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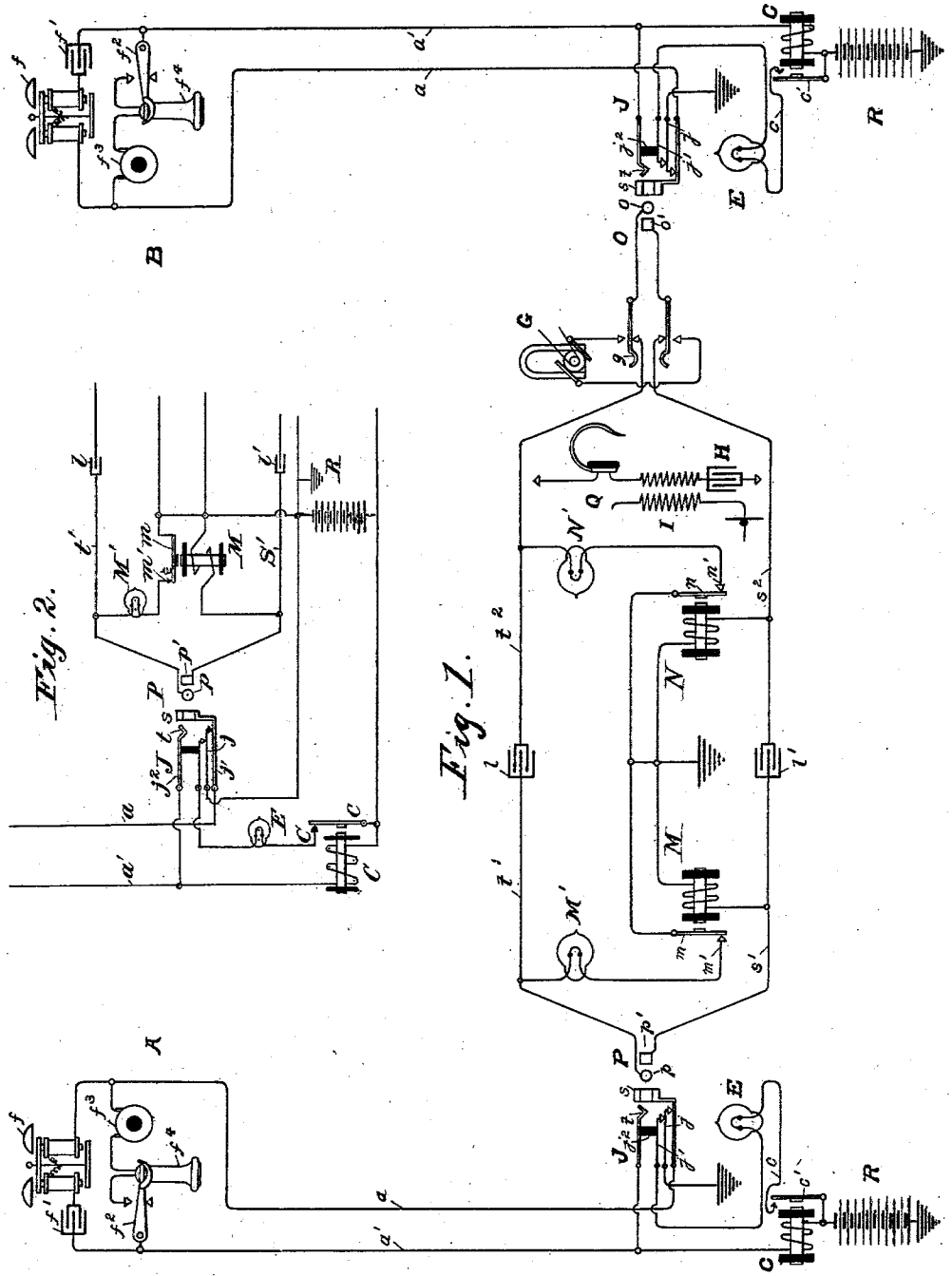
W. W. DEAN.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED MAY 9, 1901.

NO MODEL.



Witnesses.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 745,579, dated December 1, 1903.

Application filed May 9, 1901. Serial No. 59,473. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Telephone-Exchange Systems, of which the following is a specification.

My invention relates more particularly to systems for small exchanges wherein the use of a multiple switchboard is not necessary.

One object is to simplify the apparatus and to do away with what are commonly termed the "cut-off relays" belonging to the subscriber's lines.

Certain features of the invention are not confined to the use of small switchboards, but pertain to the dispensing with all coils or magnets of any nature whatever in the direct talking-circuit at the central office and the simplification of the cord and the line circuits for making connection between any two lines.

My invention is shown in the accompanying sheet of drawings, in which—

Figure 1 is a diagrammatic view of two subscribers' lines centering in a central office and an operator's cord-circuit, and Fig. 2 is a similar view showing the arrangement in slightly different form.

In the figures, A and B represent, respectively, two subscribers' stations connected by metallic circuit-lines with the central office. The limb a of each line connects with the sleeve-contact s of the spring-jack J. In like manner the limb a' of the line connects with the tip-spring t of the spring-jack J. The sleeve-contact s is normally in contact with an anvil j, which is permanently connected with the ground or with a common office-return. The anvil j normally rests against another anvil, j', which is permanently connected with one terminal of the line-lamp E. The limb a' of the line is permanently connected with one terminal of the coil of the line-relay C, the other terminal of which coil is connected with the live side of the battery R. The other terminal of this battery is connected with the ground or with the common office-return. The relay C has a pair of normally open contacts c and c', the former of which is connected with the other terminal of the lamp E, while the latter is connected with the live side of the battery R. The tip-spring t of the spring-jack bears against the spring j' by means of a small insulating-bushing j^2 in such manner as to keep the springs j and j' pressed together and spring j against the sleeve-contact s, thus keeping the three contacts j, j', and s in normal engagement. As soon as a plug is inserted into the jack, however, the tip-spring t is raised, thus relieving the pressure against the springs j' and j and allowing all of the contacts of the jack to separate.

The apparatus at the subscriber's station consists of a polarized bell f and a condenser f', bridged across the circuit of the line in the ordinary manner. It also consists of a hook-switch f^2, a transmitter f^3, and a receiver f^4, all operating in the well-known manner.

One of the cord-circuits for connecting together any two lines is shown in the center of the drawings.

P and O represent, respectively, the answering and the calling plugs, each having a tip and a sleeve terminal or contact. A condenser l is interposed between the tip-strands t' and t^2, which connect, respectively, with the tip-contacts p and o of the answering and calling plugs. In a similar manner a condenser l' is interposed between the strands s' and s^2, which connect, respectively, with the sleeve-contacts p' and o' of the answering and calling plugs. The latter condenser, l', is for the purpose of individualizing the relays, and the former condenser, l, is to make that strand of the cord-circuit correspond with the opposite stand and might be omitted.

Connected between the sleeve-strands s' and s^2 and the ground are two supervisory relays M and N, each having a pair of normally closed contacts $m\,m'$ and $n\,n'$, respectively. The contacts m and n are connected with the ground, while the contacts m' and n' are each connected with one terminal of the corresponding supervisory lamp M' and N', respectively. The other terminals of these lamps are connected to the respective tip-strands t' and t^2. The lamps M' and N' are so chosen as to their voltage that they will be properly illuminated when in a closed circuit in series with the battery R and the

coil of the line-relay C. In practice the battery R is of such a size as to give approximately twenty-four volts, in which case the relay C is wound to approximately one hundred ohms. With this combination ten-volt one-third-candle-powder incandescent lamps are properly illuminated under the conditions of operation, and such lamps may be used at M′ and N′. The lamps E are of course made to operate upon the full voltage of the battery.

The operator's telephone set, consisting of a head-receiver Q with induction-coil I and a condenser H, is adapted to be bridged across the tip-strand t^2 and the sleeve-strand s^2 of the calling-plug O. By means of a ringing-key g a generator G is adapted to be connected between the tip and sleeve contacts of the calling-plug O, the action of this key serving at the same time to break the connection back of the key, so as not to subject the other portion of the cord-circuit to the action of the generator G.

The operation of the system is as follows: When a subscriber desires to call the attention of the operator, he raises the receiver from its hook, thus allowing the hook to close the circuit through the talking apparatus between the two limbs of the line. This operates the line-relay C over the following path: from the live side of the battery R, coil of relay C, limb a' of the line, talking apparatus of the subscriber's station, limb a of the line, sleeve-contact s of the jack, anvil j to ground, and to the other side of the battery. The relay thus operated closes its contacts c c' and completes the circuit of the lamp E, which is lighted. The circuit of this lamp may be traced from the live side of the battery R, contacts c' and c of the relay, lamp E, contacts j' and j of the jack, and to ground and the other side of the battery. It will be noticed that the local circuit of the lamp contains a pair of normally open relay-contacts and a pair of normally closed jack-contacts in series. The operator, seeing the illumination of the line-lamp E, inserts an answering-plug P, thereby continuing the circuit of the line to the cord-circuit. The insertion of this plug cuts off the ground connection from the sleeve side of the line and also opens the circuit of the lamp between the contacts j and j', thus extinguishing the lamp. Having learned the connection desired, the operator completes the connection with the subscriber called for and rings the bell of this subscriber in the ordinary manner. The circuit by which talking-current is fed to the subscriber's line when a connection is made is traced from the ungrounded side of the battery R, through the coil of the relay C belonging to that line, to the limb a' of the line, through the subscriber's talking apparatus, to the limb a, through the sleeve-contact s of the jack, thence by the sleeve-strand of the cord through the relay M or N to the ground, and to the other terminal of the battery. The condensers l and l' serve to transmit the talking-current and at the same time to keep the two portions of a cord-circuit isolated with respect to direct currents. As soon as a connection is made with a line the corresponding supervisory relay M or N is operated if the subscriber's receiver is off its hook, and thus opens the circuit of the corresponding supervisory lamp. The circuit of the lamp is then complete save for the relay-contacts, since the tip of the plug is in contact with the tip-spring of the jack, which in turn is connected to ground through the coil of the relay C and the battery R, as before pointed out. As soon, therefore, as either subscriber hangs up his receiver the corresponding supervisory relay M or N lets go of its armature, thus lighting the lamp M′ or N′ as a signal to the operator. When both subscribers have hung up their receivers, both supervisory lamps will be lighted and the operator will know that a disconnection is desired. If either subscriber desires to attract the attention of the operator, he may do so by rapidly raising and lowering his receiver-hook, which will cause a winking of the corresponding supervisory lamp.

Fig. 2 shows exactly the same system as Fig. 1, except that the limb a of the line is extended directly to the grounded pole of the battery, and armatures m of the supervisory relays are likewise connected. The very same circuit connections exist, however, as in Fig. 1, and the operation is the same throughout. It is obvious that either pole of the battery or batteries may be grounded or that the ground may be entirely omitted, the common office-return being used instead, and that various other changes may be made in the arrangement and connections of the system without departing from the spirit of the invention.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a telephone system, a subscriber's line connected for conversation, a source of current, a line-signal-controlling electromagnet connected between one side of said source of current and one side of said line, a supervisory relay connected between the other side of said source of current and the other side of said line, and a supervisory lamp controlled by said supervisory relay and having a portion of its circuit coincident with a portion of the talking-circuit.

2. In a telephone system, a subscriber's line connected for conversation, a source of current, a line-signal-controlling electromagnet connected between one side of said source of current and one side of said line, a supervisory relay connected between the other side of said source of current and the other side of said line, a supervisory lamp controlled by said supervisory relay and having a portion of its circuit coincident with a portion of the talk-

ing-circuit, and means for opening the circuit of said lamp by the disconnecting of the line.

3. In a telephone system, a subscriber's line connected for conversation, a source of current permanently connected with one side of a line, a supervisory relay connected between the other side of said source of current and the other side of said line, and under the control of the subscriber, a supervisory lamp controlled by said supervisory relay and having a portion of its circuit coincident with a portion of the talking-circuit.

4. In a telephone system, a subscriber's line connected for conversation, a talking-battery, a line-signal-controlling electromagnet connected between one side of the said talking-battery and one side of said line, a supervisory relay connected between the other side of said battery and the other side of said line, and a supervisory lamp controlled by said supervisory relay and having a portion of its circuit coincident with a portion of the talking-circuit.

5. In a telephone system, a metallic circuit-line, a central and common source of current and a line-relay normally connected in series between the conductors of said line, a circuit local to the exchange controlled by said relay and containing a line-signal, a spring-jack, and contacts of said jack in the circuit of said relay and source and in said local circuit containing the signal, substantially as described.

6. The combination with a telephone-line, of a central battery with which the limbs of said line are connected, a line-relay in one limb of said line, jack-contacts in the other limb of the line, and a local circuit controlled by said relay, the said circuit also having normally closed contacts in the spring-jack of the line, and means for opening both sets of contacts when a connection is established with the line, substantially as described.

7. The combination with a telephone-line, of a central battery, one limb of said line being permanently connected with said battery, a spring-jack for the line, the second limb of the line being passed through normally closed contacts in said jack to the other pole of the battery, a cord-circuit having one strand connected with said latter pole of the battery, a supervisory relay connected therewith, and means whereby the insertion of the connecting-plug into the spring-jack of the line opens the said limb of the line through the jack and substitutes therefor the said cord-circuit strand, whereby the supervisory relay is operated from the central battery over the telephone-line, substantially as described.

8. The combination with a telephone-line, of a central source of current, a line signaling device normally included in the line-circuit, a spring-jack for the line, one limb of said line being normally completed through contacts of said jack, a cord-circuit having a strand adapted to be connected with said limb, a supervisory relay connected with said strand, and a connection to the same pole of the battery as said limb, whereby when a connection is established, the said limb is open in the jack and the battery connected between the other limb of the line and the said strand to cause current to pass through the supervisory relay and over the line-circuit, substantially as described.

9. The combination with a telephone-line, of a central source of current, a line signaling device in one limb of the line, a spring-jack for the line, the second limb of the line being normally completed through contacts of said jack, a cord-circuit having a strand adapted to be connected with said second limb, a supervisory relay connected with said strand, and a connection to the same pole of the battery as said second limb, whereby when a connection is established the second limb is opened in the jack and the battery connected between the first-named limb and the said strand to cause current to pass through the supervisory relay and over the line-circuit, substantially as described.

10. The combination with a telephone, of a central source of current, a line signaling device normally included in the line-circuit, one limb of the line being permanently connected with one pole of the battery, a spring-jack for the line, the second limb of the line being normally completed through contacts of said jack, a cord-circuit having a strand adapted to be connected with said second limb when a connection is established, a supervisory relay connected with the said strand, a conductor leading to the same pole of the battery as said second limb, whereby the substation transmitter and the supervisory relay are charged from said central battery through said strand of the cord-circuit and the permanently-connected limb of the telephone-lines, and means to prevent short-circuiting of the voice-currents through branches leading to the battery, substantially as described.

11. The combination with a telephone-line, of a central source of current, a line signaling device in one limb of the line connected permanently with the one pole of the battery, a spring-jack for the line, the second limb of the line being normally completed through contacts of said jack, a cord-circuit having a strand adapted to be connected with said second limb when a connection is established, a supervisory relay connected with the said strand, and a conductor leading to the same pole of the battery as said second limb, said signaling device and supervisory relay possessing sufficient impedance to prevent the passage of voice-currents, whereby the substation transmitter and the supervisory relay are charged from said central battery through said strand of the cord-circuit and the permanently-connected limb of the telephone-line, substantially as described.

12. The combination with a telephone-line,

of a central battery, a cord-circuit, a supervisory relay under the complete control of the subscriber of that line while the cord-circuit is connected therewith, said relay being connected with one strand of said circuit, a supervisory signal connected with the second strand of said circuit and with the same pole of said battery as said relay, the said relay serving to control the circuit of said signal substantially as described.

13. The combination with a telephone-line, of a central battery, one limb of said line being extended permanently to one pole of the battery, a line-contact of said limb, a cord-circuit, and a supervisory signaling device connected with the strand of said circuit that is adapted to be electrically connected with said contact when a connection exists, a conductor from the other terminal of said device to the second pole of the battery, and means to control the said device from the substation, substantially as described.

14. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, said source being included in the metallic telephone-line during conversation for talking purposes, a signal operated by said magnet, a cord-circuit, means to render the said signal inoperative when a connection is established with the line, a conductor from said source to one strand only of the cord-circuit during a connection, and a supervisory signal-controlling electromagnet in said conductor outside the talking-circuit, whereby it is in the path of current from said source to a line-conductor and is therefore under the control of the subscriber, substantially as described.

15. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, a cord-circuit, a conductor connected with one strand of the cord-circuit, a supervisory relay in said conductor outside the talking-circuit, and a supervisory signal in a circuit local to the exchange including part of the opposite strand of the cord-circuit and controlled by said relay, substantially as described.

16. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, a cord-circuit having two strands, a supervisory relay associated with one strand and in the path of current therein and over the telephone-line, and a supervisory signal associated with the other strand and having its circuit completed thereover in a circuit local to the exchange, said signal being under the control of the relay so as to be rendered inoperative during conversation and operative at other times during the connection and the relay being under the control of the subscriber, substantially as described.

17. The combination with a telephone-line, of a line signaling device therefor at the central office, a cord-circuit having two strands, a source of current, connections from said source to the cord-circuit, one to each strand, a relay in one of said connections and under the control of the subscriber when the line is switched for use, and a signal in the other connection under the control of the said relay and rendered inert during conversation and active at other times during the connection, the circuit of said signal being local to the exchange, substantially as described.

18. The combination with a telephone-line, of a line signaling device therefor at the central office, a cord-circuit having two strands, a source of talking-current, parallel connections from one pole of said source to the cord-circuit, one to each strand, a supervisory relay associated with the cord-circuit in the path of current from said source over one said connection and strand and adapted to be placed under the control of the subscriber, and a supervisory signal similarly arranged with reference to the other said connection and strand and controlled by said relay, substantially as described.

19. The combination with a telephone-line, of a line signaling device therefor at the central office, a cord-circuit and a connecting-plug therefor, a source of current adapted to furnish current to the substations for conversational purposes, a path for current from one pole of said source to the two line-contacts of the plug, a relay in one of said paths and under the control of the subscriber, and a supervisory signal in the other path and under the control of said relay, substantially as described.

20. The combination with a telephone-line, of a line signaling device therefor at the central office, a cord-circuit having two strands, a source of current, a branch from one pole of said source to each strand, a relay in one branch, and under the control of the subscriber, and a supervisory signal in the other branch, the continuity of the latter branch being controlled through the contacts of said relay, substantially as described.

21. The combination with a telephone-line, of a line signaling device therefor at the central office, a cord-circuit having two strands, a source of current, a branch from one pole of said source to each strand, a relay in one branch and under the control of the subscriber, and a supervisory lamp in the other branch, the continuity of the latter branch being controlled by said relay, substantially as described..

22. The combination with a telephone-line, of a line signaling device therefor at the central office, a cord-circuit having tip and sleeve strands adapted to be connected with the corresponding limbs of the line when a connection is established, a source of current for talking purposes having a connection from one pole direct to one line of conductor, a branch from the other pole thereof to the same strand of the cord-circuit and a supervisory signal therein, and a second branch from the latter pole of said source to the op-

posite strand of the cord-circuit and a relay therein adapted when energized to open the branch containing the signal, whereby when a connection is made a local circuit for the supervisory signal is established and the relay is placed under the control of the subscriber and itself controls the local circuit, substantially as described.

23. The combination with a telephone-line having tip and sleeve limbs, of a line signaling device for the line at the central office, a cord-circuit having tip and sleeve strands adapted to be connected with the corresponding limbs of the line when a connection is established, a source of current for talking purposes having a connection from one pole direct to the tip line conductor, a branch from the other pole thereof to the tip-strand of the cord-circuit and a supervisory signal therein, and a second branch from the latter pole of said source to the sleeve-strand, of said circuit and a relay therein adapted to open when energized the branch containing the said signal, whereby when a connection is made a local circuit for the said supervisory signal is established and the relay is placed under the control of the subscriber to control the local circuit, substantially as described.

24. The combination with a plurality of telephone-lines, of a source of current common to them and permanently connected with one limb of each line, the other limb of each line extending normally to the other pole of the battery but adapted to be opened when a connection is made with the line, a cord-circuit adapted to link any two of the lines together for conversational purposes, a condenser in the strand thereof adapted to connect the opened limbs of the lines together, a branch from each side of the condenser to the pole of said source opposite the permanent connection, a relay in the path of current flowing over each said branch and portion of the strand connected therewith, whereby the relays are placed under the control of the respective subscribers, similar branches leading to the other strand of the cord-circuit, and a supervisory signal in each said branch and controlled by the corresponding relay, substantially as described.

25. The combination with a plurality of telephone-lines, of a source of current common to them and permanently connected with one limb of each line, the other limb of each line extending normally to the other pole of the battery but adapted to be opened when a connection is made with the line, a cord-circuit adapted to link any two of the lines together for conversational purposes, a condenser in the strand thereof adapted to connect the opened limbs of the lines together, a branch from each side of the condenser to the pole of said source opposite the permanent connection, a relay in each said branch, like branches to the other strand of the cord-circuit, and a supervisory signal in each branch controlled by the corresponding relay, substantially as described.

26. The combination with a telephone-line, of a source of current for talking, one limb of said line being connected permanently with one pole of said source and the other limb normally connected therewith, but adapted to be opened when the line is switched for use, a cord-circuit having two strands, and a connection from each strand to the pole of said source opposite the permanent connection, a supervisory lamp in one connection, and a relay in the other controlling the continuity of said lamp connection, substantially as described.

27. The combination with a telephone-line, of a line-relay and source of current normally in circuit with the line, a spring-jack for the line, one limb of said line including jack-contacts, a cord-circuit adapted to be connected with the line and to open said jack-contacts, a supervisory signal associated therewith, and means for establishing a path for current over one side of said cord-circuit and local to the exchange to operate the said supervisory signal, and a relay adapted to render the said signal inoperative and having its winding disposed in the path of current over the other side of the said cord-circuit and telephone-line, said relay being controlled by the subscriber, substantially as described.

28. The combination with a telephone-line, of a line-signal and source of current normally in circuit with the line, said line having one limb passing through contacts associated with the jack and adapted to be opened when a connection exists therewith, a cord-circuit, a supervisory signal associated with the cord-circuit, means for operating said signal over a circuit local to the exchange when said cord-circuit is connected with the line, and means controlled by the subscriber for rendering said signal inoperative by current passed over the line-circuit, substantially as described.

29. The combination with a telephone-line, of a line-signal, a source of current normally in circuit with the line, a limb of said line being extended through jack-contacts of said line, a cord-circuit adapted when connected with the line to open said contacts and thereby render the line-signal inoperative, a supervisory signal associated with the cord-circuit, means for operating said signal over a circuit local to the exchange including a portion of the talking-circuit when said cord-circuit is connected with the line and when the subscriber's telephone is not in use, and means controlled by the subscriber for rendering said signal inoperative by current passed over the line-circuit, substantially as described.

30. The combination with a telephone-line, of a signal and source of current normally in circuit with the line, said line having a limb passing through contacts associated with the

line-jack and adapted to be opened when a connection is established to render the line-signal inoperative, a cord-circuit, a supervisory lamp associated therewith, means for operating said lamp over a circuit local to the exchange including a part of the talking-circuit when a connection is established with the line, and a relay connected with the same pole of said source as said lamp and controlled by the subscriber for rendering said lamp inert, said relay being operated by current passed over the line-circuit, substantially as described.

In witness whereof I hereunto subscribe my name in the presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:
LEROY D. KELLOGG,
KEMPSTER B. MILLER.