L. W. CARROLL.

ELECTRIC SIGNALING APPARATUS.

APPLICATION FILED JULY 16, 1906.

958,224.

Patented May 17, 1910.

3 SHEETS—SHEET 1.

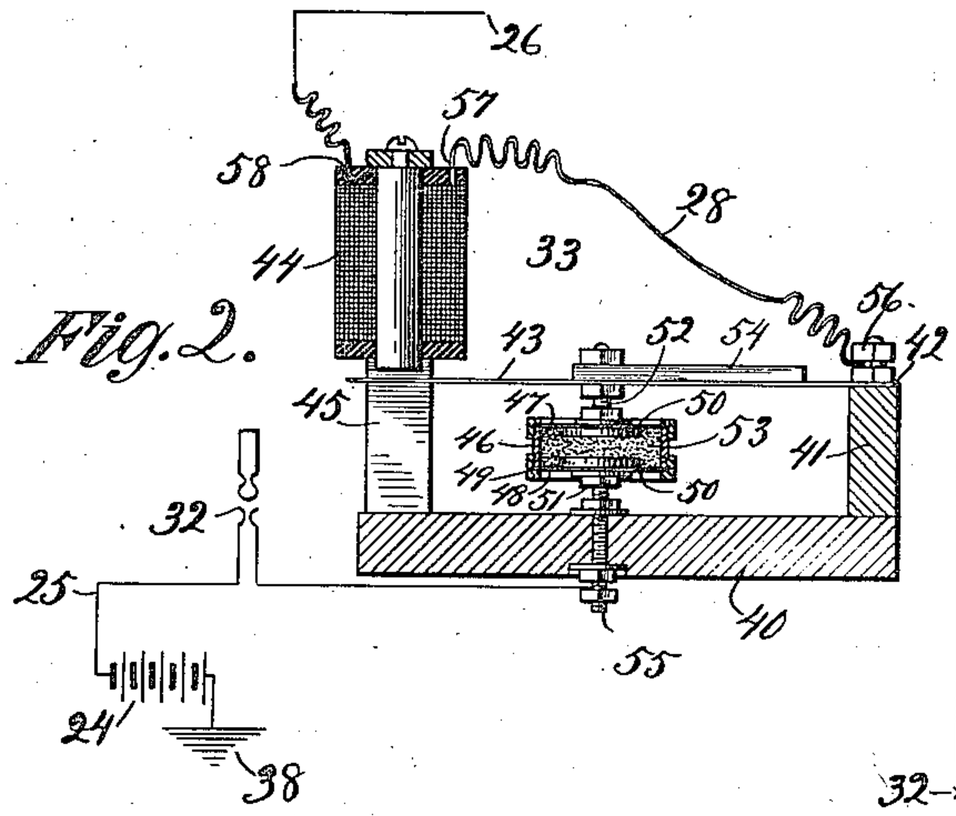


Fig. 2.

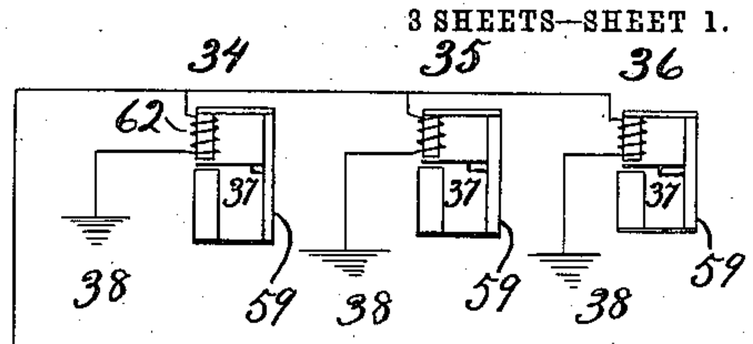


Fig. 1.

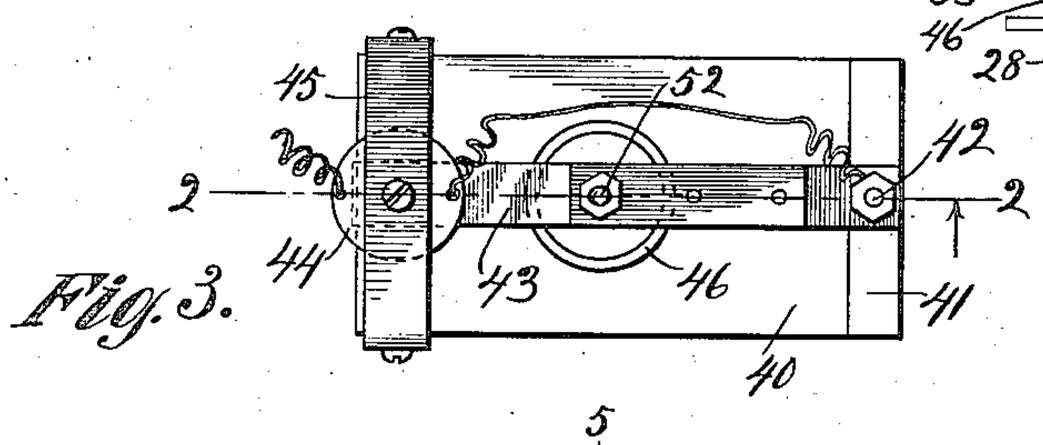
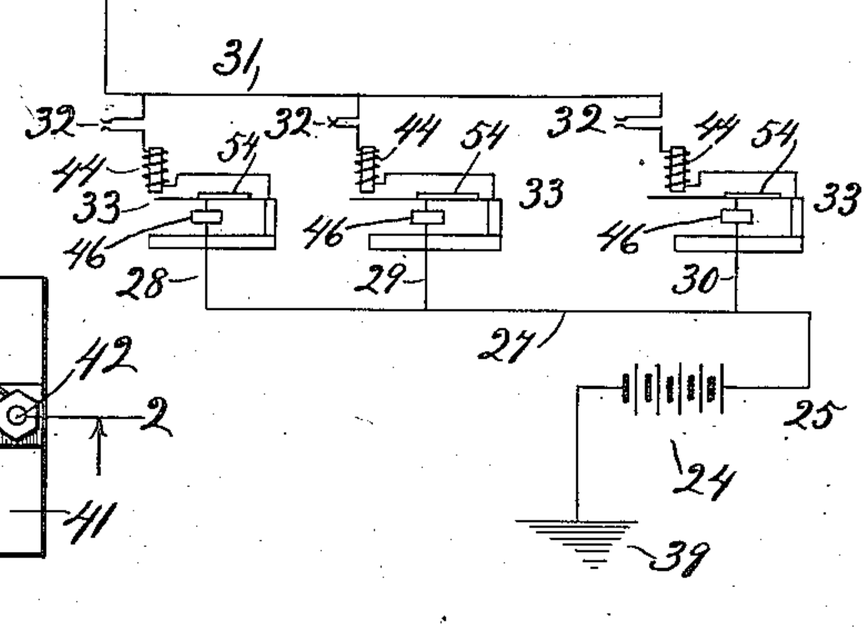


Fig. 3.



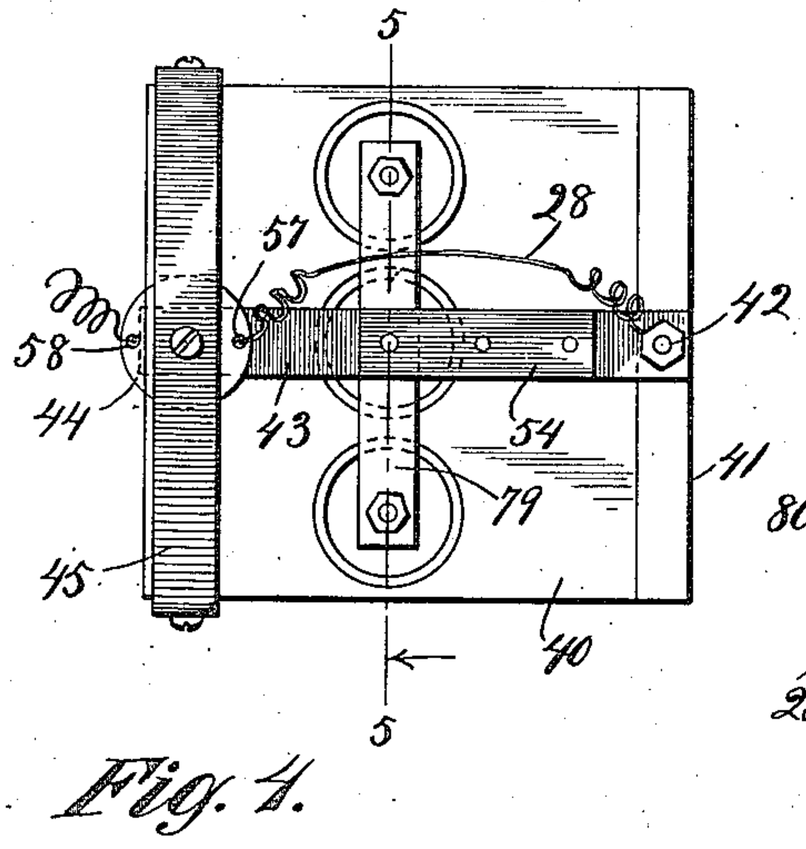


Fig. 4.

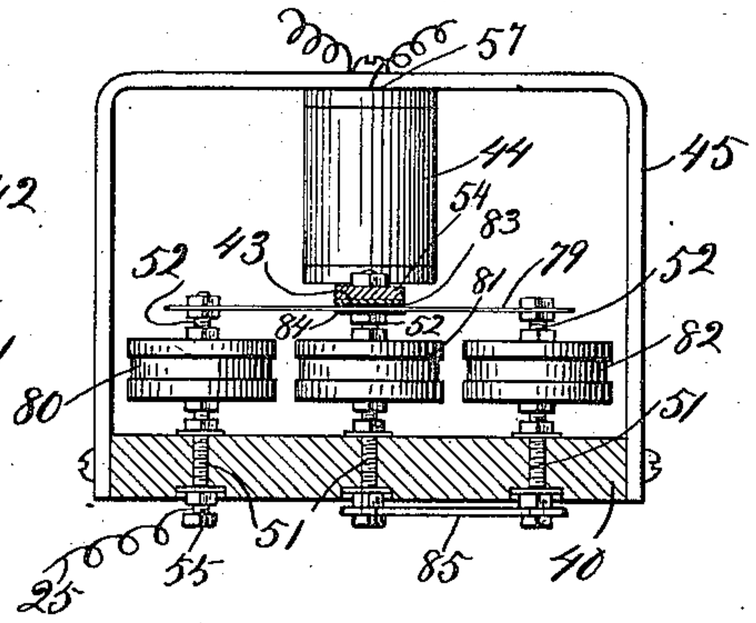


Fig. 5.

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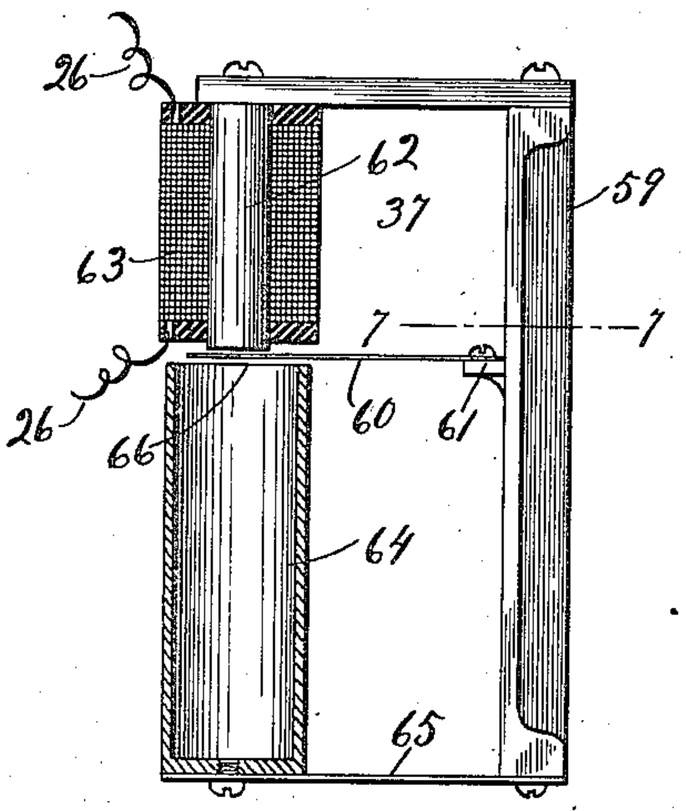

Fig. 6.

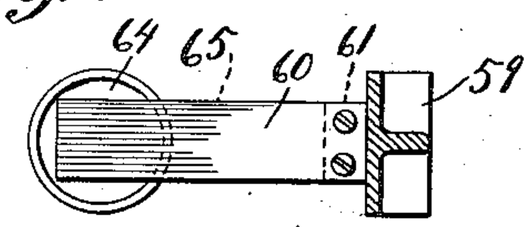

Fig. 7.

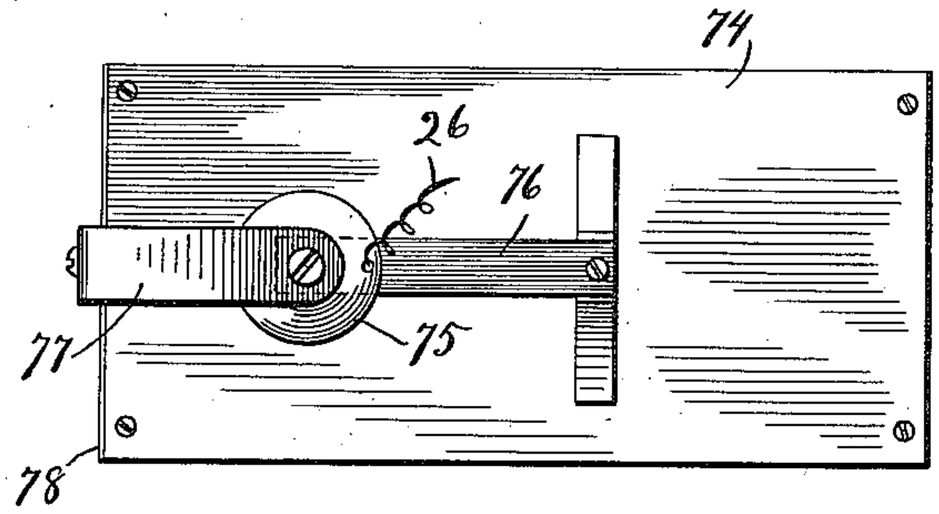

Fig. 8.

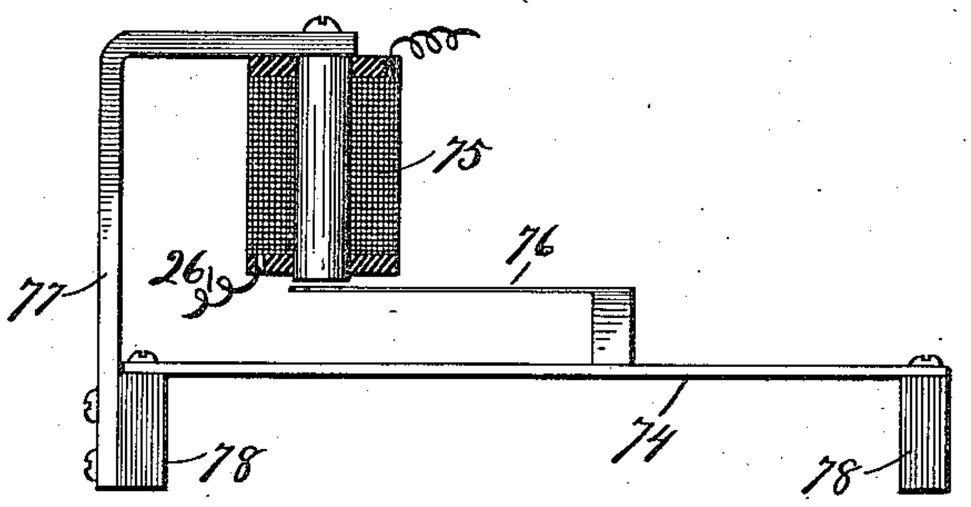

Fig. 9.

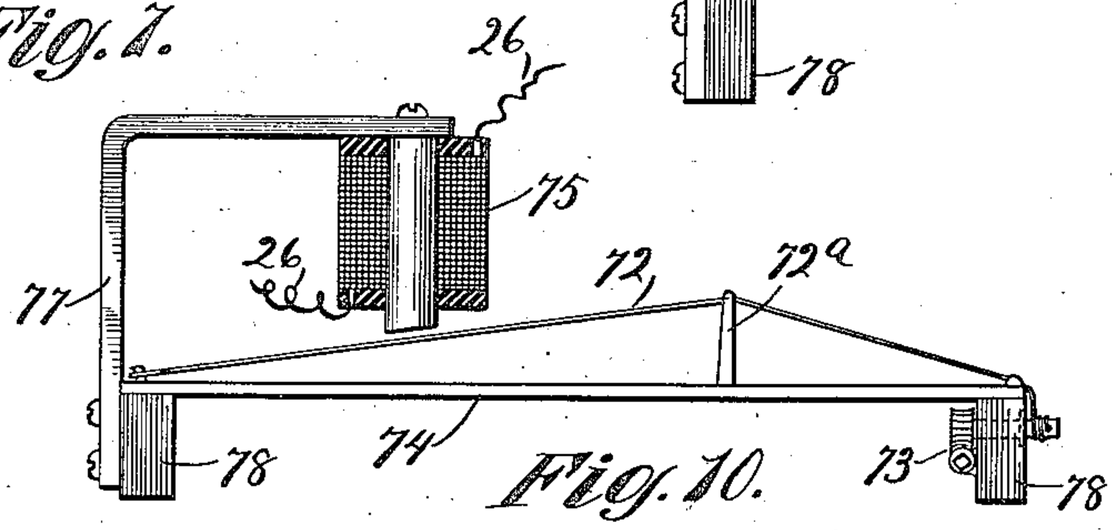

Fig. 10.

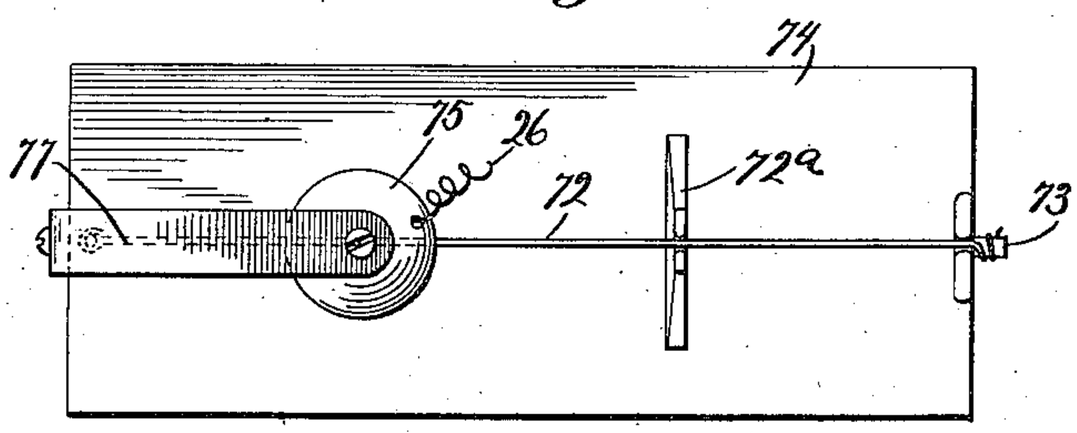

Fig. 11.

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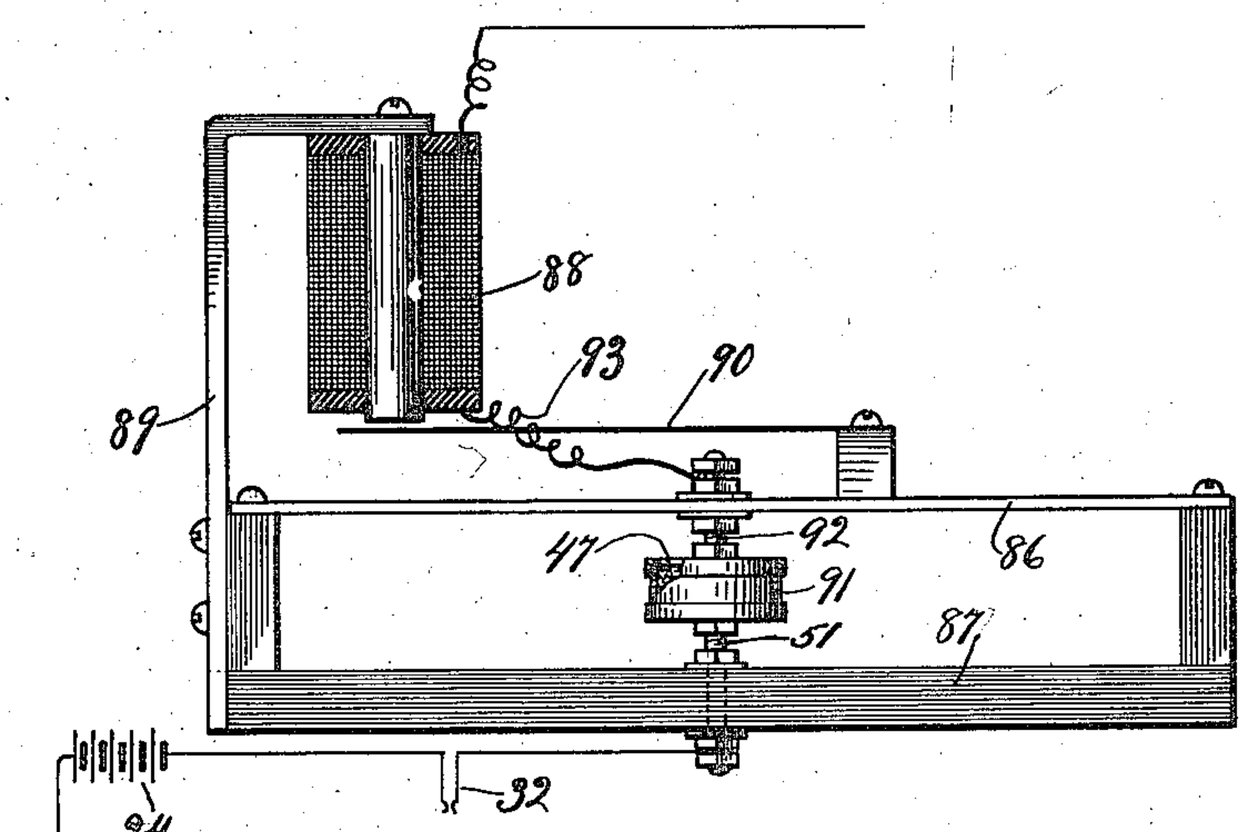

Fig. 12.

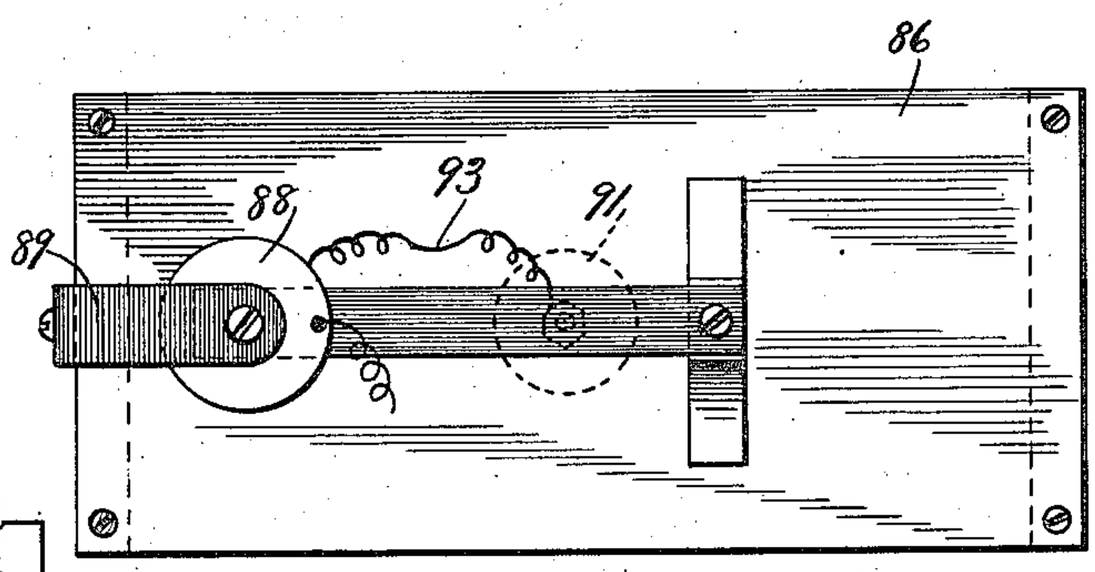

Fig. 13.

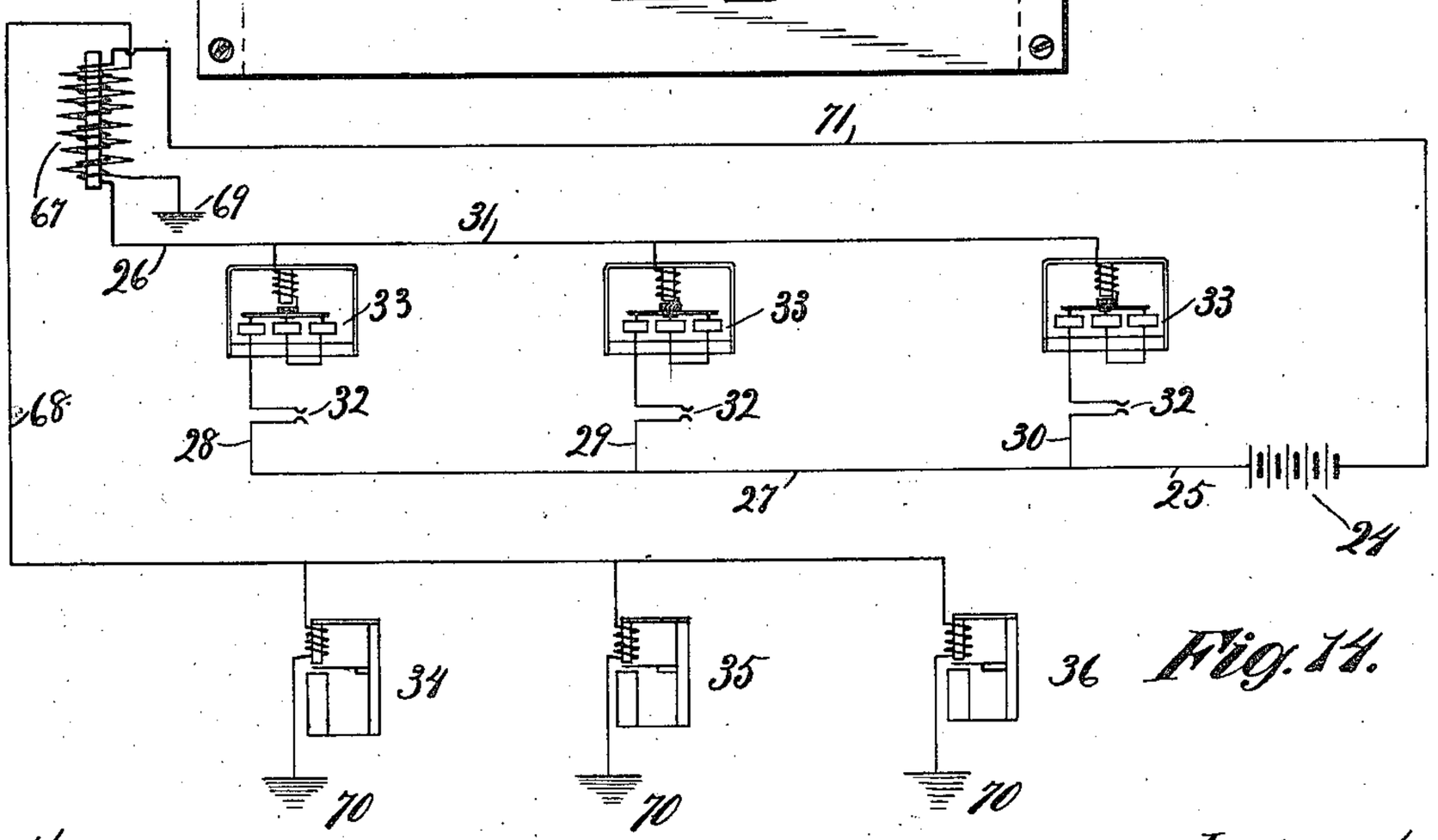

Fig. 14.

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UNITED STATES PATENT OFFICE.

LOUIS W. CARROLL, OF ANAMOSA, IOWA.

ELECTRIC SIGNALING APPARATUS.

958,224. Specification of Letters Patent. **Patented May 17, 1910.**

Application filed July 16, 1906. Serial No. 326,430.

To all whom it may concern:

Be it known that I, LOUIS W. CARROLL, a citizen of the United States, and resident of Anamosa, county of Jones, and State of Iowa, have invented certain new and useful Improvements in Electric Signaling Apparatus, of which the following is a specification, and which are illustrated in the accompanying drawings, forming a part thereof.

The invention relates to electric signaling, and contemplates apparatus particularly adapted for practicing what is commonly termed the selective method of signaling; that is, the calling of any one of a plurality of stations all served by a single signal line without giving any perceptible indication at any of the other stations upon the line that one of them is being called.

The invention has for its object to provide an improved electric signal, and especially to make it possible to signal any one of a large number of stations, all of which are upon the same electric circuit or line, by the selective method.

The apparatus provided by the invention will ordinarily be used in conjunction with the so-called party line telephone apparatus, and will then preferably include at each telephone station or instrument upon the line an electric signal comprising an acoustic vibratile body, such for example as the well-known tuning fork, that for each station upon the line having a different tone or period of vibration, and an electro-magnet for vibrating the acoustic body. At the central station there will then be provided means for sending over the line a pulsating or alternating electric current having a frequency equal to or in harmony with the period of vibration of the signal at any one of the line stations, and which therefore will actuate the signal at that particular station without appreciably affecting any of the others.

To increase the intensity of the signal there will usually be provided, at each of the line stations, some form of resonator, and this will most conveniently take the form of an open-ended tube or pipe, the mouth of which will be placed adjacent the vibratile body of the signal. This form of resonator may be tuned to respond only to the principal tone or any definite harmonic tone of the signal, and may serve, therefore, to increase the range of tone which may be practically produced by the signaling apparatus of the invention, while any vibrations produced in the signal to which it is applied, other than those of the tone to which the resonator is tuned, will not be rendered audible thereby.

In the preferred form of embodiment of the invention the apparatus at the central station for sending a pulsating or alternating electric current over the line includes some source of electric energy, as a storage battery, and a plurality of variable resistance devices each controlled by a vibratile body which is tuned in harmony with that of the signal at one of the line stations. The apparatus at the sending station also includes an electro-magnet for actuating each of the vibratile bodies at that station, and in order that the apparatus for signaling each station may be operated independently of those for signaling other stations, the electro-magnet and variable resistance device of each part of the sending apparatus are in a branch of the line circuit, and each of these circuit branches has a switch, normally open, but which may be closed to complete the line circuit through the particular branch which it controls.

In the accompanying drawings, Figure 1 is a diagrammatic illustration of one form of apparatus constructed according to the invention; Fig. 2 shows a detail of that part of the apparatus which will commonly be located at the central or sending station, some of the parts being shown in vertical section, as indicated by the line 2—2 of Fig. 3, and other parts being shown in diagram; Fig. 3 is a plan view of the parts shown in Fig. 2; Fig. 4 shows a modified form of sending apparatus; Fig. 5 is a vertical section on the line 5—5 of Fig. 4; Fig. 6 is a central vertical section of the preferred form of signal to be located at each of the line stations; Fig. 7 is a plan view on the line 7—7 of Fig. 6; Fig. 8 is a plan view of a modified form of signal; Fig. 9 is a side elevation, partly in section, of the same; Fig. 10 is a side elevation, partly in section, of a still further modified form of signal; Fig. 11 is a plan view of the same; Fig. 12 is similar to Fig. 2 but showing a modified form of sending apparatus; Fig. 13 is a plan view of certain parts shown in Fig. 12; and Fig. 14 illustrates in diagram a modified arrangement of the apparatus.

There is shown in Fig. 1 of the drawings a form of signaling apparatus comprising a central or sending station and three receiving stations, all upon the same line or electric circuit and any one of which may be called without indicating that fact at either of the others. That part of the apparatus which constitutes the central or sending station is shown at the lower portion of the figure, while the several line stations appear in the upper part of the figure.

The apparatus includes a suitable source of electric energy, such, for example, as the storage batteries indicated at 24, and from these a conducting wire 25 leads to the signal line 26, being divided at 27 into branches 28, 29, 30, one for each station to be called, and reuniting at 31. In each of the branches 28, 29, 30, there is a switch 32, shown as taking the form of the common telephone plug and socket, and by means of this switch the line circuit may be closed through the particular branch which it controls. There is also in each of the circuit branches a sending instrument 33, shown in detail in Figs. 2 and 3 of the drawings, and at each of the line stations, as 34, 35, 36, there is a signal 37, one form of which is clearly shown in Figs. 6 and 7. Each of the signals 37 is preferably "bridged" or "shunted" into the line circuit, as indicated at the upper portion of Fig. 1, and the current most conveniently returns to the sending station through the earth, grounded terminals being provided at 38 and 39 for that purpose.

For each of the sending instruments 33 there is preferably provided a base or standard 40 (Fig. 2), having, as shown, a yoke 45 from which is suspended an electro-magnet 44. For the armature of the magnet there is provided a vibratile body, such as the reed 43, and this is preferably secured to a vertical portion 41 of the base 40 by a bolt 42. The reeds 43 of the several instruments 33 have a different period of vibration or tone, this being preferably accomplished by making each of a different length, as clearly shown in Fig. 1.

A variable resistance device 46 is also mounted upon the base 40 of each of the sending instruments, and preferably this device is of that form in which an electric current is caused to traverse a quantity of granulated carbon, the resistance to the passage of the current being varied by causing the particles of carbon to become more or less compacted by pressure.

As shown the variable resistance device 46 comprises a tubular casing having its ends closed by diaphragms 47, 48, secured in place by means of threaded cap rings 49, and upon the inner face of each of the diaphragms there is a carbon disk 50. Each of the diaphragms 47, 48, is also provided with an outwardly extending threaded stem 51, 52, the lower one of which is secured to the base 40 and serves as a support for the device, while the upper one 52 connects with the reed 43. A quantity of granulated carbon 53 is inclosed within the variable resistance device between the two diaphragms 47, 48, and becomes more or less compacted by relative movement of the two diaphragms caused by the vibration of the reed 43.

In order that the connection between the threaded stem 52 of one of the diaphragms of the variable resistance device and the reed may not serve as a fulcrum as the latter vibrates, thus permitting the reed to buckle between this connection and its support, it is preferably made rigid for a portion of its length by the application thereto of a reinforcing plate 54. This reinforcing plate extends from the point of connection of the threaded stem 52 for a considerable distance toward the support 41, leaving a short section of the reed next adjacent the support free to flex as an elastic hinge when the reed is vibrated.

One of the branches, as 28, of the line circuit is caused to traverse the variable resistance device 46 and the electro-magnet 44 of each of the sending instruments, and as shown is connected with one of the threaded stems 51 of the variable resistance device at 55, with the reed (which has electrical connection with the other threaded stem 52 of the variable resistance device) at 56, and with the two terminals of the electro-magnet 44 at 57 and 58.

For the signal apparatus 37 at each of the line stations 34, 35, 36, there is provided a suitable base 59, preferably taking the form of a wall plate to be applied to the face of a telephone instrument. The apparatus of each of the signals comprises an acoustic vibratile body, as the reed 60, having one of its ends rigidly secured to the base 59 by a bolt 61 and an electro-magnet 62 carried by the base 59 in such position that one of its poles is adjacent the free end of the reed 60. Through the coils 63 of this electro-magnet the line circuit 26 is caused to pass, the magnets of the signals at the various stations being preferably connected to the line in a shunt or bridge.

In order to increase the intensity of the signal at each station, there is preferably provided for the reed 60 some form of resonator, and as shown in Figs. 1, 6 and 7 of the drawings this takes the form of an open-ended tube 64, carried, by a bracket-arm 65 of the base 59, in such a position that its mouth 66 is adjacent the free end of the reed 60. This resonator may be of the proper size to respond to the principal tone or any harmonic tone of the reed 60 when vibrated, and magnifies the sound of the vibrating reed to produce a signal of considerable intensity.

In practice, if the device is to be used in conjunction with telephone apparatus, the storage batteries 24 or other generator, the sending instruments 33 and the switches 32 will be located in any convenient position at the telephone central station, the switches 32 preferably forming a part of the operating switch board, not shown, of the telephone system, while the signal line 26 and the several signals 37 will be incorporated with the telephone line and its various instruments. When not in use the circuit will be open at each of the switches 32, and whenever a given station is to be called the switch of the branch of the circuit 28, 29 or 30 having a sending instrument 33, the vibratile body 43 of which is tuned in harmony with the vibratile body 60 of the station to be called, will be closed, thereby completing the circuit through that branch and its sending instrument.

The flow of current from the storage batteries 24 vitalizes the magnet 44 of the sending instrument and the magnets 62 of all of the receiving instruments, causing them to attract the vibratile reeds 43 and 60, respectively. The raising of the reed 43 raises the diaphragm 47 of the variable resistance device 46 and increases the resistance to the flow of current by reducing the pressure upon the quantity of granulated carbon 53 contained therein. This weakens the flow of current through the line, permitting the vibratile reeds 43 and 60, owing to their elasticity, to fall away from the magnets of the sending and receiving stations. The lowering of the reed 43 immediately diminishes the resistance to the flow of current by means of the increased pressure upon the upper diaphragm of the variable resistance device, and the magnets are again sufficiently vitalized to attract the reeds 43 and 60 which they control. In this way a rapid vibration of the reed 43 is produced and a corresponding vibration is also produced in the reed 60 of that one of the signals 37 which is of the proper tone to vibrate with it, the others, being incapable of vibrating at the same rate, are but little affected.

The vibration of the reed 60 of the receiving instrument or signal 37 is immediately communicated to the column of air contained within the resonator tube 64, and a signal in the form of a roar or whistle is thereby produced, the tone being of a pitch determined by the rate of vibration of the reed, the range being preferably comparable with that of the pianoforte scale.

The operation of each of the sending instruments 33 and the corresponding signal 37 is entirely independent of all of the others, and such a set of instruments may be used alone in an electric circuit, if desired, while each of the sending instruments 33 necessarily vibrates whenever the electric circuit through it is closed, and this part may of itself be used as a signal without other apparatus.

In the apparatus as so far described a pulsating current, composed of a series of rapidly succeeding impulses of current of greater or less strength but always of the same direction, traverses the circuit whenever a signal is in operation. An alternating current having the same frequency of vibration as the pulsating current produced by the sending instruments 33 may be caused to flow through the line of the receiving instruments by the use of an induction coil, diagrammatically indicated at 67, Fig. 14. The line circuit 68 then constitutes the secondary circuit of the induction coil and is preferably provided with ground terminals 69 and 70, while the circuit 26 including the storage batteries 24 and the sending instruments 33 constitutes the primary circuit of the induction coil, a return wire 71, leading to the batteries, being preferably substituted for the ground terminals 38, 39 of Fig. 1.

Other forms of vibratile bodies capable of vibrating at a sufficient rate to produce musical tones may be employed in the apparatus, and in Figs. 10 and 11 of the drawings there is illustrated a receiving instrument or signal having a metallic string or cord 72, stretched over a bridge 72[a] by means of a tuning key 73. A resonator in the form of a sounding board 74 is preferably incorporated with this form of receiving signal, and the same form of resonator may be employed in connection with a signal comprising a vibratile reed 76, as shown in Fig. 9. When a sounding board is employed, as a resonator, an electro-magnet 75 is supported over the board to actuate the vibratile body of the signal, and is carried by a bracket-arm 77 rising from one of a pair of suitable standards 78, which also support the sounding board.

It may be desirable in some instances to incorporate in a single sending instrument 33 a plurality of variable resistance devices of the form shown in Figs. 2 and 3, all of which may be simultaneously actuated from the vibratile reed 43 of the instrument. A sending instrument of this form is illustrated in Figs. 4 and 5, and in Fig. 14 of the drawings. Though more desirable than a sending instrument having but a single variable resistance device, it is not essential to the operation of the form of apparatus including the induction coil 67 shown in Fig. 14, and has been added to that figure merely for the purpose of illustration. In this form of sending instrument, as shown, the vibratile reed 43 is provided with a cross-arm 79, and a plurality of variable resistance devices 80, 81 and 82 are mounted upon the base 40 of the instrument imme-

diately below the cross-arm, the upper threaded stem 52 of these devices being directly connected thereto. The electric current is then led to the instrument through the wire 25 connected to the stem 51 of one of the variable resistance devices at 55, and is caused to traverse the several devices in series, as most clearly shown in Fig. 5, being led from that one at the left as viewed in that figure to the one at the extreme right, through the cross-arm 79 which is insulated from the stem 52 of the variable resistance device 81 and from the reed 43 by means of washers 83, 84 of non-conducting material, and passes from the stem 51 of the variable resistance device 82 to the corresponding stem of the variable resistance device 81 through a suitable connection 85 and through that device to the reed 43, as in the form of construction illustrated in Figs. 2 and 3.

In Figs. 12 and 13 there is illustrated a form of sending instrument having a resonator 86 in the form of a sounding board. This resonator is supported by suitable standards from a base 87, and an electro-magnet 88 is carried by a bracket-arm 89 rising from the same base and occupies a proper position over the sounding board for actuating a vibratile reed 90, mounted on the board. A variable resistance device 91 of the form illustrated in Figs. 2 and 3, is mounted on the base below the board. It is mechanically connected to the sounding board by means of a bolt 92 rising from one of its diaphragms, as 47, and is electrically connected to the magnet 88 by means of a conducting wire 93 leading from the bolt 92 to the magnet. In this form of instrument the operation of the variable resistance device is directly effected by the vibration of the sounding board rather than by that of the vibratile reed, while the sounding board serves further as a resonator to intensify the sound of the vibratile reed, and the instrument therefore is of a desirable form for use as a signal without other apparatus.

As a single electric wire is capable of simultaneously transmitting currents having different periods of vibration or phases, more than one of the signals 37 may be simultaneously operated by closing the switch 32 of more than one of the branches 28, 29, 30 at the same time. The apparatus is therefore capable of use for the purpose of sending a plurality of signals of different character over a single line at one time.

The apparatus may also be used as a musical instrument.

I claim as my invention—

1. In combination with an electric circuit having a generator, a variable resistance device, and a transmitting and a receiving electro-magnet, a tuned vibratile armature for the transmitting electro-magnet operatively connected to the variable resistance device, and a vibratile armature for the receiving electro-magnet tuned in harmony with the first-named armature.

2. In combination with an electric circuit having a generator, a variable resistance device, and a transmitting and a receiving electro-magnet, a tuned vibratile armature for the transmitting electro-magnet operatively connected to the variable resistance device, a vibratile armature for the receiving electro-magnet tuned in harmony with the first-named armature, and a resonator for the second-named armature.

3. In combination, a generator, a transmitting and a receiving electro-magnet served by the generator, a variable resistance device in circuit with the coils of the transmitting electro-magnet, a tuned vibratile armature for the transmitting electro-magnet operatively connected to the variable resistance device, and a vibratile armature for the receiving electro-magnet tuned in harmony with the first-named armature.

4. In combination, a generator, a plurality of transmitting and receiving electro-magnets served by the generator, a variable resistance device in circuit with the coils of each of the transmitting electro-magnets, a tuned vibratile armature for each of the transmitting electro-magnets operatively connected to the variable resistance device in circuit with the coils of such magnet, the armatures being of differing pitch, and a vibratile armature for each of the receiving electro-magnets, each one of such armatures being tuned in harmony with a separate one of the armatures of the transmitting electro-magnets.

5. In combination, a primary electric circuit having a generator, a variable resistance device, and an electro-magnet, a tuned vibratile armature for the electro-magnet operatively connected with the variable resistance device, a secondary circuit having an electro-magnet, and a vibratile armature for the last-named electro-magnet tuned in harmony with the first-named armature.

6. In combination, a primary electric circuit having a generator, a variable resistance device, and an electro-magnet, a tuned vibratile armature for the electro-magnet operatively connected with the variable resistance device, a secondary circuit having an electro-magnet, a vibratile armature for the electro-magnet of the secondary circuit tuned in harmony with the first-named armature, and a resonator for the second-named armature.

7. In combination, a primary electric circuit having a generator and a plurality of parallel branches, an electro-magnet, a switch and a variable resistance device in each of the branches, a tuned vibratile armature for the electro-magnet of each of the branches of the circuit operatively connected

with the variable resistance device of the same branch of the circuit, the pitch of each of the armatures being different from that of all of the others, a secondary electric circuit having a plurality of electro-magnets, and a vibratile armature for each of the electro-magnets of the secondary circuit, each of such armatures being tuned in harmony with one of the first-named armatures.

8. In combination, a primary electric circuit having a generator and a plurality of parallel branches, an electro-magnet, a switch and a variable resistance device in each of the branches, a tuned vibratile armature for the electro-magnet of each of the branches of the circuit operatively connected with the variable resistance device of the same branch of the circuit, the pitch of each of the armatures being different from that of all of the others, a secondary electric circuit having a plurality of electro-magnets, a vibratile armature for each of the electro-magnets of the secondary circuit, each of such armatures being tuned in harmony with one of the first-named armatures, and a resonator for each of the second-named armatures.

9. In combination, a fixed support, a tuned vibratile reed having an elastic hinged connection with the fixed support and a rigid body portion, an electric variable resistance device, operative connection between the variable resistance device and a rigid portion of the vibratile reed, an electro-magnet acting upon the reed, and electrical connection between the coils of the electro-magnet and the variable resistance device.

10. In combination, a fixed support, a tuned vibratile reed having an elastic hinged connection with the fixed support and a rigid body portion, an electric variable resistance device comprising a movable diaphragm connected by a bolt to a rigid portion of the vibratile reed, an electro-magnet acting upon the reed, and electrical connection between the coils of the electro-magnet and the variable resistance device.

11. In combination, a tuned vibratile body of magnetizable material, a plurality of electric variable resistance devices, operative connection between the vibratile body and each of the variable resistance devices, an electro-magnet acting upon the vibratile body, and electrical connection between the coils of the electro-magnet and all of the variable resistance devices.

12. In combination, a tuned vibratile body of magnetizable material, a plurality of electric variable resistance devices each comprising a movable diaphragm having operative connection with the vibratile body, an electro-magnet acting upon the vibratile body, and electrical connection between the coils of the electro-magnet and all of the variable resistance devices.

13. In combination, an electric circuit having a generator, an electro-magnet and a variable resistance device comprising a movable diaphragm, and a tuned vibratile armature for the electro-magnet operatively connected to the movable diaphragm of the variable resistance device.

14. In combination, an electric circuit having a generator, an electro-magnet and a plurality of variable resistance devices each comprising a movable diaphragm, and a tuned vibratile armature for the electro-magnet having a cross-arm connected by a bolt to the movable diaphragm of each of the variable resistance devices.

15. In combination, a fixed support, a tuned vibratile reed having an elastic hinged connection with the fixed support and a rigid body portion, a cross-arm on the rigid body portion of the reed, a plurality of electric variable resistance devices each comprising a movable diaphragm connected by a bolt to the cross-arm of the reed, an electro-magnet acting upon the reed, and electrical connection between the coils of the electro-magnet and all of the variable resistance devices.

16. In combination, a generator, a plurality of transmitting and receiving electro-magnets served by the generator, a variable resistance device and a switch in circuit with the coils of each of the transmitting electro-magnets, a tuned vibratile armature for each of the transmitting electro-magnets operatively connected to the variable resistance device in circuit with the coils of such magnets, the armatures being of differing pitch, and a vibratile armature for each of the receiving electro-magnets, each one of such armatures being tuned in harmony with a separate one of the armatures of the transmitting electro-magnets.

17. In combination, a generator, a plurality of variable resistance devices, a transmitting electro-magnet served from the generator having its coils in circuit with each of the variable resistance devices, a plurality of tuned vibratile transmitting electro-magnet armatures of differing pitch, operative connection between each of such armatures and one of the variable resistance devices, a receiving electro-magnet served from the generator through the coils of the transmitting electro-magnet, and a plurality of receiving electro-magnet armatures, each one of such armatures being tuned in harmony with a separate one of the transmitting electro-magnet armatures.

18. In combination, a branching electric circuit having a generator and an electro-magnet, a plurality of variable resistance devices each in a branch of the circuit, a plurality of tuned vibratile electro-magnet

armatures of differing pitch, and operative connection between each of such armatures and one of the variable resistance devices.

19. In combination, a branching electric circuit having a generator and an electro-magnet, a plurality of variable resistance devices each in a branch of the circuit and each comprising a movable diaphragm, a plurality of tuned vibratile electro-magnet armatures of differing pitch, and operative connection between each of such armatures and the diaphragm of one of the variable resistance devices.

20. In combination, an electric circuit having a generator, an electro-magnet and a variable resistance device comprising a fixed and a movable diaphragm, and a vibratile armature for the electro-magnet operatively connected to the movable diaphragm of the variable resistance device.

21. In combination, a generator, a plurality of variable resistance devices, a plurality of switches, an electro-magnet served from the generator and having its coils in circuit with each of the variable resistance devices and one of the switches, a plurality of tuned vibratile electro-magnet armatures of differing pitch, and operative connection between each one of such armatures and a separate one of the variable resistance devices.

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Witnesses:
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LOUIS K. GILLSON.