April 7, 1931. J. W. GOODERHAM 1,799,811

SIGNALING SYSTEM

Filed Feb. 24, 1930 3 Sheets-Sheet 1

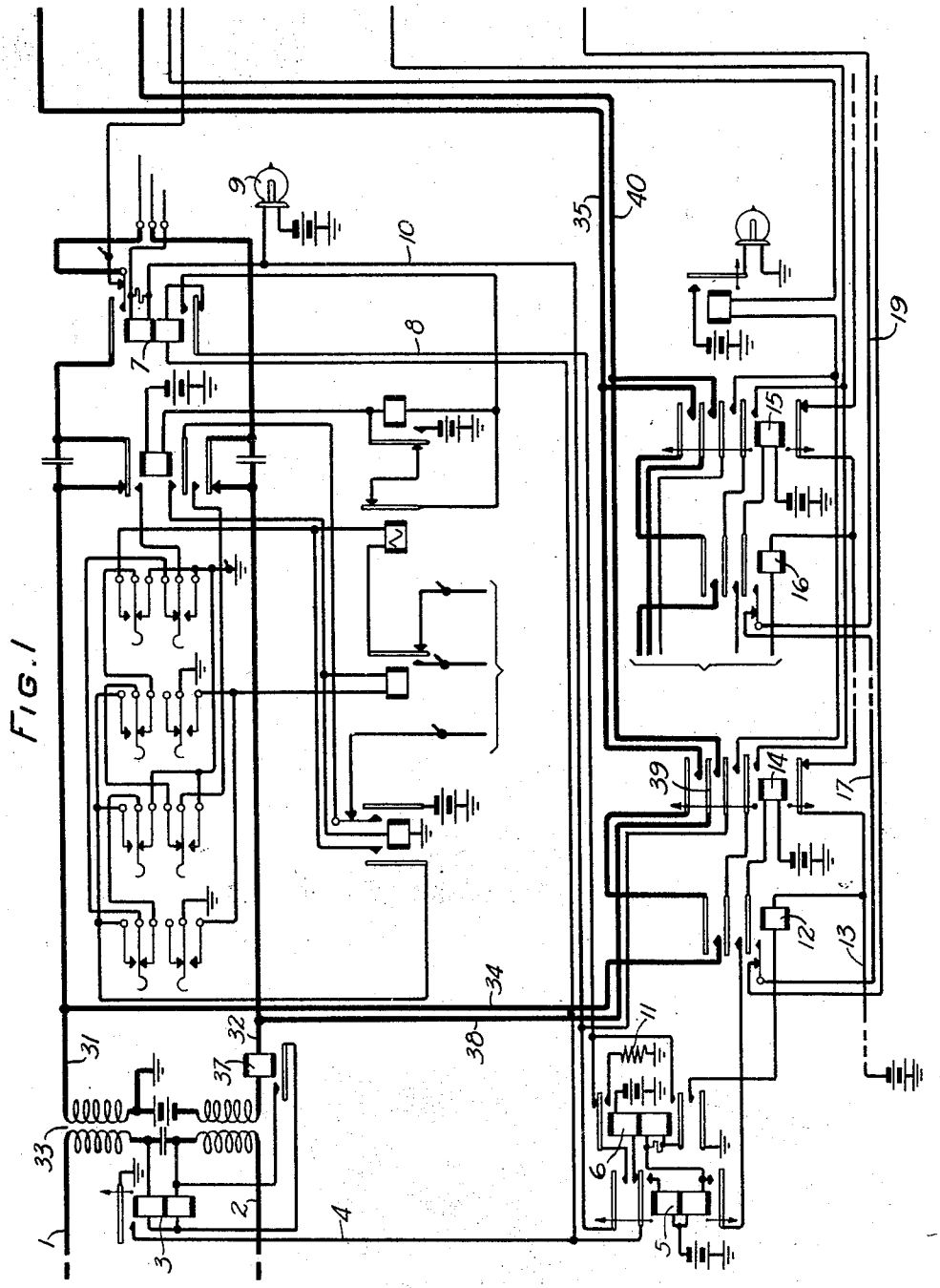

FIG. 1

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SIGNALING SYSTEM

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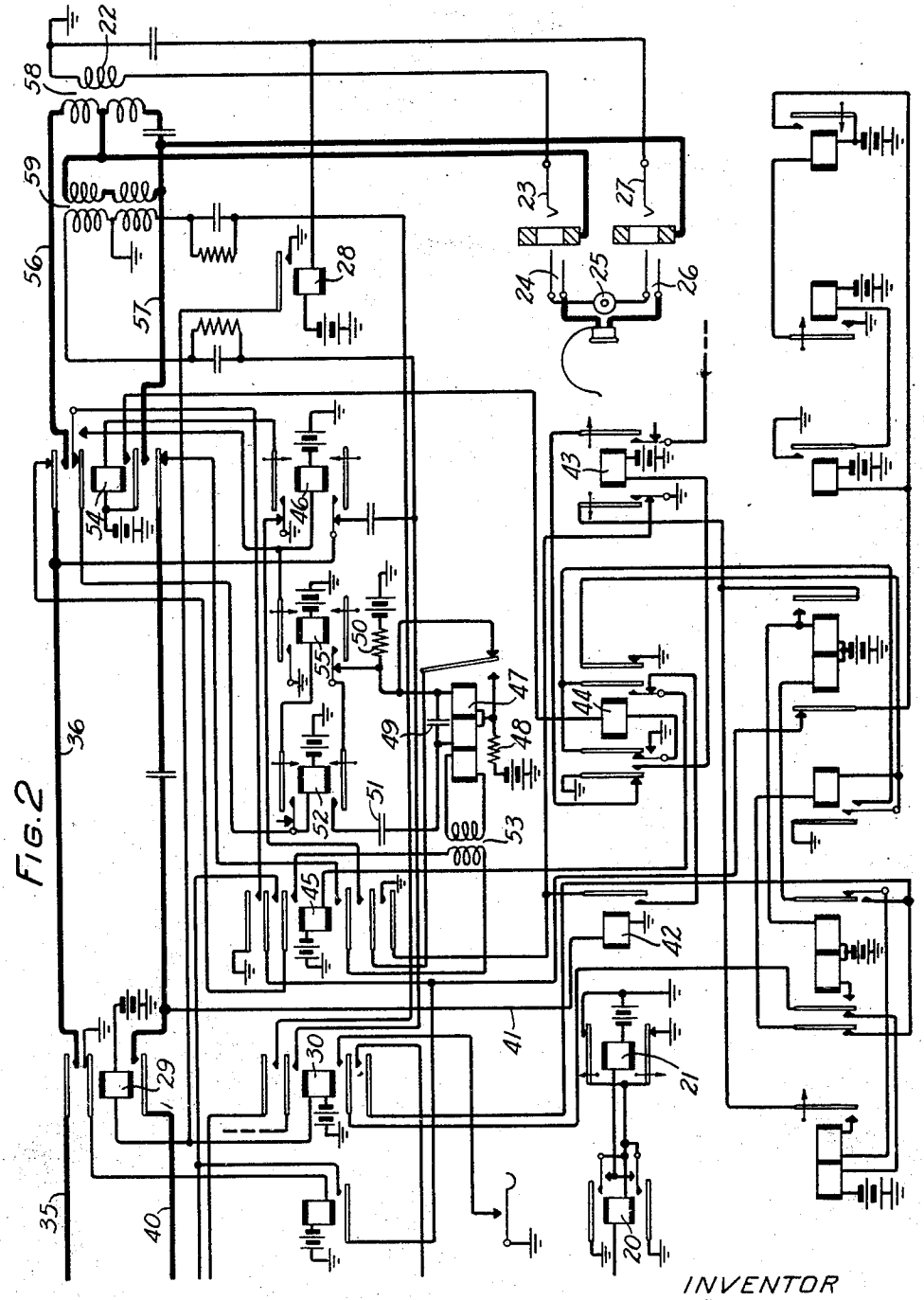

FIG. 2

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SIGNALING SYSTEM

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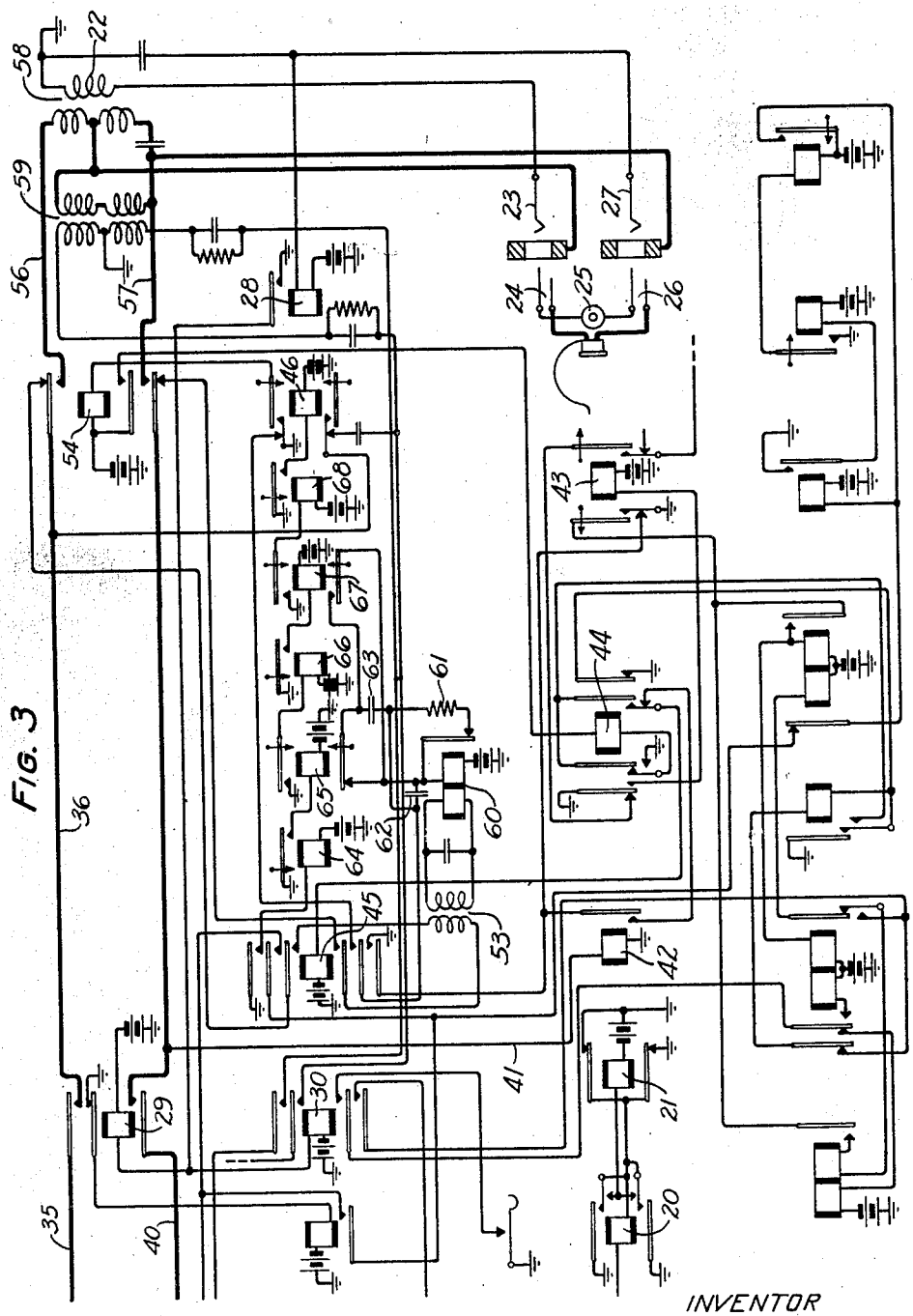

FIG. 3

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Patented Apr. 7, 1931 1,799,811

UNITED STATES PATENT OFFICE

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SIGNALING SYSTEM

Application filed February 24, 1930. Serial No. 430,475.

This invention relates to signaling systems and particularly to means for producing audible tones for use in telephone systems.

The invention consists essentially of a signaling arrangement for producing a tone current of definite time duration divided into several shorter periods of different pitch characterized in this, that the tone is produced through the vibrations of a relay and the pitch thereof is changed through variation of an electrical network in the energizing circuit of the relay.

The drawings consist of three sheets of circuit diagrams. Fig. 1 shows the incoming end of a straightforward trunk and part of a sequence circuit through which the straightforward trunk is connected to an operator's control circuit. Fig. 2 when placed to the right of Fig. 1 shows an operator's telephone and control circuit. Fig. 3 is a modification of the circuit of Fig. 2 and may be placed to the right of Fig. 1 to form a complete circuit arrangement.

When the straightforward trunk is seized at its outgoing end, battery and ground are placed on conductors 1 and 2, whereupon current will flow through the two windings of relay 3 in series. Relay 3 becoming energized places ground on conductor 4 which will extend through the inner upper armature and back contact of relay 5, the upper winding of relay 6 to battery and ground. Relay 6 becomes operated and completes a connection from ground on conductor 4 through the lower winding of relay 7, the back contact and lower armature of relay 7, conductor 8, front contact and inner lower armature of relay 6, lower winding of relay 6, lower winding of relay 5 to battery and ground. Relay 5 becomes operated in this circuit in series with the lower winding of relay 6 which now holds through such lower winding. Upon the energization of relay 5, a circuit for signal lamp 9 is established from battery, lamp 9, conductor 10, outer upper armature and front contact of relay 5, upper armature and front contact of relay 6, resistance 11 to ground.

Due to the operation of relay 6, a circuit is now established from ground, lower armature and front contact of relay 6, winding of relay 12, conductor 13 through a chain of contacts such as those formed by the lower armatures and back contacts of relays 14 and 15 and indicated by the dotted line 13 to the left and thence to battery. Relay 12 becomes energized in this circuit and through its inner upper armature connects the winding of relay 14 to conductor 17. Conductor 17 may be traced through a chain of contacts such as the normal contacts of the inner upper armature of relays 12 and 16 and thence to conductor 19, winding of relay 20, armatures and back contacts of relay 21 to ground. Providing the various chain circuits above described are closed, which will indicate that a call may be at this time attended to by the operator, relays 14 and 20 will become energized.

Relay 20 in operating connects an auxiliary ground through its own armatures, front contacts and winding to conductor 19 and at the same time operates relay 21. Relay 21 opens the original connection to ground but since ground is supplied by the armatures of relay 20 and since such substitute ground was connected to conductor 19 before relay 21 became energized, there will be no break in the continuity of this circuit.

It will be noted at this point that when at some later period the circuit including conductor 19 is opened and relay 20 becomes energized during the period between the deenergization of the fast relay 20 and the slow releasing relay 21, ground will be disconnected from conductor 19 for a predetermined period of time.

Upon the energization of relay 14 it will be noted that through its lower armature the continuity of the first chain circuit described is broken so that no other trunk can advance to the point of cooperation with the operator's control and telephone circuit.

Assuming that the operator's set shown at the right of Fig. 2 has been put in service, a circuit will be established from ground, transformer winding 22, tip 23 of the operator's telephone jack, tip 24 of the operator's telephone plug, transmitter 25, tip 26 of the

operator's telephone plug, tip 27 of the operator's telephone jack, winding of relay 28 to battery and ground. So long as the operator has her telephone set plug in its jack, relay 28 will remain operated and will mark this operator's control and telephone circuit as active. The operation of relay 28 results in the operation of relays 29 and 30.

Upon the operation of relays 12 and 14 the tip and ring conductors 31 and 32 of the trunk are connected to the operator's control circuit. A connection from ground may be traced through the upper right-hand winding of repeating coil 33, conductor 31, conductor 34, front contact and outer upper armature of relay 12, outermost upper armature and front contact of relay 14, conductor 35, outer upper armature and front contact of relay 29 to conductor 36. Since this ground connection plays no part at the present time it will not be further traced.

A connection from battery may be traced through the lower right-hand winding of repeating coil 33, winding of supervisory relay 37, conductor 32, conductor 38, armature 39 and its front contact, conductor 40, lower armature and front contact of relay 29, conductor 41, winding of relay 42 to ground. Relay 42 is of very high resistance and while it becomes energized in this circuit, will not cause the energization of the supervisory relay 37.

Upon the energization of relay 42, a circuit is established from ground and normal contact of the armature of relay 43, armature and front contact of relay 42, normal contacts of the inner right-hand armature of relay 44, winding of relay 45 to battery and ground. Relay 45 becomes energized in this circuit. Through its outermost lower armature and front contact, relay 45 provides a substitute ground for its own energization in place of that originally supplied by the normal contact of the left-hand armature of relay 43.

Through its middle lower armature and front contact relay 45 establishes a circuit from ground, normal contact of the upper armature of relay 46, the front contact and middle lower armature of relay 45, armature and back contact of relay 47, right-hand winding of relay 47, resistance 48 to battery. Before the armature of relay 47 moves, it will be noted that a ground is connected to the right-hand terminal of condenser 49 and a battery connection through the middle winding of relay 47 is connected to the left-hand terminal of condenser 49. Relay 47 becomes energized through its right-hand winding and upon moving its armature from its back to its front contact it reverses the direction of the current flow in the right-hand winding thereof, since the armature is now connected to the lower terminal of the right-hand winding and the upper terminal thereof being connected through resistance 50 to battery. Also the connections to condenser 49 are reversed so that this results in a discharge of the condenser and a charge in the opposite direction, the current for this purpose flowing through the middle winding of relay 47. Since the movement of the armature of relay 47 results in a reversal of the field strength, this goes through a zero point at which the armature will release and re-establish the original energizing condition. Thus the armature of relay 47 vibrates rapidly between its front and back contact and the rate at which this takes place is regulated by the value of condenser 49, since the capacity of this condenser determines the value of the transient currents flowing through the middle winding of relay 47.

It will be noted that an extra condenser 51 will be placed in parallel with condenser 49 upon the energization of relay 52. This is to change the rate of vibration of the armature of relay 47 and thus change the pitch of the tone produced by this relay.

A third winding, the left-hand one, on relay 47 is connected to the primary winding of a transformer 53, the secondary winding of which is connected through the innermost upper and innermost lower armature and front contacts of relay 45 to the tip and ring conductors of the trunk through the back contacts and outermost armatures of relay 54. Therefore, as soon as relays 12 and 14 have been energized as described resulting in the energization of relay 42, relay 47 will begin to vibrate at one rate to produce a tone of a given pitch. This will be transmitted back over the tip and ring conductors 35 and 40 and thence over the trunk conductors 1 and 2 to the operator at the outgoing end thereof.

Upon the operation of relay 45 a circuit is also closed from ground, the outermost upper armature and front contact of relay 45, the back contact and inner upper armature of relay 54, winding of relay 52 to battery and ground. Relay 52 is a slow operating relay and therefore in a short interval after the closure of the circuit just traced becomes energized. Relay 52 places condenser 51 in parallel with condenser 49 and this results in changing the pitch of the tone being transmitted to the operator at the distant end of the straightforward trunk of Fig. 1.

Through its upper armature, relay 52 extends the ground for its own energization to the winding of relay 55 and this becomes energized in a short interval. Upon the energization of relay 55 the connection of condenser 51 is broken and relay 47 begins to vibrate now at its original rate, thus producing the tone originally produced. Upon the energization of relay 55 a circuit is also closed for the energization of relay 46 and this relay becoming energized after a short interval

opens the energizing circuit of relay 47 so that this now ceases to vibrate.

Thus during the successive energization of relays 45, 52, 55 and 46 a tone divided into three intervals of two different pitches has been transmitted back to the operator at the outgoing end of the straightforward trunk.

Upon the energization of relay 46 a ground is connected through the winding of relay 54 to battery so that this relay now becomes operated. Relay 54 disconnects the tip and ring conductors 35 and 40 from the secondary winding of transformer 53 through the outermost armatures of relay 54 to tip and ring conductors 56 and 57 respectively. These tip and ring conductors are connected to the transformers 58 and 59 in such a way that the operator's transmitter and receiver now become effective so that she may communicate with the operator at the distant outgoing end of the trunk.

Since further operations of this circuit are not material to the present invention, they will not be further described.

When Fig. 3 is placed to the right of Fig. 1 in place of Fig. 2, the modification of the present invention will be illustrated. Since the circuit of Fig. 3 is in many respects the same as the circuit of Fig. 2, the same figures will be used to designate corresponding apparatus.

In this instance relay 42 becomes operated in the same manner and results in the operation of relay 45. Relay 45 closes a circuit for the energization of relay 60. This circuit may be traced from ground, normal contacts of the upper armature of relay 46, middle lower armature and front contact of relay 45, resistance 61, back contact and armature of relay 60, right-hand winding of relay 60 to battery. Relay 60 acts as a buzzer in this circuit since upon its energization it breaks its own circuit at its own back contact.

Condenser 62 is bridged around the armature and back contact of relay 60 and its value determines the rate of vibration thereof. Another condenser 63 normally placed in parallel with condenser 62 through the back contact of relay 65 aids in the determination of the speed of vibration of relay 60. It will be noted that relays 64, 65, 66, 67 and 68 form a chain of slow operating relays which will be sequentially operated. Therefore, upon the operation of relay 45, relay 60 begins to vibrate at one rate and through its left-hand winding induces a tone current into the transformer 53 which is as in the previous case transmitted to the operator at the outgoing end of the straightforward trunk.

When relay 65 becomes operated the circuit of condenser 63 is opened and the speed of vibration of relay 60 changes and therefore the pitch of the tone being transmitted changes. After a short interval, relay 66 becomes operated and then relay 67 becomes operated. Upon the operation of this latter relay, condenser 63 is again connected in parallel with condenser 62 so that the relay 60 now vibrates at its original speed and the tone is changed back to its original pitch. When in the course of time relay 68 becomes operated and then relay 46 becomes operated, the original circuit for relay 60 will be opened and this relay will cease to function.

Thus in the case of the circuit shown in Fig. 3 the same result will be attained, that is, upon the extension of the straightforward trunk to the operator's control circuit a tone will be passed back to the originating operator in the form of three intervals of two different pitches.

Since the operations of the remainder of the apparatus as shown on this figure are not material to the present invention they will not be further described.

What is claimed is:

1. In a signaling system, a sequentially operating timing arrangement, a source of tone current energized thereby, and means controlled by said timing arrangement for changing the pitch of the tone produced by said source during its period of energization.

2. In a signaling system, a sequentially operating timing arrangement, a vibrating relay for producing a tone current, said relay being energized for a definite period by said timing arrangement, and means controlled by said timing arrangement for changing the speed of vibration of said relay during its period of energization.

3. In a signaling system, a sequentially operating timing arrangement, a vibrating relay for producing a tone current, said relay being energized for a definite period by said timing arrangement, a variable electrical network for controlling the speed of vibration of said relay, and means controlled by said timing arrangement for varying said network during the period of energization of said relay.

4. In a signaling system, a sequentially operating timing arrangement, a vibrating relay, a winding of said relay for delivering a tone current, said relay being energized for a definite period by said timing arrangement, a variable electrical network for controlling the pitch of the tone delivered by said relay winding, and means controlled by said timing arrangement for varying said network during the period of energization of said relay.

In witness whereof, I hereunto subscribe my name this 19th day of February, 1930.

JOHN W. GOODERHAM.