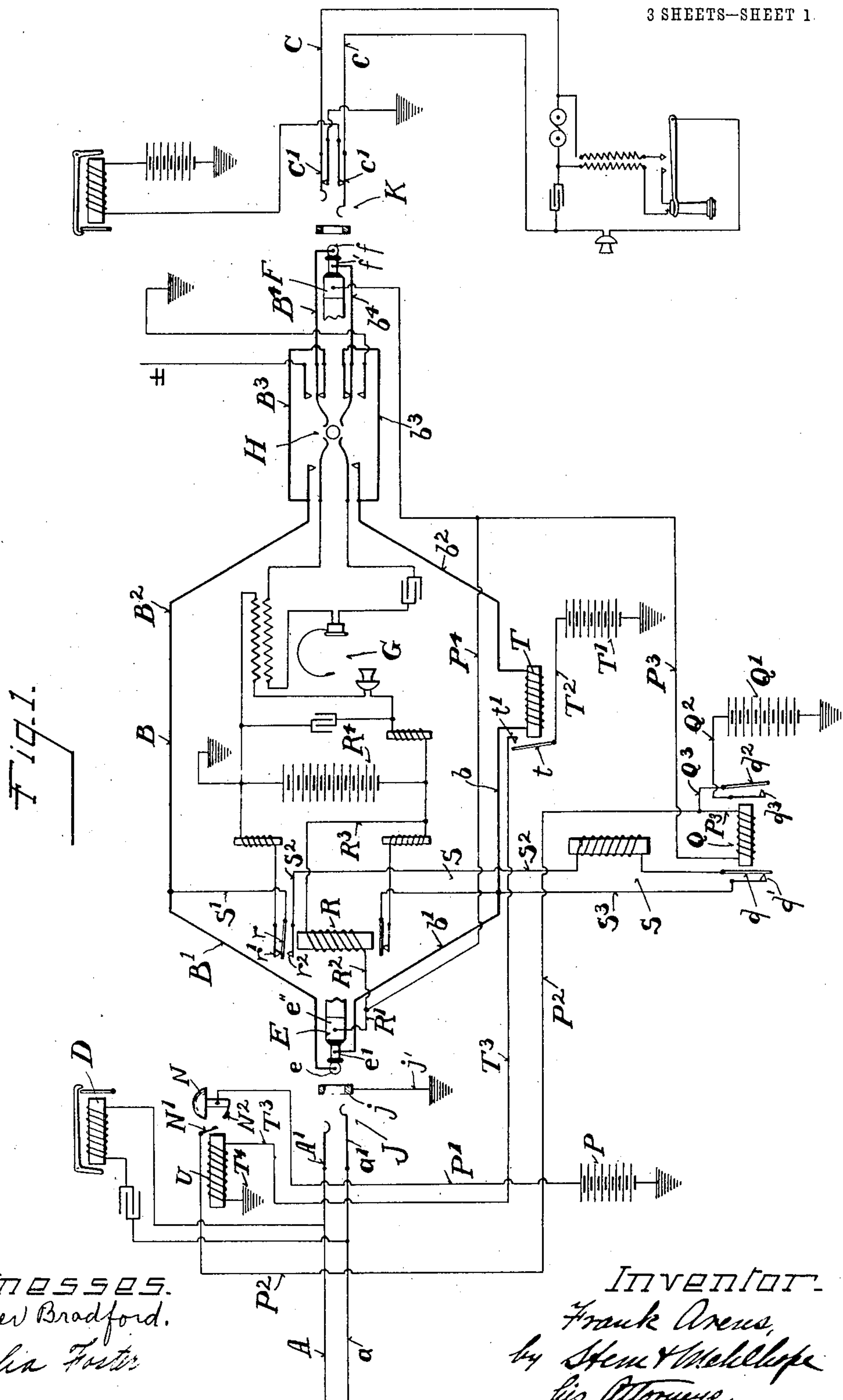


F. ARENS.  
PRIVATE BRANCH EXCHANGE TELEPHONE SYSTEM.  
APPLICATION FILED DEC. 28, 1907.

906,602.

Patented Dec. 15, 1908.

3 SHEETS—SHEET 1.



WITNESSES.  
Homer Bradford.  
Cecilia Foster

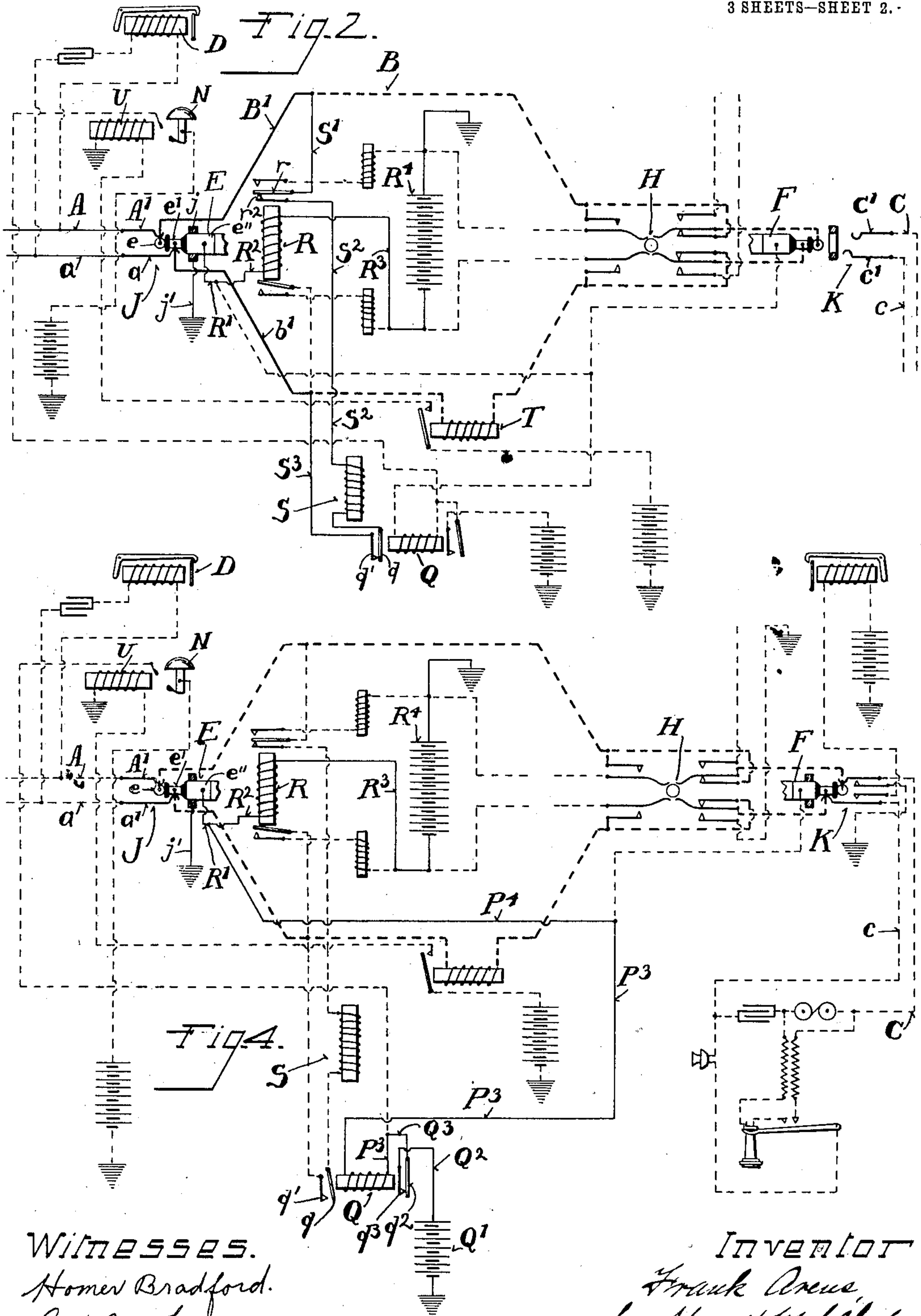
INVENTOR.  
Frank Arens,  
by Stem & McKellogg  
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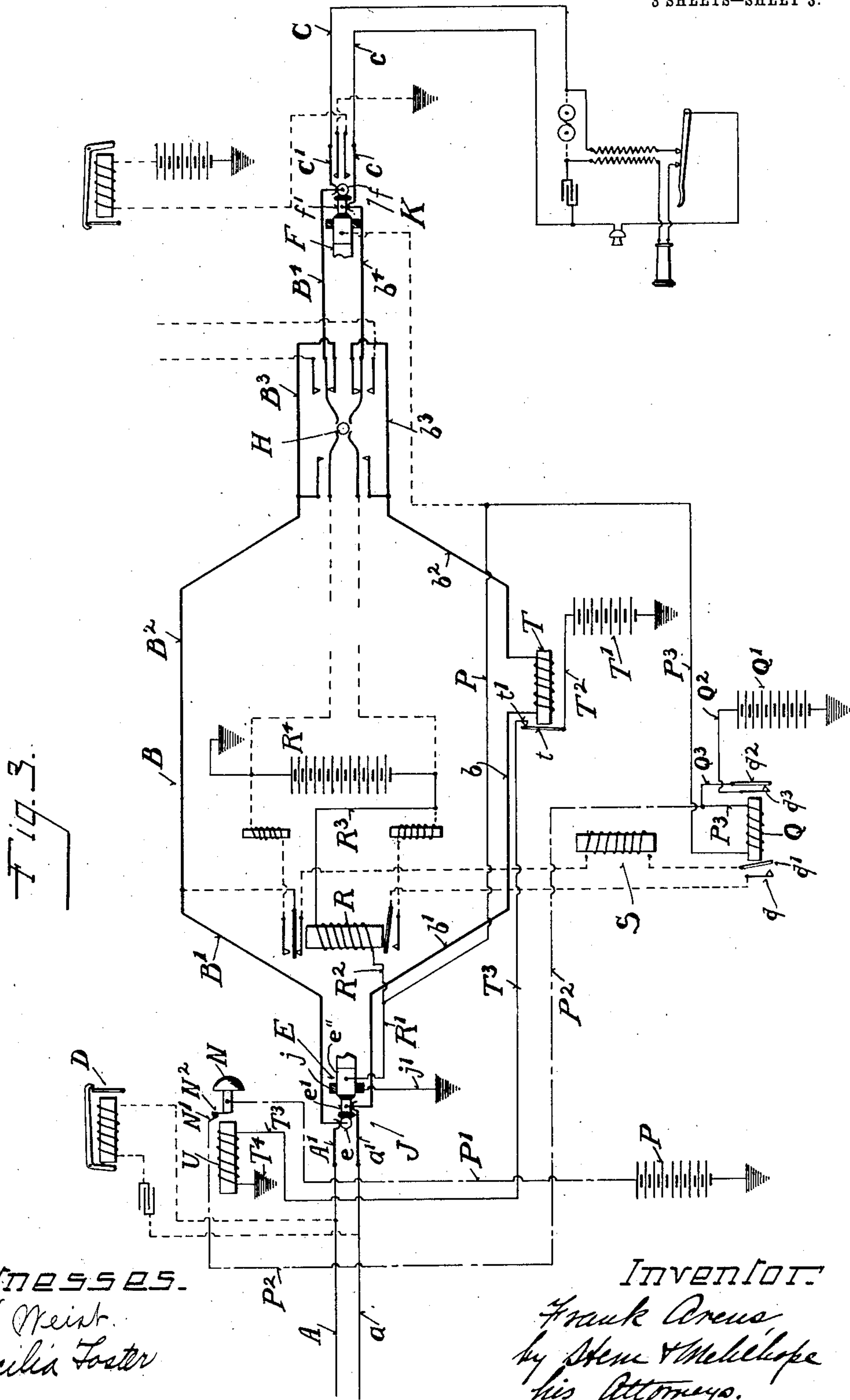
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3 SHEETS—SHEET 3.



WITNESSES.  
L. V. Meist.  
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Frank Arens  
by Stern & Melchrope  
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# UNITED STATES PATENT OFFICE.

FRANK ARENS, OF CINCINNATI, OHIO.

## PRIVATE-BRANCH-EXCHANGE TELEPHONE SYSTEM.

No. 906,602.

Specification of Letters Patent.

Patented Dec. 15, 1908.

Application filed December 28, 1907. Serial No. 408,383.

*To all whom it may concern:*

Be it known that I, FRANK ARENS, a citizen of the United States, and a resident of Cincinnati, in the county of Hamilton and State of Ohio, have invented a certain new and useful Improvement in Private-Branch-Exchange Telephone Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form part of my specification.

My invention relates to an improvement in private branch exchange systems for telephones and particularly to an improved means for supervision from the private branch exchange to the main exchange or central.

The object of my invention is to provide a means, whereby the department on the private branch exchange, will supervise directly to both the central operator and to the private branch exchange operator, instead of as heretofore, only to the private branch exchange operator, who in turn would have to supervise to the central operator.

At present when a party calls a department on a private branch exchange, his answering operator at central plugs up in the multiple and rings the private branch exchange trunk; the private branch exchange operator then inserts her answering plug and, when informed what department is wanted, calls that department. The insertion of her answering plug bridges some kind of a shunt on the trunk or cord, which indicates to the central operator that she has answered. After the particular department called has finished talking, he hangs up his receiver, which signals to the private branch exchange operator that he is through. The hanging up of the receiver by the party originally calling, indicates to the central operator that he is through. If the private branch exchange operator is on hand and sees the signal from her department, no difficulty is encountered; but ordinarily, such is not the case and no signal is given to the central operator that the trunk leading to the private branch exchange is no longer in use. The result is that the central operator receives an indication from the original caller that he is through, but no indication whatever from the private branch exchange operator, although the department called has hung up his receiver, for the reason that the shunt originally placed on the trunk by the

private branch exchange operator is still in place. If the central operator who answered the calling party, upon receiving notice from him that he has finished, takes out her connections, it is apparent that a calling light will be brought in on the board of the answering operator of the private branch exchange trunk, the shunt being still on said trunk. She will take this for a call, and after wasting time in trying to find out who called, will conclude that the private branch exchange operator is not there and that she has left in her plug. As the line lamp is annoying to her, however, she may leave a half connection on the line to keep the lamp from burning, in which case the line would test busy and parties desiring to get the private branch exchange trunk would not be able to get it, although it was not in use. Again, she might ring the private branch exchange, and owing to the fact that the private branch exchange operator's connections are still in place, the ring would pass through to the department last talking and he would have to answer, when he was not wanted, to his great annoyance.

It is to overcome these objectionable features that my invention is designed.

It consists essentially in replacing the permanent shunt which has heretofore been placed on the trunk or cord by the private branch exchange operator, in answering central, by a different kind of shunt, which is automatically broken by the taking off of the receiver of the department called by the private branch exchange operator. In other words, in systems prior to my invention, the shunt placed across the wires of the trunk by the private branch exchange operator when inserting her answering plug, can only be broken by the withdrawal of said plug; whereas in my device the shunt made by the insertion of the said answering plug is not permanent, but is so arranged that it may be regulated by the department called by the private branch exchange operator, whether or not her answering plug be withdrawn.

Another advantage of my invention results from the automatic cutting out of the shunt placed across the trunk by the private branch exchange operator in answering central. This shunt being cut out when the department called takes down his receiver, we have added to the current of the system for the transmitter of the department called,



and also for private branch exchange supervision, that current which was heretofore consumed by the shunt. This is a very important advantage, as in cases where the department called was a long distance from the private branch exchange operator, which frequently occurs, the permanent shunt cut down the current to such an extent as to make it necessary to adopt various means for raising the current up to the proper voltage.

In the drawings, Figure 1 is a diagrammatic view of a private branch exchange system, showing one of the lines leading to one department and the extremities of a trunk leading to the private branch exchange; Fig. 2 is a similar diagrammatic view showing the electrical connections upon the insertion of the private branch exchange operator's answering plug; Fig. 3 is another diagrammatic view showing the electrical connections when the private branch exchange operator has inserted her calling plug and the department called has taken down his receiver; and Fig. 4 shows the connections when the department called has hung up his receiver, but the private branch exchange operator has left her plugs in place.

In the drawings all the wires are shown in full lines in Fig. 1. In the rest of the figures only those wires through which current is passing, are shown in full lines, the balance being shown in dotted lines.

In carrying out my invention the main wires of the cord are connected by what we may call the shunt circuit, which circuit is broken by two spring contacts operated by relays,—one of which is normally open and the other of which is normally closed. The insertion of the answering plug brings the relay operating the first spring into action, thus closing the shunt circuit and thereby bridging the wires of the cord. The relay operating the second spring is brought into action when the private branch exchange drop signal, comes in, indicating that the department has answered,—a circuit being thereby closed which supplies current to the said relay. The operation of this spring breaks the shunt circuit. The second relay also operates another spring which bridges another circuit, by means of which said relay is supplied with a supplemental current, so as to keep the shunt circuit broken at this point even after the original circuit supplying the relay, has been broken by the return of the private branch exchange signal to its normal position, upon the hanging up of the department receiver. Thus the circuit of the private exchange and of the trunk leading to the private branch exchange are both opened, though the answering plug is still in place.

In the drawings A *a* indicate the wires of the trunk leading to the private branch ex-

change; B *b* the main wires of the private branch exchange cord; and C *c* the wires of a department of the private branch exchange.

D represents the operator's calling signal; E, the answering plug; F, the calling plug; G, the operator's telephone set; H, the listening and ringing key; J, the answering jack; and K, the calling jack.

*e* and *e'* represent respectively the tip and ring of the answering plug E and *f* *f'*, the tip and ring of the calling plug F. The tips *e* *f* are connected by the circuit B and the rings *e'* *f'* by the circuit *b*. The circuit B comprises the wires B<sup>1</sup>, B<sup>2</sup>, the strap B<sup>3</sup> and the wire B<sup>4</sup>. The circuit *b* comprises the wires *b*<sup>1</sup>, *b*<sup>2</sup>, the strap *b*<sup>3</sup> and the wire *b*<sup>4</sup>. The circuits A *a* are connected with the jack J respectively by the spring contacts A<sup>1</sup>, *a*<sup>1</sup> and within the jack is also located the sleeve *j* which is adapted to contact with a sleeve *e''* on the plug E; the sleeve *j* is connected to the ground by means of a wire *j'*.

S represents the shunt circuit; R and Q respectively the two relays and *r* *q* the two spring contacts located in the shunt circuit; the first normally open and the second normally closed. *r'* *r''* are the two contacts of the spring *r* and *q'* is the contact of the spring *q*. The relay R is magnetized by the circuit comprising the wires R<sup>1</sup> connected to the sleeve *e''*, R<sup>2</sup> and R<sup>3</sup> leading to the battery R<sup>4</sup>.

The wire *b* of the cord circuit is passed through a relay T adapted to operate a spring *t* and close it on a contact *t*<sup>1</sup>. This spring is located in a circuit leading from the battery T<sup>1</sup>, through the wire T<sup>2</sup>, the wire T<sup>3</sup> which passes through the signal winding U and thence to the ground T<sup>4</sup>. This circuit operates the private branch exchange supervision signal N which is a drop signal and which drops upon the taking down of the receiver of the department called. This drop signal is provided with a spring N<sup>2</sup> which makes connections with a contact N<sup>1</sup>, upon the dropping of the signal, the two being located in the circuit which operates the relay Q in the first instance. This circuit comprises the battery P, the wire P', the drop signal N, the spring and contact N<sup>2</sup> N<sup>1</sup>, the wire P<sup>2</sup>, the wire P<sup>3</sup>, passing through the relay and the wire P<sup>4</sup>, which latter connects with the wire R', leading to the sleeve *e''*. The initial operation of the relay Q closes a spring *q*<sup>2</sup> on a contact *q*<sup>3</sup>, thereby completing a circuit leading from battery Q', through the wire Q<sup>2</sup>, spring and contact *q*<sup>2</sup>, *q*<sup>3</sup>, wire Q<sup>3</sup>, which connects with wire P<sup>3</sup> and thence follows as before through the wire P<sup>3</sup> etc. to the sleeve *e''*.

A call from central to the private branch exchange operator is indicated on the drop signal D in the usual manner, whereupon the private branch exchange operator inserts



the answering plug E in the answering jack J. This connects the wires A and B through the spring A<sup>1</sup> and the tip e, and the wires a and b, through the spring a<sup>1</sup> and ring e<sup>1</sup>. The sleeve e'' is also brought into contact with the sleeve j. The insertion of the answering plug thus closes a circuit leading from ground to battery through the relay R,—viz., from ground j<sup>1</sup>, to sleeve j, to sleeve e'', through wires R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, to battery R<sup>4</sup>. This causes the spring r in the shunt circuit to swing from contact r<sup>1</sup> to contact r<sup>2</sup>, thereby closing the shunt circuit, which consists of the wire S<sup>1</sup>, the spring r, contact r<sup>2</sup>, wire S<sup>2</sup>, spring q, contact q<sup>1</sup>, wire S<sup>3</sup>, which connects with wire b<sup>1</sup> of the cord wire b. This shunt placed across the wires of the cord cuts out the supervision light at central, which indicates to the central operator that the private branch exchange operator has answered. The currents pass now as indicated in Fig. 2. The private branch exchange operator asks central what department is wanted, and upon learning inserts her calling plug F and rings the particular department required in the usual manner. It is not necessary for the purpose of a description of this invention to go into a description of the operator's telephone set and answering and ringing key, as these are connected up in the usual manner.

The insertion of the calling plug connects the wires B b with the wires C c respectively through the tip f and spring C' and the ring f' and spring c'. The department called then takes down his receiver which closes the circuit through the wires C c in the usual manner. We then have current passing through the wires B and b. When the current passes through the wire b it magnetizes the relay T and closes the spring t on the contact t<sup>1</sup>, thus closing the circuit leading from battery to ground and comprising the battery T<sup>1</sup>, wire T<sup>2</sup>, spring t, contact t<sup>1</sup>, wire T<sup>3</sup>, passing through the signal winding U and to ground T<sup>4</sup>. This brings the signal winding U into action and causes the signal N to drop, showing the private branch exchange operator that the department has answered. The dropping of this signal N brings the spring N<sup>2</sup> against the contact N<sup>1</sup> and closes the circuit that energizes the relay Q. This circuit comprises the battery P, the wire P<sup>1</sup>, the signal N, the spring and contact N<sup>2</sup> N<sup>1</sup>, the wire P<sup>2</sup>, the wire P<sup>3</sup>, which passes through the relay Q, the wire P<sup>4</sup>, the wire R<sup>1</sup>, the sleeves e'' and j, the ground j'. The current flowing through this circuit energizes the relay Q and breaks the connection between the spring q and the contact q<sup>1</sup>, thus opening the shunt circuit. The operation of this relay Q also closes the spring q<sup>2</sup> on the contact q<sup>3</sup>, which closes the circuit leading from the battery Q<sup>1</sup>, through the wire Q<sup>2</sup>, contact q<sup>3</sup>,

spring q<sup>2</sup>, wire Q<sup>3</sup>, wire P<sup>3</sup> and thence through the relay to the sleeves e'' j and to ground. We then have the currents and circuits indicated in Fig. 3. When the department talking has finished, he hangs up his receiver which breaks the circuits C c and also the circuits B b. The current therefore ceases to flow through the relay T, whereupon the spring t breaks away from the contact t<sup>1</sup>, thus breaking the circuit which energizes the signal winding U and permitting the drop signal N to return to its normal position, thereby supervising to the private branch exchange operator. This breaks the connection between the spring N<sup>2</sup> and the contact N<sup>1</sup> which breaks the circuit which originally energized the relay Q. This relay, however, continues to be energized by the supplemental circuit leading from the battery Q<sup>1</sup> as above described, and thus holds the spring and contact q and q<sup>1</sup> apart, and keeps the shunt circuit broken. For this reason the breaking of the circuits is also produced on the trunk line A a, so that the supervision light at central is brought in by the hanging up of the receiver of the department using the line. We then have the circuits indicated in Fig. 4. Removing the answering plug returns the apparatus to its first position.

While describing and illustrating my invention, I have shown and referred to several batteries and grounds; it is to be of course understood that these circuits could all be led from one battery, the different batteries being used simply for the sake of clearness. It is also apparent that by the arrangement described I am enabled to use the full force of the current passing through the trunk for the transmitter of the department called and also for private branch exchange supervision.

Having thus described my invention, what I desire to claim as new and to cover by Letter Patent is:—

1. In a private branch exchange system, in combination with the cord mains, the answering jack and plug, the calling jack and plug, and the supervision signal, a shunt circuit connecting the mains, said circuit being interrupted by two spring contacts, the first of said spring contacts being normally open, and the second, normally closed, relays for actuating said spring contacts, a circuit to energize the first relay adapted to be closed by the insertion of the answering plug, a circuit to energize the second relay adapted to be closed upon the operation of the supervision signal, a supplemental circuit connected with the second relay and terminating in the answering plug, said circuit being normally open, and a spring contact adapted to close said supplemental circuit, said spring being operated by said second relay.

2. In a private branch exchange system, 130



in combination with the cord mains, the answering jack and plug, the calling jack and plug, and the supervision signal, a shunt circuit connecting the mains, said circuit being  
5 interrupted by two automatically operated switches, the first of which is normally open and the second, normally closed, mechanism adapted to close the first switch upon the  
10 insertion of the answering plug, means actuated by the supervision signal to open the

second switch, and supplemental connections brought in to play upon the opening of said second switch adapted to hold said switch in open position until the withdrawal of the answering plug.

FRANK ARENS.

Witnesses:

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CECILIA FOSTER.