(No Model.)

R. PFUND.

MULTIPLE TELEPHONY AND TELEGRAPHY.

No. 604,499. Patented May 24, 1898.

Fig. 1.

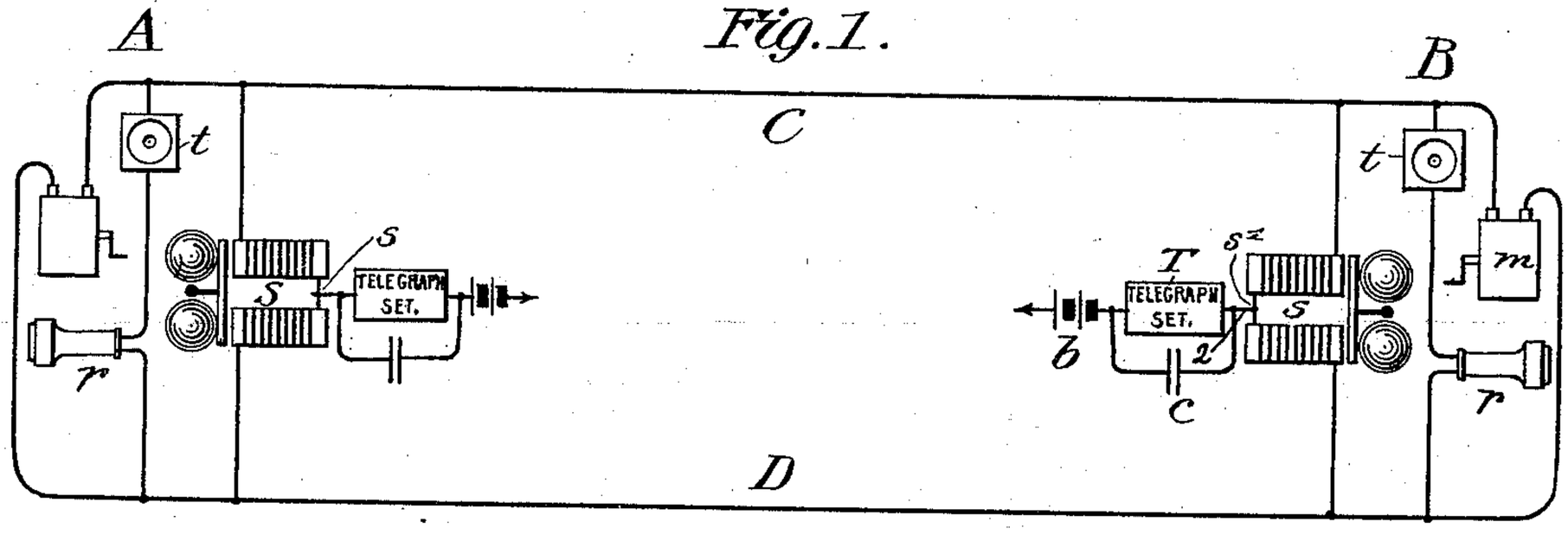


Fig. 2.

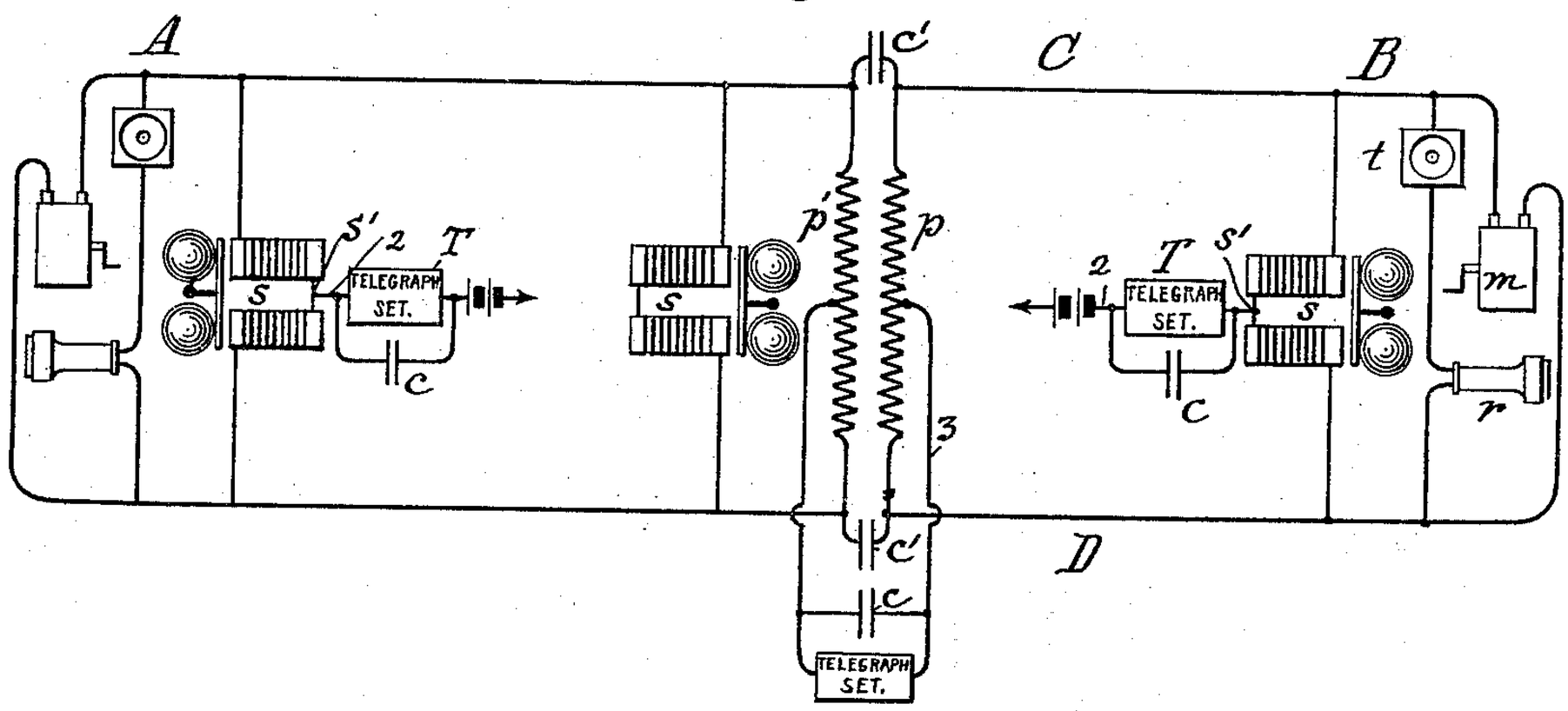
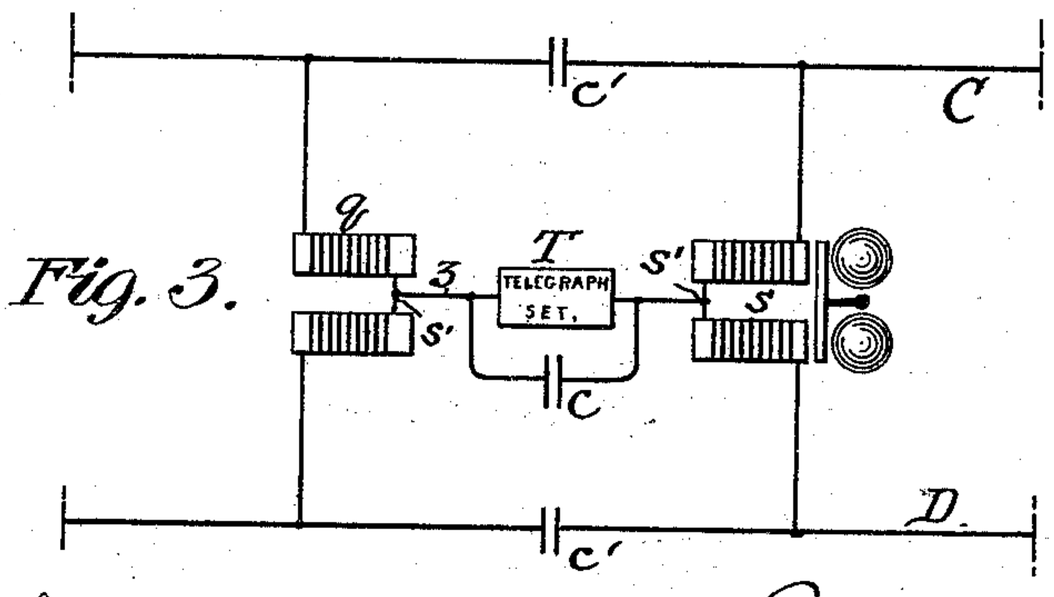


Fig. 3.



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MULTIPLE TELEPHONY AND TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 604,499, dated May 24, 1898.

Application filed October 22, 1897. Serial No. 656,007. (No model.)

To all whom it may concern:

Be it known that I, RICHARD PFUND, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Multiple Telephony and Telegraphy, of which the following is a full, clear, and exact description.

This invention relates to multiple telephony and telegraphy, and has special reference to systems wherein telegraphic and telephonic communication may be carried on between stations either terminal or intermediate simultaneously or at will without interference. Such systems, I am aware, have been proposed heretofore; but the object of my invention is to accomplish the result above mentioned in the simplest manner and with the least apparatus possible.

My system comprehends the usual metallic or two-wire circuit which constitutes the outgoing and return conductors of the telephonic system. These two conductors are at the same time utilized in parallel as one side of the telegraphic circuit, the other side being the earth. As a consequence of this my system requires only the usual two main wires and is a simplification over those systems employing an additional or third wire. As a means for preventing interference between the telegraphic and telephonic currents I bridge across the two main wires at each station, self-inductive resistances, sometimes called "retardation-coils," and connect the earth side of the telegraphic circuits with the middle point of these resistances. This feature is not original with me; but I propose to utilize the high-resistance bell-magnet of the telephone set for the self-inductive resistance, and thereby dispense with one piece of apparatus. The counter electromotive force of these retardation-coils prevents the short-circuiting of the telephonic currents and forces them to travel their proper circuits through the telephonic instruments. On the other hand, telegraphic currents which are impressed upon the line by instruments connected in the earth side of the circuit divide at the middle point of the retardation-coils or bell-magnets and travel in the same direction through each of the main wires, and consequently do not interfere with telephonic currents that may be passing in opposite direction over the same main wires.

In order to connect in the intermediate or way telephone and telegraph stations, I open both sides of the main circuit at such stations and connect across the pairs of terminals thus formed the primary and secondary coils, respectively, of a transformer or repeating coil, the primary being connected across the "east" terminal and the secondary coil across the "west" terminal, or vice versa. As an alternative of this, I may connect across one side of the break the high-resistance bell-magnet of the intermediate telephone-station and across the other side of the break a retardation-coil of the same value as the bell-magnet. In both cases I bridge the break in each main conductor with a condenser which will carry the telephonic currents and so aid the repeating-coil in the first case, but which will not carry the telegraphic currents. In both of these arrangements I connect the telegraphic set of the intermediate station between the middle points of the resistances—that is to say, in the first form where the repeating-coil is used I connect the telegraphic set directly across between the middle points of the primary and secondary, and in the other case I connect the telegraphic set directly across between the middle point of the bell-magnet coil and the middle point of the retarding-coil. Thus the telegraphic currents, which will not pass the condensers, have a free path east or west from and to the intermediate station.

My invention will be described in detail with reference to the accompanying drawings, in which—

Figure 1 is a diagram of the circuits and apparatus comprehended by my invention as applied to a circuit having terminal stations only. Fig. 2 is a similar diagram showing the apparatus and method of connecting at the intermediate stations, and Fig. 3 is a modification of the plan shown in Fig. 2.

Referring to the drawings, we will first consider the system illustrated in Fig. 1, wherein a telegraph and telephone station is located at each end of a line, there being no intermediate stations. A and B are the two terminal stations, connected together by a metallic circuit C D, one being the outgoing and

the other the return for the telephonic currents. Each station is equipped with the usual transmitter *t* and receiver *r*, connected directly in the main circuit in the usual way, the magneto call-box *m* and the signaling instrument consisting of bell and magnet *s* directly across the main wires. This is the usual high-resistance long-distance bell-magnet. It is of the horseshoe type and carries coils on each leg of equal resistance. At *s'*, the middle point between the two coils on the magnet, is connected a wire 2, leading through a telegraph set (key and relay) T, through a battery *b*, to earth. The telegraphic set is shunted by a condenser *c* for the purpose of absorbing the discharge of the relay-magnet on the break of the circuit. In the operation of this system the high-resistance bell-magnet *s* acts as a retarding-coil or self-inductive resistance, so that telephonic currents traveling from one station to the other will be prevented from short-circuiting through the bell-magnet by the counter electromotive force of self-induction, in consequence of which the telephonic currents can never travel over the earth-circuit. On the other hand, the telegraphic currents between the instruments T will in traveling, say, from station A divide at the point *s'*, pass in opposite directions through the bell-magnet, thence in the same direction along both of the main wires C and D, then in opposite directions through the coils of the bell-magnet at the opposite end of the line to the point *s'*, thence through the telegraphic instruments, and returning by the earth-circuit. These currents cannot affect the telephonic instruments, because they must necessarily divide at the points *s'* and, traversing the inductive resistance in both directions, will reach the main wires and, traversing both of these in the same direction, have no other circuit open to them than by way of the said main wires (which jointly constitute one side of the telegraphic circuit, the earth being the other side) to the point from which they originally started.

Referring now to Fig. 2, wherein one method of connecting in an intermediate telephone and telegraph station is shown, it will be seen that both sides of the metallic telephone-circuit are opened and then closed through the condensers *c'*, which are capable of carrying the telephonic currents, but will not carry the telegraphic currents. *p p'* represent two equal parts, the primary and secondary of a repeating-coil or transformer. One coil is connected to the two line-wires coming from, say, the east and the other to the two wires from the west. Between the middle points of each of these two coils is connected a circuit-wire 3, including the telegraph set bridged, as before stated, by the condenser *c*. The high-resistance bell *s* of the telephone set is connected across the main wires, as before. Telephonic currents coming from either east or west will pass through the intermediate station by induction between the coils *p* and *p'*, aided by the condensers *c'*, and will not enter the circuit 3, containing the telegraphic instruments. On the other hand, telegraphic currents received or sent by the instruments at the intermediate station will flow in opposite directions through the two parts of each coil *p p'* and in the same direction through the main wires C and D and will return by the earth-circuit connecting the terminal stations. It will be seen that the current traveling to or from the telegraph instrument connecting together the coils *p p'* cannot by the reciprocal induction of the coils affect the telephone instruments, because the said currents travel in opposite directions through the coils, and the induction created by one half is offset or neutralized by that created by the other half.

Referring to Fig. 3, which illustrates a different way of obtaining the same result at way-stations, it will be seen that the main wires are open at *c'* and *c'*, where condensers are inserted, as before, and in the place of the repeating or transformer coils *p p'* the bell-magnet coils of the telephone set are bridged across on one side, while a coil *q* of exactly the same value as the bell-magnet is connected across on the other side, the telegraph instruments T being connected between the middle points of the two magnet-coils and bridged by the condenser *c*. In this case the telephonic currents are carried by the condensers entirely, while the telegraphic currents take the same path through the bell and the extra coil *q* as before described through the coils *p p'*.

Having thus described my invention, I claim—

1. A through metallic circuit having telephone-stations included therein or connected therewith, signaling-magnets for said stations bridged across the two wires of the circuit, an extra circuit uniting the middle points of the signal-magnets whereby an independent circuit is obtained between the stations, and instruments for communication, located in said extra circuit, substantially as described.

2. A through metallic circuit having terminal and way stations, the terminal stations including a self-inductive resistance bridged across the mains, communicating instruments located in or connected with the metallic circuit at said stations, the two sides of the metallic circuit being opened at the way-stations and closed through condensers, self-inductive resistances connecting the two sides of the metallic circuit on each side of the condensers at the way-stations, in the manner described, extra conductors connecting the middle points of the two resistances at the way-stations and including communicating instruments, and an extra circuit connecting the middle points of the resistances at the terminal stations and including communicating instruments, as described.

3. A through metallic circuit having ter-

minal and way stations, the terminal stations including a signaling-magnet bridged across the mains, communicating instruments located in or connected with the metallic circuit at said stations, the two sides of the metallic circuit being opened at the way-stations and closed through condensers, self-inductive resistances connecting the two sides of the metallic circuit on each side of the condensers at the way-stations, in the manner described, extra conductors connecting the middle points of the two resistances at the way-stations and including communicating instruments and an extra circuit connecting the middle points of the coils of the signaling-magnets at the terminal stations and including communicating instruments, as described.

4. A metallic circuit having terminal and way stations, the terminal stations including self-inductive resistances bridged across the mains, communicating instruments located in or connected with the metallic circuit at said stations, the two sides of the metallic circuit being opened at the way-stations, self-inductive transformer or repeating coils connected across the mains, one half on each side of the opening in the mains in the manner described, extra conductors connecting the middle points of each half of the transformer and including communicating instruments and an extra circuit connecting the middle points of the resistances at the terminal stations and including communicating instruments, substantially as described.

In testimony whereof I subscribe my signature in presence of two witnesses.

RICHARD PFUND.

Witnesses:
WM. W. ROSENBAUM,
HARRY BATLEY.