

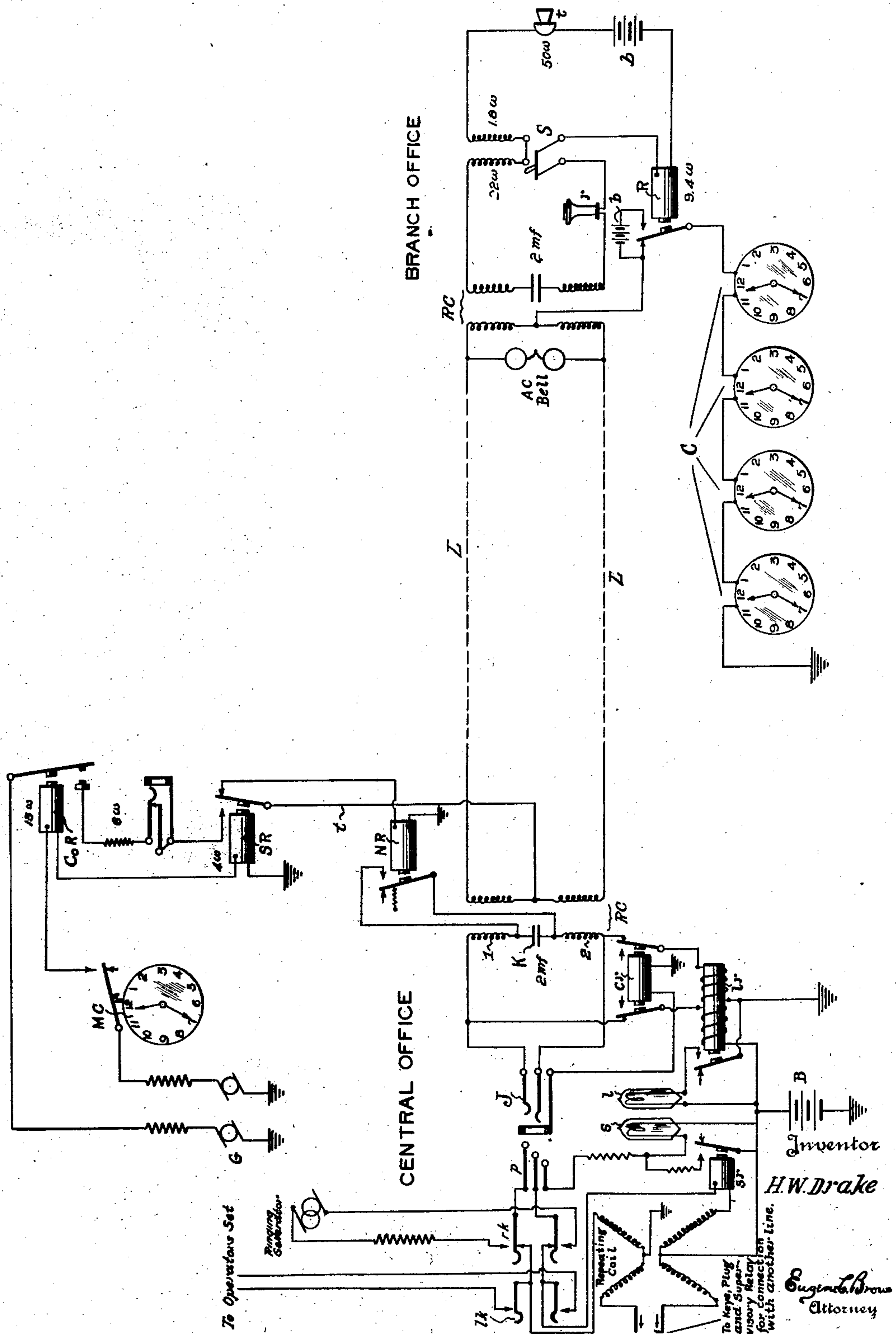
Oct. 18, 1927.

1,646,354

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**SYNCHRONIZING CLOCKS OVER SIMPLEX CIRCUITS HAVING CENTRAL
BATTERY TELEPHONE SIGNALING**

Filed March 19, 1926



UNITED STATES PATENT OFFICE.

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SYNCHRONIZING CLOCKS OVER SIMPLEX CIRCUITS HAVING CENTRAL-BATTERY TELEPHONE SIGNALING.

Application filed March 19, 1926. Serial No. 95,992.

This invention relates to synchronizing apparatus for clocks in which a telephone line serves as the medium for the transmission of the synchronizing impulse. It is particularly concerned with a means for synchronizing over simplex circuits having central battery signaling whereby the resistance of the synchronizing circuit is reduced to a minimum.

According to present practice, the simplex circuit of a composite system has a bridge arrangement of very high resistance and inductance, at the electrical center of which the Morse wire is connected. This high resistance makes the circuit unsuitable for clock synchronizing service. By my invention I provide a simplex circuit in which a path to ground is provided, by way of the clocks to be synchronized, through a conductor connected to the electrical center of the telephone repeating coil, and the resistance of this circuit is maintained at a low value by the use of relays having very low resistance.

The manner of operation of my system, with its attendant advantages, will be apparent upon inspection of the accompanying drawing, which shows the new low resistance method applied to a common battery telephone system in which:

L represents the line conductors extending between the central office and a station, which may be a branch office or any subscriber's station. The branch office telephone equipment is connected to the line through the usual telephone repeating coil RC. At the central office a repeating coil is interposed between the line and the telephone jack. These line conductors in parallel provide a simplex circuit which is grounded at the central office end through a neutral relay NR, and at the branch office through the clocks C, to be synchronized. As will be apparent from the following description, this simplex circuit serves a double function. When a source of current is inserted into the branch office ground connection, the simplex circuit serves to transmit a calling signal to the central office. When, however, a source of current is applied to the central office ground connection, the simplex circuit serves to transmit a synchroniz-

ing impulse from central office to all the blocks on the synchronizing circuit.

At the branch office *t* and *r* represent the usual telephone transmitter and receiver, and S any desired form of switch for completing the talking circuit at the branch office. The transmitting circuit is closed, upon operation of S, through an induction coil and the relay R.

At the central office, a neutral or non-polar relay NR is arranged for front contact operation, and its contacts operate to shunt the condenser K which is in series with the coils 1, 2 of the repeating coil. A direct current circuit is completed by way of this shunt from battery B through both windings of line relay *lr* and both armatures and back contacts of cut-off relay *cr*. The armature of *lr* controls the circuit of a calling signal or line signal lamp *l*. Cut-off relay *cr* has its circuit under control of jack J, in the usual manner. The usual supervisory signal *s* is provided, normally shunted through operation of the supervisory relay *sr*, when the operator's listening key *lk* is closed, but lighted upon opening of the shunt about the repeating coil condenser K when the relay NR is deenergized as the branch office operator opens switch S to restore her telephone apparatus to its inoperative condition.

The synchronizing means of my invention comprises a master control clock MC which controls the closing of an energizing circuit through control relay CoR and signal SR. Operation of these two relays completes a circuit from generator G over armature and contact of relay CoR, armature and contact of relay SR, conductor *t*, repeater coils RC, the line conductors L in parallel, armature and back contact of relay R, through the clocks C, to be synchronized and to ground. When relay SR operates, it opens the circuit of neutral relay NR, and as its armature falls back, the short circuit about the condenser is opened.

Briefly, the operation of the system may be summarized as follows: When the operator at the branch office closes her calling key, indicated at S, which may be any suitable type switch, relay R is energized by the transmitter battery *b* and, through the se-

quence of operations previously described, causes the lighting of line signal lamp *l*, thereby indicating to the central operator that the branch office is calling. If it should happen that the master control clock MC closes its switch to send out the synchronizing impulse at the same moment that the branch office operator closes her calling key, the energizing circuit of neutral relay NR will be held open at the armature contact of signal relay SR so that the line signal lamp will not immediately light. However, since this condition lasts for only a second, the time necessary to send out the synchronizing impulse, the lighting of the line signal lamp will be delayed only a second. Immediately upon the opening of the master control clock circuit, neutral relay NR will be energized and the calling signal will be indicated by the lighting of lamp *l*.

If the synchronizing impulse is sent out by the master clock while the central and branch offices are engaged in conversation, the neutral relay NR will be deenergized only for an instant, thus causing only a momentary deenergization of the supervisory relay *sr*, which will be indicated by a short flash of the supervisory lamp. The interval is so short that the conversation will not be interrupted.

When the operator at the branch office opens her key or switch S, the relay NR is deenergized and removes the short circuit about the condenser K. This deenergizes the relay *sr* and thus causes the supervisory lamp *s* to light, indicating to the central office that the branch office operator is through.

When the central station operator calls the branch office, she operates her ringing key *rk* as usual after inserting the plug *p* in the jack J, thereby ringing the bell at the branch office. When the branch office operator closes her switch S, the relay NR is energized, which closes the short circuit about condenser K and causes the lamp *s* to glow. As central station operator then closes her listening key *lk*, the relay *sr* is energized and closes a shunt around the lamp *s*.

Accordingly, it is clear that the operation of the master control clock will have practically no effect on the use of the system for telephone purposes, because its control of the line lasts for only one second. Moreover, the chance that the telephone line will be in use at the synchronizing moment is only one to many, particularly in systems where the synchronizing impulse is sent out only once or twice during each twenty four hours.

Since the relays used are low resistance relays, and the operating circuit is simplexed over the telephone conductors in parallel, it is apparent that the resistance of the synchronizing circuit is maintained at so low a value as to make possible the transmission of a

strong current impulse for synchronizing purposes.

While I have disclosed only a single embodiment of my invention, it is apparent that various changes may be made in the details of the system without departing from the spirit of the invention.

I claim:

1. In a combined telephone and clock synchronizing system, a master control clock and a plurality of clocks to be synchronized, a central office and a branch office and telephone line conductors extending therebetween and terminating at each end in repeating coils, means at each office for connecting the electrical midpoint of the line winding of the repeating coil to ground to provide a simplex circuit over said telephone conductors in parallel, means for transmitting a synchronizing current from the master clock to the other clocks over said simplex circuit and means for transmitting a calling current from the branch office to the central office over said simplex circuit.

2. In a combined telephone and clock synchronizing system, a master control clock and a clock to be synchronized, a pair of telephone line conductors extending therebetween, means for sending a calling signal over said line conductors in parallel, and means for sending a synchronizing impulse to said second mentioned clock over said line conductors in parallel.

3. In a combined telephone and clock synchronizing system, a branch office comprising a telephone transmitter, a local energizing circuit therefor, and a relay in said energizing circuit, means for simplexing the telephone line conductors to provide a connection to ground at said branch office, a plurality of clocks in said ground connection and means under control of said relay for inserting a battery into said ground connection.

4. In a combined telephone and clock synchronizing circuit, a central station, a local station, a pair of telephone line conductors extending therebetween, means for simplexing the telephone conductors to provide a clock synchronizing circuit, a call signal at the central station, and means under control of the local station to operate the call signal over the simplex synchronizing circuit.

5. In a combined telephone and clock synchronizing system, a pair of telephone conductors, a call signal at the central station and relay means for controlling operation of the signal over a circuit including the telephone conductors, a master control clock, and a clock to be synchronized, a synchronizing circuit superposed upon said relay control circuit, and means under control of the master clock for delaying operation of said relay means.

6. In a combined telephone and clock syn-

chronizing system, a central office and a branch office and telephone line conductors extending therebetween, a simplex circuit extending through the telephone conductors in parallel and connected to ground at the central office and at the branch office, a relay in the ground connection at the central office, a plurality of clocks to be synchronized in the ground connection at the branch office, and means under control of the branch office for inserting a battery into the last mentioned ground connection, whereby the relay at the central office is operated over the simplex circuit including the plurality of clocks.

7. In a combined telephone and clock synchronizing system, a central office and a branch office and telephone line conductors extending therebetween, a simplex circuit comprising a connection to the electrical midpoint of a repeating coil at the central office and a similar connection to a repeating coil at the branch office, a signal at the central office, means for operating the signal including a relay in said connection at the central office, a plurality of clocks in the connection at the branch office, a master clock, and means under control of the master clock for disconnecting said relay and connecting a generator to the said connection at the central office.

8. In a combined telephone and clock syn-

chronizing system, a central office and a branch office and telephone line conductors extending therebetween, a simplex circuit comprising a connection to the electrical midpoint of one winding of a repeating coil at the central office and a similar connection at the branch office, a relay in the connection at the central office, a condenser in series with the other winding of the repeating coil at the central office, means under control of the relay for short circuiting said condenser, a master control clock, a plurality of clocks to be synchronized in the connection at the branch office, a control relay and a signal relay at the central office in a circuit under control of the master clock, and means under control of the signal and control relays respectively for disconnecting said first-named relay and connecting a source of synchronizing current to the said connection at the central office.

9. The combination according to claim 8 in which the armature of the signal relay is connected to the electrical midpoint of the repeating coil and has front and back contacts connected respectively to the winding of said first-named relay and to the source of synchronizing current.

In testimony whereof I affix my signature.

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