

May 17, 1938.

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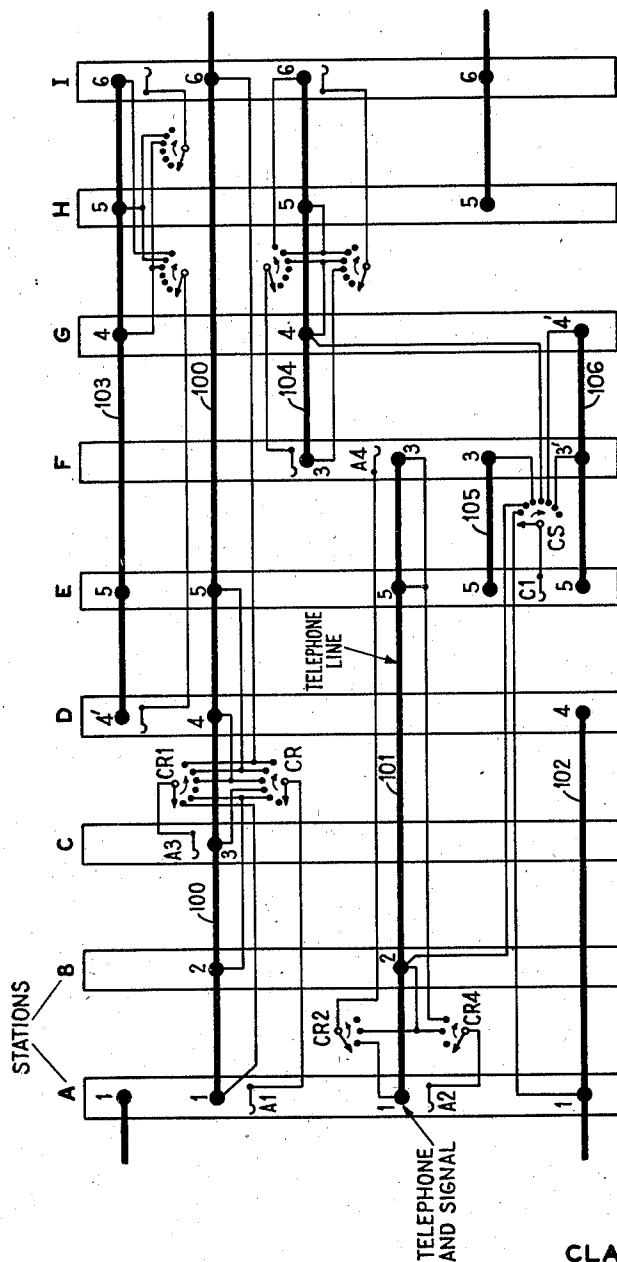
2,117,488

SIGNALING SYSTEM

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3 Sheets-Sheet 1

FIG. 1



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3 Sheets-Sheet 2

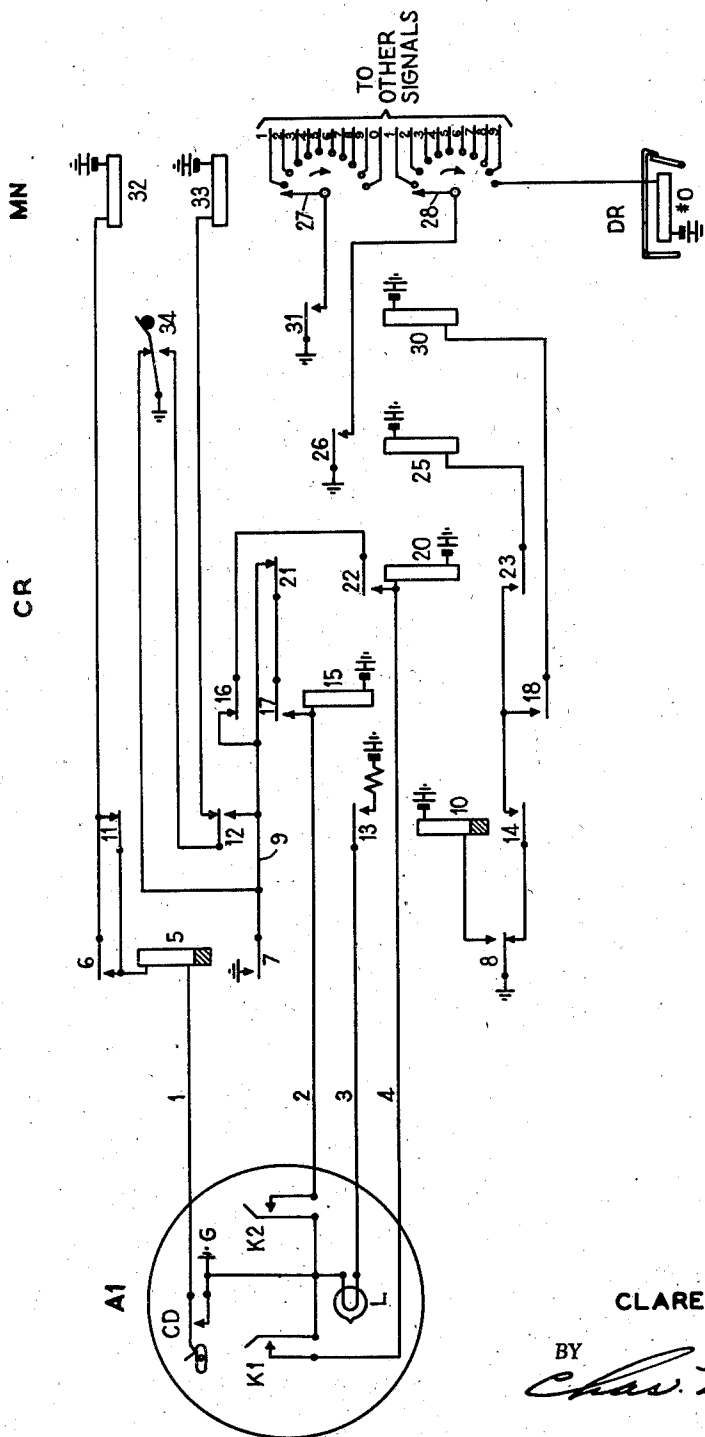


FIG. 2

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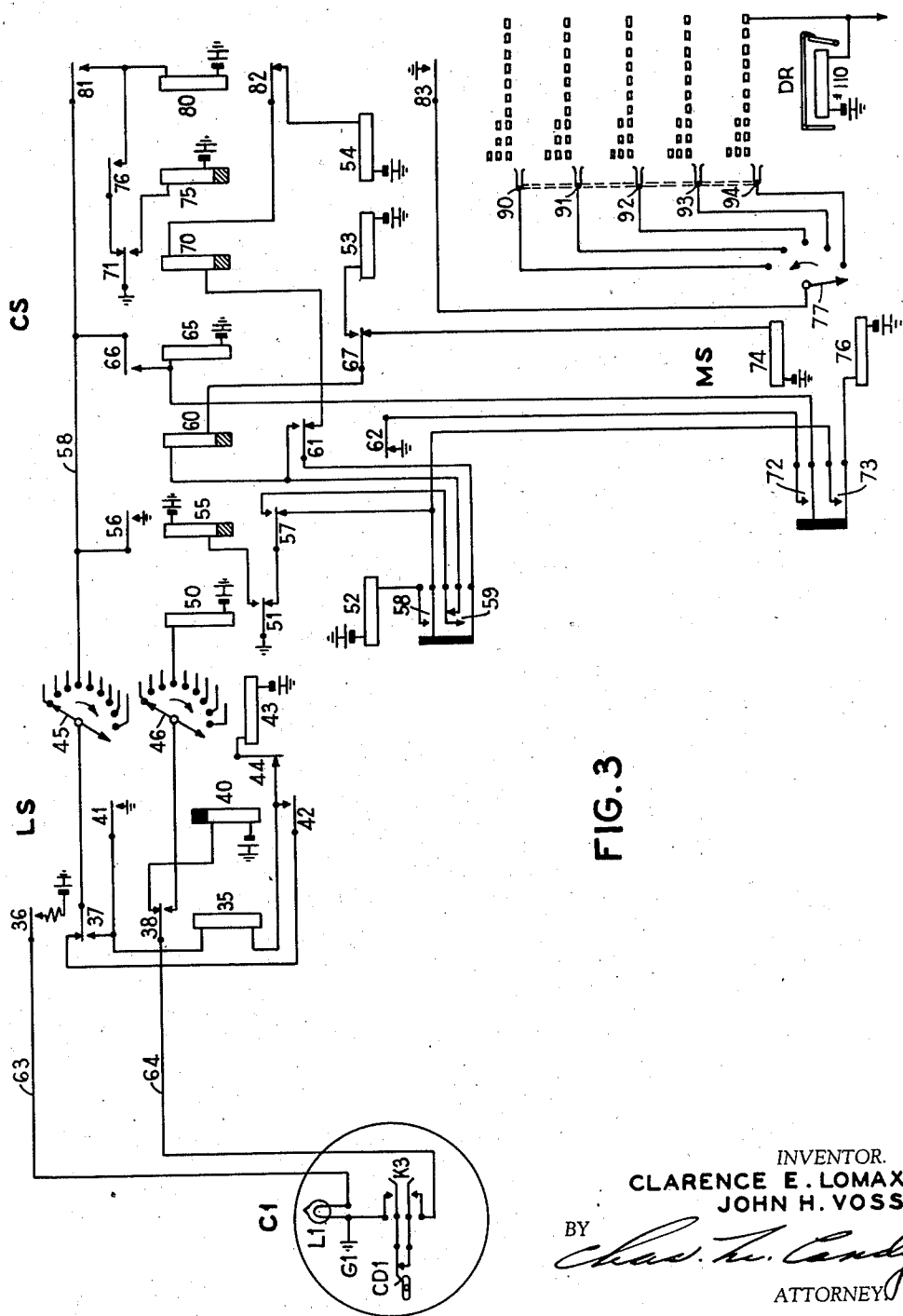
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3 Sheets-Sheet 3



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2,117,488

SIGNALING SYSTEM

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3 Claims. (Cl. 179—1)

This invention relates in general to signaling systems but more particularly to an improved signaling system of a type adaptable for use in installations such as on ships, in large buildings, and for fire or other emergency alarm systems, and the principal object of the invention consists of new and improved circuit and wiring arrangements for systems of the above character whereby economy and ease of installation is effected, where the amount of wiring required is considerably reduced, and the continued operation of the system as a whole is insured in case of a break down of any part of it.

A further object of the invention is to provide a signaling system in which all the cables, wires or conductors from the signal stations do not terminate at a common switching center. A further object is to provide certain calling signaling stations with means for calling a large number of other stations, but which other stations are arranged to only call a certain small number of stations. A further object of the invention is to provide a signaling system which is an adjunct but not necessarily an integral part of a telephone or other communication system.

In accordance with the above objects certain particular features of novelty are incorporated in the signal selecting switches and circuit arrangements therein as well as their association in the signaling system as a whole. Other objects and features will be apparent hereinafter in connection with the description of an embodiment of the invention.

The invention will be described generally in connection with an installation of a system on board a ship, although no particular change in the arrangement would be necessary in case the system is installed in locations such as large rambling buildings containing a large number of separate rooms where a private self-contained signaling system is required. In places of this character it has heretofore been the usual practice in providing signaling systems for these installations to concentrate all the switching equipment including the wiring and the battery or other source of current, in a common central position or switchboard, wherein all the conductors or wires from each of the signaling stations in the system extend to the common switchboard and at which point the connections for establishing the various signaling operations may be made. Such systems are in common usage and serve a practical purpose. It is, however, readily apparent that should any case of serious trouble occur at the switchboard or common switching center,

such as a fire, explosion or other accident, it will seriously damage or interrupt the communicating facilities provided by the signaling system; inasmuch as the common central switchboard may be either wholly or partially destroyed resulting in a complete stoppage of the communication facilities which under certain circumstances may be a very serious occurrence, for example, on board a ship where during times of danger, communication must under all circumstances be maintained between the different parts of the ship.

In the above described arrangement utilizing a centralized switchboard where all of the wiring for the complete system is concentrated at a single point or switchboard, it will be apparent in the case where numerous stations are required for signaling that the wires and cabling will be somewhat extensive. Furthermore, in certain installations of this nature not all stations are required to communicate with all others in the system but certain groups of stations will only have intercourse between each other and not necessarily with other stations. It is not necessary under these circumstances, to connect these signaling stations, which may be said to be isolated, to the centralized switchboard, and thereby add to the mass of circuits or wiring required. Furthermore, in certain instances these isolated groups of signaling stations may be located at some distance from the central switchboard.

The above disadvantages and uneconomical arrangements are avoided by the arrangement provided in accordance with this invention, whose principal object is to supplant the previous type of systems with that to be disclosed and which in addition presents a number of desirable advantages, as well as a number of novel features of operation. The embodiment of the invention is illustrated in the accompanying three sheets of drawings in which:

Fig. 1 diagrammatically illustrates a general layout of a section of a ship or other installation employing a signaling and communication system in accordance with the invention;

Fig. 2 illustrates a circuit diagram of a single signaling station together with its associated selecting switch, whereby it is enabled to select a definite number of other station signals; while

Fig. 3 is a circuit diagram of a signaling station and its associated selecting switches for selecting a larger group of signaling stations.

Referring now particularly to Fig. 1, a general description of a portion of the general lay-out of the system will be given. Broadly speaking the

signaling system as illustrated diagrammatically in Fig. 1 is an arrangement whereby no centrally located wiring center or switchboard is provided, but instead a number of smaller units are located throughout the premises of the building or ship on which the installation is made. These isolated or decentralized wiring and switchboard centers are provided to the best advantage throughout the premises in order to conserve space and wiring or cables. As shown in Fig. 1, the signaling system is provided as an adjunct to a telephone or communicating system. The signaling system is used to select and operate a particular signal at a telephone station while direct communication between any stations is made over a separate telephone line.

In the example shown in Fig. 1 which is only representative of a fragmentary portion of a ship structure or building, the arrangement is such that a large number of locations designated as stations, positions, or rooms, and indicated as A, B, C, D, etc., are provided throughout the length of the ship or building. Each station may consist of a room having a number of telephones arranged around the walls thereof with a person in close proximity to each one or a single person for all of them. In the case of a supervisory position such as on the bridge of a ship or the engine room, the supervisor would give orders to a person at each telephone. At each of these stations, for example, at station A a number of separate and independent telephone sets are provided. The number of these telephones at the stations may vary in accordance with the particular importance of that station with relation to all other stations. For example, on the captain's bridge or in the engine room where communication may be desired with a large number of other stations a corresponding large number of individual telephone sets would be provided. These particular telephones are preferably of the magnetic type, that is, telephones which require no particular source of battery current or other power to operate them, but which are actuated solely by magnetic means. They may be constructed and operate similar to that disclosed in the application S. N. 738,030, filed August 2, 1934, of C. R. Obergfell and Hans Sengebusch. Each of the magnetic telephones at a particular station is connected to a separate telephone line extending between any one or more other stations throughout the ship. For example, at the station A a telephone No. 1 is connected to line 100 which likewise has telephone No. 2 connected to this line at station B, telephone 3 at C, 4 at D, and 5 at E, and telephone 6 at station I. These telephones are all connected to the line 100 in the manner of the well known party line telephone systems. By merely removing the handset from the switchhook the telephone is connected directly to the line. Some of the telephone lines, it will be noted, have a large number of telephones connected to them, while other lines may consist of only a few telephones. For example, only three telephones are connected with the line 106, while line 100 has six or more telephones. The reason for this is that certain locations or stations have recourse to call a large number of other stations while they may have no necessity of calling certain other stations at any time, and it is therefore not required that the telephones at both of these stations be connected to a common line.

In accordance with the foregoing arrangement it will be seen by inspection of the arrangement of

Fig. 1 that between stations A and B telephone line 100 has connected to it the telephone No. 1 at station A and No. 2 at station B. Similarly the telephone line 101 at the same stations has additional telephones Nos. 1 and 2 connected to this line, thus affording a double telephone path or connection between the two stations. In other words, a person at one particular telephone station may communicate with a person at another station over any one of several different lines. In addition these two stations have other telephones connected to other telephone lines. From the foregoing it is seen that each telephone line constitutes in itself, together with the magnetic telephone at each station connected to this line, a separate and independent telephone system, not associated with any other telephone line in the system. No particular switching arrangement is provided for switching any two individual telephone lines together into a common intercommunicating circuit. When it is necessary to provide communication between one station and another station it is merely necessary to provide an extra telephone line with the two connecting telephones, or an existing line may be extended to the other station so that direct communication can be established.

By providing the de-centralized telephone system described it will be readily apparent that should any one or more of the telephone lines incur a break or other serious damage rendering them incapable of transmitting speech thereover only that particular line will be affected and communication can take place over any of the other lines without interference so that orders may be given or received between the different stations, for example, on shipboard.

The foregoing describes generally the telephone system used according to the invention. As will be seen, numerous possible connections may be established between different telephones and different stations. However, it will be noted that in order for any two or more stations to be connected in communication with each other it must be necessary to first signal them or in some way notify them that their connection to the line is desired. The particular signaling system and arrangement according to the invention as used in conjunction with the telephone system will now be pointed out, referring first specifically to the arrangement shown generally in Fig. 1.

Each telephone on every telephone line of the system is provided with a call signal, preferably a drop as illustrated, although this may take the form of any other well known type of signal, such as a bell, gong, lamp, or annunciator, the particular purpose of which is to attract the attention of a person in the immediate vicinity of the telephone so that he may answer a call on the telephone line to which his telephone is connected. Generally speaking each telephone is also provided with a dial or impulse sender which is associated with a selector switch that is operated in accordance with the dial impulses to select the signal of the station being called. For example, at the station A telephone No. 1 connected to telephone line 100, has the impulse sender A-1 associated with it and connected to the stepping switch CR. At the station C the impulse sender A3 of telephone No. 3 on line 100 is associated with the selector switch CR1.

The bank contacts of both of these switches it will be noted are interconnected so that if digit 1 is called the switch CR1 steps to the first contact and operates the signal of telephone No. 1

of line 100 at station A. When the digit 2 is called on either switch the signal at telephone No. 2 of line 100 at station B is operated. Digit 3 on switch CR steps the wipers to the third bank contact to select the signal of telephone 3 of line 100 of station C, and so on throughout the remaining bank contacts. Referring to station F the telephone 3 of line 101 is equipped with a dial A4 having associated therewith the switch CR2 which switch is connected so as to operate the signals at telephone 1 or 2 on line 101 at stations A and B as desired. At station A the telephone 1 of line 101 is provided with a dial A2 associated with switch CR4 which in turn is operated to select either the signal at telephone 2 of line 101 at station B or telephones 5 and 3 of stations E and F of line 101. The bank contacts of the switches CR2 and CR4 are connected together and they extend to the same signal in a similar manner as the bank contacts of switch CR and CR1.

The switches CR1 and CR, it will be noted, are connected or located in a position between the stations C and D of the line 100. This is as near as possible the wire center for all the telephones and dial connections extending to the telephones. In other words, this is the center point of distribution of all connecting leads extending between the signals and dials and the switches, and as these two switches are not associated with any other lines or telephones but are separate and distinct within themselves it is seen that a considerable saving in wire distribution is effected. Similarly the switches CR4 and CR2 are located between the stations A and B at which point the conductors radiate to the different stations located on the telephone line 101. The line 104, which is connected to the telephones at stations F, G, H, and I, is provided with a switching or wire center between the stations G and H, while the telephone line 103 may have a switch for telephone number 4 of station D located between stations G and H, and another switch for telephone number 6 of line 103 at station I located between the stations H and I. The bank contacts of these two switches are connected together as the distance between them may be relatively close together.

In certain instances it may be necessary that each of the telephones at some stations be provided with calling devices, while other stations may have only a single calling device for a number of its stations. That is, station A for example, is provided with a calling device A1 for station 1 on line 100 and a calling device A2 for station 1 of line 101, whereas the other telephones No. 1 at this same station are not provided with dials. Station B has both of its telephones No. 2 on line 100 and line 101 without a calling device. That is so because only certain stations may be permitted to have dials to call other telephones as these stations are only arranged to receive calls but not to make them. It may likewise be arranged that a telephone be provided with a dial and a switch arranged so that by proper manipulation of the same not only a single telephone may be signaled on that line, but two or more may be actuated, so that a number of these telephones may be connected at the same time to the same line. In case several stations have the same telephone lines extending through them and telephones connected to this line, it may be necessary to provide only a single calling device to signal between them and the signaling can take place over any one of the lines. The main

purpose in all of the foregoing arrangements is to conserve the installation, space, and amount of wiring required between the various stations and telephones. It is seen that numerous possible connections or combinations between the telephones and signals may be arranged in any manner desired, only a few having been illustrated and described. When one station has signaled another on a telephone line the called station merely removes the handset from the switch-hook and direct communication between the two telephones is immediately established over the telephone line. Separate sets of batteries may be provided for operating the signaling system, that is, a set of batteries for the signaling system of line 100 may be provided and another separate set for the line 101 may be provided. If desired one single battery may be provided for several different signaling systems.

As in the case of the telephone system the principal object of the signalling system and the purpose of decentralizing the switching equipment is to preclude the possibility of interrupting the signalling system in case of accident or damage to a portion of it. For example, should the switches CR1 and CR2 incur a break-down it will not affect the operation of the switches CR2 and CR4 or any other switches or conductors in the remaining sets of the signaling system. Under certain conditions in case one of the signaling systems incurs damage and the particular telephone with which it is associated still remains intact communication may be established over some other telephone line or the same line by merely removing the handset and talking over the line.

In certain instances it may be desirable for the captain of a ship or a supervisor at a location to be provided with means for connecting or signaling not only on one particular telephone line, but on a large number of others. This entails the necessity of providing a selector switch having a large contact field and for this purpose the switch CS is provided. The station E has a calling device C1 associated with the selecting switch CS, the bank contacts of which are connected to a large number of signals located on different lines. For example the first bank contact of the switch CS connects to the signal at telephone 1 on line 102 at station A. The second bank contact connects to the signal at telephone 2 of line 101 at station B. The third bank contact connects to signal at telephone 3 of line 105 of station F, and the remaining bank contacts are similarly disposed as indicated. After operating the required signal the supervisor or captain takes down the receiver of the telephone connected to the line of the telephone which he has called and is thereby connected in direct communication with the called telephone. It is only in exceptional circumstances and in very few instances that a switch such as the switch CS is provided. A number of these conditions may exist aboard ship and in this case three or more switches are provided, the bank contacts of which are all multiplied together. Under these circumstances the switches will all be located at a convenient point which is centrally located from all the wires extending to and from the switch in order to conserve the amount of wire and decentralize the equipment as much as possible. A person operating a calling device at a particular telephone or station first selects an idle one of the switches automatically before directly operating the switch. In this manner a larger number of important per-

sons may be provided with the services of a comparatively few number of selector switches, thereby further conserving the above equipment. If desired it may be arranged that the selecting switch connect to the signal of every telephone in the entire system and although all telephones may be signaled it may not be necessary to talk over the telephone line to the signaled telephone but instead the person at the telephone controlling the switch CS may establish a conference calling telephone circuit over the single line between all the telephones on this line by signaling them even though he is not in actual communication with this line himself.

From the foregoing it is seen that numerous possibilities for establishing telephone connections between different points and numerous possible combinations of the signaling means are available. This includes others than that which are shown in Fig. 1 and the various different modifications are easily perceptible to anyone skilled in the art, the underlying principle of the complete system being the decentralization of equipment.

Consideration will now be given to the numbering system employed in the signaling arrangement. It is desirable that each of the telephones on a single telephone line be given a different number, for example, line 100 has, 6 or more telephone stations on it numbered 1, 2, 3, 4, 5, 6, etc., each telephone being at a different station. The calling device, for example, A1, may be operated in accordance with a particular digit associated with the desired signal at the wanted telephone, and by dialling, for example, No. 4 switch CR steps to its fourth bank contact and operates the signal at the telephone No. 4, line 100, station D. In the same manner when calling device A3 at telephone 3 on line 100 at station C is operated in accordance with the fourth digit, switch CR1 advances four steps to select the same signal. Referring now to telephone line 101 the telephones thereon are numbered 1, 2, 5, 3, and the signals at these stations are selectively operated by the switches CR2 and CR4 in accordance with the number of the stations associated with the signal. The fact that these stations have call numbers assigned to them which are similar to the call numbers of the stations on line 100 will not cause confusion, inasmuch as these telephone lines and their associated signaling systems are entirely separate and distinct from one another. For this reason all the signals or telephones at station A will be designated No. 1, all the telephones at station B, No. 2, at station C, No. 3, and so forth. The numbering system is arranged conveniently in accordance with the telephone line having the greatest number of telephones connected to it and the lines having a lesser number of telephones are arranged to the best advantage in the same numbering scheme. For example, telephone line 103 is a comparatively short one having only five stations thereon, has the telephone numbers of the stations assigned to it similar to those of line 100, that is, station G has the number of the telephone on this line designated as No. 4. As line 100 does not have any telephone connected at this station the number 4 can conveniently be used for the other telephones on the other lines of this station. The telephone 4' of station D, however, is an exception because of the fact that line 100 already has a telephone designated No. 4. Certain instances similar to this, however, can well occur and the wiring of the switches for selecting the signals at the tele-

phones must therefore be somewhat altered from the general numbering scheme in these isolated instances.

A description and general outline of the system having been given, the detailed circuit arrangements and operation of the specific selective switches used in the signaling systems will now be pointed out. Referring specifically to Fig. 2, this shows a selective switch MN capable of connecting with any one of a maximum of twenty different signals, one of which is shown at DR as a drop. The signaling means A1 is located at any telephone station and is connected to the control relays CR which control the operation of the selector switch MN. This switch is the well known type of minor switch used extensively in automatic telephony. It comprises essentially a stepping magnet 32 for rotating the wipers 27 and 28 step by step in a forward direction across their bank contacts on each of its energizations, and a release magnet 33 for restoring the wipers to normal. In addition a pair of off-normal springs 34 are provided which operate at the instant the first step is taken by the switch. The specific structure of the switch MN is well known and need not further be described.

The signaling equipment A1 located at any telephone station comprises a calling device or impulse sender CD of well known construction such as that commonly used in automatic telephony, the object of the device being to open and close the line circuits in accordance with the digits dialled. A supervisory lamp L and a pair of keys K1 and K2 are also located at the station. The purpose of the keys K1 and K2 is to preselect the particular group of signals in which a desired call signal is located. By operation of the key K1 through the medium of the control relays CR, the wiper 28 is connected up and selects a signal in the group of signals associated with this wiper. In initiating a signaling operation the person at the position A—1 at the telephone first momentarily operates the key K—1, for example. This completes a circuit extending from ground G at the position A1 through the closed contacts K1, conductor 4, through the winding of relay 20 to battery. Relay 20, upon energizing over this circuit, operates its armatures and at front contact and armature 22 prepares a locking circuit for itself. The calling device CD is then operated in accordance with the digits of the called signal, for example, if one digit 0 is selected ten impulses will be transmitted by the calling device CD. The initial impulse closes a circuit by way of ground G, impulse springs of the calling device CD, line 1, through the winding of slow-release relay 5, armature 11 and its back contact, through the winding of stepping magnet 32 to battery. Relay 5, upon energizing, remains operated for the duration of the series of impulses due to its slow acting characteristic. At front contact and armature 6 it closes a path for the remaining impulses to flow to the stepping magnet 32 independent of armature 11 and also to close a locking circuit for itself at this contact. The front contact of armature 7 on conductor 9 is grounded and this ground extends by way of back contact and armature 16 to armature 22 to lock relay 20 energized. At front contact of armature 8 relay 5 closes an obvious circuit for slow release relay 10, which thereupon energizes and operates its armatures. At front contact and armature 13 battery is connected to conductor 3 through the supervisory station lamp L to ground G, to illuminate this lamp. At armature 11 and its back

contact it opens the initial circuit for stepping magnet 32, at armature 12 and at its back contact a point in the circuit of release magnet 33 is opened, while at armature 14 a circuit is prepared for relay 25.

The impulses transmitted by the impulse contacts of the calling device CD operate the stepping magnet 32 of switch MN in a step by step manner to rotate the wipers 27 and 28 in the rotary direction across their respective bank contacts. As the digit 0 has been dialled the stepping magnet rotates both wipers onto their tenth position. Upon the initial step of the stepping magnet 32 the off normal contacts 34 are operated to their alternative position, thereby disconnecting the ground through the armature spring of the off-normal contacts 34 from direct contact with conductor 9 and transferring it instead by way of armature 12 and its front contact to conductor 9, this ground serving as a holding or locking circuit for relays 15 or 20 when relay 5 is deenergized.

As soon as calling device CD has restored to normal the impulse springs permanently open and after a short interval relay 5 deenergizes and retracts its armatures. The stepping magnet 32 likewise comes to rest and the wipers are positioned on the back contacts in accordance with the number of impulses sent from the calling device. Immediately after slow release relay 5 has completely deenergized it opens its armatures from its front contacts and at armature 6 opens a further point in the stepping magnet circuit while at armature 7 it removes ground from conductor 9 which, however, is now grounded from off normal contacts 34 and armature 12. At armature 8 it opens the circuit of slow release relay 10 which after a short interval starts to restore. A short interval before it opens its contact from its armature 14 a circuit is closed from ground on armature 8 and its back contact, armature 14 and its front contact, front contact and armature 23 of relay 20 which is at this time locked energized, through the winding of relay 25 to battery. Relay 25, upon operating, closes ground from its armature onto its front contact through the wiper 28, the tenth bank contact upon which the wiper is now positioned, to the signal or drop DP, energizing the same and indicating to any one in the vicinity of the telephone associated with this drop that a call should be answered on the telephone line with which the telephone is connected. After relay 10 opens the front contact of its armature 14, it interrupts the circuit just described. The signal or drop DC will remain in operated position until manually restored. This drop may take the form of any other type of signal if desired, such as a bell, a gong, lamp or annunciator or any other audible or visible means suitable for attracting attention. The operation of the signal is for a duration sufficient to call attention to its actuation.

As a further result of the deenergization of relay 10 it closes its armature 12 onto its back contacts, thereby closing the circuit for the release magnet 33 of switch MN through this armature to ground at the off normal springs 34. The release magnet 33 upon operating withdraws the holding pawl from the hub upon which the wipers 27 and 28 are mounted and under spring control these wipers restore to normal position. A short instant before complete restoration of the wipers is effected the off normal springs 34 are opened, thereby opening the circuit of release magnet 33. At the front contact of armature 12 the locking ground from the off normal springs

34 is removed from conductor 9, thereby opening the locking circuit for the relay 20 which extended over armatures 16 and 22. The minor switch MN as well as all of the control relays CR have now been restored to their unoperated condition ready to be actuated again to select a signal.

From the foregoing operation it will be seen that by merely operating one of the keys K and actuating the dial CD in accordance with the number of the wanted signal the complete operation of operating the switch to select signals and then the releasing of the switch as well as of all of the relays, is effected automatically.

In case a signal is to be selected, which is located in the group to which wiper 27 has access, the key K2 would have been momentarily operated before proceeding with the dialling of the number. This would result in the operation and the locking of relay 15 by way of armature 21 and its back contacts to grounded conductor 9. At front contact and armature 18 relay 15 would operate relay 30, which in turn at armature 31 and its front contact places ground on wiper 27 and the selected contact and drop upon which it is positioned by the calling device. Relay 30 is operated after relay 5 restores and before relay 10 has completely restored. In the foregoing manner by operating key K1 or K2 momentarily before proceeding with the dialling operation, a maximum of a possible twenty different signals may be selected.

In case it is desired that a telephone station in the general scheme be required to select not more than ten other signals, the group selecting keys K1 and K2 and one of the wipers as well as relays 15, 20, 25, and 30 would be eliminated as is easily conceived.

The purpose of the lamp L at the station A1 is so that the person operating the calling device will not immediately operate the calling device again in calling another signal when it is required that a number of them be dialled in succession. The illumination of the lamp is an indication to not dial the digits immediately in succession, but to wait a slight interval between each so that there will be sufficient time for the slow release relays 5 and 10 to completely restore and until the time the switch MN is in its normal position. Although the release takes place practically instantly should a person immediately dial another number before the equipment has released a mutilated number may result.

The arrangement disclosed in Fig. 3 will now be described. As pointed out in the description of Fig. 1 the arrangement of Fig. 3 is for the purpose of providing a telephone with signaling means and switching means whereby a large number of signals may be selected and operated. As stated, only a few telephones would be provided with the facilities for selecting such a large number of signals. Such stations may be important positions throughout the ship under control of some supervising officer. In Fig. 3, C1 indicates the signal calling station comprising a calling device CD1, a connecting key K3, and a supervisory lamp L1. This equipment is connected by means of the line conductors 63 and 64 with the rotary line switch LS. This rotary line switch is of well known construction such as is commonly used in automatic telephony and comprises a stepping magnet 43 which automatically rotates the wipers 45 and 46 step by step in a forward direction across their bank contacts

until an idle connector switch CS is found. The wipers always rest upon the set of contacts last stepped to. In accordance with the preferred arrangement there will be a comparatively small number of connector switches such as CS, while there may be a considerable number of signaling stations C1, each with its associated line switch LS, in order to economize in cost and amount of equipment required. This is possible as all signaling stations presumably will not be signaling at the same time.

The connector switch CS is of the well known Strowger type commonly used in automatic telephony in which a number of wipers 90 to 94, inclusive, are first elevated vertically opposite a set of bank contacts under control of dial impulses and then are rotated horizontally to the desired contacts of the selected row leading to the wanted signal. As the construction of this two-motion switch is well known its structural details need not further be described. A minor switch MS is associated with switch CS and is constructed similar to that shown in Fig. 2, the purpose of this switch MS being to selectively associate its wiper with one of the wipers of the connector switch CS to render the same effective. The bank contacts of the switch CS are multiplied to the same bank contacts of all the other switches such as CS.

The arrangement shown in Fig. 3 is capable of selecting up to a maximum of five-hundred signals such as DR, and the operation generally is such that the line switch LS operates automatically to seek an idle connector switch after which a first digit from the calling device CD1 at the station C1, directly operates the minor switch MS to step its wiper 77 to a wiper of the connector switch CS corresponding to the digit dialled. The second series of impulses thereupon are transferred to the vertical magnet of the connector switch whereby the wipers are elevated opposite the desired level, and the third set of impulses corresponding to the third digit rotate the wipers to the desired bank contacts for operating the selected signal.

A detailed explanation will now be given of the manner of making a call to operate a signal. At the signaling station C1 which is associated with some particular telephone in the general arrangement of the system, the key K3 is first operated. This key is of the locking type and remains operated until manually restored. The operation of this key closes a circuit extending from the ground connection G1, closed contacts of key K3, closed impulsing contacts of the calling device CD1, the other closed contacts of the key K3, conductor 64, armature 38 and its back contact, through the winding of line relay 40 to battery, this relay being slightly slow to operate, due to a copper slug on its armature end. Line relay 40, upon operating, at armature 41 closes ground through the winding of switching relay 35, interrupter contacts 44, winding of the stepping magnet 43 to battery. The bank contacts stepped over by wipers 45 and 46 are multiplied to other connectors beside the connector CS, and in case these are busy wiper 45 will encounter ground on the first bank contact which extends by way of armatures 37 and 42, through the interrupter contacts 44 and stepping magnet 43 to battery. This ground is connected to one side of the switching relay 35 at armature 42 while the ground from armature 41 is connected to the other side of the switching relay, thereby short circuiting it and preventing its operation. The

grounded bank on wiper 45 operates the stepping magnet 43 which upon energizing opens its interrupter contacts 44 so that it immediately de-energizes and rotates wipers 45 and 46 onto the next set of bank contacts. In case this set of bank contacts are likewise grounded by the engaged connector the stepping magnet 43 takes a further step. This action continues with the switching relay short circuited as long as grounded bank contacts are encountered.

When wiper 45 reaches the fourth bank contact to which conductor 58 is connected and which is associated with the connector switch CS ground is no longer encountered, and the switching relay 35 is therefore no longer short circuited. Accordingly it energizes from the ground on armature 41 through its winding and in series with the stepping magnet 43, but due to the high resistance of the switching relay 35 stepping magnet 43 can no longer energize. Switching relay 35 upon operating its armature, at armature 38 and its back contact, opens the circuit of line relay 40 allowing it to deenergize so that at armature 41 the original energizing circuit for the relay 35 and the stepping magnet 43 is disconnected and the short circuiting armature 42 is opened. At front contact and armature 36 battery potential is connected to line conductor 63 and extends through the station lamp L—10 to ground, illuminating this lamp and serving as an indication to the person at the station that dialling may commence. As a further result of the operation of relay 35 ground is connected from the connector G—1 at the station over conductor 64, armature 38 and its front contact, wiper 46, the bank contact upon which it is now resting, through the winding of impulse relay 50 to battery, at the connector CS. Relay 50 on operating its armature 51 connects ground through its front contact to battery through slow release relay 55. Relay 55, upon energizing, connects ground through its front contact and armature 56 to conductor 58 and over the bank contact upon which wiper 45 is resting, to armature 37 and its front contact, winding of relay 35, interrupter contacts 44, stepping magnet 43 to battery. Relay 35 thereby remains energized under control of relay 55. This control circuit for relay 35 is connected up before relay 40 completely restores and opens its armature 41 and original energizing circuit for switching relay 35. Relay 55 at armature 57 prepares the operating circuit for the connector switch CS responsive to the reception of dialling impulses from the station. The ground on conductor 58 from armature 56 prevents other line switches LS from seizing the engaged connector switch CS.

The person at the signaling station C—1 noting the illumination of the lamp L—1 commences to dial the number of the desired signal. This dialling operation will consist of three digits or three separate series of impulses corresponding to the number of the desired signal. The calling device CD—1 is operated in accordance with the first digit thereby transmitting a series of interruptions from the impulsing springs over a circuit extending from ground G1, closed contacts to key K3, impulsing springs of the calling device, conductor 64, armature 38 and its front contact, wiper 46, and the bank contact upon which it is resting, to impulsing relay 50 and battery. Impulsing relay 50 follows the series of interruptions and attracts and retracts its armature 51 accordingly. The first impulse of the series permits armature 51 to retract and

thereby close ground through armature 51 and its back contact, armature 57 and its front contact, (relay 55 being slow to release remains operated for the duration of the series of impulses), normally closed off normal springs 59, winding of the series relay 60 which is also slow to release and remains operated throughout the series of impulses, armature 67 and its back contacts, through the winding of stepping magnet 74 to battery in the minor switch MS. Relays 55, 60, and the stepping magnet 74 are all energized in the foregoing circuit. Relay 60 operates its armatures 61 and 62, and at armature 62 opens a point in the circuit of relay 65, while at armature 61 it prepares an alternative path for the impulses to flow over which, however, is without effect at this time, as the off normal contacts 58 and 59 do not operate at this time.

The stepping magnet 74 is operated over the above circuit path step-by-step in accordance with the impulses transmitted, to rotate the wipers 77 to the desired bank contact corresponding to the transmitted digit, the purpose being to select the wiper of the connector CS which has access to the group of one-hundred bank contacts in which the desired one is located. The instant that the wiper 77 takes its initial step the off normal contacts 72 and 73 close, and at the contact 72 the circuit for relay 65 is prepared which, however, is opened at this time by armature 62. At off normal contacts 73 the release circuit for release magnet 76 is prepared; which, however, at this time is opened by armature 57. After the last impulse of the first digit has been transmitted relay 50 remains energized and holds relay 55 operated. After a short interval the series relay 60 deenergizes due to the opening of its circuit at the back contact of armature 51 and this relay restores its armatures 61 and 62. At back contact of armature 62 ground is connected through the off-normal contacts 72, winding of relay 65, to battery. Relay 65, upon energizing, operates its armature 66 onto its front contact to close a locking circuit for itself to the ground on armature 56, while at the front contact of armature 67 it connects the vertical magnet 53 of the connector switch CS in circuit, while at the back contact of this armature it disconnects the stepping magnet 74 of the switch MS.

The person at the signaling station C1 now operates his calling device in accordance with the second digit of the wanted signal number, the resultant impulses flowing over conductor 64 operate and deenergize the line relay 50 correspondingly. The series of interruptions maintain relay 55 operated as before and at the back contact of armature 51 extends the ground to armature 57 and its front contact, normally closed off normal springs 59, winding of series relay 60, armature 67 and its front contact, to the winding of vertical magnet 53 to battery. The vertical magnet 53 operates the wipers 90, 91, 92, 93 and 94 of the switch CS and elevates the shaft upon which these wipers are attached one vertical step opposite the first level or set of bank contacts in the bank of the switch CS. Shortly after the switch has taken the first vertical step the off-normal springs 58 and 59 are operated. At off normal springs 58 a point in the circuit of release magnet 52 is prepared, while at off normal springs 59 the normally closed contacts are open and the normally open contacts are closed, so that the remaining series of impulses extend from grounded armature 51

and its back contact, armature 57 and its front contact, normally open off normal contacts 59, armature 61 and its front contact, which now maintains relay 60 operated, through relay 60, armature 67 and its front contact, through the winding of vertical magnet 53. The remaining series of impulses transmitted over this circuit operate the vertical magnet 53 step by step to elevate the shaft upon which the wipers are mounted until they are opposite the desired level of bank contacts.

After the second digit has been dialled relay 50 again remains energized and at its back contact and armature 51 opens the circuit of relay 60 which thereupon retracts its armature 61 and at the front contact permanently opens its energizing circuit so that it and the vertical magnet 53 cannot again become energized because off normal springs 59 which are normally closed are now open. The dialling of the third digit transmits impulses to line relay 50, which at its armature 51 repeats these impulses over a circuit path from ground at armature 51 and its back contact, armature 57 and its front contact, the now closed off normal springs 59, armature 61 and its back contact, through slow release series relay 70, armature 62 and its back contact, through the winding of rotary magnet 54 to battery. Relay 70 energizes in this circuit and remains so for the duration of the series of impulses. The rotary magnet 54 likewise operates and in a step by step manner rotates the wipers 90 to 94, inclusive, horizontally across the level of bank contacts to the desired one which is connected to the signal to be operated. Relay 70, upon energizing, operates its armature 71 and closes ground through its front contact to the winding of slow release relay 75 to battery. Relay 75 energizes and at its armature 76 closes its front contact to prepare a circuit for relay 80.

After the third series of impulses corresponding to the third digit have been transmitted relay 50 remains permanently energized as likewise does relay 55. At the back contact of armature 51 ground is disconnected from the windings of relay 70 and rotary magnet 54, resulting in their deenergization. Relay 70, at its armature 71 and its front contact, opens the circuit of relay 75, which slowly releases. Before, however, it has completely restored its armature 76, ground is connected by way of armature 71 and its back contact, armature 76 and its front contact, through the winding of relay 80 to battery. Relay 80, upon energizing, operates its armature 82 and opens a further point in the rotary magnet 54 circuit. At the front contact and armature 81 a locking circuit for relay 80 is completed to ground on armature 56 by way of conductor 58. An instant later relay 75 permanently deenergizes and opens the original energizing circuit of relay 80.

As a further result of the operation of relay 80, it closes ground on its front contact and armature 83 which extends through wiper 77 of switch MS, the bank contact upon which this wiper is now resting, and which is, for example, connected to wiper 90 of the connector switch CS, the bank contact upon which the wiper 90 is resting, through the winding of the drop or signal DR to operate the same. The operation of the signal DR calls attention at the telephone at which it is positioned that a call is waiting to be answered on the telephone line associated with its signal.

After the dialling has been completed and the

wanted telephone signalled the key K3 at the signal station C1 is restored manually, thereby disconnecting the ground G1 from line conductor 64. This results in the deenergization of the line relay 50 of connector CS, which thereupon retracts its armature 51 to close ground through its back contact and opens the circuit of relay 55 at its front contact and which after a slight interval slowly retracts its armatures. With relays 50 and 55 completely deenergized, a releasing circuit is completed by way of armature 51 and its back contact, armature 57 and its back contact, through closed off normal springs 73 of the switch MS and the winding of its release magnet 76 to battery. The operation of this release magnet 76 permits the wiper 77 under spring control to restore to its normal position, and an instant before this occurs the off normal springs 72 and 73 are opened again. The switch MS is now in its normal position. A branch of the releasing circuit extends by way of the off normal contacts 58 of the connector switch CS through the release magnet 52 of this switch to battery. Release magnet 52 upon energizing permits the shaft carrying the series of wipers 90 to 94, inclusive, to restore to its lowermost normal position, and an instant before this occurs the off normal contacts 58 and 59 are opened permanently, resulting at contacts 58 in the opening of the circuit of the release magnet 52.

As a further result of the deenergization of relay 55 ground is disconnected at armature 56 from the guarding conductor 58. The removal of this ground opens the locking circuit for 89 which extended over locking armature 81 and this relay at armature 83 upon deenergizing opens armatures 83 and 81. At front contact and armature 66 the locking circuit of relay 65 is opened. The removal of ground from guarding conductor 40 58 which extended over wiper 45 of the line switch LS opens the locking circuit of switching relay 35 which extended through front contacts of armature 37 in series with the stepping magnet 43, and the relay 37 consequently deenergizes and restores all its armatures. At its armature 36 the circuit for the supervisory lamp L1 at the signaling station C1 is disconnected and it goes out. The line switch LS remains with its wipers positioned upon the set of contacts last used and does not rotate them to a normal position. The complete series of switches including all their controlling relays are now restored to their normal position ready to receive another call to operate a signal in the system.

Having described the invention, what is considered to be new and is desired to be protected by Letters Patent will be set forth in the following claims.

What is claimed is:

1. A signaling system for use in interstation communication confined to a small area comprising, a plurality of stations, at least one telephone at each of said stations, a plurality of independent lines interconnecting the telephones of said stations in a manner such that each line and certain of said telephones comprise a unitary signaling system operable independently of the condition of each of the other unitary systems thus formed, a call signal associated with each of said telephones, calling means individually associated

with at least a portion of said telephones, and switching means associated with each of said lines and adapted to be interconnected with the calling means and call signals associated with the telephones of the corresponding lines to permit selective operation of any call signal of any line from any calling means of the same line, each of said switching means being so located relative to the telephones connected to the associated line as to be at the approximate wire center of the interconnections between the switching means, the calling means and the call signals of the said associated line.

2. A signaling system for use in interstation communication confined to a small area comprising, a plurality of stations, at least one telephone at each of said stations, a plurality of independent lines interconnecting the telephones of said stations, in a manner such that each line and certain of said telephones comprise a unitary signaling system operable independently of the condition of each of the other unitary systems thus formed, certain of said stations having therein two or more telephones individually connected by different lines with two or more telephones of other stations, a call signal associated with each of said telephones, calling means individually associated with at least a portion of said telephones, and switching means associated with each of said lines and adapted to be interconnected with the calling means and call signals associated with the telephones of the corresponding lines to permit selective operation of any call signal of any one line from any calling means of the same line, each of said switching means being so located relative to the telephones connected to the associated line as to be at the approximate wire center of the interconnections between the switching means, the calling means and the call signals of the said associated line.

3. A signaling system for use in interstation communication confined to a small area comprising, a plurality of stations, at least one telephone at each of said stations, a plurality of independent lines interconnecting the telephones of said stations in a manner such that each line and certain of said telephones comprise a unitary signaling system operable independently of the condition of each of the other unitary systems thus formed, a call signal associated with each of said telephones, calling means individually associated with at least a portion of said telephones, and switching means associated with each of said lines and adapted to be interconnected with the calling means and call signals associated with the telephones of the corresponding lines to permit selective operation of any call signal of any one line from any calling means of the same line, each of said switching means being so located relative to the telephones connected to the associated line as to be at the approximate wire center of the interconnections between the switching means, the calling means and the call signals of the said associated line, and means controlled from at least one of said stations for operating the call signals of telephones individually associated with at least two different lines.

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