M. S. CONNER.

TELEPHONE SYSTEM.

APPLICATION FILED JULY 1, 1908.

**955,633.**

**Patented Apr. 19, 1910.**

2 SHEETS—SHEET 1.

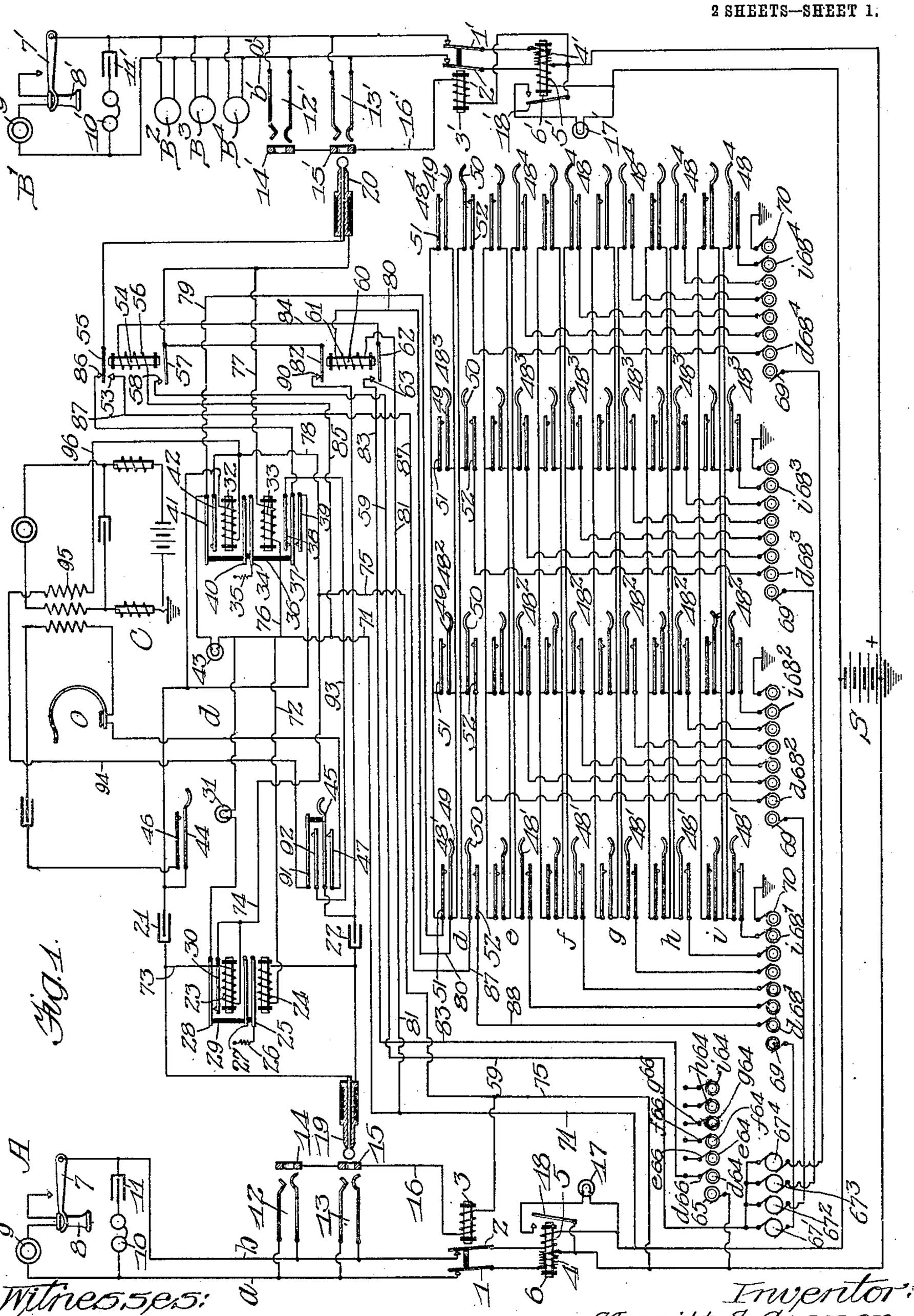

Fig. 1.

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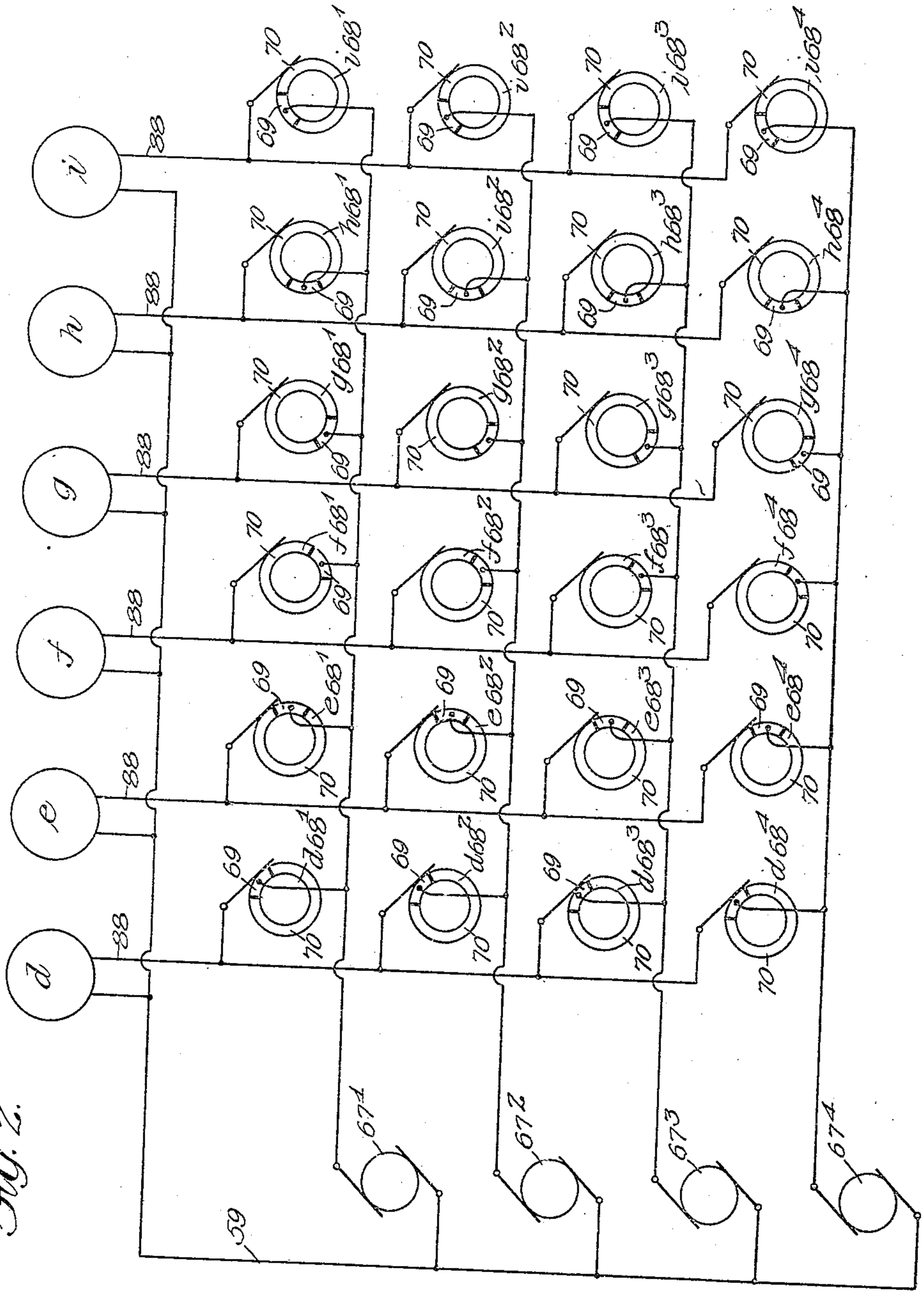


Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

**955,633.** Specification of Letters Patent. **Patented Apr. 19, 1910.**

Original application filed January 23, 1907, Serial No. 353,690. Divided and this application filed July 1, 1908. Serial No. 441,493.

*To all whom it may concern:*

Be it known that I, MERRITT S. CONNER, a citizen of the United States of America, residing at Oakdene, Hale, Cheshire, England, have invented a new and Improved Telephone System, (Case 14,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems, more particularly to improved automatic selective ringing arrangements therein, and its object is to provide an exchange system with a ringing equipment which may be maintained at a minimum expense, and which is of greater reliability and efficiency than ringing arrangements of the prior art.

Broadly, the invention provides a ringing arrangement, wherein the ringing current source, which may be of considerably less power than those which were employed in ringing equipments of the prior art, is kept constantly loaded so that instead of employing a ringing current generator of great power as in prior systems, where at one period a large demand might be made upon the machine, and at another no demand be made thereon, a generator of smaller power is employed and is so arranged that there is constantly a steady load thereon, whereby the various advantages herein pointed out are secured.

This invention may be considered as an improvement over, and is particularly adaptable in connection with such telephone systems as disclosed in the patent granted to Arthur R. Kahl, No. 853,304, dated May 14, 1907. In the system disclosed in this Kahl patent, means are provided whereby any one of the signaling current generators, which differ from each other in pulsations per second, could be connected with the telephone line. In this system, however, the ringing equipment was such that there might be a very large number of substation bells simultaneously in operation, and another time there might be a very small or practically no demand upon the ringing current generator. In order, therefore, to maintain the proper operation of such a system, the ringing current generators employed were necessarily of large power, so that they would be able to meet the large demand which might be placed upon them.

The present invention, however, eliminates this necessity, and provides means whereby a limited number of bells may be rung simultaneously, all the other bells connected with the exchange at that time remaining inert. Thus the bell of the subscriber who is being signaled would be active for a definite period, and would remain inactive while the bells of certain other subscribers being signaled are active. To this end the circuits are arranged in groups, which for convenience in this description may be termed ringing divisions, each division being provided with its own selective keys and interrupters.

Means are provided in this invention whereby several ringing divisions are brought into such relation with each other, that ringing current will be supplied to one ringing division at a time; that is, the ringing period of one division follows that of another division and is immediately succeeded by the ringing period of another division. The signal current is thus fed to the circuit divisions in regular consecutive order, the maximum demand at any one time being that made by all the circuits in a single division. The maximum demand at any one time is thereby greatly reduced and generators of smaller power may, therefore, be employed.

This is a divisional case of my Patent 901,689, granted October 20th, 1908, and is directed particularly to party line telephone signaling systems.

These various improved relations and arrangements of my invention whereby an efficient power automatic selective signaling system is obtained, will be best understood by reference to the accompanying drawings in which—

Figure 1 diagrammatically illustrates a system arranged according to my invention, and Fig. 2 illustrates diagrammatically the arrangement whereby the different signaling currents are supplied to the circuits, the collateral apparatus, however, being omitted for the purpose of clearness.

In Fig. 1, I have illustrated a sub-station A connected by line limbs *a* and *b* with the central exchange C, these line limbs be-

ing continuous normally through armatures 1 and 2 of the cut-off relay 3 and including the windings 4 and 5 of the indicator relay 6, connecting them with the terminals of the common source of current S. At the sub-station is provided the usual telephonic apparatus comprising a switchhook 7, receiver 8, transmitter 9, signal bells 10, and condenser 11. The multiple spring jacks 12 and 13 are connected in bridge of the line limbs, and the test thimbles 14 and 15 thereof are connected together by conductor 16 which includes the cut-off relay 3 and terminates at the positive pole of the battery S. A line signal 17 is included in a local circuit controlled by the armature 18 of the indicator relay 6. A sub-station $B^1$ is provided with similar apparatus as sub-station A and connects through the line limbs with the central exchange C, the cut-off relay mechanism and connections therefor being the same as those connected with the sub-station A. The reference characters of the sub-station $B^1$ telephone apparatus, line and central station apparatus are, however, primed. This line is shown as a party line, and besides the sub-station $B^1$ are indicated the sub-stations $B^2$, $B^3$ and $B^4$.

The cord circuit at the central exchange terminates in the answering plug 19 and the calling plug 20. Condensers 21 and 22 are included in the strands of the cord circuit respectively to prevent their conductivity between the answering and calling sides thereof. The supervisory relay for the answering side is of the compound type, comprising windings 23 and 24. The armature 25 for the winding 24 is mechanically connected with the spring 26 which tends to hold this armature in its unattracted position. Armature 27 is provided for the winding 23 and is mechanically connected with the actuating spring 28 by means of the insulating piece 29. Armature 25 is adapted to mechanically engage the armature 27, and the actuating spring 28 has associated therewith a contact spring 30 from which it is normally disengaged, but which it is adapted to engage when the winding 24 is energized whereby the armature 25 is attracted against the tension of the spring 26, thus allowing the armature 27 to drop, and causing the actuating spring 28 to engage the contact spring 30. The contact springs 28 and 30 control a circuit containing the supervisory lamp 31 and the source of current. The supervisory relay for the calling side comprises the windings 32 and 33. The armature 34 for the winding 33 is mechanically connected with the spring 35 which tends to hold it in its unattracted position. Mechanically connected with the armature 34 by means of the insulating piece 36 is the actuating spring 37 which has the alternate contacts 38 and 39, the purpose of which will be hereinafter pointed out. The armature 34 by reason of the tension of the spring 35 is adapted to engage the armature 40 for the winding 32 whereby the actuating spring 41 by reason of its mechanical engagement with the armature 40 may be held normally out of engagement with the contact spring 42. The actuating spring 41, however, is adapted to engage the contact spring 42 when the winding 33 is energized to attract the armature 34 against the tension of the spring 35, thus allowing the armature 40 to drop and the actuating spring 41 to engage the contact spring 42. When the winding 33 is thus energized, the actuating spring 37 is adapted to engage the spring 39, and when it is not energized, the actuating spring 37 engages the contact spring 38 by reason of the tension of the spring 35. The contacts 41 and 42 control a local circuit through the supervisory lamp 43 for the calling side and common source of current. The connection with the line of the operator's telephonic apparatus O is controlled by the position of the key springs 44 and 45. These key springs 44 and 45 are adapted upon actuation to engage respectively the contact springs 46 and 47 which are directly connected with the operator's telephonic apparatus.

For the purpose of facilitating the proper description the operation of these arrangements is explained in regard to a single cord circuit, but as will be hereinafter pointed out, when the ringing arrangements are explained, this cord circuit should be considered as a group of cord circuits which are supplied in parallel with the proper ringing current. While these ringing divisions hereinbefore mentioned may be of any reasonable number, I have for the purpose of illustration shown six divisions, these divisions being designated conveniently as *d*, *e*, *f*, *g*, *h* and *i* respectively. It must be remembered that each of the divisions comprise a group of cord circuits, the number of such groups determining, according to this invention as will be hereinafter described, the relative lengths of the active and silent periods of the signaling devices at the sub-stations. For the purposes of illustration and description six groups or divisions are shown. Thus in signaling a subscriber the signaling device would be active one-sixth of the time and silent five-sixths. Each of the groups of cord circuits is provided with selective automatic ringing apparatus including the keys $48^1$, $48^2$, $48^3$, and $48^4$. In order that the drawings may not be too complicated, I have omitted in Fig. 1 the groups of cord circuits which are connected respectively with the keys $48^1$, $48^2$, etc., of the ringing divisions *e*, *f*, *g*, *h* and *i*, and I will describe the operation of the system of Fig. 1 with reference to the selective

keys of group *d* alone. Each of the keys $48^1$, $48^2$, $48^3$, and $48^4$ consist of the actuating springs 49 and 50 and the contact springs 51 and 52 adapted to be engaged by the actuating springs 49 and 50 respectively. The actuating springs 50 of all the keys $48^1$, $48^2$, $48^3$, and $48^4$ are connected together and to the front contact 53 of the relay 54 which contact is adapted to be engaged by the armature 55 when the winding 56 of the relay 54 is energized. The relay 54 is provided also with the contact armature 57 which has the front contact 58, this front contact being connected with one pole of the signaling current generators by means of the conductor 59. The actuating spring 52 which makes the contact with the actuating spring 50 is connected with the other pole of the signaling current generators through the associated interrupting devices, as will be hereinafter described. The armatures 55 and 57 are connected with the strands of the cord circuit, and it will appear evident that when the relay 54 is energized, these armatures will be attracted to cause the signaling current to be bridged across the cord strands.

As will be hereinafter pointed out, each of the keys of the selective apparatus of any cord circuit group is adapted to send current over the line which has different characteristics from any of the currents which are sent over the line by the actuation of any of the other keys of the selective apparatus for that particular group. In order that the current source may be connected with the line until the called subscriber has answered his call, I provide automatic means whereby any particular key when depressed will be retained in such depressed position by means of the energization of a relay, and further means is provided whereby the circuit through this locking relay is controlled by the position of the switchhook at the called station. Thus, when the called subscriber removes his receiver from the switchhook, this locking relay is deenergized to cause the release of the selective key, and the signaling current is, therefore, automatically disconnected from the line when the subscriber has answered his call. This locking relay is designated at 60 in Fig. 1, and one terminal of its winding 61 is connected with the actuating springs 49, 49, while the other terminal thereof is connected with the negative pole of the battery. The springs 49 are adapted to engage respectively their associated contacts 51 which are connected together and with the spring 41 of the supervisory relay. The contact 42 associated with the spring 41, as before stated, is connected with the positive pole of the battery. The relay 60, therefore, is adapted to be energized upon contact between springs 49 and 51 and simultaneous contact of springs 41 and 42. Means are provided whereby contacts 41 and 42 are closed together upon the insertion of the calling plug in the jack, and the depression of any selective key when the calling plug is in the jack will cause contact between the springs 49 and 51 and will thereby close the circuit through the relay 60 to energize the same, thus locking the depressed key in position. Means are also provided whereby the springs 41 and 42 are parted upon the removal of the receiver from the hook at the called sub-station, and the circuit through the relay 60 is thus broken to deënergize the same and allow the selective key to return to its normal position. The mechanical arrangements and the precise construction of the selective apparatus are shown in detail in the co-pending application of Kahl referred to, and I, therefore, here simply describe the operation of this key mechanism with reference to the diagram in a general way, as it will appear evident that any kind of electro-magnetic locking and releasing means may be employed.

It appears evident that the signaling current can be supplied to the line only when the relay 54 is energized, and as will appear evident from the foregoing, signaling current should be sent over the line only when the relay 60 is energized. I, therefore, provide an armature 62 which has the front contact 63 and which primarily controls the circuit through the relay 54. This circuit through the relay 54 is secondarily controlled by means of the interrupter *d*64. The constant contact 65 of this interrupter is connected to the positive pole of the battery, and the brush contacts *d*66, *e*66, *f*66, etc., are connected respectively with the similar relays of their associated cord circuit groups. Thus, the brush contact *d*66 is connected to all the relays 54 in group *d*. The interrupter *d*64, therefore, controls the relay 54 after the relay 60 has been energized. The active period of the interrupter *e*64 begins immediately upon the close of the active period of the interrupter *d*64, and the active period of the interrupter *f*64 begins immediately upon the cessation of the active period of the interrupter *e*64, etc. Since, as in the present instance, there are six interrupters, one for each cord circuit group, there are six ringing periods of equal duration to take place, each immediately after the cessation of the preceding one. Therefore, the complete cycle represented by the sum of the ringing periods of all the different divisions would be represented by one revolution of one interrupter. Thus, the relays 54 of group *e* may become energized immediately after the relays 54 of group *d* have become deenergized.

The ringing circuit which is bridged across

the cord strands whereby the current may be sent over the lines includes the current generator 67 which is one of the set $67^1$, $67^2$, $67^3$, and $67^4$, the interrupter 68 which is one of the interrupters *d*68, *e*68, *f*68, *g*68, etc., and one of the pairs of springs 50 and 52 of either the keys $48^1$, $48^2$, $48^3$ or $48^4$. The interrupters 68 and the interrupters 64 may be mounted on a common shaft. The generators 67 deliver currents which differ from one another in pulsations per second, and each of the sub-station bells on the telephone line are adapted to respond only to currents from one of said generators. The selective keys $48^1$, $48^2$, etc., are, therefore, adapted to connect any one of the generators $67^1$, $67^2$, $67^3$, etc., with the telephone line whereby a particular signal bell on that line is actuated.

I provide means whereby the current delivered from generator $67^1$ is adapted to be connected with all the selective keys $48^1$, and I also provide means whereby this current from the generator $67^1$ may be first connected with the key *d*$48^1$, next with the key *e*$48^1$, then with the key *f*$48^1$, etc. Similarly I provide means whereby the current delivered from the generator $67^2$ is adapted to be connected with any of the keys $48^2$, and also means are provided whereby this current may be fed first to key *d*$48^2$, then to key *e*$48^2$, then to key *f*$48^2$, etc. Similarly the same may be said of the groups $48^3$ and $48^4$. This arrangement is most clearly shown in Fig. 2 where the ringing means alone have been diagrammatically shown.

The various groups of cord circuits are indicated at *d*, *e*, *f*, *g*, *h*, and *i*, and there is shown in this figure only the ringing arrangements which are adapted to be bridged across the cord circuits in the respective groups. The similar poles of the generators $67^1$, $67^2$, $67^3$ and $67^4$ are connected together and are shown as leading to the various groups of cord circuits. The interrupters are shown as being disposed in groups *d*, *e*, *f*, *g*, *h* and *i* corresponding with the cord circuits. As shown, the other conductor leading from each group of cord circuits is connected with all the interrupter brush contacts in the corresponding interrupter group. The interrupters are also arranged in groups 1, 2, 3 and 4. All the constant contacts in group 1 are connected with the other pole of generator $67^1$; all the constant contacts in group 2 are connected with the other pole of generator $67^2$; all the constant contacts in group 3 are connected with the other pole of generator $67^3$, and all the constant contacts in group 4 are connected with the other pole of generator $67^4$. It will be convenient in this description to characterize the reference characters given the parts as to cord circuit groups by the letter indicating the cord circuit group and to give the reference characters exponents corresponding with the exponents of the generator characters to distinguish them in the generator groups. Each of the interrupters 68 consists of the active portion 69 and the inactive portion 70; that is, inactive with regard to Fig. 2 where the collateral arrangements are omitted. The function of the portion 70, however, will be explained with reference to Fig. 1. It will be noted that the positions of the active portions 69 which may be called the ringing segments, are the same in each cord circuit group. Since for the purpose of illustration, I have herein shown six groups of cord circuits, the ringing segment of each group is one-sixth of a revolution of the succeeding group. These ringing segments are equal, and when the contact brush has left the ringing segment of the last interrupter, the contact brush of the first interrupter will thereupon immediately engage its ringing segment. When the contact brush has left the ringing segment of the first interrupter, the brush of the second interrupter will engage its ringing segment, and immediately upon leaving its ringing segment, the brush of the third interrupter will engage the ringing segment of the third interrupter, etc. Thus, when the interrupters have made one complete revolution, the currents from the generators have been delivered to each of the cord circuits, first one, then another, and so on. Of course, it must be remembered that the selective keys are depressed to effectively employ but one generator at a time; that is, when a selective key is depressed, the circuit is closed through the desired current generator and the associated interrupter. Thus, it appears that any one of the generators may be effectively employed for any of the cord circuit groups, current, however, being adapted to be connected with but one group of cord circuits at any time.

Having thus described in general the various arrangements and relations of the mechanisms, I will now proceed to describe the operation of the system with reference to Fig. 1. For the purpose of illustration I will assume the subscriber at sub-station A to be the calling subscriber. When he removes his receiver from the switchhook, a circuit is closed through the indicating relay 6, thereby attracting its armature 18 to cause the closure of the local circuit through the line lamp 17. The operator then inserts her answering plug 19 into one of the associated spring jacks connected with the calling line and actuates her listening key to cause contact between the springs 45 and 47 and 44 and 46 respectively. The operator's telephonic apparatus O is thereby connected across the line, and she may converse with the calling subscriber to ascertain the connection desired. Immediately upon the insertion of the calling plug in

the line jack, a circuit is closed through the cut-off relay 3 as follows:—from the negative side of the battery, through conductor 71, conductor 72, winding 24, the sleeve strand of the answering side of the cord circuit, through the plug sleeve contact and jack thimble, conductor 16 and through the cut-off relay winding to the positive side of the battery. The armatures 1 and 2 then leave their back contacts, and the winding 24 being also energized, the armature 25 is also attracted against the tension of the spring 26. This would tend to allow the spring 28 to make contact with the spring 30, but these springs are held in a disengaged position by reason of the energization of the winding 23 which is included in a circuit as follows:—from the negative side of the battery S, through conductor 71, conductor 72, winding 24, sleeve strand and sleeve contact of the answering plug, through the spring jack, through line limb *b*, through the telephonic apparatus at the sub-station A, through line limb *a*, through the spring jack to the tip contact and strand of the cord circuit, conductor 73, winding 23, conductor 74, conductor 75 to the positive pole of the battery. Thus, the armature 27 is held in its attracted position whereby the springs 28 and 30 are held disengaged, the local circuit through the signal 31, therefore, being held open. Suppose for the purpose of illustration that the subscriber at sub-station A desires to be connected with the subscriber at sub-station $B^1$. The operator inserts her calling plug 20 into the spring jack of the line leading to sub-station $B^1$, thereby closing a circuit through the cut-off relay 3′ and the supervisory relay 33 for the calling side of the cord circuit as follows:—from the negative side of battery S, through conductor 71, conductor 76, winding 33, conductor 77, sleeve strand of the calling side of the cord circuit, sleeve contact of the plug, thimble 15′, conductor 16′, cut-off relay 3′ and back to the positive side of the battery. The armatures 1′ and 2′ are, therefore, attracted to leave their respective back contacts, and winding 33 is energized to attract its armature 34 against the tension of the spring 35. The spring 41 will then be allowed to make contact with the spring 42, since the winding 32 of the armature 40 which controls the spring 41 is not energized.

It may be stated in passing that the winding 32 is controlled by the position of the switchhook at the sub-station when the plug is inserted in the jack. The receiver at the sub-station $B^1$, however, being at this time on its hook, the circuit through the winding 32 is not closed, and this winding remains deënergized. Since the springs 41 and 42 are thus allowed to come into contact, the local circuit through the supervisory lamp 43 is closed as follows:—from the positive side of the battery, through conductor 75, conductor 78, springs 42 and 41, supervisory lamp 43, and conductor 71 to the negative side of the battery. Being thus connected with the line with which the desired subscriber is connected, the operator actuates the selective key which is connected with the source of current to which only that signal bell on the called line which is at the sub-station of the called subscriber is responsive. For illustration, it may be considered that the key $48^1$, is adapted to connect the generator $67^1$, to which the signal bells located at sub-station $B^1$ only are responsive. When the operator, therefore, depresses the selective key $d48^1$, spring 49 will immediately make contact with spring 51, and a circuit is closed through the locking relay 60 as follows:—from the positive pole of the battery, through conductor 75, conductor 78, contacts 42 and 41, which, as before stated, are now in engagement, conductor 79, spring 51, spring 49, conductor 80, winding 61 of the relay 60, conductor 81, conductor 71, and back to the negative side of the battery. The locking relay 60 is thus energized, and its armature, as before stated, is so mechanically connected with the actuating keys of the associated selective apparatus that upon energization, it locks any key which has been depressed until it is deënergized. The key $d48^1$ is, therefore, locked in its depressed position. When the relay 60 is thus energized, its armature 82 is attracted to interrupt the sleeve strand of the cord circuit and its armature 62 is attracted to engage the contact 63. This closes a circuit through the relay 54 and the associated interrupters $d64$ as follows:—from the positive pole of the battery, through interrupter $d64$, conductor 83, contact 63, armature 62, conductor 84, winding 56, conductor 85 and conductor 71, back to the negative pole of the battery. Thus, during the time that the interrupter $d64$ closes the circuit just traced, the relay 54 will be energized to attract its armatures 55 and 57. When the armatures 55 and 57 are thus attracted, they engage respectively the front contacts 53 and 58. The armature 55 leaves the back contact to interrupt the tip strand of the cord circuit. The associated current generator for the cord circuit group under consideration is connected between the contacts 53 and 58 through an associated interrupter 68 and a selective key. Thus, upon energization of the relay 54, and since the key $d48^1$ is depressed at this time, as before stated, a bridge will be closed through the current generator $67^1$, the interrupter $d68^1$ and key $d48^1$ as follows:—from contact 53, through conductor 87, spring 50, contact 52, conductor 88, interrupter $d68^1$, current generator $67^1$, conductor 59 to contact 58. Therefore, when the relay 54 is

energized, the selected current will be sent over the line with which the calling plug has been connected. Since, as before stated, the signal bells at sub-station $B^1$ only are responsive to current generator $67^1$, the subscriber at sub-station $B^1$ will be the only signaled subscriber on the line. The active segment of the interrupter *d*64 is so relatively adjusted as to position with the interrupter $d68^1$ that immediately upon the energization of the relay 54, the bridged circuit through the signaling current generator will be closed. The active segment, however, of the interrupter *d*64 is made slightly longer than the ringing segment of the interrupter *d*68. The purpose of this construction is as follows:—When the active segment of the interrupter *d*64 connects with conductor 83, the circuit through the relay 54 will be closed, thereby placing the plug cords in the ringing position. Ringing segment 69 of interrupter $d68^1$ will at the same instant connect the ringing current to the line. If these segments were of the same length, when interrupter *d*64 opens the circuit to release relay 54, the ringing current would also be cut off immediately by ringing segment 69.

Upon deënergization of relay 54, the tip strand is continued through armature 55 and contact 86, through contacts 37 and 39, winding 32 of the supervisory relay and through conductors 78 and 75 to the positive grounded side of the battery, and as the sleeve side of the cord circuit when connected with the line, has always connection through winding 33 of the supervisory relay and through conductor 71 with the negative side of the battery, the entire charge which the condensers in the telephones and the lines have received will pass through the supervisory winding 32, and as this winding controls the contacts 41 and 42 included in the circuit for relay 60 which in turn controls the circuit through relay 54, the signaling would be seriously interfered with. It is, therefore, necessary to maintain the actuation of relay 60 and relay 54 controlled thereby a sufficient length of time to allow the discharge of the line through the ground connection for the signaling current interrupters, and this is accomplished by making the active segment of the interrupter *d*64 slightly longer than ringing segment 69 of the interrupter $d68^1$. Relay 54 is energized and ringing current at the same time applied to the cord conductors and connected lines. After the corresponding brush leaves the ringing segment of the interrupter $d68^1$, the active segment of the interrupter *d*64 on account of its greater length still engages its brush and maintains closure of the circuit for relay 54 and the charge retained in the condensers and the line is led to ground through the grounded segment 70 of the interrupter $d68^1$. After the corresponding brush leaves the active segment of the interrupter *d*64, the circuit for relay 54 is opened and the relay deënergized to again complete the tip strand through the winding 32 to ground. The line and other circuits are, therefore, entirely relieved of static charges before and after application of the ringing impulses thereto. It must be understood, of course, that the foregoing explanation in regard to the relative disposition of the active segments of the interrupters *d*64 and $d68^1$ may be applied to the interrupters 64 and 68 of all the ringing divisions.

The ringing circuit to signal the subscriber may be traced as follows:—from generator $67^1$ through interrupter $d68^1$, conductor 88, contact 52, spring 50, conductor 87, contact 53, armature 55, tip strand of the calling side of the cord circuit, tip spring of the spring jack 13′, line limb *a*′, through condenser and signal bells at sub-station $B^1$, back to the central station through line limb *b*′, sleeve spring of the spring jack, sleeve contact of the plug, sleeve strand, armature 57, contact 58, and conductor 59, back to the other pole of the signal current generator $67^1$. When the active segment of the interrupter *d*64 becomes disconnected from conductor 83, relay 54 becomes deënergized, but on account of the arrangement above described, the lines will be free from static charge. The length of such current flow for the relay 54 must evidently be adjusted to correspond to the adjustment of the ringing segments of the corresponding ringing current interrupters which have hereinbefore been described in detail. Upon receiving the signal, the called subscriber removes his receiver from the switchhook, thereby closing a circuit through winding 32 as follows:—from the positive pole of the battery, through conductor 75, conductor 78, winding 32, through a part of the tip strand, contacts 39 and 37, through another part of the tip strand, contact 86, armature 55, tip strand, tip contact of the plug, tip spring of the spring jack 13′, line limb *a*′, the switchhook and telephonic apparatus at the sub-station, line limb *b*′, sleeve strand of spring jack 13′, sleeve contact of the plug, sleeve strand, conductor 77, winding 33 and conductor 71 to the negative pole of the battery. Winding 32 is thus energized, and the armature 40 is attracted whereby the springs 41 and 42 part contact. These contacts, as before stated, control the local circuit through the supervisory lamp 43, and this lamp is, therefore, extinguished upon the removal of the receiver from the switchhook at the called sub-station. As before stated, the contacts 41 and 42 also control the circuit through the locking relay 60, and when this circuit is opened by the removal of the receiver from the hook at the called station, the lock-

ing relay is deënergized, and on account of its mechanical connection with the selective apparatus releases the key $d48^1$. This immediately breaks connection between the ringing generator and the line, and the operator is notified by the extinction of the supervisory lamp 43 that the called subscriber has answered. The subscribers are now connected for telephonic conversation through the following circuit:—from the telephonic apparatus at sub-station A, through line limb *b*, sleeve contact of spring jack 13, sleeve contact of plug, sleeve strand, through condenser 22, contact 90, armature 82, sleeve contact of plug, sleeve spring of spring jack 13′, line limb *b*′, telephonic apparatus at sub-station $B^1$, line limb *a*′, tip spring of spring jack 13′, tip of plug, tip strand, through armature 55, contact 86, contacts 37 and 39 and condenser 21, tip of answering plug, tip spring of spring jack 13, line limb *a* and back to the telephonic apparatus at sub-station A, current being supplied to the line by the common battery S.

When the subscriber at sub-station A replaces his receiver on the hook, the circuit through the winding 23 is broken. Thus, the armature 27 is permitted to retract, since, as before stated, the winding 24 is energized to attract the armature 25 on account of contact between the plug sleeve contact and thimble 15. This release of the armature 27 allows the spring 28 to engage the spring 30, and the circuit through the supervisory lamp 31 is closed. Similarly, when the subscriber at sub-station $B^1$ has replaced his receiver on the hook, the circuit through winding 32 of the supervisory relay for the calling side is opened to allow the armature 40 to retract whereby the springs 41 and 42 are brought into engagement, thus closing the circuit through supervisory lamp 43. Being thereby notified that conversation has been completed, the operator removes the plugs from the jacks to restore the entire apparatus to its normal condition. The cord circuits may also be provided with a busy test arrangement controlled by the auxiliary contacts 91 and 92 of the operator's listening key. Before the calling plug is inserted in the jack of the called line, the operator, in order to test whether or not the line is busy, applies the tip of the plug to the jack thimble and actuates her listening key. If the line is busy, current will flow as follows:—from the negative pole of the battery, through conductor 71 and winding 33 of the supervisory relay connected with the busy cord circuit, through the sleeve contact, through the engaged thimble, through the tip of the applied testing plug, through the tip strand of the testing cord circuit, through armature 55 and contact 86 of the relay 54, through contacts 37 and 38, through conductor 93, through engaging test contacts 92 and 91, through conductor 94, through the test winding 95, through conductor 96 and through conductors 78 and 75 to the positive pole of the battery. This will cause the usual click in the operator's receiver, and she will be notified of the busy condition of the line. If the line is not busy, this circuit will not be closed through the test winding, and the operator connects the calling plug with the jack of the line to be called and then proceeds as hereinbefore described. The relative arrangement between the selective signaling apparatus and the cord circuits as herein described has been found to be very efficient and capable of being operated with a minimum expense. It is a desirable feature that small signaling current generators may be employed, and it is evident from the foregoing that with the cord circuits at the exchange arranged in ringing divisions, better results may be obtained by the employment of large ringing current generators to meet the demands which may be made upon them. With the arrangements as described herein, the current is distributed as to time, all ringing divisions being supplied with the same amount of current, there being, however, but one division supplied at a time. I wish to have my invention construed broadly, therefore, as providing means whereby the cord circuits in an exchange are divided into ringing divisions, each division being supplied with current after the cessation of the supply to another division, whereby motors of small power may be employed, the arrangement being such as to positively distribute the current among cord circuit groups as to time to prevent at any time an overdemand upon the current generators.

I do not wish to be limited to the exact arrangement and relation of the parts herein shown, as changes may be readily made by those skilled in the art without departing from the spirit and scope of my invention.

I claim as new and desire to secure by Letters Patent:

1. In a party line telephone system, the combination with a central exchange, of sub-stations connected therewith through telephone lines, interconnecting means at the central exchange, a plurality of sources of ringing current, interrupter means between said ringing current sources and said cord circuits, and means whereby any of said ringing current sources may be connected with the interconnecting means, said interrupter means being so timed relatively to each other that said sources of current may be effectively connected with said cord circuits during regularly successive periods.

2. In a party line telephone system, the combination with a central exchange, of

sub-stations connected therewith through telephone lines, a signaling device at each sub-station, a plurality of sources of current at the central exchange, each being of such characteristics that but one signaling device on each telephone line may respond thereto, cord circuits at the central exchange, and interrupting means connected between said sources of current and said cord circuits whereby said sources of current may be connected with each of said cord circuits successively.

3. In a party line telephone system, the combination with a central exchange, of sub-stations connected therewith through telephone lines, a signaling device at each sub-station, a plurality of sources of current of different characteristics at the central exchange, cord circuits at the central exchange, manually operative means for connecting any one of said sources of current with said cord circuits, and interrupting means connected between each of said sources and each of said cord circuits whereby the effectively connected source of current may supply each of said cord circuits in regular successive order.

4. In a party line telephone exchange, the combination with a central exchange, of cord circuits arranged in groups at the central exchange, a plurality of ringing current sources, and interrupter means between each of said sources and each of said cord circuits whereby said ringing current sources may be successively connected with each of said groups.

5. In a party line telephone system, the combination with telephone party lines terminating at a central exchange, interconnecting cord circuits at the central exchange, a plurality of sources of current of differing characteristics for selectively signaling the sub-stations on said party line, an interrupter between each source of current and each cord circuit, and manually operative means for connecting any one of said current sources with the cord circuits, said interrupters being so timed that the connected source of current may be effectively connected with said cord circuits in regularly successive periods.

6. In a party line telephone system, the combination with a plurality of telephone party lines terminating in a central exchange, of cord circuits arranged in groups at the central exchange, a plurality of signaling current sources of differing characteristics for selectively signaling the substations on said telephone lines, manually operative means for connecting any one of said sources with the telephone line, and a series of interrupters connected with each ringing current source, there being one interrupter in each series for each cord circuit, said interrupters being so timed relatively to each other that the connected source of current may be effectively connected with each of said cord circuits during regularly successive periods.

7. In a party line telephone system, the combination with a plurality of telephone party lines terminating at a central exchange, of cord circuits arranged in groups at the exchange, a plurality of signaling current sources of different characteristics for selectively signaling the sub-stations on said telephone lines, a series of interrupters for each source of current, the similar segments of which are connected together and to one terminal of said source of current, there being an interrupter in each series for each cord circuit group, and a brush contact for each interrupter, said interrupters being so timed that the ringing segments thereof will engage the brush contact in regular successive order, each cord circuit being connected with all the brush contacts for the similarly disposed interrupters.

8. In a party line telephone system, the combination with a plurality of telephone lines terminating at a central exchange, of cord circuits arranged in groups at the exchange, a plurality of ringing current sources of differing characteristics for selectively signaling the sub-stations on said telephone lines, an interrupter connected between each cord circuit group and each current source, all the interrupters for one cord circuit group being similarly timed and so timed relatively to the interrupters for the other cord circuit groups that the ringing current sources are connected with each of said cord circuit groups in regular successive order.

9. In a party line telephone system, the combination with telephone lines terminating in a central exchange, cord circuits arranged in groups for interconnecting said telephone lines, a plurality of ringing current sources, and a series of interrupters connected with each of said current sources, each of said series being composed of interrupters timed so that the source connected with that particular series may be periodically connected with each of said cord circuit groups in regular successive order, the similarly disposed interrupters in all the series being connected together and with a particular cord circuit group.

10. In a party line telephone system, the combination with a central exchange, of cord circuits arranged in groups at the central exchange, a plurality of ringing current sources, and switching means for automatically connecting said ringing current sources successively with each of said cord circuit groups.

11. In a party line telephone system, the combination with a central exchange, of sub-

stations connected therewith through telephone lines, a signal device at each sub-station, a plurality of sources of current at the central exchange, each being of such characteristics that but one signaling device on each telephone line may respond thereto, cord circuits arranged in groups at the central exchange, and switching means for automatically connecting said ringing current sources successively with each of said groups.

In witness whereof, I hereunto subscribe my name this 15th day of June, A. D. 1908.

MERRITT S. CONNER.

Witnesses:

TOM PAYNE,

FREDERICK JAMES TOMKINSON.