

Aug. 6, 1929.

V. P. THORP

1,723,220

CARRIER TELEGRAPH ALARM SYSTEM

Filed Nov. 2, 1927

3 Sheets-Sheet 1

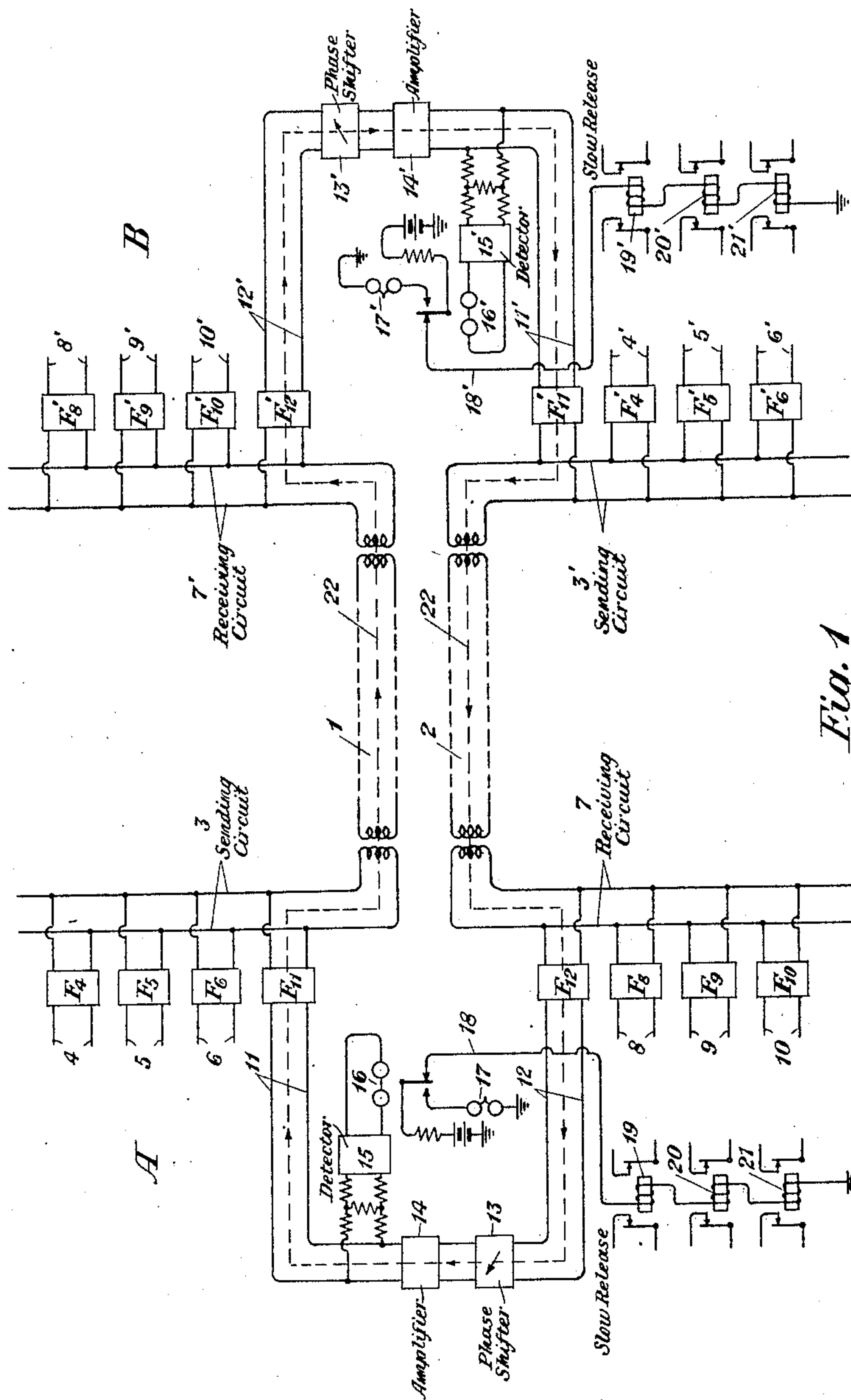


Fig. 1

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3 Sheets-Sheet 2

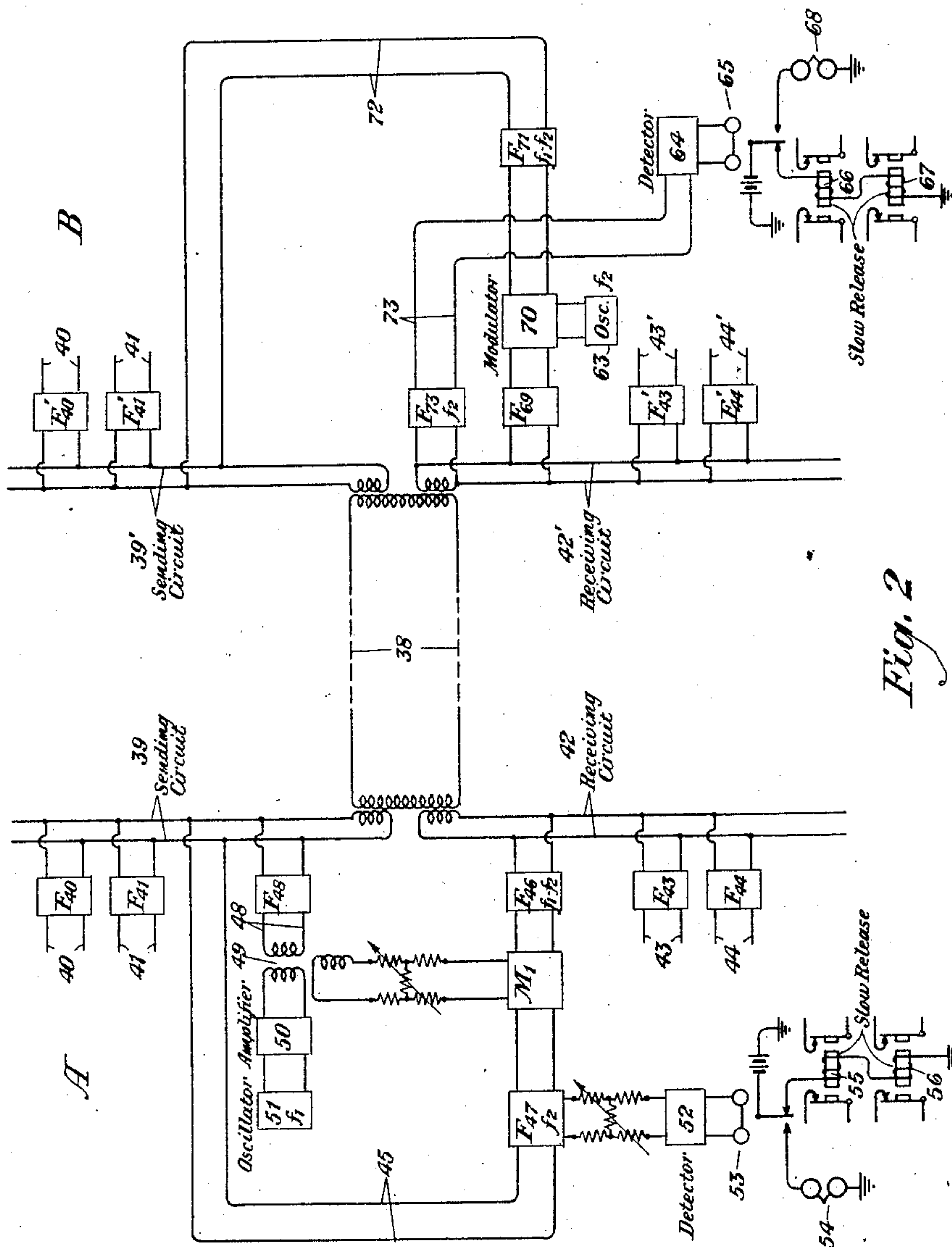


Fig. 2

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3 Sheets-Sheet 3

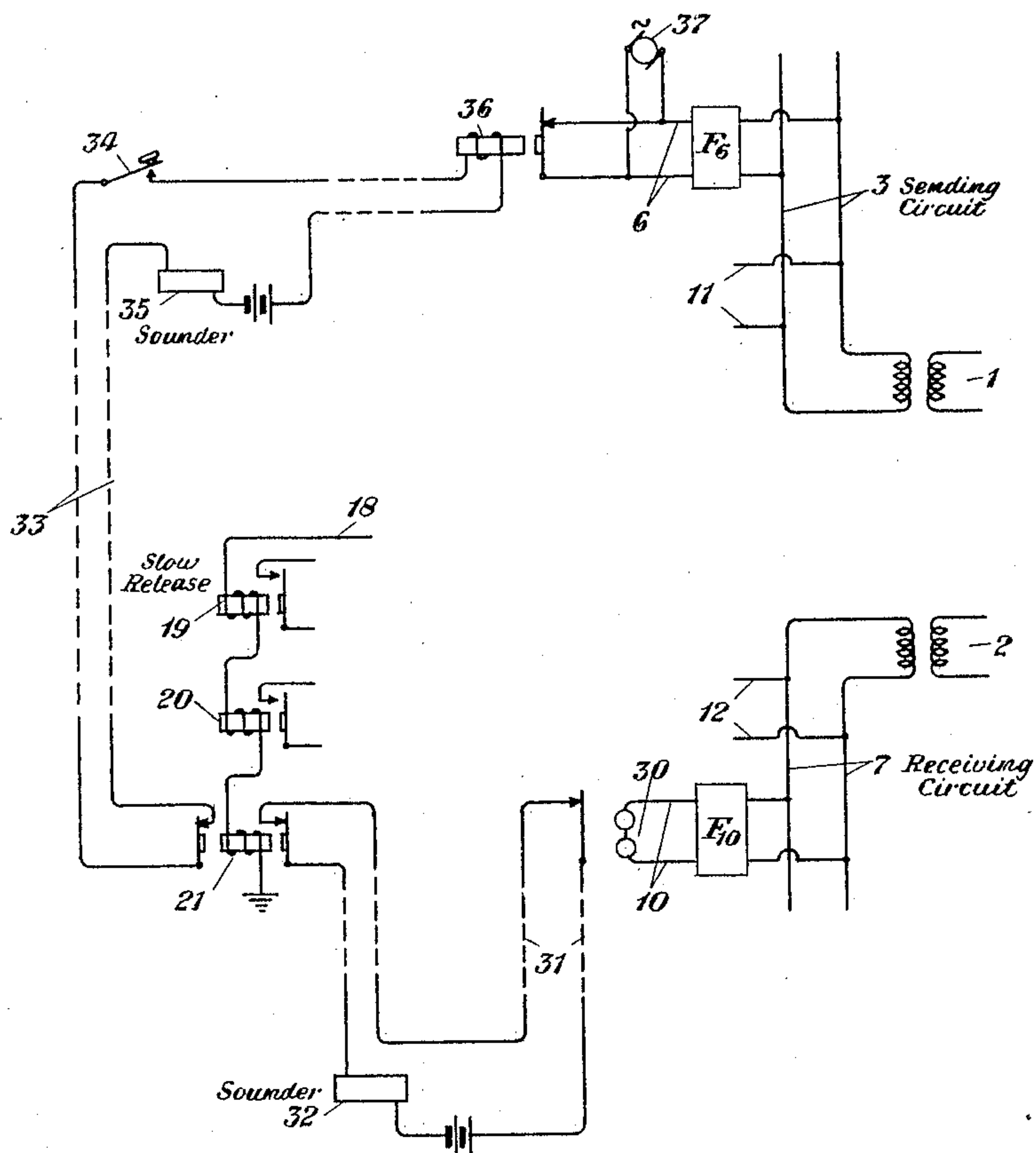


Fig. 3

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CARRIER-TELEGRAPH ALARM SYSTEM.

Application filed November 2, 1927. Serial No. 230,638.

This invention relates to carrier telegraph systems, and more particularly to improved alarm arrangements whereby attendants and operators at each end of a carrier telegraph system will be notified in case the carrier line is open, short-circuited, grounded, or subjected to other trouble.

It has been found in practice that in former carrier telegraph systems trouble has arisen due to the fact that the sending operator on a full duplex carrier channel has no means of knowing if the line is in trouble, and he may send for some time without knowing that his signals are not reaching their destination. The same condition holds in the case of a half duplex four-wire circuit, such as is used in the voice-frequency carrier system, when the line fails in the direction of transmission. Accordingly, it is the primary object of the arrangements of the invention to provide an alarm system to be used in connection with a carrier telegraph system to provide an alarm at the terminal office and to stop the sending at the subscribers' offices when the carrier line is open, short-circuited, or otherwise in trouble. Other features and objects of the invention will appear more fully from the detailed description of the invention hereinafter given.

The alarm method of the invention comprises utilizing a carrier frequency or frequencies within or near the band of frequencies used for the regular carrier telegraph channels. A steady carrier frequency is transmitted over the line, rectified at the terminal station and used to control relays in the terminal equipment. These relays, when held in the operated position, maintain the circuits of the terminal equipment in their normal condition. If the line should become short-circuited or open, the controlling carrier frequency is cut off and the relays in the terminal panels release. These relays give an alarm to the repeater attendants, and, at the same time, open the sending and receiving loops of all channels of the system.

The invention may be more fully understood from the following description, together with the accompanying drawing in the Figures 1, 2, and 3 of which the invention is illustrated. Fig. 1 is a circuit diagram illustrating the arrangements and method of the invention as applied to a cir-

cuit of the four-wire type. Fig. 2 is a circuit diagram showing the invention as applied to a two-wire circuit. In Fig. 3 there is shown in more detail the operation of certain of the relay arrangements of the invention. Like reference characters have been used to denote like parts in all of the figures.

Referring to Fig. 1, A and B represent terminal offices connected by the two sides 1 and 2 of a four-wire circuit. Connected to circuit 1 is a sending circuit 3, to which would be connected a plurality of individual sending channels, such as 4, 5, and 6. These sending channels would be rendered selective for different frequencies by the filters F_4 , F_5 , and F_6 . At station A, connected to the circuit 2, would be a receiving circuit 7. Connected to the receiving circuit 7 would be a plurality of selective receiving channels, such as 8, 9, and 10, which would include the filters F_8 , F_9 , and F_{10} , respectively. In parallel with these sending and receiving channels is connected the circuit 11, 12 which will include the filters F_{11} and F_{12} , and comprises a portion of the alarm circuit of the invention. Other equipment in this alarm circuit would comprise a phase-shifting arrangement 13, an amplifier 14, a detector 15, and a relay circuit 16. Controlled by this relay circuit would be an alarm, such as a bell 17 and a circuit 18, having included in series therein a plurality of slow-releasing relays, such as 19, 20, and 21. It is pointed out that one slow-releasing relay would be provided for each pair of sending and receiving channels. The equipment at station B is identical with that at station A, and similar parts throughout, with respect to station A, have been indicated with similar reference characters with the added designation (') prime.

In the drawing there is shown a dotted line 22. If this dotted line is traced it will show the path of the carrier current used in the alarm circuit of the invention. This path is as follows:

From circuit 2 through filter F_{12} , circuit 12, phase shifter 13, amplifier 14, circuit 11, filter F_{11} , circuit 1, filter F'_{12} , circuit 12', phase shifter 13, amplifier 14', circuit 11', filter F'_{11} to circuit 2 again. It will be seen that this path is a closed circuit. It will furthermore be seen that it is oscillatory, since the output of each of the amplifiers 14 and 14' is eventually connected to its input.

A high impedance detector circuit, such as the circuits including detectors 15 and 15', is bridged across this alarm circuit at each terminal station for the purpose of operating the alarm relays, such as 19, 20, and 21, and 19', 20', and 21'. The frequency of the carrier channel used over the alarm circuit is determined by the filters F_{11} , F_{12} , F'_{11} , and F'_{12} at each terminal in conjunction with the phase shifters 13 and 13'. The phase-shifting circuits are necessary to maintain the proper phase relation between the input and output voltages of the amplifiers, and should be variable to take care of lines having different constants.

It will be seen that with this arrangement a steady carrier current will be flowing over the previously traced alarm circuit. A part of this current will be rectified by devices 15 and 15' and will hold the relays 16 and 16' operated, and will maintain a closed circuit, such as 18 and 18', through the alarm relays. If, for any reason, this closed or singing alarm circuit should be broken, such as would be the case if the lines 1 or 2 were short-circuited, opened, or grounded, the relays 16 and 16' in the detector circuits would move from the marking to the spacing contacts, thereby operating the alarm bell, such as 17 or 17' at each terminal office, and at the same time allowing the chains of slow-release relays in each terminal panel, to release. This would open the loops of all the subscribers, as will be pointed out in more detail in Fig. 3 hereinafter. When the circuit is restored to normal, the alarm circuit again oscillates, the receiving relay and the slow-release relays operate, and the subscribers' circuits are placed in condition for sending and receiving telegraph signals once again. The slow-release relays, mentioned above, are used in preference to quick-acting relays, so they will not operate due to short line interruptions or external interference.

In Fig. 3 is shown in more detail the operation of the chain of slow-release relays 19, 20, and 21 provided at the terminal station A. Similar reference characters have been used to denote like parts with reference to Fig. 1. It has already been pointed out that a slow-release relay is provided for each pair of receiving channels and sending channels. When the sending circuit of Fig. 1 is functioning to transmit a steady carrier current over the system, the relays 19, 20, and 21 will be held in an operated condition. Connected to the receiving channel 10, for purposes of illustration, would be a receiving relay 30. This would control a circuit 31, leading to a subscriber's set, which would include a battery and the sounder 32, which would record the signals coming in over the line. It is pointed out that should the relay 21 release, as would be the case if the circuit were

opened or grounded, its armature would fall back and open the circuit 31 to the subscriber's set, thereby rendering it inoperative. Circuits similar to the circuit 31 would be connected from the relays 19 and 20 to other of the receiving circuits, such as 8 and 9, of Fig. 1. Connected to the sending circuit, such as circuit 6, is a steady source 37 of carrier current. In order to transmit signals the subscriber would operate his key 34 at his station. This would operate a relay 36 which would open a short-circuit across the source 37 and allow oscillations to be transmitted out over the line. It is pointed out that should the relay 21 release, as would be the case should the line be opened or short-circuited, this would serve to open the circuit 33 connected to the subscriber's set and thereby render it inoperative. Circuits similar to 33 would be connected to relays 19 and 20, and thence would be connected to other transmitting circuits, such as 4 and 5 of Fig. 1.

In the arrangements of Fig. 2, the method of the invention is illustrated as applied for use on a two-wire circuit, such as the circuit 38. However, this modification of the invention may be applied to four-wire circuits, if desired. In the arrangements of Fig. 2, an oscillator and modulator are provided at each terminal to produce the steady carrier frequencies necessary for operation of the alarm circuit. At station A is provided an oscillator 51, generating a frequency of f_1 . At station B an oscillator 63 is provided, generating a frequency of f_2 . At station A is provided a detector circuit including the detector 52 and a relay 53. The relay 53 will control a series of slow-releasing relays, such as relays 55 and 56, and an alarm bell 54, which will be similar to the slow-releasing relays of Fig. 1, heretofore described.

Terminal station A transmits a carrier frequency f_1 which is selected by means of a filter F_{69} at station B. Here it is combined in the modulator 70 with the carrier frequency f_2 produced by the oscillator 63 at station B and the resulting frequency $f_1 - f_2$ is transmitted through the filter F_{71} and over circuit 72 and thence over circuit 38 back to the station A. At station A the $f_1 - f_2$ frequency is selected by filter F_{46} and is combined in the modulator M_1 with the frequency f_1 and a part of the resulting frequency $f_1 - (f_1 - f_2)$ or f_2 is transmitted through the filter F_{47} to the detector 52, where it is rectified and caused to operate the relay 53. This will hold the relay 53 in operated condition and maintain a closed circuit through the slow-release relays, such as 55 and 56. The remainder of this f_2 frequency will be transmitted over the following path: over circuit 45, circuit 38, filter F_{73} , circuit 73, detector 64 where it is rectified, and then to relay 65. This rectified cur-

rent will operate the relay 65 and hold it in an operated condition. The relay 65 will accordingly maintain a closed circuit through the slow-release relays 66 and 67. It is evident that if the line circuit or any part of the intermediate repeater circuit becomes short circuited, opened, or grounded, the current supplied to the detector circuits at each terminal will be cut off and the alarm relays will operate. Therefore the sending subscribers' loops will be opened on all channels and the alarm bells will notify the repeater attendants at each station that trouble exists. The arrangements at station B which are similar to those at station A have been designated by like reference characters with the added designation (') prime.

While the arrangements of the invention have been disclosed in certain specific arrangements which are deemed desirable, it is understood that they are capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A carrier telegraph system adapted for the transmission of a plurality of message channels, means to transmit a steady carrier frequency over said system, and an alarm system operated when the continuity of said steady carrier frequency is broken.

2. A carrier telegraph system adapted for the transmission of a plurality of message channels, means to transmit a steady carrier frequency over said system, relay means maintained in an operated condition by said steady carrier frequency, and means controlled by said relay means when operated for rendering operative said plurality of message channels.

3. A carrier telegraph system adapted for the transmission of a plurality of message channels, means to transmit a steady carrier frequency over said system, a chain of slow release relays at one of terminals of said system maintained in an operated condition by said steady carrier frequency, and means controlled by each of said relays for individually controlling the operativeness of separate ones of said message channels.

4. A carrier telegraph system adapted for the transmission of a plurality of message channels, means to transmit over said system a steady alarm current of carrier frequency, means at one of the terminals of said system for rectifying said steady alarm current, a relay operated by said steady alarm current as rectified, an alarm circuit operated by the release of said relay, and a circuit controlled by said relay when energized for maintaining the operativeness of said message channels.

5. A carrier telegraph system adapted for the transmission of a plurality of message channels, said carrier system including two one-way line sections for transmission in opposite directions, alarm circuits including amplifiers at each end of said system, said alarm circuits with amplifiers being so connected to said one-way line sections that the combination of said line sections and alarm circuits will form an oscillatory or "singing" circuit, and means at each terminal station to operate an alarm system by the current generated by said oscillatory or "singing" circuit.

In testimony whereof, I have signed my name to this specification this 31st day of October, 1927.

VAUGHN P. THORP.