

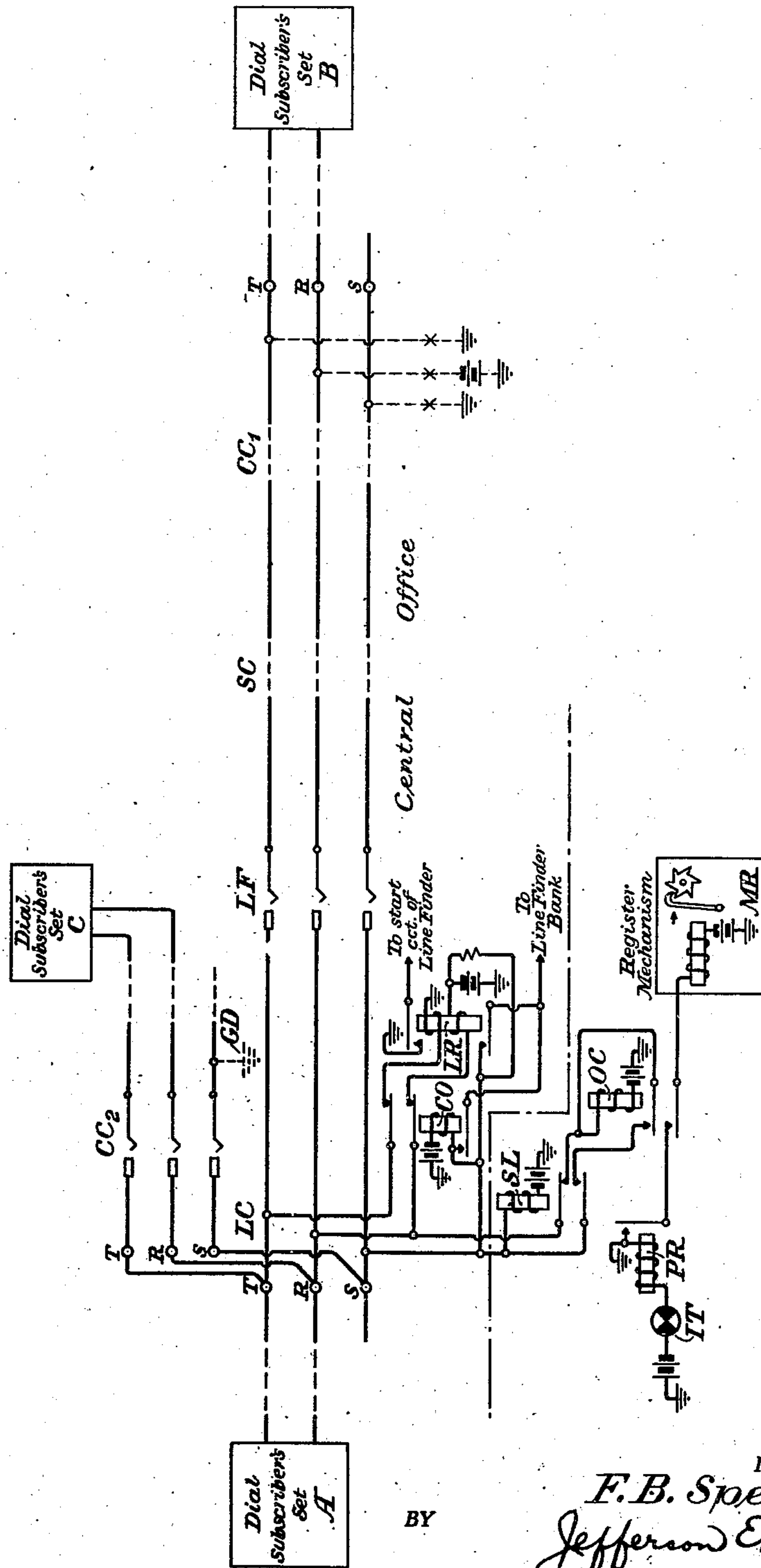
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LINE USAGE RECORDER CIRCUIT

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LINE USAGE RECORDER CIRCUIT

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This invention relates generally to telephone systems and, more particularly, to arrangements in telephone systems for recording the number of calls made from a subscriber's station or for recording the length of time that a subscriber's station is in use for calls originating at the subscriber's station.

Dial central offices are generally designed so that each subscriber's line appears before two sets of switches, one set carrying calls originated by the subscriber's station, and a different set carrying terminating calls to be completed to the subscriber's station. Means are provided for shifting lines from one group of originating switches to another without changing subscriber's telephone numbers. It is accordingly desirable to have information regarding the amount of time that the various lines are busy on originating calls to aid in balancing the loads carried by different groups of originating switches.

Message registers are used in telephone systems to record the number of calls originating in a subscriber's station for which a charge is to be made. Such a message register may be operated under control of an associated polarized relay connected in series with the subscriber's line. The polarized relay is operated by a reversal of current which occurs after a call is completed, if the call originates at the subscriber's station and is one for which a charge is to be made. Such message registers do not indicate the length of time that a subscriber's station is in use, nor the number of calls that the subscriber may attempt to make in any given time interval.

Accordingly, it is an object of this invention to provide a simple and relatively inexpensive arrangement for indicating the total time during which a subscriber's station may be in use on originating calls. Such information obtained during busy hours from a number of subscribers' stations in a given telephone central office will be of value in determining whether the subscribers' stations observed are overloading a group of available lines of the central office and, therefore, whether some of those subscribers' stations should not be transferred to less heavily loaded line groups. Such information may also be of value in determining whether any of the lines are underloaded so that such lines may likewise be redistributed to effect a balanced load.

Another object of this invention is to provide a simple arrangement for indicating the number of calls that a subscriber's station is attempting to make during any given time interval.

The objects of this invention may be accomplished by two relays connected in a novel circuit arrangement to the ring and sleeve conductors at the central office. The first of these relays is connected to the sleeve conductor of the line to be observed. The second relay is connected to the ring conductor of the line through one of the armatures of the first relay and its back contact. The second relay becomes operated immediately after the subscriber removes his receiver from its switch-hook and remains operated, under control of the first relay, as long as the receiver is off its switch-hook. When the subscriber's telephone set is connected to the selectors of the central office, the sleeve conductor will become grounded so as to operate the first relay, but the second relay will be held operated. The second relay, when operated, actuates a timing or register mechanism or circuit to record the time during which the subscriber's line is busy during the call originated by the subscriber's station. When the subscriber returns his receiver to its switch-hook at the end of the call, ground will be removed from the sleeve conductor, thereby releasing the first relay which in turn will cause the second relay to be released also. The timing or register mechanism will therefore cease operating.

Although the timing or register arrangement will record the time usage of the subscriber's circuit for calls originating at the subscriber's station, the circuit of the two relays is set up so that calls received by the subscriber's station from another station will fail to operate the timing or register mechanism. The timing or register mechanism will thus distinguish between incoming and outgoing calls.

This invention will be better understood from the more detailed description hereinafter following, when read in connection with the accompanying drawing which illustrates the invention applied generally to a step-by-step telephone system, although the invention is equally applicable to any other type of telephone system.

Referring to Figure 1 of the drawing, there is shown a dial subscriber's telephone set A connected to a line circuit LC at the central office. The line circuit LC includes, among other things, a line relay LR and a cutoff relay CO. The upper winding of the line relay LR connects ground to the tip conductor T through the upper outer armature and back contact of relay CO. The lower winding of line relay LR connects battery to the ring conductor R through the upper inner armature and back contact of relay CO. The line

circuit LC may be of any well known type. A suitable form of line circuit is shown, for example, in R. L. Stokely Patent 1,799,654, issued April 7, 1931.

When a call is made from the subscriber's set A, then upon the removal of the receiver from its switch-hook the line relay LR will become operated. The operating circuit for relay LR will include battery, the lower winding of relay LR, the upper inner armature and back contact of relay CO, conductor R, subscriber's set A, conductor T, the upper outer armature and back contact of relay CO, the upper winding of relay LR and ground. The operation of relay LR controls the start circuit of a line finder LF of well known type, which will hunt for the calling party's line. When the line finder LF has found the calling line, it extends the conductors T, R and S into the first selector SC. The selector SC connects ground to the sleeve conductor S, thereby making the line test busy to incoming calls, and operating the cutoff relay CO. Operation of the relay CO disconnects the windings of relay LR from the line, causing relay LR to release and remove the line finder start condition. Upon dialing digits corresponding to the called party's set B the calling party's line will then be connected in a well known manner through the selector SC and then through a connector such as CC₁ to the called party's set B if it is idle. The line finder (or trunk finder) LF, the selector SC and the connector CC₁ may be of any well known types. The E. D. Butz Patent 2,021,286, issued November 19, 1935, for example, shows suitable forms of these switching structures.

When measurement of originating traffic is desired the equipment below the dotted line is provided and is connected to the R and S terminals of the line circuit as indicated. It is observed that the winding of relay OC is connected to the ring conductor R through the inner armature and back contact of relay SL. The winding of relay SL is shown connected to the sleeve conductor S. The two relays OC and SL are the control relays at the central office for actuating the line usage recorder equipment to determine the length of time that the subscriber's set A is in use for calls originating at that telephone set, as will now be described.

When the receiver of the subscriber's set A is removed from its switch-hook, as already described, to complete a call to a distant subscriber's set B, for example, the relay OC will become operated due to the grounding of the tip conductor T. The circuit completed to operate relay OC will include battery, the winding of relay OC, the inner armature and back contact of relay SL, the ring conductor R, the telephone set A, the tip conductor T, the upper outer armature and back contact of relay CO, the upper winding of relay LR and ground. In operating, relay OC partially closes a locking circuit for itself through its lower inner armature and make contact. This locking circuit for relay OC can be completed only after relay SL becomes operated. Ground will be applied to the sleeve conductor S when the line finder LF finds the calling party's line and this ground will be maintained after selector SC and connector CC₁ are seized and the telephone circuit is completed to the called party's set B. This ground is shown generally at the connector CC₁. The grounding of the sleeve conductor S will cause relay SL to operate over

a circuit including battery, the winding of relay SL, and the grounded sleeve conductor S. The operation of relay SL will complete the locking path for relay OC through the lower outer armature and make contact of relay SL. Relay OC will be held operated as long as relay SL is operated and relay SL will in turn be held operated as long as sleeve conductor S is grounded.

The operation of relay OC is accompanied by the periodic operation of the register circuit MR. The register circuit includes battery, the winding of the magnet of register MR the lower outer armature and make contact of relay OC, the armature of relay PR and its make contact and ground. The relay PR is periodically operated over a circuit including battery, the interrupter IT, the winding of relay PR and ground. The relay PR and interrupter IT constitute a pulsing circuit, operating relay PR at regular intervals of, for example, six seconds. When relay OC is operated, the magnet of the register MR will be operated at like intervals of time. The wheel controlled by the armature of the magnet of register MR will record the number of time intervals that relay OC is operated. As relay OC operates immediately after the receiver of telephone set A is removed from its switch-hook to initiate a call, the register mechanism MR will submit readings from which the length of time that telephone set A is in such use may be determined. When the call is completed, relay OC will release and thereby stop the operation of the register mechanism MR.

On incoming calls to the subscriber's set A from a telephone subscriber's set such as C, a similar circuit will be completed by the central office equipment including a connector CC₂ to establish the necessary telephone path between the telephone sets. The connector CC₂ will hunt for the called line or station in the usual way and, on finding the sleeve conductor S of the called line or station ungrounded, it will apply ground to the sleeve conductor S. This ground is shown in dotted lines at GD and its presence at the sleeve terminal S will guard the circuit against seizure by other parties. The application of ground to sleeve conductor S occurs before the called party is rung and before he removes his receiver from its switch-hook. This ground on the sleeve conductor S will operate relay SL over the circuit including battery, the winding of relay SL, sleeve conductor S, and ground at GD. The operation of relay SL will open the circuit to relay OC at the back contact of the lower inner armature of relay SL and thereby prevent the operation of relay OC for the incoming call.

It is observed that the winding of relay SL is connected to the sleeve terminal S and that the winding of relay OC is connected to the ring terminal R through the inner armature and back contact of relay SL. An outgoing call from station A will operate relay OC before relay SL becomes operated. On the other hand, an incoming call to station A will operate relay SL before relay OC becomes operated. This arrangement distinguishes between incoming and outgoing calls without polarized relay structures. Outgoing calls alone will operate the register apparatus MR. The arrangement is simple and inexpensive. Any number of these arrangements can be connected to a line finder group in the central office to observe the line usage times of the associated telephone stations and to determine which of the various stations or groups of stations are

overloaded (or underloaded) during the day or part of the day.

The relay SL should be adjusted so that the make contact of its lower outer armature will be closed before the back contact of its lower inner armature is opened. This will insure the completion of the locking circuit for relay OC before the main operating circuit for relay SL is opened.

If the register mechanism MR is to furnish a record of the number of times that the subscriber at station A attempts outgoing calls, then the relay PR and interrupter may be omitted. In that case the make contact of the lower outer armature of relay OC will be connected to ground (not shown). Each attempted outgoing call from station A will operate relay OC once and each operation of relay OC will operate the register mechanism MR once.

Although the arrangement of this invention has been shown and described generally in connection with step-by-step central office equipment, it will be understood that the invention may be set up in other and widely varied organizations and may be applied to other types of telephone or signaling systems, without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a telephone system, the combination of tip, ring and sleeve terminals, a subscriber's set connected to said tip and ring terminals, a first relay having its winding connected to said sleeve terminal, a second relay having its winding connected to the ring terminal through the armature and back contact of said first relay, register mechanism controlled by said second relay, means responsive to a call initiated by said subscriber's set to operate said second relay and to lock said second relay, and means responsive to a call received by said subscriber's set to operate said first relay to prevent the operation of said second relay.

2. In a telephone system, the combination of a subscriber's set, a first relay, a second relay, register mechanism controlled by said second relay, means responsive to the removal of the receiver of said subscriber's set from its hook to initiate a call to operate said second relay and lock said second relay in its operated position, and means responsive to a call to said subscriber's set to operate said first relay and to prevent the operation of said second relay.

3. Telephone apparatus comprising tip, ring and sleeve terminals, a first subscriber's set connected to the tip and ring terminals, a second subscriber's set which may also be connected to

said tip and ring terminals, a first relay having two armatures, the winding of said first relay being connected to said sleeve terminal and operable when said sleeve terminal becomes grounded, a second relay connected to the ring terminal through one of the armatures of said first relay and its back contact, a locking circuit for said second relay extending through the other of the armatures of said first relay and its make contact to the sleeve terminal, recording apparatus controlled by said second relay, means responsive to a call initiated from said first subscriber's set to operate said second relay, and means responsive to a call initiated by said second subscriber's set to operate said first relay and to prevent the operation of said second relay.

4. Telephone apparatus comprising tip, ring and sleeve terminals, a subscriber's set connected to said tip and ring terminals, a first relay controlled by ground applied to said sleeve terminal, a second relay connected to the ring terminal through the armature of the first relay and its back contact, recording apparatus controlled by said second relay, means responsive to a call initiated by said subscriber's set to operate said second relay and said recording apparatus, and means responsive to a call received by said subscriber's set to operate the first relay and to prevent the operation of said second relay.

5. Telephone line usage recorder apparatus for a telephone subscriber's set, comprising tip, ring and sleeve terminals, a first relay connected to said sleeve terminal and operated when the sleeve terminal becomes grounded, a second relay connected to the ring terminal through the armature and back contact of said first relay, said second relay being operated when the subscriber's receiver is removed from its switch-hook, and pulsing and recording apparatus controlled by said second relay.

6. In a step-by-step telephone system, the combination of tip, ring and sleeve terminals, a subset connected to the tip and ring conductors, a first relay connected to the sleeve terminal and operated only when the sleeve terminal becomes grounded, a second relay connected to the ring terminal through the armature and back contact of said first relay and operated when the receiver of the subset is removed from its switch-hook to initiate a call, means responsive to the completion of a call from said subset to operate the first relay and to lock the second relay in operated condition, and recording apparatus controlled by said second relay.

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