

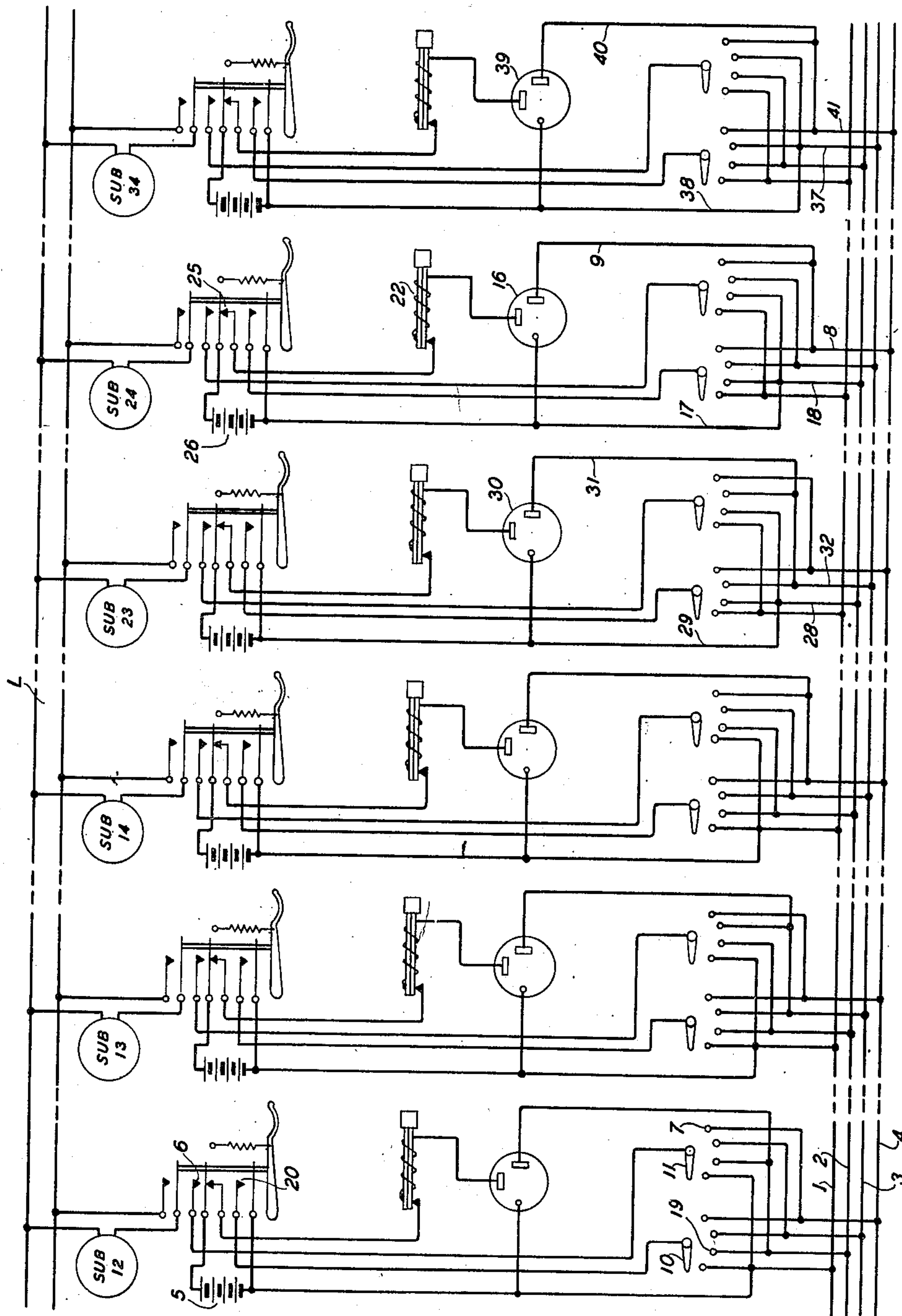
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## SIGNALING SYSTEM

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## SIGNALING SYSTEM

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This invention relates to telephone signaling systems and particularly to telephone systems of the intercommunicating type.

Telephone signaling systems have been devised heretofore in which a common talking channel provides the medium over which speech signals are transmitted between the stations, and each station is provided with an individual two-wire signaling channel over which call signals between stations are transmitted and by means of which each station of the system may be selectively signaled. In order to reduce to a minimum the number of conductors interconnecting the several stations of such systems it has been proposed heretofore to provide fewer signaling conductors than there are stations, and to provide means for selectively combining each signal conductor with every other signal conductor to provide the required number of two-wire signaling channels. In accordance with the well-known formula having to do with the number of combinations that are available from a predetermined number of elements taken two at a time, it is possible to effect six separate two-wire channels from four conductors; fifteen channels from six conductors; etc.

Signaling systems of the type described above require a signal device at each station connected across the particular combination of two conductors which define the signal channel which is individual to the particular station. Such signaling devices operate in a well-known manner when a signaling voltage is impressed on the corresponding channels. However, such systems are characterized by the fact that not only is the signal associated with a selected channel subjected to the impressed signaling voltage but also two or more signaling devices at stations other than the selected station will be subjected, in some degree, to the impressed voltage and will respond falsely. This characteristic results from the fact that when a particular signaling channel is selected, it is possible to trace series circuits through two or more signaling devices between any two conductors which are combined to effect a single signal channel.

It is the object of this invention to preclude the possibility of false signaling in a signaling system in which the stations of the system are interconnected by signal conductors fewer in number than there are stations, and in which each signal conductor may be combined with every other signal conductor to provide a separate two-wire signal channel for each station of the system.

This object is attained in accordance with a feature of the invention by utilizing as the signal device at each station of the system a normally open-circuited voltage responsive device in the nature of a cold cathode gas-filled tube, and a signaling voltage whose magnitude is such as to be ineffective to operate such devices when connected, two or more, in series across the signal channel to which the signaling voltage is applied.

The invention will be readily understood from the following detailed description made with reference to the accompanying drawing which diagrammatically illustrates a six-station intercommunicating system of the type described above, the stations of which are interconnected by but four signaling conductors which may be selectively combined in a manner to provide six separate signaling channels.

The equipment at all four stations is identical and comprises a telephone set of any well-known type, a source of current in the nature of a battery, a pair of individually operable switches for selectively combining the four signaling conductors to effect six signaling channels, a three-element cold cathode gas-filled tube and a thermal device for resetting the tube.

It is believed that the invention will be best understood from a detailed description of the operation of the system and for this purpose it will be assumed that the party at station 12 desires to communicate with the party at station 24. The subscriber at station 12 actuates switch arm 10 to contact 19 and the switch arm 11 to contact 7 and then removes the receiver, or handset from its mounting. The subscribers' telephone instruments are not illustrated but it is intended that when the receiver or handset is removed from its mounting at any station the switchhook contacts are operated in the well-known manner. The switchhook contacts are illustrated in the drawing in their normal unactuated positions.

When the switches 10 and 11 are set as described and the receiver or handset at station 12 is removed from its mounting a circuit is completed which extends from the positive terminal of battery 5, switchhook contact 6 (now closed), switch 11, contact 7, signal conductor 4, conductors 8 and 9 at station 24, across the control gap of the cold cathode gas-filled tube 16, conductors 17 and 18, signal conductor 2, switch contact 19, switch arm 10, switchhook contact 20 at station 12 to the negative terminal of battery 5. The voltage of battery 5 is of sufficient magnitude to cause the tube 16 at station 24 to fire. The tube



16 fires and completes its anode circuit which includes the operating winding of thermal device 22, normal switchhook contact 25 and battery 26. The tube 16 accordingly functions as a visual signal which operates intermittently as a call signal. The thermal device 22 may be of any suitable design and functions as a self-interrupting controller. The tube 16 will continue to operate as long as the battery 5 is connected to the signaling channel 2—4 or until the subscriber at station 24 answers the call by removing the receiver, or handset thereat from its mounting. The latter act opens the anode circuit to the tube 16 and the tube is extinguished. Should the station 24 be unoccupied at the time when the call signal 16 operates, this signal device will be extinguished when the calling party at station 12 abandons the call by restoring the receiver or handset to its mounting. When this is done, the tube 16 will not re-fire after the last opening of its anode circuit by the device 22 since the starting potential furnished by battery 5 is no longer connected across its control electrodes.

If the station 24 is occupied when signal device 16 operates, the call will be answered by the subscriber thereat in the usual manner. When this is done the telephone at station 24 is connected to the common talking channel L and conversation between the parties at the two stations 12 and 24 may be carried on, it being understood that the removal of the receiver or handset at station 12 connects the telephone set thereat to the line L. Talking battery, if required, may be supplied to the common talking channel L in any suitable manner. At the termination of conversation both parties restore their respective receiver, or handset to its mounting and the circuit is restored to normal condition.

In the connection just described the signaling voltage was impressed on the signaling channel made up of conductors 2 and 4, this signaling channel being individual to the station 24. It will be observed, however, that a circuit may be traced from the signal conductor 2, conductors 28 and 29, control gap of tube 30 at station 23, conductors 31 and 32, signal conductor 3, conductors 37 and 38, control gap of tube 39 at station 34, conductors 40 and 41 and back to signal conductor 4. Thus when battery 5 was connected across the signal conductors 2 and 4 in signaling the station 24, the voltage of this battery is also impressed on the circuit just traced which includes the control gaps of tubes 30 and 39 at stations 23 and 34, respectively, in series, so that these tubes are also subjected to the voltage applied to the signal channel 2—4 which is individual to station 24. In systems of the type described and which employ the usual type of signal device, such as an electromagnetic ringer, or filament type lamp, such signal devices would respond to the impressed voltage and falsely signal the stations 23 and 34. By using a normally open-circuited signal device, such as the cold cathode gas-filled tube, the possibility of false signaling is precluded. The voltage of the signal batteries at each of the stations of the system disclosed is such as to cause the breakdown of but one tube and is insufficient to cause two or more serially connected tubes, such as the tubes 30 and 39, to fire. Thus, when the signaling voltage is impressed on a signal channel such as the channel made up of conductors 2 and 4 only tube 16 will be operated to bring in a call signal at the station 24, and the signal devices 30 and 39, though serially connected across the channel 2—4

will not operate. False signaling, accordingly, is prevented.

It is deemed unnecessary to describe in detail how each of the remaining stations of the system disclosed may be signaled from any other station since the description of the operation of the system hereinbefore made in connection with the origination of a call at station 12 and intended for station 24 sets forth all the necessary switching operations required of any station subscriber in initiating a call. Suffice it to say that station 12 is individual to the signal channel made up of conductors 1 and 2; station 13 is individual to the signal channel made up of conductors 1 and 3; station 14 is individual to the signal channel made up of conductors 1 and 4; station 23 is individual to the signal channel effected by combining conductors 2 and 3; and station 34 is individual to the signal channel made up of conductors 3 and 4. Station 24, as hereinbefore described, is individual to the signal channel effected by combining conductors 2 and 4. These stations are signaled from a calling station by placing the signal switches at the calling station on switch contacts associated with the signal channel individual to the desired called station in the manner described in connection with the signaling of station 24 from station 12. It is understood, also, that the number of stations is not limited to the six stations illustrated. Any desired number of stations may be accommodated in the system disclosed.

Though the invention is shown applied to a telephone signaling system it is apparent that it is suitable for use in other applications of remote selective control wherein it is desirable to selectively control the operation of a number of devices over a signal conductors fewer in number than the number of devices.

It is also understood that systems incorporating this invention need not be limited to a common talking circuit. If the impedance of the conductors is kept sufficiently low to preclude cross talk two conversations may be carried on simultaneously over three wires, and accordingly the signaling combinations may be used as speech channels.

What is claimed is:

1. The combination in a signaling system of a plurality of stations, a plurality of signal conductors fewer in number than the number of stations, a signaling channel for each station comprising a different two-wire combination of said signal conductors, certain of said two-wire combinations including a common one of said signal conductors, a normally open-circuited signaling device terminating each of said signaling channels, a source of signaling voltage at each of said stations, and means at each of said stations for selectively connecting its respective source of signaling voltage to said signaling channels.

2. The combination in a signaling system of a plurality of stations, a plurality of signal conductors fewer in number than the number of stations extending between said stations, means at each of said stations for selectively combining each of said signal conductors with every other signal conductor to effect a plurality of distinct two-wire signaling channels greater in number than the number of signal conductors, and a normally open-circuited signal device connected across each of said signaling channels.

3. The combination in a signaling system of a plurality of stations, signal conductors fewer in number than the number of said stations inter-



connecting said stations, switches at a station for selectively combining each of said signal conductors with every other signal conductor to effect a plurality of distinct two-wire signaling channels greater in number than the number of signal conductors, a normally open-circuited signal device at each of said stations permanently connected across a different two-wire signaling channel, and means at a station for impressing a signaling voltage on the two-wire signaling channel effected by the operation of said switches.

4. The combination in a signaling system of a plurality of stations, a plurality of signal conductors fewer in number than the number of stations extending between said stations, selectively operable means at each station for combining each of said signal conductors with every other signal conductor to effect a plurality of distinct two-wire signaling channels greater in number than the number of signal conductors, and a space discharge signal device connected across each of said signaling channels.

5. The combination in a signaling system of a plurality of stations, a space discharge signal device at each of said stations, a source of voltage at a station for initiating the operation of said signal devices, and means at a station for selectively connecting said source of voltage to the control electrodes of each of said signal devices, said connecting means comprising signal conductors fewer in number than the number of said stations and associated with the control electrodes of said signal devices and means for connecting said source of voltage to said signal conductors selectively in pairs.

6. The combination in a signaling system of a plurality of stations, a plurality of signal conductors fewer in number than the number of stations extending between all of said stations, a normally open-circuited signal device at each station responsive to a predetermined value of voltage and so connected to said signal conductors that when a particular pair of said signal conductors is combined to effect a two-wire signal channel a signal device at one of said stations is connected directly across the effected signal channel and the signaling devices of at least two other of said stations are connected in

series across the effected signal channel, a source of current having the said predetermined value of voltage, and means at each station for selectively combining said signal conductors one with each other to effect a plurality of two-wire signaling channels greater in number than the number of signal conductors and for connecting said source of current to the effected signaling channels.

7. The combination in a telephone system of a multi-station line circuit, signal conductors of lesser number than the number of stations on said line circuit interconnecting said stations, a normally open-circuited space discharge signal device at each of said stations, each signal device having its terminals connected across a different signaling channel made up of various two-wire combinations of said signal conductors, means at each of said stations for seizing said signal conductors in various combinations of two conductors to selectively establish connections to the said signaling channels, and means at said stations for impressing a signaling voltage on the selected two-wire combinations of said signal conductors to selectively operate the space discharge signal devices associated with the corresponding signaling channels.

8. The combination in a telephone signaling system of a multistation line circuit, signal conductors of lesser number than the number of stations on said line, a space discharge signal device at each station having a pair of control electrodes, means permanently connecting one electrode of each of a group of said signal devices to a common one of said signal conductors, means permanently connecting the other electrode of each of said group of signal devices to separate others of said signal conductors, means at a station for selectively combining the said common one of said signal conductors with each of the said others of said signal conductors, and means at a station for impressing a signaling voltage on a selectively combined pair of said signal conductors to cause the operation of the signal device whose electrodes are connected to the selected signal conductors.

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