the corresponding start switches are closed, the energizing circuit for each such sequence relay subsequent to the first being established through contacts of the preceding relay which is energized, connections operated by energization of the last of said relays to open the energizing circuit of the first of said relays and thus to cause sequential de-energization of the energized relays at intervals determined by the timing circuits thereof, whereby the individual output means associated with the selected sequence relays are rendered separately operable in substantially continuous succession.

4. A sequence control system comprising a chain of sequence devices having individual output means associated therewith and controlled thereby, a manually operated activating device for each sequence device, an impulse device to initiate cycles of operation of the sequence devices, means for operating in a definite cycle only those sequence devices for which the activating devices have been set in operative position, timing means to determine timed operation of the individual sequence devices during which each device is in control of its associated output means to cause separate and successive operation of said devices in a cycle of variable length depending on the number of sequence devices in oper-

ation, and means controlled by the last of the activated sequence devices in the chain to operate the impulse device to initiate a subsequent cycle of operation.

5. A sequence control system comprising a chain of sequence relays having individual output means associated therewith and controlled thereby, a manually operated activating device for each sequence relay, an impulse device to initiate cycles of operation of the sequence relays, means for operating in a definite cycle only those sequence relays for which the activating devices have been set in operative position, timing means to determine timed operation of the individual sequence relays during which each relay is in control of its output means to cause separate and successive operation of said output means in a cycle of variable length depending on the number of sequence relays in operation, and means controlled by the last of the activated sequence relays in the chain to operate the impulse device to initiate a subsequent cycle of operation.

6. A sequence control system comprising a chain of sequence devices, activating means for each sequence device effective to control operation thereof, an impulse device having connections through said activating means to only the sequence devices for which the activating means are in effective position to abnormalize said sequence devices, means for immediately thereafter normalizing said sequence devices sequentially including timing means for determining definite times of normalization for said devices, individual output circuits associated with the sequence devices, each operable only during the interval of normalization of the corresponding sequence device, and means controlled by normalization of the last activated sequence device to operate the impulse device to cause a repetition of the cycle, whereby said selected sequence devices and associated output means are separately operated in substantially continuous succession.

7. A sequence control system comprising a chain of sequence relays, a manually operated activating device for each relay, an impulse device to energize the first sequence relay for which the activating device has been set, connections for rapidly energizing successive activated sequence relays, said connections for each sequence relay operating from the preceding sequence relay which is energized, means for slowly de-energizing the sequence relays successively, individual output means associated with the sequence relays and each operable during the interval of de-energization of the corresponding sequence relay, and means controlled by de-energization of the last sequence relay for operating the impulse device to initiate a new cycle of said operations, whereby the selected sequence relays and their associated output means are separately operated in substantially continuous succession.

8. A sequence control system comprising a chain of sequence relays, activating means for each sequence relay effective to control operation thereof, an impulse device having connections through said activating means to only the sequence relays for which the activating means are in effective position to abnormalize said sequence relays, means for immediately thereafter normalizing said abnormalized sequence relays sequentially including timing means for determining definite times of normalization for said relays,

individual output circuits operable during the intervals of normalization of the corresponding sequence relays, and means controlled by normalization of the last activated sequence relay to operate the impulse device to cause a repetition of the cycle, whereby the selected sequence relays and associated output circuits are rendered separately operable in substantially continuous succession.

9. A sequence control system comprising a chain of sequence relays, a master relay, a main energizing circuit from contacts of the master relay to the first of the sequence relays, energizing circuits from contacts of each sequence relay to the relay next succeeding and from contacts of last sequence relay to the master relay, manual switch means for each sequence relay to render the energizing circuit therefor either effective or ineffective, a de-energizing circuit for each relay including timing means to determine a time of slow de-energization thereof, means for sequentially establishing the de-energizing circuits for the energized relays only, and individual output circuits operated in the intervals of slow de-energization of the corresponding sequence relays.

10. A sequence control system comprising a chain of sequence relays, a master relay, a main energizing circuit from contacts of the master relay to the first of the sequence relays, energizing circuits from contacts of each sequence relay to the relay next succeeding and from contacts of last sequence relay to the master relay, manual switch means for each sequence relay having, when in active position, a contact to connect the relay with its energizing circuit and, when in inactive position, another contact connected with the energizing circuit of the succeeding relay, the master relay having contacts to open the main energizing circuit when the master relay is energized, a timing circuit for each relay to determine a time of slow de-energization thereof, contacts closed when the master relay is energized to effect sequential de-energization of the energized relays under control of their timing circuits, and individual output circuits operated in the intervals of slow de-energization of the corresponding sequence relays.

11. A sequence control system comprising a chain of sequence relays each in control of an output circuit, individual timing means associated with each relay for determining the duration of the period such relay, upon being rendered operative, is in control of its output circuit, manually operated devices in control of each relay for selecting the relays to be operated in sequence, means for operating one after another of the selected relays to cause each to be successively in timed control of its output circuit, said means including connections which, upon the completion of the control period of one relay, cause the immediate initiation of the control period of the next selected relay, whereby only one relay and its output circuit is operative at a time and the length of a cycle of operations is substantially the sum of the separate control periods of the selected relays, and means operative upon completion of a cycle of operation of any length to render operative again the first selected relay of the sequence and thereby immediately initiate a new cycle of operation of selected relays.

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