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SIGNALING SYSTEM

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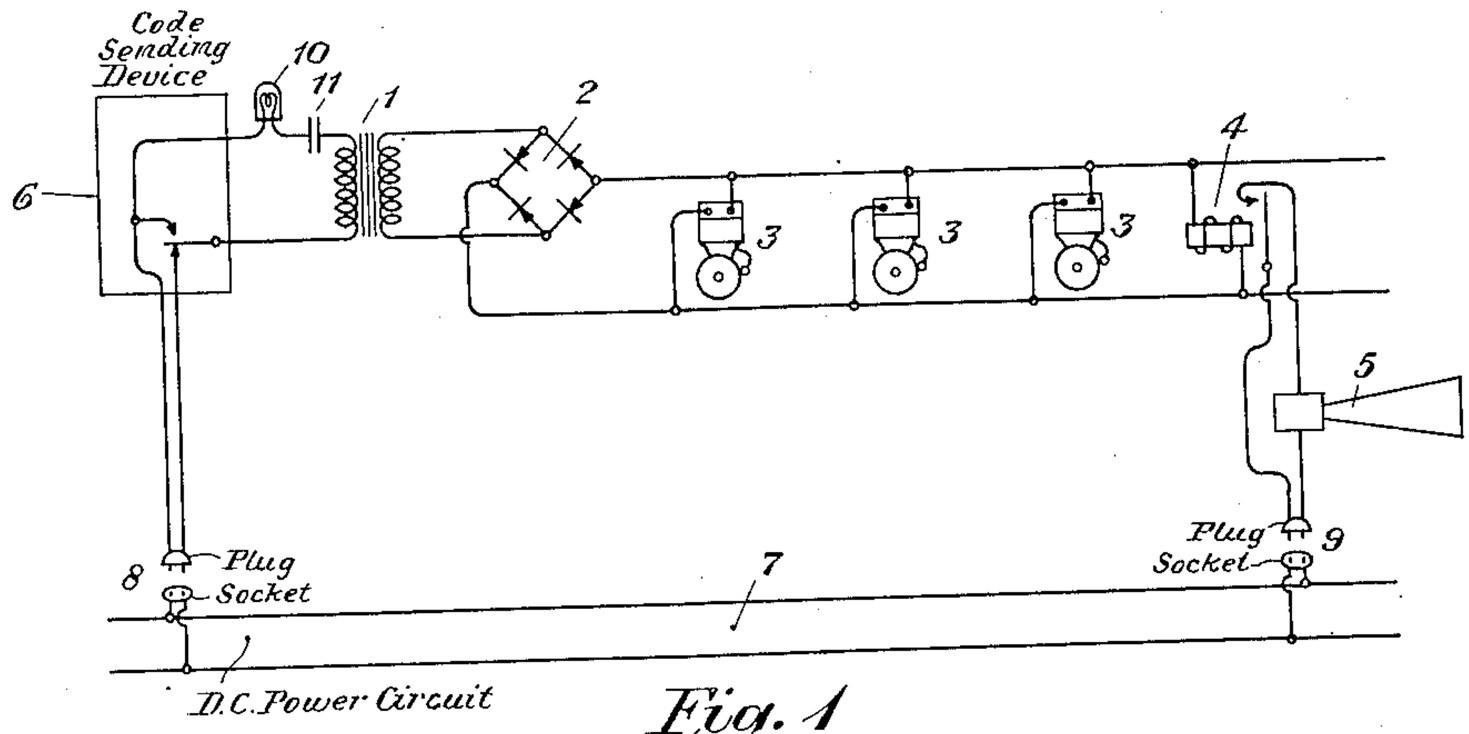

Fig. 1

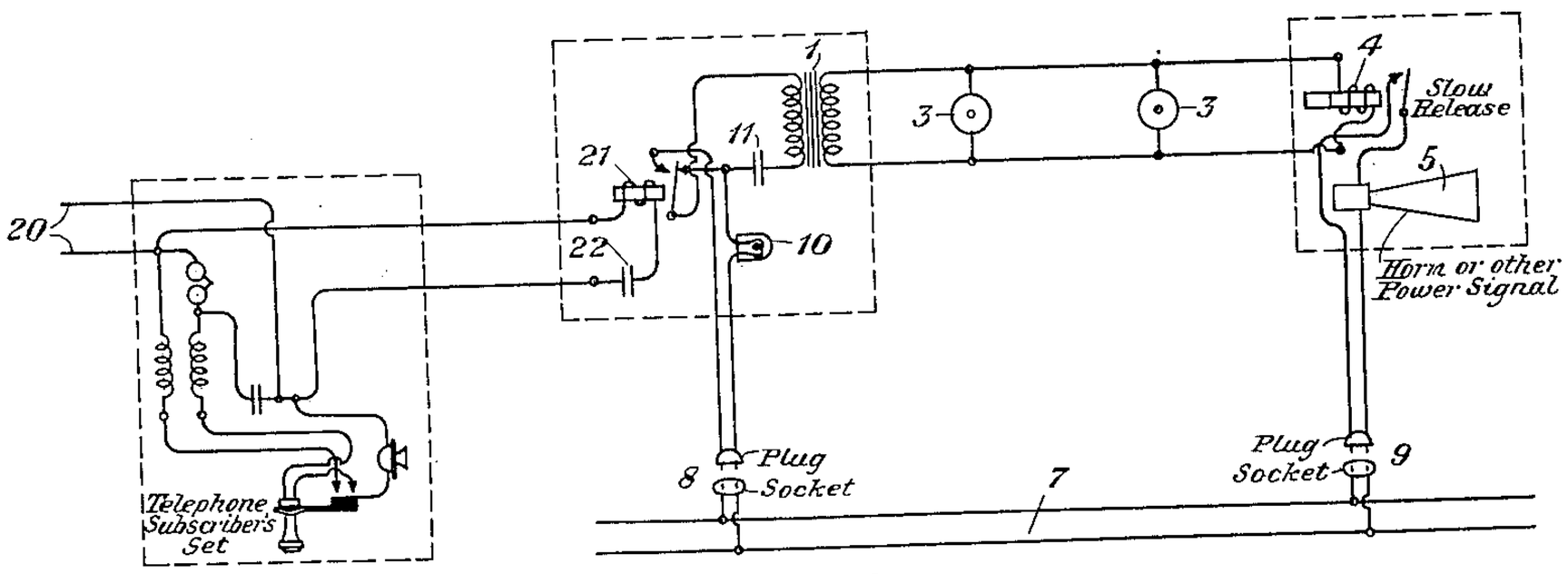

Fig. 2

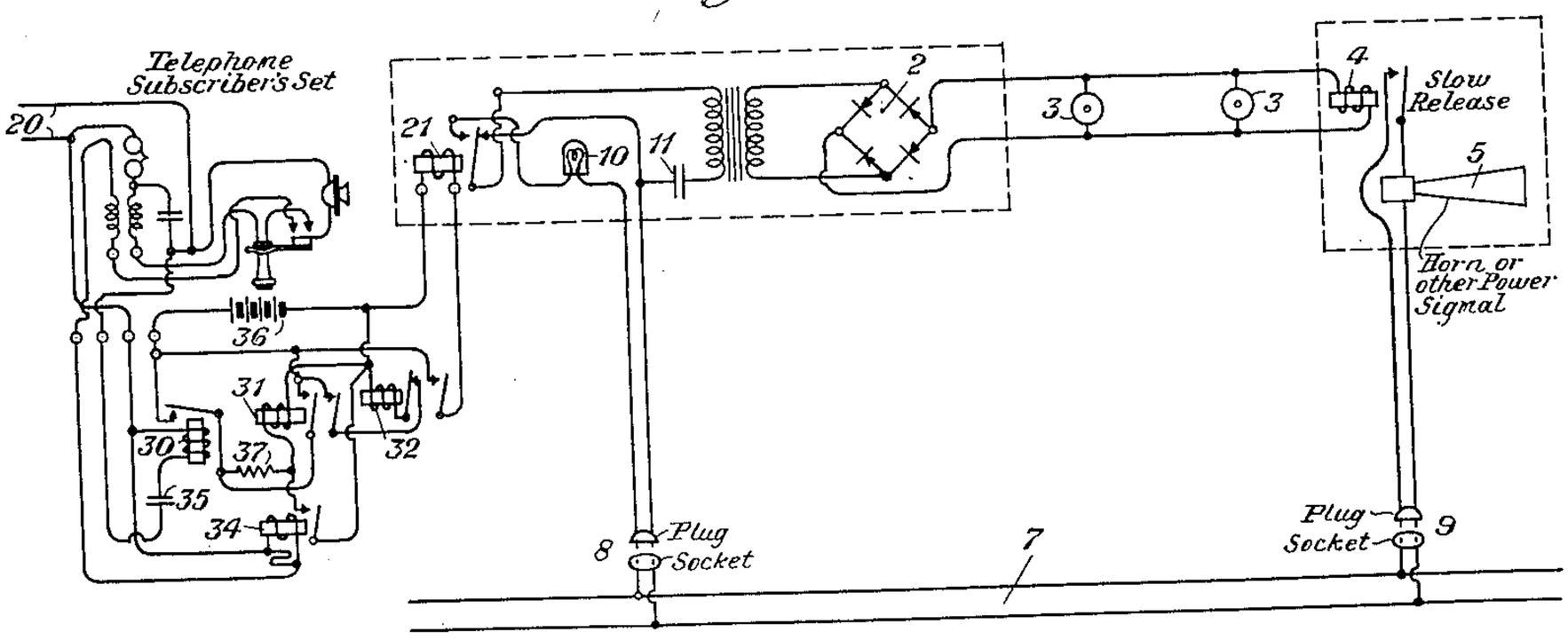

Fig. 3

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SIGNALING SYSTEM

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7 Claims. (Cl. 177—7)

This invention relates to signaling systems. More particularly this invention discloses an improved code-calling system of the type which may be used for simultaneously operating signaling devices at a plurality of locations in accordance with selected codes without requiring the use of power wiring. It also discloses an improved auxiliary signaling system for producing signals over signaling conductors in conjunction with telephone calls.

A code calling system of the type involved in this invention may find application in large organizations where certain officials or employees whose business carries them to all parts of the plant are wanted from time to time at headquarters or on the telephone, and whose whereabouts in the plant at any particular instant may be unknown. In such cases it would involve much loss of time if an individual search for the person wanted were made, and this would react detrimentally upon the efficiency of the organization.

One arrangement for locating an individual quickly involves the placement of a plurality of electrically operated gongs or other signaling apparatus at various points about the plant, and causing these gongs or other apparatus to be operated in accordance with a predetermined code when a certain person is desired. A different code may, of course, be assigned to each person likely to be wanted. As a general matter it will be found most convenient to have the control apparatus for ringing the various gongs located near or at the local switchboard which serves the organization. The local switchboard operator, when informed of the person desired, will cause the proper code to be rung. Upon hearing his signal, the individual wanted will step to the nearest phone and inform the operator of his whereabouts and he may, if desired, be placed in communication with the party wanting him.

Electrically operated code sounding devices and systems are well-known in the art which, upon depression of a selected one of a plurality of keys or upon the insertion of a plug in a certain jack, will cause a sound device or a plurality of such devices, i. e., one or more gongs or other signaling apparatus, to be operated in accordance with a desired code. The code calling systems known to the art in general require considerable power for the operation of these various sounding devices, and hence these devices are often operated from the usual 110 volt lighting and power supply where this is available. Such a system has the disadvantage that it requires a considerable amount of power wiring and the wiring must be run in flexible armored cable or conduit in order to satisfactorily meet the requirements for fire protection. Sounding devices may, of course, be designed to operate from a low voltage supply which utilize the same amount of power for operation as the higher voltage devices. However, the use of such devices would not reduce the wiring cost because the proportionally greater current would continue the fire hazard and also require an expensive wiring installation.

It will be seen from the above explanation of the purpose of the code calling system involved in this invention that it will be utilized as an adjunct of the local telephone system. Thus it will be desirable from the standpoints of installation and maintenance to have a code calling system which will operate satisfactorily and produce signals distinctly even with the greatest amount of power wiring, the system being operated from a power supply comparable with that ordinarily utilized by telephone equipment. Any system meeting the requirements set forth hereinabove will permit a considerable saving in the cost of installation, due to the fact that the circuits could be run in the usual type of telephone or annunciator wiring, such circuits being known as low voltage circuits.

This application discloses a code calling system meeting the requirements set forth hereinabove, one of the essential features of which is the sensitive low voltage sounding device which requires a relatively small amount of power and furnishes signals sufficiently loud for the purpose intended. The system can, therefore, be installed with the usual type of telephone or annunciator wiring. Another of the essential features lies in the use of a power source of direct current, and this feature involves the provision of means for insulating the source of direct current from the signaling circuit. These and other features of the invention will be better understood from the description hereinafter following.

In Figure 1 of my copending application, Serial No. 286,017, filed June 16, 1928, which has since issued as Patent No. 1,976,660, dated October 9, 1934, an alternating current of comparatively high voltage is interrupted at intervals, stepped down in voltage, rectified and then impressed upon a plurality of gongs to cause their operation. In the present application the source of alternating current is replaced by a source of direct current which may be of equally high

voltage, the output of which may be transmitted and similarly interrupted. The interrupted current may then be converted into an alternating current wave, stepped down in voltage if so desired, rectified, and similarly impressed upon a plurality of gongs for their operation. The current which is interrupted in the invention involved in the present application is impressed upon a transformer which, in effect, converts the interrupted direct current into alternating current.

This invention will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing, in which Fig. 1 represents a code-calling device embodying the principles of this invention, Fig. 2 shows a circuit adapted to operate gongs or other audible devices in response to the impression of ringing current at a telephone subscriber's set, and Fig. 3 shows an arrangement for maintaining the gongs or other audible devices operated until the subscriber answers the call.

Referring now to Fig. 1 of the drawing, it will be seen that a code-calling device 6 is connected to the usual direct current power and lighting circuit or line 7 by means of a plug and socket 8, as indicated. The output of the code-sending device is connected to the primary winding of a transformer 1 through a lamp 10 which may have a tungsten filament and a condenser 11, preferably having a high capacity. The transformer 1 may have fewer turns on its secondary winding than on its primary for the purpose of stepping down any alternating potentials impressed on its primary winding, although it may be desirable to use a unity ratio transformer, or a transformer of any other ratio.

The secondary winding of transformer 1 is connected to a rectifier indicated by the reference character 2. This rectifier may be of any well known type, but it is preferably a full wave rectifier of the recently developed copper oxide type. The output terminals of the rectifier are connected to a plurality of sensitive single-stroke gongs 3 which may be connected in parallel relationship as shown. These gongs of course, may be placed at suitable locations throughout a plant or building. Each of these gongs may be of the type shown in Fig. 2 of the copending application just mentioned.

When the key of the code-sending device 6 is operated, the condenser 11 may become charged to the voltage of the line or circuit. Upon the depression of this key the flux in the core of transformer 1 is built up and then it dies down and soon there is no flux. During the building up process, current will flow in the secondary winding of transformer 1 in one direction. When the flux in the core of this transformer is at a maximum the current in the secondary winding will be reduced to zero. When the flux decreases, the current in the secondary will build up in the opposite direction. When the flux is a minimum or zero, the current in the secondary will be a minimum or zero.

When the key is released, the condenser 11 will discharge in a circuit which includes the primary winding of transformer 1, the key of the code-sending device 6 and its back contact, and the lamp 10. Upon the release of the key the current in the primary winding increases to a maximum and then dies down and subsequently becomes zero. Again, during the building-up process the current flows through the secondary winding of transformer 1 in one direction and this current is reduced to zero when the flux in the core of the transformer becomes a maximum. When the flux decreases, the current in the secondary will build up in the opposite direction and will become zero when the flux is practically negligible.

In the circuit of the secondary winding of transformer 1 there will be one complete alternating current wave for each closure of the key and another similar wave displaced 180 degrees in phase upon the opening of the key. Thus, there will be two complete alternating current waves for each closure and opening of the key. The full wave rectifier 2 converts these two alternating current waves into four pulses of direct current and, due to the filtering action of the rectifier and due to the presence of inductance in the signaling circuit, the resultant will be a wave representing a slightly varying direct current. Each of the gongs 3 sounds and operates but once during the period in which the key is closed and subsequently opened. This is so because the varying direct current flows in but one direction. Thus, each gong remains operated practically throughout the period during which the key is closed and opened.

In case it is desired to operate very loud gongs, horns, or other signaling devices which may require more energy than can be supplied through transformer 1 and rectifier 2, the scheme shown at the right of Fig. 1 may be adopted. Here the reference character 4 designates a sensitive relay which can be operated by the slightly varying direct current transmitted through the rectifier 2. The reference character 5 designates a horn or other power-operated signaling device which may be connected to the line or circuit 7 by means of a plug and socket 9. Each time relay 4 operates, its armature will close the circuit which supplies the power to operate the horn 5. It will be apparent that no power wiring is required in this case and that the plugs may be connected to any available 110-volt lighting circuit or the like.

The lamp 10 is included in the circuit of the primary winding of transformer 1 as a protective device. This lamp operates with a low resistance under normal conditions. The resistance of the tungsten filament will increase with voltage and, accordingly, excessive current increases will be prevented. If there should be a short-circuit in or about the primary or secondary of transformer 1, the current through the filament of lamp 10 will increase and its resistance will be similarly increased in order to prevent excessive discharges which may be dangerous.

It is to be noted that the transformer 1 completely insulates the power circuit or line 7 from the signaling circuit associated with the rectifier 2. Moreover, the condenser 11 is one of large capacity in order to reduce the resonant frequency of the circuit.

The condenser 11 may be eliminated, if desired, in which case there will be no need for the back contact on the key of the code-sending device 6. Then, when the key is closed, the flux in the core of transformer 1 will build up and reach a maximum value and upon release of the key this flux will be reduced to a minimum value. In that event, when the key of the code sending device is operated and released, there will be but one cycle of alternating current.

Fig. 2 shows a line 20 connected with a telephone subscriber's set, as indicated. A sensitive relay 21 and a condenser 22 are connected

in series relationship with the line 20. Thus, it will be apparent that the winding of relay 21 and condenser 22 are bridged across the ringer and condenser of the telephone subscriber's set.

The armature of relay 21 will be attracted with a frequency practically twice that of the alternating current used for ringing purposes. Thus, if ringing is done with 20-cycle current, the armature of relay 21 may be attracted forty times per second. Condenser 11 will become charged as the armature of relay 21 closes its front contact and it will be discharged when the armature is released so as to close its back contact.

It will be apparent that no rectifier is shown in the arrangement disclosed by Fig. 2 for the reason that code signals are not being transmitted. Here the gongs 3 operate as long as does the ringer of the telephone subscriber's set. It will be understood that these gongs may be replaced by ringers of the type ordinarily used in telephone subscribers' sets and may be operated in the usual manner.

The winding of relay 4 is directly connected across the secondary winding of transformer 1. This relay is preferably of the slow release type, as shown, in order that the horn 5 or other sounding device may remain operated throughout the interval of time that ringing current is being applied.

Fig. 3 discloses an arrangement in which the gongs or other sounders may be operated continuously and remain operated until the telephone subscriber answers the call. When ringing current is impressed upon line 20, an alternating current relay 30 will be operated by virtue of the connection of its winding in series with line 20 and with a condenser 35. The armature of relay 30 will be alternately attracted while ringing current flows over line 20 and released during the periods between rings. When the armature of relay 30 closes its contact, a relay 31 will be operated, current flowing from a battery 36, which may include a plurality of dry cells, through a circuit which includes the winding of relay 31, a resistance 37, and the armature and contact of relay 30. Relay 31 will then become locked up by virtue of the closure of the contact associated with its first armature, the interconnected circuit including battery 36, the winding of relay 31, resistance 37, and the first armature and contact of relay 31. Upon the closure of the contact associated with the second armature of relay 31, relay 32 will become operated, the interconnected circuit including battery 36, the winding of relay 32, the first armature and contact of relay 32, and the second armature and contact of relay 31. Upon the closure of the contact associated with the second armature of relay 32, the relay 21 will become operated, current flowing from battery 36 through the winding of relay 21 and the second armature and contact of relay 32. Immediately after relay 32 is operated, this relay will become released by virtue of the opening of the contact associated with its first armature which is in series with the winding of relay 32. Upon the release of relay 32, relay 21 will become released by virtue of the opening of the contact associated with the second armature of relay 32. Thus, relay 21 will become operated and released practically in synchronism with the operation and release of relay 32. It will be apparent that the armature of relay 21 will be attracted and released at a rather rapid rate even while relay 31 remains locked. However, when the receiver of the telephone set is removed from its switch hook, the relay 34 will become operated by virtue of the flow of the same current through its winding as flows through the transmitter of the subscriber's set. Upon closure of the contact associated with the armature of relay 34, relay 31 will become released because the armature and contact of relay 34 will be connected in shunt with the winding of relay 31. Upon the release of relay 31 all of the remaining relays will be released and will remain released.

While this invention has been disclosed in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed:

1. The method of converting direct current into alternating current which consists in transmitting the direct current to a condensive element to charge the condensive element, deriving a cycle of alternating current from the charging current, breaking the circuit of the direct current and connecting the condensive element to another circuit so as to discharge the condensive element, and deriving another cycle of alternating current from the discharging current.

2. A current translating method which consists in transmitting direct current to a condenser to charge the condenser, intermittently breaking the circuit transmitting the direct current to the condenser and connecting the condenser to another circuit so that the condenser may become discharged, deriving a cycle of alternating current from each charge of the condenser by the direct current, deriving another cycle of alternating current displaced 180 degrees in phase at each discharge of the condenser, and rectifying both halves of each alternating current cycle.

3. A current translating method which consists in transmitting a direct current to charge a condensive element, breaking the circuit of the direct current and connecting the condensive element to another circuit so as to allow the condensive element to discharge, producing two cycles of alternating current displaced 180 degrees in phase with each other from the respective charge and discharge of the condensive element, and converting both alternating current cycles into a slightly varying direct current.

4. In combination, a source of direct current, a condenser, a key having a front contact and a back contact, means for transmitting said direct current to said condenser over the front contact of said key so as to charge the condenser, means for breaking the circuit of said direct current and for connecting the condenser to a circuit which includes the back contact of said key so as to allow the condenser to become discharged, means for deriving a cycle of alternating current from the charging current and another cycle of alternating current displaced 180 degrees in phase with respect to the first cycle from the discharging current.

5. In combination, a source of direct current, a condenser, a device having two contacts, means for transmitting said direct current to said condenser over one of the contacts of said device so as to charge the condenser, means for breaking the circuit of the direct current and for con-

necting the condenser to a circuit including the other of the contacts of said device so as to allow the condenser to become discharged, means for deriving from the charging current a cycle of alternating current and for deriving from the discharging current another cycle of alternating current, and means for converting both alternating current cycles into a slightly varying direct current.

6. The combination of a source of direct current, a key having a front contact and a back contact, a condenser, a transformer, said source of direct current, the front contact of said key, said condenser and the primary winding of said transformer being connected in series relationship for charging said condenser, the back contact of said key being connected in series relationship with said condenser and the primary winding of said transformer for discharging said condenser, and a full wave rectifier connected to the secondary winding of said transformer.

7. The method of converting direct current into alternating current with apparatus including a condenser and a transformer which consists in transmitting the direct current through the primary winding of the transformer to the condenser so as to charge the condenser, receiving a complete cycle of alternating current from the secondary winding of the transformer, breaking the circuit of the condenser and connecting the condenser to another circuit including the primary winding of the transformer so as to discharge the condenser, and receiving a second complete cycle of alternating current from the secondary winding of the transformer.

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