No. 779,533. PATENTED JAN. 10, 1905.

# W. W. DEAN.

## PARTY LINE TELEPHONE SYSTEM.

APPLICATION FILED JUNE 15, 1903.

2 SHEETS—SHEET 1.

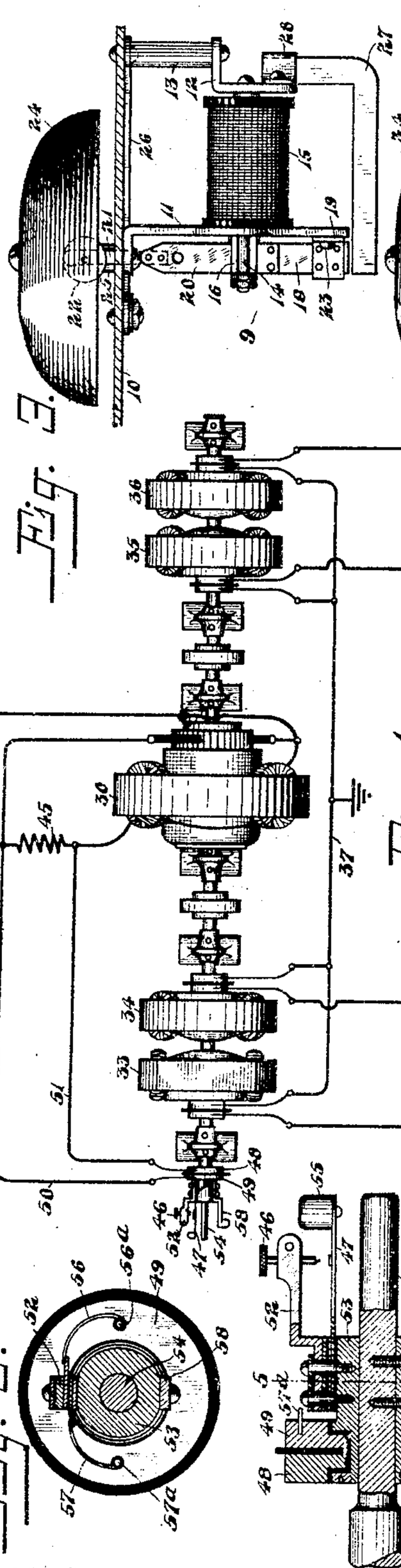

Fig. 3.

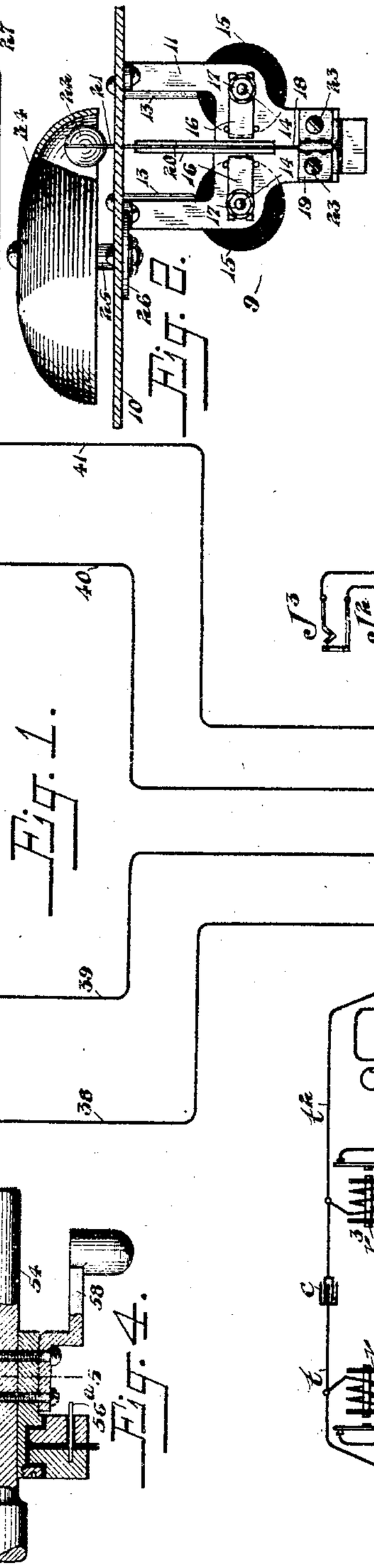

Fig. 2.



Fig. 1.



Fig. 5.



Fig. 4.

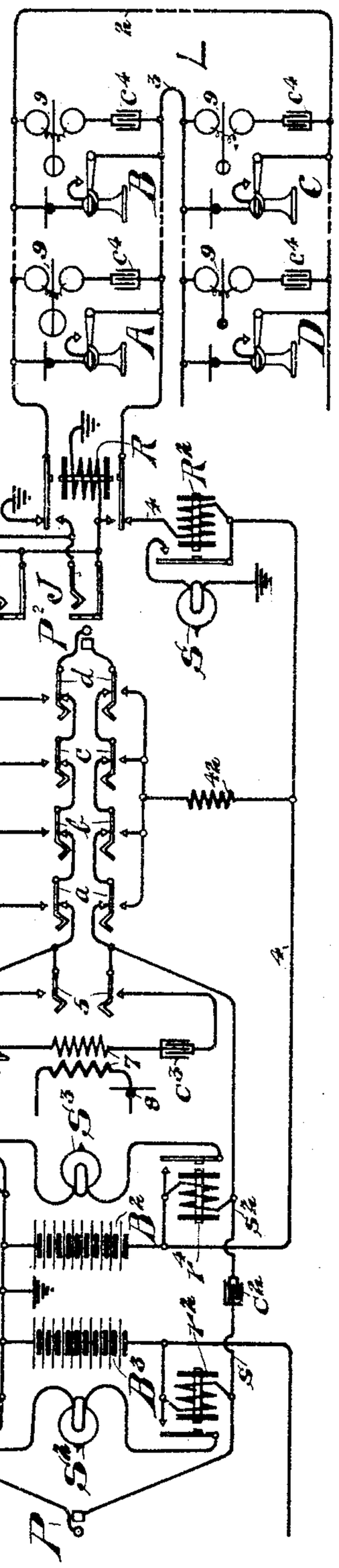

Fig. 7.



Fig. 6.

Witnesses.
R. H. Burfeind
Kempster B. Miller.

Inventor:
William W. Dean.
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# PARTY LINE TELEPHONE SYSTEM.

APPLICATION FILED JUNE 15, 1903.

2 SHEETS—SHEET 2

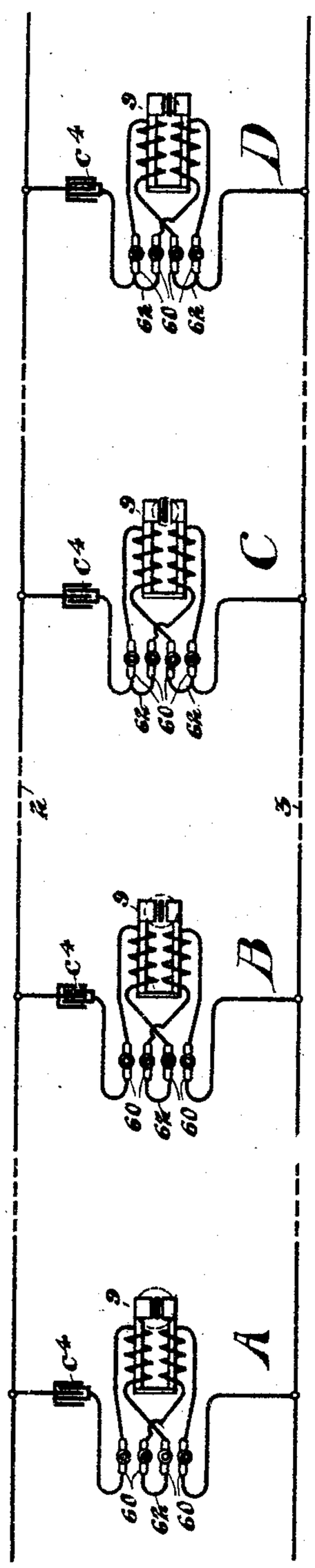


Fig. 6.

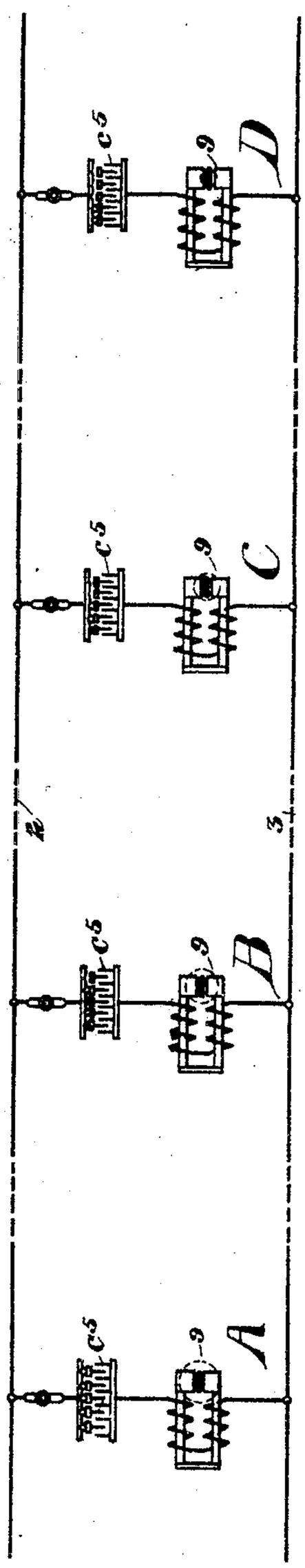


Fig. 7.

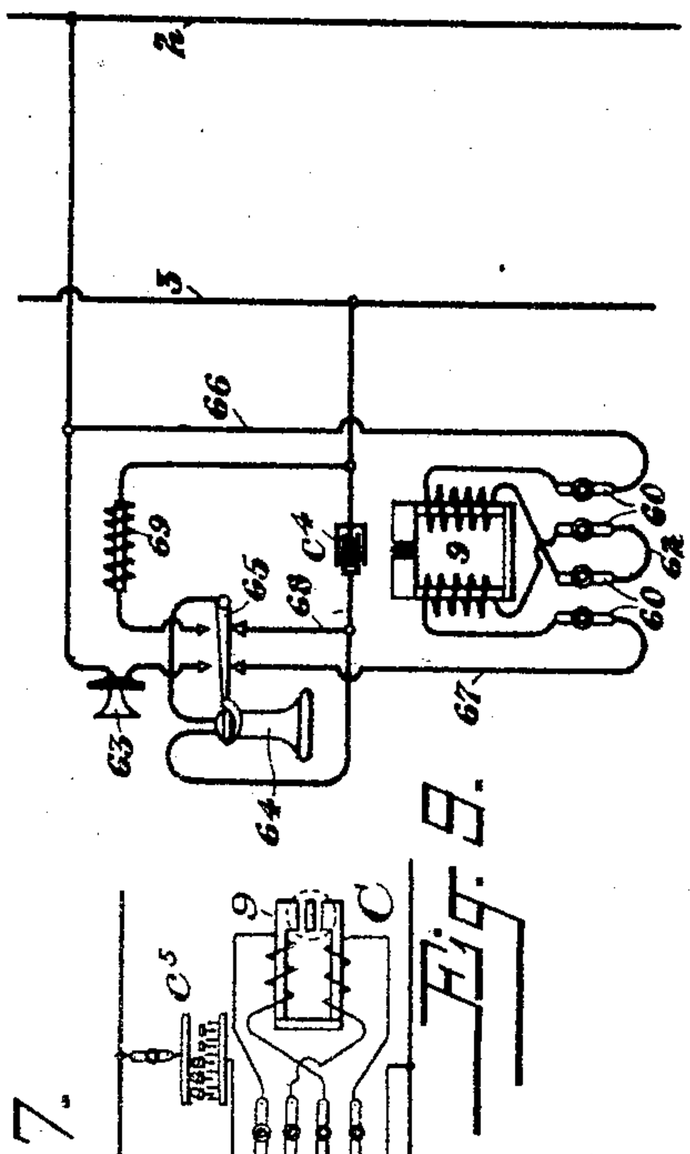


Fig. 9.

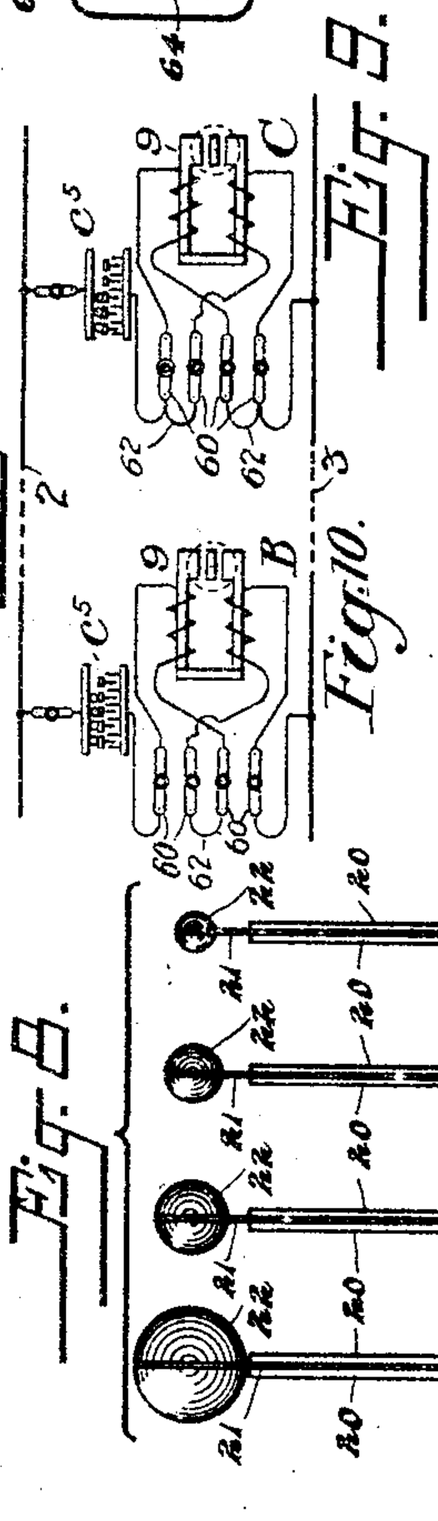


Fig. 10.




Fig. 8.

Witnesses.
R. H. Burpinid
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Inventor:
William W. Dean,
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No. 779,533. Patented January 10, 1905.

# UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## PARTY-LINE TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 779,533, dated January 10, 1905.

Application filed June 15, 1903. Serial No. 161,527.

*To all whom it may concern:*

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Party-Line Telephone Systems, of which the following is a specification.

My invention relates to improvements in party-line telephone systems, and has for its objects, generally speaking, the provision of a harmonic selective signaling system for such lines.

In most of the harmonic selective signaling systems heretofore attempted the reeds merely closed local circuits at the substations by which the signals were sounded. These were objectionable for the reason that it is very difficult to secure and maintain a good contact between a rapidly-vibrating reed and a stationary contact and for the further reason that the delicate adjustment of such apparatus at the various stations is likely to be changed by variations in temperature and by other unavoidable causes. It has also been attempted to provide each substation of a party-line with simple electromagnetic bells in which tuned reeds formed the tongues of the bells and to place at the central office simple circuit-breakers of the same type as the bells and having tuned reeds of the same characteristic rate of vibration as the reeds of the bells at the substations and which were adapted to send pulsating current out over the lines to operate the said bells. Systems of this type, however, are unsuccessful and uncommercial for various reasons. In the first place it is practically impossible to operate a tuned bell of the type mentioned by means of pulsating or alternating current of a frequency or pitch corresponding to the pitch or natural rate of vibration of the tuned reed forming the tongue of the bell. The weight of the hammer carried by the reed, the manner of applying the attractive force of the operating-magnet, and the striking of the gong of the bell by the hammer destroys and prevents the natural vibration of the reed, and the whole system is so thrown out of harmony that it is inoperative and unsuccessful. Again, the same objection to the tuned circuit-breakers at the central office exists, as before mentioned, with reference to the tuned reeds at the substations.

In my invention of a harmonic selective signaling system I apply to the lines ringing-currents having frequencies corresponding to the operative rates of vibration of the reed tongues of the bells and which rate is the resultant of the natural pitch of the reed as modified by the weight of the hammer or ball, the armature, and the action of the bell-gong when it is struck. This modification so far as the gong is concerned is in the line of acceleration, so that the operative pitch or resultant characteristic of the signaling device as a whole is something higher than the pitch of the weighted reed tongue alone. In other words, the gong in being struck rapidly serves to speed up the vibration of the tongue.

In carrying out my invention, which has been worked out for commercial purposes and is now in successful practical operation, I provide at each station of a party-line a call-bell having a tongue in the form of a tuned reed, which carries the magnet-armature and bell-hammer and which has a definite natural rate of vibration or pitch, the reeds at each substation preferably having a characteristic pitch differing from that of the other bells on the same line, and at the central office I provide a ringing outfit adapted to impress, preferably, alternating currents upon the telephone-lines corresponding in frequencies to the various operative or resultant rates of vibration of the said bells. These frequencies may not be in exact synchronism with these resultant or operative rates of actuation of the bells; but they are sufficiently close to successfully operate the bells, and since the tongues must be started from a state of rest the frequencies of said currents must also be sufficiently close to the natural vibration of the tongues to start them vibrating when current is first impressed upon the line.

For the sake of convenience of manufacture

and maintenance I prefer to vary the frequencies or pitches of the instruments by varying the sizes of the hammers or balls carried by the reed-tongues of the bells, a comparatively large and heavy hammer or ball being employed for the lowest rate of vibration and lighter ones for the higher rates of vibration. I find it preferable also, and particularly with the heaviest balls or hammers, to make the armature portion or central portion of the tongues rigid to prevent the reed from vibrating in nodes or intermediate of its ends and the ball standing still. I also mount the hammers or balls upon a flexible end of the tongue, so that the force of the blow upon the gong is taken up without impairment of the action of the tongue. The bells are polarized by permanent magnets, as in an ordinary alternating-current bell, and the ringing apparatus which I prefer to employ consists of a generating device driven at a constant speed and capable of generating alternating currents corresponding to the different operative or resultant frequencies of the vibrating bells. These frequencies, as stated, are close enough to the natural rates of vibration of the tongues to start the same vibrating when the ringing-currents are first impressed upon the line, whereby as soon as the gongs are struck the tongues are brought into practical synchronism with the ringing-currents. While various generating outfits may be employed, I prefer a self-contained motor-generator machine in which a single motor acting at constant speed serves to drive the plurality of alternating-current generators located upon the same shaft as the motor, the different frequencies of current being obtained by varying the number of poles of the generators. The constant speed of the motor and generators is obtained by means of a suitable governor.

At the substations the bells are preferably located in bridges of the line conductors, by means of which arrangement all ground connections and ground-returns are dispensed with, though it is apparent that other circuit arrangements may be employed without departing from the principle and broad scope of my invention.

While it is not essential to the successful operation of my invention that the branches of the bells at the substations be electrically attuned or made resonant to the ringing-currents, such electrical tuning of the said branches may be made, and my invention also contemplates the combination of thus mechanically and electrically tuning the substation devices. An approximate electrical tuning is obtained in a simple and practical manner by variously connecting the two coils of the electromagnets in the said bell branches as hereinafter pointed out, or such electrical adjustment may be accomplished by variations in the capacities of the condensers in the said branches. The condensers in the bell branches are preferably also employed for talking purposes.

My invention is illustrated in the accompanying drawings, in which the same reference characters are used throughout, and in which—

Figure 1 is a diagram of a system embodying my improvements. Fig. 2 is a front elevational view of one of the ringers. Fig. 3 is a side elevational view of the same. Fig. 4 is a sectional view of the motor-governor. Fig. 5 is a cross-section of the governor, taken on the line 5 5 in Fig. 4. Fig. 6 is a diagram of the party-line system, showing a simple method for approximately tuning the bell branches at the various stations. Fig. 7 is a similar diagram showing another method for accomplishing the same result. Fig. 8 shows the various tuned reeds employed at the substations of the party-lines. Fig. 9 shows in diagram a preferred arrangement of the talking instruments at the substations of the party-lines. Fig. 10 shows diagrammatically the combination of both methods of attuning the bell branches.

Referring to Fig. 1, L indicates a telephone-line of the polystation type extending in two limbs 2 and 3 from the substations A, B, C, and D to the central office. At the central office the line is provided with an answering-jack J and with a plurality of multiple jacks $J^2$ and $J^3$, connected therewith and forming the switchboard-section of the telephone-line, which terminates at the forward contacts of the springs of the cut-off relay R of the telephone-line, which has its winding grounded from the sleeve side of said switchboard-section of the line. The line conductor 2 of the telephone-line is normally grounded through one of the springs of the cut-off relay R, while the other conductor 3 of the telephone-line is normally connected by the other spring of the cut-off relay with a conductor 4, containing the winding of the line-relay $R^2$, which controls the local circuit of the line-signal S, and leads thence to the live pole of battery $B^2$ common to the cord-circuits and a plurality of the lines of the exchange.

For the purpose of making connections with the lines for conversation each operator is provided with a plurality of cord-circuits, one only being indicated in the drawings, each cord-circuit having an answering-plug P and a calling-plug $P^2$, provided with tip and sleeve contact-surfaces adapted to register with the corresponding contact-surfaces of the spring-jacks of the telephone-lines when the plugs are inserted therein. The tip-contacts of said plugs are joined by the flexible strands $t$ and $t^2$ and the interposed condenser $c$, while their sleeve-contacts are likewise joined by similar strands $s$ and $s^2$ and the interposed condenser $c^2$. Supervisory relays $r$ and $r^2$, together with a common battery $B^3$, are connected across the answering end of the

cord-circuit, said relays controlling through their contacts the local circuit of the supervisory signal $S^2$, while across the calling end of the cord-circuit similar supervisory relays $r^3$ and $r^4$ are placed upon each side of the battery $B^2$ and serve in a manner similar to the other pair of relays to control the supervisory signal $S^3$. By means of suitable listening-key springs 5 the operator is enabled to connect her receiver 6, the secondary of her induction-coil 7, and a condenser $c^3$ across the calling end of the cord-circuit, the transmitter 8 and the primary of the induction-coil 7 being charged from any suitable source and which may be the battery $B^2$.

The selective ringers at the substations are shown at 9 at the various substations in preferably permanent bridges of the line, said bridges each including a condenser $c^4$. The practical construction of these tuned ringers is indicated in Figs. 2 and 3, 10 indicating the plate or support, to one side of which the framework of the ringer is secured. This framework comprises a front plate 11, secured by suitable screws or rivets to the plate 10, and a rear plate 12, supported by posts 13, also secured to plate 10. Between the front and back plates the cores 14 of the magnet-coils 15 are secured, the plate 12 serving to complete the magnetic circuit at the rear ends of said cores. Pole-pieces 16 are carried upon the forward ends of the cores 14 in front of the support 11 and are secured in place by means of the nuts 17, threaded upon the ends of said cores. The pole-pieces are slotted to permit adjustment upon the cores 14. A permanent magnet 27 is secured at its rear end to the plate 12 by means of a strap 28, while its forward end projects into proximity with the front ends of the cores. The tongue or reed of the bell comprises a spring 18, rigidly mounted in a suitable clip 19 at its lower end and having affixed to its free end the armature-plates 20, playing between the opposing ends of the pole-pieces 16. An elastic strip 21 is carried at the upper ends of the armature-plates 20, and the hammer or ball 22 is secured to the upper end of the strip 21. By means of suitable screws 23 the clip 19 may be readily secured to or removed from the front plate 11. A single gong 24 is located upon the other side of the support 10 and is carried by post 25, secured to an adjustable plate 26 upon the opposite face of plate 10. The bell-tongue thus constructed has a certain natural rate of vibration; but when it is operated the ball 22 strikes the gong 24, and the vibration of the tongue is accelerated. In order to vary the rate of vibration of the tongue, it is found convenient to apply different sizes of balls thereto, this being indicated in Fig. 8 as well as in diagram in Fig. 1. This general construction of the tongue is important, for while the spring-strip 21 between the ball 22 and the armature 20 is essential to permit a certain independent freedom or elasticity of movement of the hammer 22 when the gong is struck and the reed is in operation the rigidity between the ends of the tongue or reed is likewise essential to prevent the reed from vibrating in nodes or at the center alone or in other undesired secondary manner and the ball standing still.

Inasmuch as the party-line is provided with four stations, the ringing outfit is arranged to generate ringing-current of frequencies corresponding to the resultant or operative pitch of the four ringing devices at the substations. In this ringing apparatus 30 represents a shunt-wound direct-current motor, which is connected in the power-circuit 31 32 in the ordinary manner. Upon the shaft of the motor are placed the alternating-current generators 33, 34, 35, and 36. One brush of each generator is connected to ground through the common lead 37, while the other brushes of the several pairs are respectively connected with the ringing-keys *a*, *b*, *c*, and *d* of the operator's cord-circuit by means of conductors 38, 39, 40, and 41. The sleeve-springs of said ringing-keys are connected through a suitable resistance 42 and the conductor 4 with the live-pole of battery $B^2$. With this arrangement and when plug $P^2$ of the cord-circuit is connected with the line the depression of the ringing-key *a* serves to connect the generator 33 with the telephone-line L to operate the bell at station A, while key *b* likewise connects the generator 34 with the line to operate the bell at station B. In a similar manner the operation of keys *c* and *d* serves to connect the generators 35 and 36 with the line to operate the bells at stations C and D.

In the operation of the system any subscriber may call the central office by taking up his receiver, thereby completing a path for current over the telephone-line from the battery $B^2$ or $B^3$ and operating his line-signal S. In response to the call the operator inserts the answering-plug P of her cord-circuit in the answering-jack of the calling telephone-line and operates the cut-off relay of that line by current over the sleeve-strand of the cord-circuit in the usual manner to render the line-signal inoperative. Learning that a subscriber located upon the polystation line is desired, the said line is tested in the usual manner to determine its idle or busy condition. Assuming that the line is found idle, the calling-plug $P^2$ is inserted in one of the multiple jacks of the line, which operates the cut-off relay of the line to prevent the line-signal from operating during the connection and to connect the switchboard-section of the line with the external line-circuit. Assuming that station A upon the line L is desired, the springs *a* of the ringing-key are operated, with the result that current from the ringing-generator 33 flows from ground-lead 37

through said generator, over conductor 38 to the tip-spring *a* of the ringing-key, thence over the tip side of the telephone-line, through the coils of the ringing device at station A and the condenser $c^4$, thence back to the central office over conductor 3, and through resistance 42 and conductor 4 through the battery $B^2$ to ground. The ringing-current in this path is of the proper frequency to operate the ringer 9, located at the station A, to call the wanted subscriber, while current from the battery $B^2$ finds a path through the cut-off relay R to ground to maintain the same operated during ringing. The bells located at the other stations of the party-line do not respond, for the reason that their reeds are not tuned to the frequency of the calling-current now impressed upon the line. In the specific arrangement shown the generator 33 generates current of the lowest frequency employed in ringing, and hence operates only the ringer, as at station A, which is provided with the largest ball or hammer. Generator 34 produces the next lowest frequency of current and is therefore adapted to ring the bell at station B when the key *b* is depressed. This current likewise does not affect the ringers at any of the other stations, so that they all remain silent. Machine 35 generates current of still higher frequency and generator 36 of the highest frequency employed in the particular systems described herein.

The reeds or tongues employed for the various ringers are shown in Fig. 8, and the only change required in any ringer to cause it to operate at the desired rate is to apply thereto the proper tongue. Thus the cost of manufacture, installation, and maintenance is reduced to a minimum.

For the most successful operation of a system of this type it is essential that the generators be actuated at practically constant speed. This is obtained in the machine of my system in the following manner: A resistance-coil 45 is included in the field-circuit of the motor 30. Upon the end of the shaft of the motor the governor shown in Fig. 4 is placed. This governor includes a rigidly-connected contact 46 and a weighted spring-contact 47, adapted to revolve with the said shaft and suitably connected with the commutator-rings 48 and 49. The brushes of these two rings are connected by conductors 50 and 51 upon each side of the resistance 45. The contact 47, as stated, is mounted upon a suitable spring, so that when the speed of the motor is slightly increased beyond the normal amount the said contact 47 is thrown out by centrifugal force and completes a shunt with contact 46 and conductors 50 and 51 around resistance 45. This resistance being cut out of the field-circuit of the motor causes the motor to decrease its speed in a manner well understood. Likewise should the speed of the motor fall below normal the contact is opened and the resistance 45 is thrown into the field-circuit, which causes the motor to increase the speed. The result of this continued making and breaking of the shunt-circuit at contacts 46 and 47 is to maintain the speed of the motor and generators practically constant.

Of course the motor, resistance, and governor must be properly proportioned to the work in hand. For example, if the power-circuit carries two hundred and twenty volts, as is usual in practice, and a variation of twenty volts in either direction is experienced a suitable working margin is obtained if the motor be designed to operate at nine hundred revolutions per minute when the voltage on the power-circuit rises to two hundred and forty with the resistance cut out and at eleven hundred revolutions when the voltage falls to two hundred and the resistance 45 is cut into the circuit. With this arrangement the governor, if properly adjusted, will maintain the speed of the motor constant at one thousand revolutions per minute. The construction of this governor is shown more clearly in Fig. 4, in which the contact 46 is seen to consist of an adjustable set-screw 46, carried in an arm 52, which is secured by suitable screws to the sleeve 53, mounted upon the reduced end 54 of the motor and generator-shaft. The contact 47 is formed of a spring provided with a weight 55 at its outer end and is likewise secured to the collar 53, but is insulated therefrom. The arm 52 and the spring 47 are suitably insulated from each other and the collar 53 and are connected, as by wires or conductors 56 and 57 and pins $56^a$ and $57^a$, with the commutator-rings 48 and 49. A balancing member 58 is secured to said collar 53 opposite said arm 52 and contact 47. It is thus seen that the centrifugal force when the shaft reaches a certain speed will cause the contacts 47 and 46 to engage, while a less speed will cause them to separate.

The generators are preferably two, four, six, and eight pole machines and rotated at one thousand, two thousand, three thousand, and four thousand cycles per minute, to which currents the bells at the substations respond. It will be understood that the bells might be designed to operate only at such rates that interference would be harmonically impossible; but this would probably require that the generators be operated at different speeds, which would involve the use of gearing of some sort between the motor and the several generators and would not be satisfactory in practice. I therefore prefer the arrangement shown and described, in which no interference is experienced in practice and by which a thoroughly-commercial system and apparatus is obtained. These ringing-currents are sufficiently close to the natural frequencies of the bell-tongues to start them vibrating when the said currents are first impressed upon the line.

In the system so far described only the me-

chanical tuning of the substation devices has been referred to, and this is all that is necessary for the successful operation of the system. It is apparent, however, that the bell branches at the substations may be electrically tuned and made resonant to the ringing-currents adapted to be impressed upon the line. As is well understood, this is accomplished by suitably proportioning the inductance and capacities of the branches in accordance with well-known electrical laws. One method of accomplishing this approximately is indicated in Fig. 6, in which the bell-coils are shown terminating at clips 60, mounted on the substation, set in any desired manner, the outer terminals of the coils being connected with the outer clips 60, while the inner terminals of the coils are cross-connected with the inner clips, as shown. The outer clips are connected with the corresponding line conductors 2 and 3, suitable condensers $c^4$ being included between the bell and one line conductor. At the stations at which the bells are operated by the lower-frequency ringing-currents the two inner clips are connected together by a short wire or jumper 62, so that the said coils are connected in series in the branches and the proper proportion of the retardation to the capacity of the condensers is thus secured for the ready passage of the low-frequency ringing-currents, to which the bells are responsive. At the other two stations, however, and at which the bells are operated by high-frequency ringing-currents, the jumpers 62 are connected between the adjacent outer and inner clips, so that the bell-coils are connected in parallel relation in the bridge of the line. The retardation is thus reduced and again the approximate resonant relationship between the capacity of the condensers and the retardation of the bell-coils is secured to permit the free passage of the high-frequency ringing-currents. It will be understood that while this is not an accurate method of attuning the bell branches it is a practical method of arriving at an approximate attuning with exceedingly simple apparatus. The electrical attuning of the branches may also be accomplished by means of varying the capacities inserted in the bell branches, as is indicated by the adjustable condensers $c^5$ in Fig. 7, or in any other desired manner, the greatest capacity being introduced into the circuit at stations A, which is called by the lowest-frequency current, while less capacity is introduced at the other stations, where the higher-frequency currents are employed. With this arrangement the proper proportion between the capacity of the condensers and the retardation of the bell-coils may be secured to adjust the bell branches to the ringing-currents. The combination of the methods of both Fig. 6 and Fig. 7 may, if preferred, be employed, as shown in Fig. 10.

Fig. 9 shows the practical arrangement of the substation outfit upon the party-line, the usual transmitter 63 and receiver 64 being employed, the latter normally supported upon the switch-hook 65. It is thus apparent that normally the bell branch includes the conductor 66, connected with the line-wire 2 and coils of the bell 9, the conductor 67 leading to switch-hook 65, conductor 68, and a condenser $c^4$ to the other side, 3, of the telephone-line. The ringing-current traverses this path when the subscriber is being called. When the subscriber takes his receiver off the hook, the bell branch is opened between the conductors 67 and 68 by the switch-hook, and a path for steady current from the central office through the transmitter 63 is provided through the upper contacts of the hook and the retardation-coil 69. The receiver 63 and the condenser $c^4$ are at this time connected in a parallel circuit with said retardation-coil 69, and the rapidly-varying voice-currents find a ready path through this parallel branch containing the receiver and condenser. The steady current is thus prevented from passing through the receiver-coils. I also prefer to arrange the contacts of the hook-switch so that if the switch-hook is depressed by hand to attract the attention of the operator during an established connection the connection will be established by the switch-hook with conductor 68, and the "extra current" will not cause a noise in the receiver. It is thus apparent that the condenser $c^4$ is used both for signaling and talking. Other substation circuit arrangements may be employed; but I prefer the one shown and described.

In the above system the ringing is wholly metallic—that is, without ground or common return; but the invention is readily applicable to systems of this latter type. For instance, with the same ringing-machine at the central office, as described, four positions could be rung between either line conductor and ground or common return, so that the line would accommodate eight parties instead of four. It is considered better practice, however, to employ only the metallic ringing, since a four-party service is all that is now required to meet the demands of ordinary usage, and grounds or similar connections are expensive to install and maintain.

I claim—

1. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a bell provided with a tuned reed-tongue at each substation, the operative rates of actuation of the bells being the natural rates of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, and means at the central office for impressing upon the line ringing-current of frequencies corresponding to such operative rates of actuation of the bells and sufficiently close to the natural rates of the tongues to start the same vibrating, substantially as described.

2. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a bell provided with a tuned reed-tongue at each substation, the operative rates of actuation of the bells being higher than the natural rates of vibration of the reed-tongues, and means at the central office for impressing upon the line ringing-current of frequencies corresponding to such operative rates of actuation of the bells and sufficiently close to the natural rates of the tongues to start the same vibrating, substantially as described.

3. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a polarized bell provided with a tuned reed-tongue at each substation, the operative rates of actuation of the bells being the natural rates of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, means at the central office for impressing upon the line alternating ringing-current of frequencies corresponding to such operative rates of the bells and sufficiently close to the natural rates of the tongues to start the same vibrating, substantially as described.

4. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a polarized bell provided with a tuned reed-tongue at each substation, the operative rates of actuation of the bells being higher than the natural rates of vibration of the reed-tongues, and means at the central office for impressing upon the line alternating ringing current of frequencies corresponding to such operative rates of actuation of the bells and sufficiently close to the natural rates of the tongues to start the same vibrating, substantially as described.

5. In a party-line telephone system, the combination with a metallic telephone-line, of a plurality of substations located on the line, bells provided with vibrating reed-tongues at the substations in branches of the line conductors whereby the resistance of the bells is removed from the line conductors, the operative rates of actuation of the bells being the natural rates of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, and means at the central office for impressing upon the line ringing-current of frequencies corresponding to such operative rates of actuation of the bells and sufficiently close to the natural rates of the tongues to start the same vibrating, substantially as described.

6. In a party-line telephone system, the combination with a metallic telephone-line, of a plurality of substations located on the line, a bell provided with a vibrating reed-tongue at each substation in a bridge of the line conductors, whereby the resistance of the bells is removed from the line conductors, the operative rates of actuation of the bells being the natural rates of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, and means at the central office for impressing upon the line ringing-current of frequencies corresponding to such operative rates of actuation of the bells and sufficiently close to the natural rates of the tongues to start the same vibrating, substantially as described.

7. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, bells provided with vibrating reed-tongues at the substations of the lines, the operative rates of actuation of the bells being the natural rates of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, a steady-current interrupter in the bell branches at the substations, a common source of continuous current connected with the line at the central office, said steady-current interrupters preventing the passage of current from said continuous source through the bell branches, and means at the central office for impressing upon the line ringing-current of different frequencies corresponding to such operative rates of actuation of the said bells to operate them to signal the subscribers, the frequency of said ringing-currents being sufficiently close to the natural rates of the tongues of the bells to start the same vibrating from a state of rest, substantially as described.

8. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, bells provided with vibrating reed-tongues at the substations in branches from the line conductors, each bell having a characteristic rate of actuation that is the natural rate of vibration of the reed as modified by the action of the gong, hammer and armature, a condenser in each bell branch at the several substations, a common source of current connected with the line at the central office for telephonic purposes, the said condensers preventing the passage of current from said source through the bell branches, subscribers' talking apparatus at each of the substations, said condenser being also employed with the said apparatus for talking purposes, and means at the central office for impressing upon the line ringing-current of the proper frequencies to operate said bells, substantially as described.

9. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a bell provided with a reed-tongue at each substation, the operative rate of actuation of the bell being the natural rate of vibration of the tongue as modified by the action of the gong of the bell in being struck, such operative rates being characteristic at each substation, a generating apparatus at the central office to

generate current of the proper frequencies to operate said bells upon the telephone-line, and means to maintain the speed of the generating apparatus constant to thereby permit the desired operation of the bells, substantially as described.

10. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a bell provided with a reed-tongue at each substation, the operative rate of actuation of the bells being characteristic thereto and being the natural rates of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, a generating apparatus at the central office consisting of a plurality of generators mounted upon a single shaft and rotated at constant speed, said generators being arranged to deliver currents of different frequencies corresponding to the said operative rates of the bell, substantially as described.

11. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a bell provided with a reed-tongue at each substation, the operative rate of actuation of the bells being the natural rate of vibration of the reed-tongue as modified by the action of the gongs of the bell in being struck, a generating apparatus at the central office consisting of an electric motor and a plurality of generators mounted upon a common shaft, a governor to maintain the speed of said motor and generators constant, said generators being arranged to deliver ringing-current to the line of frequencies corresponding to such operative rates of actuation of the bells, substantially as described.

12. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a polarized bell provided with a vibrating reed-tongue at each substation, the operative rate of actuation of the bells being the natural rate of vibration of the reed-tongues as modified by the action of the gongs of the bells in being struck, such operative rates being different at some of the substations from that at others, a ringing apparatus at the central office consisting of a plurality of alternating-current generators mounted upon a common shaft, means to operate said generators at constant speed, said generators having different numbers of poles so as to deliver alternating ringing-current to the line of frequencies corresponding to such operative rates of actuation of the bells, substantially as described.

13. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, bells provided with tuned reed-tongues at the substations in branches of the line conductors, each bell having a characteristic rate of actuation, means at the central office for impressing ringing-current upon the line of frequencies corresponding to such operative rates of actuation of the bells, and means including the coils of the bells for electrically attuning said bell branches to the ringing-currents of the associated bells, substantially as described.

14. In a party-line system, the combination with a telephone-line, of a plurality of substations located on the line, bells provided with tuned reed-tongues at the substations in branches of the line conductors, each bell having a characteristic rate of actuation, means for impressing ringing-current upon the line of frequencies corresponding to such operative rates of actuation of the bells, said bells having a plurality of coils, and means for variously connecting said coils in the said branches to vary the extent of retardation thereof to the passage of ringing-currents, substantially as described.

15. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, bells provided with tuned reed-tongues at the substations in branches of the line conductors, each bell having a characteristic rate of actuation, and means at the central office for impressing ringing-current upon the line of frequencies corresponding to such operative rates of actuation of the bells, said bells having two coils and means for readily connecting said coils in parallel or in series in said branches in order to vary the impedance thereof to the ringing-currents, substantially as described.

16. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, bells provided with tuned reed-tongues at the substation in branches of the line conductors, each bell having a characteristic rate of actuation, condensers in said branches, means at the central office for impressing ringing-current upon the line of frequencies corresponding to such operative rates of actuation of the bells, and means for adjusting both the capacities of the condensers and the retardation of the bell-coils in said branches, substantially as described.

17. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a calling-signal at each substation, an electromagnetic device also at each substation having a tuned reed to control the operation of the associated signal, the operative rates of actuation of the said devices being the natural rates of vibration of the reeds thereof as modified by the work of controlling such signals, and means at the central office for impressing upon the line ringing-current of frequencies corresponding to such operative rates of actuation of said devices and sufficiently close to the natural rates of the reeds to start the same vibrating from a condition of rest.

18. In a party-line telephone system, the

combination with a telephone-line, of a plurality of substations located on the line, a calling-signal at each substation, an electromagnetic device also at each substation having a tuned reed to cause the operation of the associated signal, the operative rates of actuation of the said devices being the natural rates of vibration of the reeds thereof as modified by the action of the objects against which such reeds strike in vibrating to cause the operation of the signals, and means at the central office for impressing upon the line ringing-current of frequencies corresponding to such operative rates of actuation of said devices and sufficiently close to the natural rates of the reeds to start the same vibrating from a condition of rest.

19. In a party-line telephone system, the combination with a telephone-line, of a plurality of substations located on the line, a calling-signal at each substation, an electromagnetic device also at each substation having a tuned reed to cause the operation of the corresponding signal when the reed is actuated, the operative rates of actuation of the said devices being different at the several substations and being also the natural rates of vibration of the reeds of such devices as modified by the action of the objects against which they strike when vibrating to cause the operation of the signals, and means at the central office for impressing upon the line ringing-currents of frequencies corresponding to such different operative rates of actuation of said devices, such ringing-currents being sufficiently close in their frequencies to the natural rates of vibration of the reeds to start the same vibrating from a condition of rest.

Signed by me at Chicago, county of Cook, State of Illinois, this 12th day of June, 1903.

WILLIAM W. DEAN.

Witnesses:

EVA A. GARLOCK,

ROBERT LEWIS AMES.