

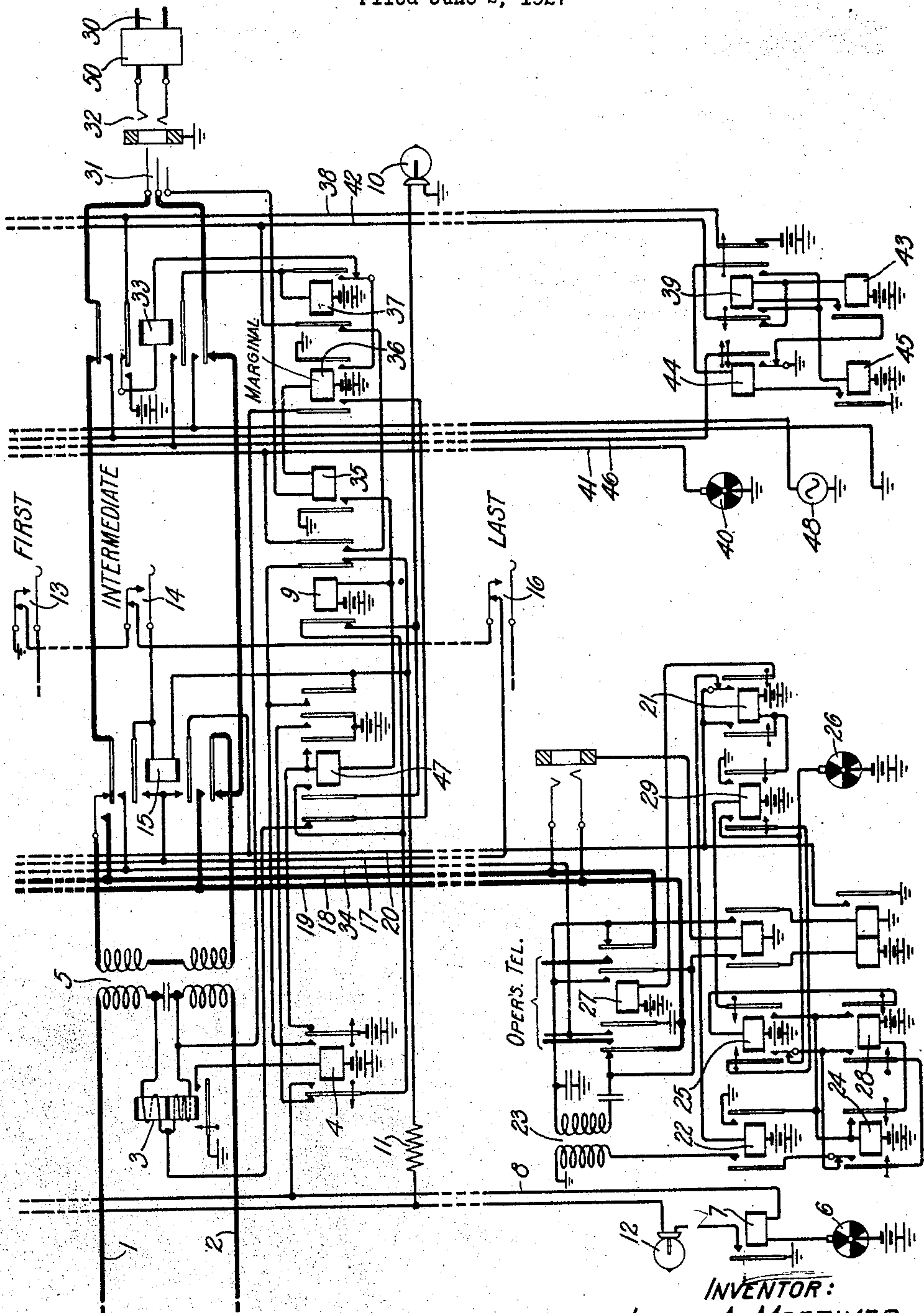
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TELEPHONE SYSTEM

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## TELEPHONE SYSTEM.

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This invention relates to telephone systems and particularly to means whereby signaling current may be automatically applied to a seized line for a single period of predetermined length.

In accordance with a feature of this invention a series of timing relays under control of a timing interrupter are common to a plurality of trunks and may be exclusively appropriated for a definite interval by one or simultaneously by several trunks. Other trunks attempting to use this common equipment during such period are barred and must await the beginning of a new timing period.

In accordance with another feature of the invention means for applying signaling current to a connected trunk line for a single period of predetermined length is made common to the incoming ends of connecting trunks whereby the amount of expensive timing apparatus heretofore made individual to the outgoing ends of the connected trunks is reduced to a minimum.

The drawings comprise a diagrammatic representation of the incoming end of a straightforward trunk and the outgoing end of a toll line over which a telephonic connection may be established. The upper part of the drawing shows the incoming end of a straightforward trunk circuit representative of a group of such trunks and the outgoing end of a toll line also representative of a group. In the lower part of the drawing apparatus common to the incoming trunks is shown, such as the pilot lamp, the order tone circuit, the operator's telephone set and the ringing current timing circuit.

In general the operation is as follows. A distant "A" operator seizes the straightforward trunk and the trunk lamp thereupon flashes. The "B" operator then "listens in" by operating the individual trunk key 14. In the process of connecting the operator's telephone set to the trunk, a signal consisting of three successive momentary applications of tone to the trunk is transmitted to the distant "A" operator. The talking circuit between the operators being established information as to the wanted line is passed and the "B" operator extends the connection to the toll line 30. While the present arrangement may be employed generally it is especially designed for use with toll line where the operator at the far end

is signalled by a single application of a ringing current for a period of predetermined duration. Due to the fact that toll lines are generally long and employ composite ringers here generally indicated by the box designated 50, the application of ringing current must be maintained for an appreciable time, for example, two seconds. When the connection is extended to the toll line certain apparatus common to the incoming end of the straightforward trunk, if it is not in use at that instant, is appropriated and acts to transmit a signal over the toll line. Also in response to the extension of the connection to the toll line, the operator's telephone set is automatically disconnected, the trunk lamp becomes dark and the supervisory signal at the distant "A" operator's position is actuated. At the end of the conversation, when the distant "A" operator disconnects from the trunk, the trunk lamp lights steadily. If the distant "A" operator again seizes the trunk before the "B" operator has taken the connection down the trunk lamp flashes and the "B" operator will have to take down the old connection before she can act to establish a new one.

The above operations in detail will now be described.

A connection is extended over the straightforward trunk line shown in the drawings by connecting battery and ground to conductors 1 and 2 of the trunk in any well known manner, whereupon current will flow over these conductors, the left hand windings of repeating coil 5 and the upper low resistance and lower high resistance windings of relay 3 in series. Relay 3 attracts its armature and establishes an obvious circuit for relay 4. Relay 4 attracts its armatures and extends a connection from battery, interrupter 6, relay 7, conductor 8, front contact and left hand armature of relay 4, left hand armature and back contact of relay 9, signal lamp 10 to ground. Lamp 10 flashes in unison with the operation of interrupter 6. Relay 7 operates in this circuit and applies ground to one terminal of pilot lamp 12. The other terminal of pilot lamp 12 extends through resistance 11, back contact and inner right hand armature of relay 9, front contact and right hand armature of relay 4 to battery and ground so that lamp 12 flashes in unison with individual lamp 10. The operator at this position as soon as she is free to



do so depresses individual key 14 to connect her headset to the trunk line.

It will be noted that the individual listening keys of a group of trunks are all connected in a chain circuit so that ground is extended from the first listening key 13 through its normal contacts and then in series through the normal contacts of all intermediate trunk keys such as 14 and the normal contacts of the last trunk key 16 to the conductor 17. Upon depression of key 14, ground is extended over this chain circuit as far as key 14 and thence through the alternate contacts of key 14, winding of relay 15, back contact and inner right hand armature of relay 9, front contact and right hand armature of relay 4, to battery and ground. Relay 15 becomes energized in this circuit and when key 14 is returned to normal locks in a circuit including the chain contacts of the listening keys, conductor 17, front contact and inner upper armature of relay 15, winding of relay 15, back contact and inner right hand armature of relay 9, front contact and right hand armature of relay 4 to battery.

It will be noted that relay 15 will remain energized in this circuit until the chain circuit through the listening keys is disturbed as when for instance some other listening key is actuated or when relay 9 is operated upon the insertion of plug 31 in jack 32, whereupon the locking circuit for relay 15 is opened.

Upon the operation of relay 15, conductors 18 and 19 are connected to the right hand windings of repeating coil 5 so that the operator's set which will be shortly connected to these conductors will be associated with the trunk circuit. Upon the operation of relay 15 ground on conductor 17 supplied over the chain circuit above described is extended through the front contact and inner lower armature of relay 15, conductor 20, normal contacts of the right hand armature of relay 21, winding of relay 22 to battery. Relay 22 becoming energized completes a circuit from ground, primary of induction coil 23, front contact and left hand armature of relay 22, normal contacts of left hand armature of relay 24, normal contacts of the left hand armature of relay 25, interrupter 26 to battery and ground. The interrupted current flowing through the primary of induction coil 23 causes a tone to be induced in the secondary winding thereof which being connected through the back contacts of the outer right and left hand armatures of relay 27 to the conductors 18 and 19 causes a tone to be transmitted back over the trunk.

Relay 22 in energizing closes a circuit from ground, front contact and right hand armature of relay 22, winding of relay 24 to battery, whereupon relay 24 becomes energized and opens the circuit for interrupter

26 so that the tone transmitted back over the trunk is now cut off. Relay 24 also extends the ground which was used for its energization over its front contact and right hand armature to the winding of relay 28. Relay 28 establishes a circuit from ground, the primary of induction coil 23, front contact and left hand armature of relay 22, front contact and left hand armature of relay 24, left hand armature and front contact of relay 28, normal contacts of the left hand armature of relay 25 to interrupter 26 so that tone is again transmitted back over the trunk.

Upon the energization of relay 28 a circuit is established from ground, front contact and right hand armature of relay 22, front contact and right hand armature of relay 28, winding of relay 25 to battery and ground, whereupon relay 25 attracts its armatures and again opens the circuit of interrupter 26 so that the tone is now for a second time cut off from the trunk. Through its right hand armature relay 25 extends ground to the winding of relay 29 whereupon a circuit is established from ground, primary of induction coil 23, front contact and left hand armature of relay 22, front contact and left hand armature of relay 24, left hand armature and front contact of relay 28, front contact and left hand armature of relay 25, left hand armature and front contact of relay 29, to interrupter 26 so that tone is now for a third time transmitted back over the trunk. Relay 29 in energizing also closes an obvious circuit for the energization of relay 21. Relay 21 in energizing extends a connection from ground, front contact and right hand armature of relay 29, left hand armature and front contact of relay 21, front contact and right hand armature of relay 21, to the winding of relay 27, whereupon the secondary circuit of induction coil 23 is opened and the tone is for the last time cut off from the trunk. Relay 21 becomes locked in a circuit including the ground at the key 13 through the key chain circuit, conductor 17, front contact and inner lower armature of relay 15, conductor 20, front contact and left hand armature of relay 21, winding of relay 21 to battery.

Upon the energizations of relay 21, the original circuit for relay 22 is opened and thereupon in turn relays 22, 24, 28, 25 and 29 become deenergized leaving relays 21 and 27 in their energized conditions. This condition will be maintained until relay 15 becomes deenergized.

Upon the operation of relay 27, the operator's telephone is connected to conductors 18 and 19 and she may communicate with the distant operator by means of repeating coil 5 and trunk conductors 1 and 2. Information will now be passed to the opera-



tor for the further extension of the connection. Assuming that the connection is to be extended over toll line 30 the operator may touch the tip of plug 31 to the sleeve of jack 32. If a busy condition is encountered it will cause a flow of current over the tip of plug 31, the upper outer armature and back contact of relay 33, the upper outer armature and front contact of relay 15, conductor 34, to the busy test winding of the induction coil associated with the operator's telephone set which will result in the ordinary busy test indication.

Assuming that the toll line 30 is found to be idle the operator will insert plug 31 into jack 32 thereby establishing a circuit from ground, sleeve of jack 32 and sleeve of plug 31, winding of relay 35 and winding of relay 36 to battery. Both these relays become energized. Relay 35 closes an obvious circuit for the energization of relay 9 whereupon the holding circuit of relay 15 is opened and this relay returns to normal thereby disconnecting the operator's telephone set from the trunk. At the same time the circuit for lamp 10 is opened and this lamp becomes dark. Since lamp 10 is in series with relay 7, relay 7 now ceases to operate and pilot lamp 12 becomes dark.

Relay 36 through its left hand armature and front contact short circuits the lower high resistance winding of relay 3, thus causing an increase of current in conductors 1 and 2 for supervisory purposes. The right hand armature of relay 36 extends ground through the normal contacts of the right hand armature of relay 37, winding of relay 33, normal contacts of the inner upper armature of relay 33, conductor 38, the outer right hand armature and back contact of relay 39 to battery. If relay 39 is not at this instant in its deenergized condition the circuit just described will not be effective. When relay 39 returns to its normal position, relay 33 will become energized in the circuit described and will lock through the alternated contacts of its inner upper armature. Relay 33 in operating impresses ringing current on the trunk and causes the composite ringer here designated by the numeral 50 to function.

When interrupter 40 reaches a given position where the circuit is closed therethrough, ground will be extended over conductor 41, the outer right hand armature and front contact of relay 9, the back contact and left hand armature of relay 37, conductor 42, left hand armature and back contact of relay 39, winding of relay 43 to battery. Relay 43 becomes energized and establishes a connection from ground, the normal contacts of the armature of relay 44, armature and front contact of relay 43, winding of relay 39, but this circuit is ineffective as long as interrupter 40 maintains a closed circuit.

When interrupter 40 now opens its circuit relay 39 will become energized and relay 43 will remain energized over the circuit just described. After a predetermined period interrupter 40 will again close the circuit to conductor 41 so that ground is now extended over the left hand armature and front contact of relay 39, winding of relay 45 to battery. Relay 45 becomes energized and closes a circuit from ground, left hand armature and front contact of relay 45, winding of relay 44, inner right hand armature and front contact of relay 39 to the winding of relay 45, but this circuit is ineffective to cause the energization of relay 44 so long as interrupter 40 maintains a ground connection on conductor 41. As soon as interrupter 40 opens the circuit to conductor 41, relay 44 becomes energized in series with relay 45 and relay 45 remains energized. The energization of relay 44 closes a circuit from ground, front contact and armature of relay 44, conductor 46, front contact and inner lower armature of relay 33, winding of relay 37 to battery. Relay 37 becoming energized locks to the ground supplied by the right hand armature of relay 36 and opens the holding circuit of relay 33 so that relay 33 now releases and cuts off ringing current from the toll line 30. At the same time relay 37 opens the connection to conductor 42 so that the impulses set up by interrupter 40 will now no longer be effective to operate the timing relays. Relay 44 in operating also opens the circuit of relays 39 and 43 and these relays return to normal. Relay 39 being slow to release maintains the circuit for the energization of relays 44 and 45 for a short period after which these relays return to normal.

At the end of the conversation the distant operator breaks the connection to conductors 1 and 2 and relay 3 and in turn relay 4 becomes deenergized. A circuit is thereupon established from ground, right hand armature and back contact of relay 4, winding of relay 47, front contact and armature of relay 35 to ground. A circuit may now be traced from battery, the middle right hand armature and front contact of relay 47, back contact and left hand armature of relay 4, front contact and inner left hand armature of relay 47, signal lamp 10 to ground so that lamp 10 now glows steadily to indicate to the operator having charge of this trunk that the connection may be broken. Relay 47 also locks up through its inner right hand armature and front contact so that if the distant operator should again seize the trunk and cause the energization of relays 3 and 4, relay 47 will not become deenergized. In case this happens, relay 4 in energizing will establish a circuit from battery, interrupter 6, relay 7, conductor 8, front contact and left hand armature of relay 4, front con-



tact and inner left hand armature of relay 47 to lamp 10 so that lamp 10 will again flash as when the trunk was first seized. This will act as a calling signal so that the operator will remove plug 31 from jack 32 and proceed to establish a new connection in the manner hereinbefore described.

Under ordinary conditions when lamp 10 glows steadily the operator will remove plug 31 from jack 32 which will result in the immediate restoration to normal of relays 35, 36, 37 and relay 9.

It will be noted that the ringing relay 33 can only be energized when relay 39 is in its normal position and hence the period during which relay 33 may remain energized is definitely measured by the operation of interrupter 40 so that ringing current from source 48 will be applied to the tip and ring conductors of plug 31 and jack 32 to cause the operation of the composite ringer 50, for a definite and predetermined period of time. It will be further noted that the circuit for relay 33 may be prepared during the operation of the train of timing relays. It may happen that several such relays 33 are prepared for operation and hence when relay 39 becomes deenergized each of these relays 33 will become operated and hence ringing current will be applied to several corresponding trunks simultaneously. Other relays 33 which may be prepared for operation during this period may not be operated until this ringing period has ceased and a new ringing period as determined by the operation of interrupter 40 has been initiated.

What is claimed is:

1. In a telephone system, a link circuit, a trunk line, means for connecting said link circuit to said trunk line and means common to said link circuit responsive to the establishment of said connection for impressing signaling current on said trunk line for a single period of predetermined duration.

2. In a telephone system, a straightforward trunk line, a trunk line, means for connecting said straightforward trunk line to said trunk line and means common to said straightforward trunk line responsive to the establishment of said connection for impressing signaling current on said trunk line for a single period of predetermined duration.

3. In a telephone system, a link circuit, a trunk line, means for connecting said link circuit to said trunk line and a timing arrangement common to said link circuit responsive to the establishment of said connection for impressing the signaling current on said trunk line for a single period of predetermined duration.

4. In a telephone system, a link circuit, a trunk line, means for connecting said link circuit to said trunk line, means common to

said link circuit for impressing signaling current on said trunk line for a single period of predetermined duration, means responsive to the establishment of said connection for causing said common means to operate and means responsive to the busy condition of said common means for delaying its operation.

5. In a telephone system, a link circuit, a trunk line, means for connecting said link circuit to said trunk line, a ringing relay individual to said link circuit for impressing ringing current on said trunk line, means common to said link circuit for causing said individual relay to operate for a single period of predetermined duration and means responsive to the establishment of said connection of said link circuit to said trunk line for setting said common means into operation.

6. In a telephone system, a link circuit, a trunk line, means for connecting said link circuit to said trunk line, a ringing relay individual to said link circuit for impressing ringing current on said trunk line, means common to said link circuit for causing said individual relay to operate for a single period of predetermined duration, means responsive to the establishment of said connection of said link circuit to said trunk line for setting said common means into operation and means responsive to the busy condition of said common means for delaying the operation of said individual relay.

7. In a telephone system, a plurality of link circuits, a trunk line, means for connecting any one of said link circuits to said trunk line, a ringing relay individual to each of said link circuits for impressing ringing current on said trunk line, means common to said link circuit for causing said individual relay to operate for a single period of predetermined duration, means responsive to the establishment of a connection between any one of said link circuits and said trunk line for preparing for the operation of a corresponding individual relay and means responsive to the idle condition of said common means and to said last means for operating said individual relay.

8. In a telephone system, a plurality of link circuits, a plurality of trunk lines, means for connecting any one of said link circuits to any one of said trunk lines, a ringing relay individual to each of said link circuits for impressing ringing current on a connected trunk line, means common to said link circuits for causing said individual relays to operate for a single period of a predetermined duration, an energizing circuit for each of said individual relays, means responsive to the establishment of a connection between a link circuit and a trunk line for preparing a corresponding energizing circuit for operation, and means responsive



to the idle condition of said common means and to the preparation of one of said energizing circuits for operating a corresponding one of said individual relays.

5 9. In a telephone system, a plurality of link circuits, a plurality of trunk lines, means for connecting any one of said link circuits to any one of said trunk lines, a ringing relay individual to each of said link  
10 circuits for impressing ringing current on a connected trunk line, means common to said link circuits for causing said individual relays to operate for a single period of predetermined duration, an energizing circuit  
15 for each of said individual relays, means responsive to the establishment of a connection between a link circuit and a trunk line for preparing a corresponding energizing circuit for operation and means responsive  
20 to the idle condition of said common means and to the simultaneous preparation of a plurality of said energizing circuits for operating a corresponding plurality of said individual relays.

25 10. In a telephone system, a plurality of link circuits, a plurality of trunk lines,

means for connecting any one of said link circuits to any one of said trunk lines, a relay individual to each of said link circuits for impressing ringing current on a connected trunk line, means common to said link circuits for causing said individual relays to operate for a single period of predetermined duration, an energizing circuit for each of said individual relays, means responsive to the establishment of a connection between a link circuit and a trunk line for preparing the corresponding energizing circuit for operation, means responsive to the idle condition of said common means and to the preparation of one of said energizing circuits for operating a corresponding one of said individual relays and means responsive to the preparation of other of said energizing circuits during the operation of said individual relay for delaying the operation of the corresponding other of said individual relays.

In witness whereof, I hereunto subscribe my name this 1st day of June, A. D. 1927.

LOUIS A. MORTIMER.