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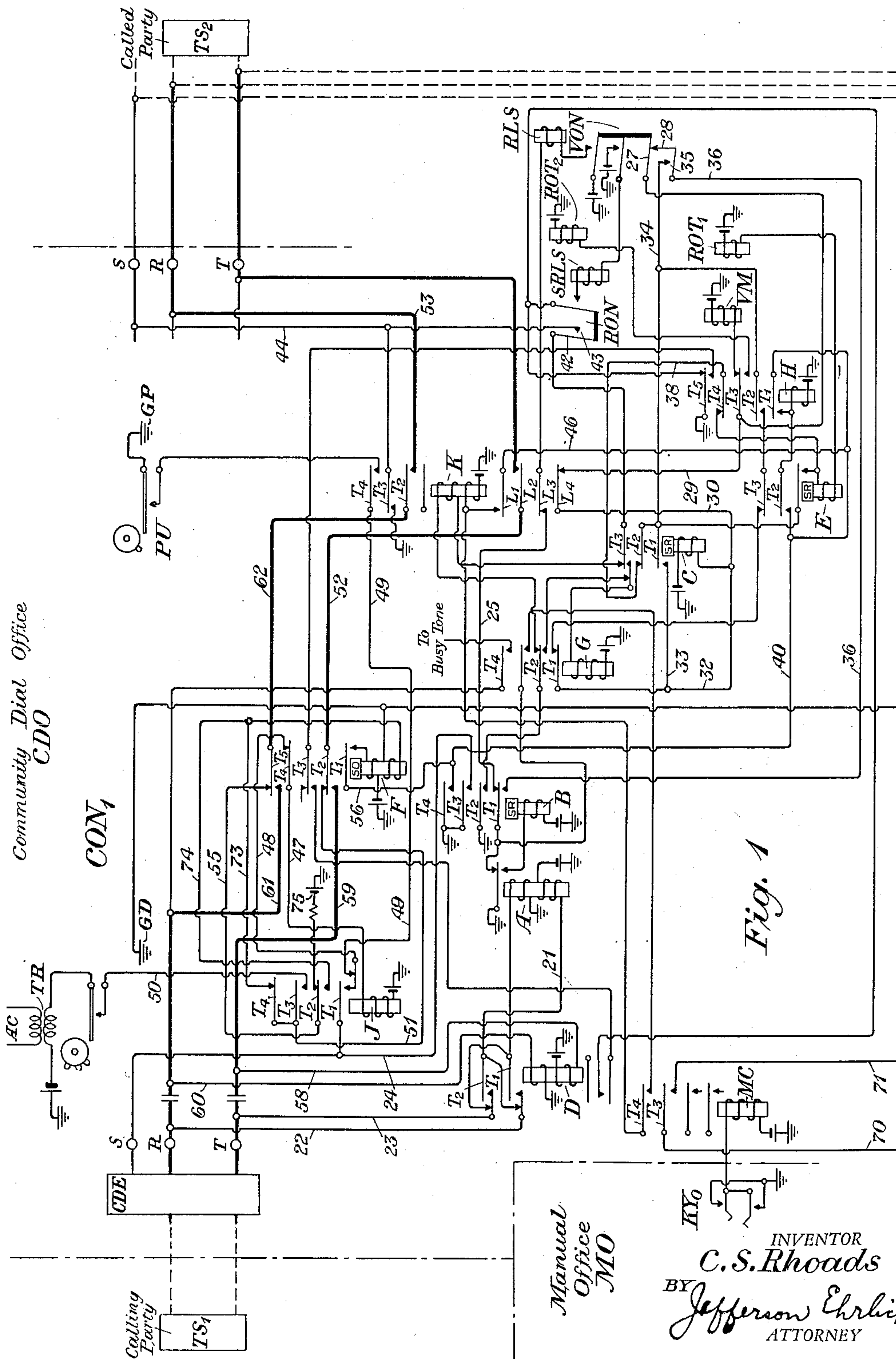
C. S. RHOADS

2,377,453

TELEPHONE SYSTEM

Filed March 11, 1944

2 Sheets-Sheet 1



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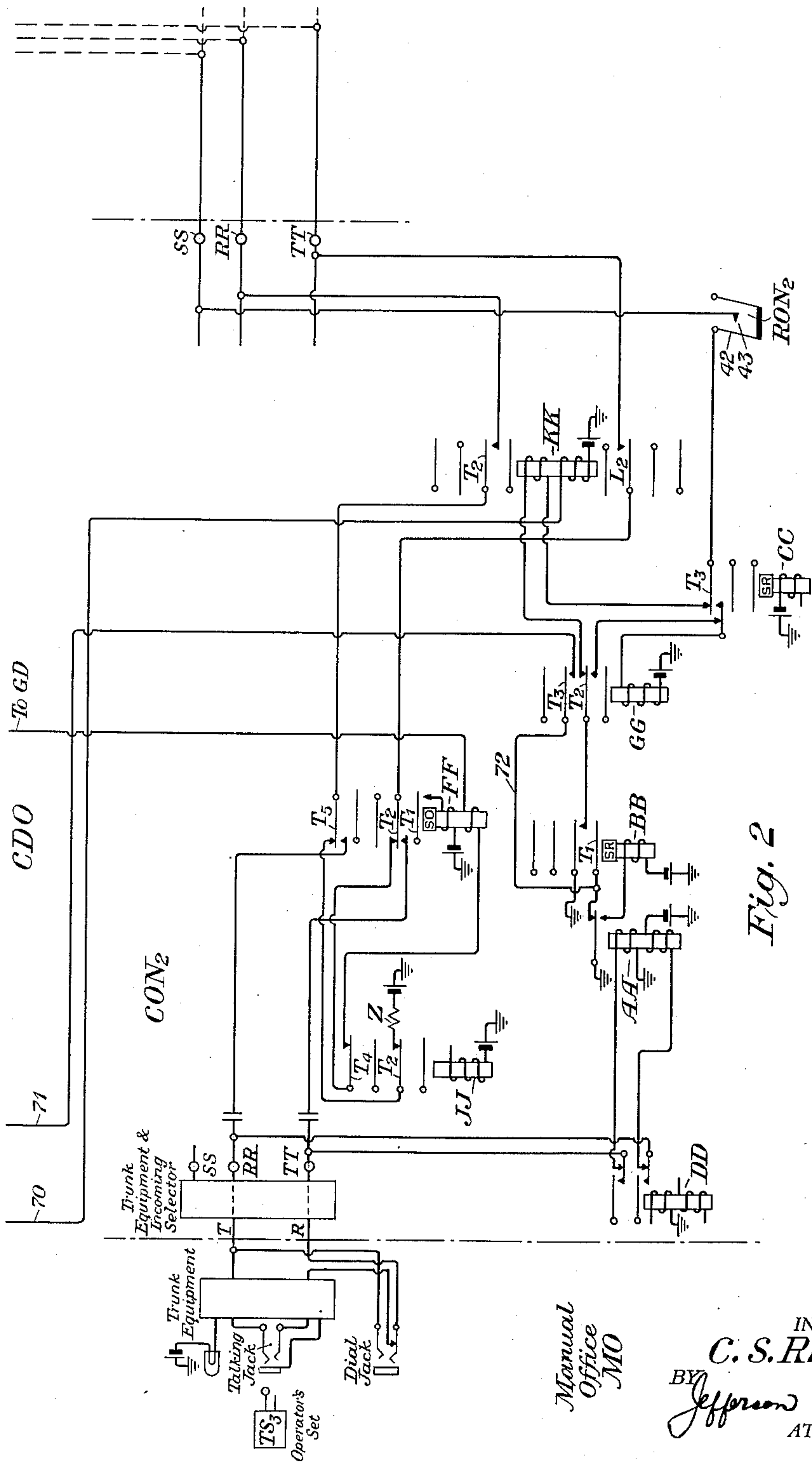


Fig. 2

Manual
Office
MO

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TELEPHONE SYSTEM

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7 Claims. (Cl. 179—27)

This invention relates to telephone systems and, more particularly, to step-by-step telephone systems. This invention also relates to arrangements for determining whether or not a subscriber's line is busy or out of order. This invention also relates to arrangements for enabling a telephone operator either to "override" a line appearing to be busy so that she may determine whether the line actually is busy or out of order, or to monitor the busy line, or, if desired, to converse with the parties to the telephone conversation on the busy line.

According to present telephone practices a manual office—which may be located, for example, in a city and may be attended by one or more telephone operators—may be connected to a community dial office—which is a much smaller office located in an outlying village or hamlet and is generally unattended. A subscriber in the community dial office area may be connected to another subscriber in the area of the community dial office in a well-known manner as, for example, by dialing the latter party in the usual way. During the conversation between the two parties or at any time when the line to the subscriber of the community dial office is out of order, as occurs, for example, when the latter's receiver is off the hook, it is practically impossible for the operator at the manual office to determine whether the subscriber's line actually is busy or out of order. Such information would be of value to the operator at the manual office for she may have another call awaiting connection to the called party and may, therefore, have considerable telephone equipment tied up while waiting for the busy line to become idle. If she were able to determine definitely that the line is out of order, she could then release the telephone equipment for other purposes. Moreover, the operator might have an urgent call that must be made to the called party and in that event it would be of value to have an arrangement to enable the operator to "override" the busy circuit and connect her own telephone set to the called party's line to converse with that party.

Accordingly, it is one of the objects of this invention to provide a simple and inexpensive arrangement for enabling an operator at, for example, a manual telephone office, to seize a subscriber's line extending, for example, from a community dial office, to monitor the line while it is busy, or to converse with the parties engaged in the conversation. Such an arrangement will also serve to apprise the operator (and

others) as to whether or not the subscriber's line is out of order.

In one of the arrangements to be described hereinafter, a subscriber in a community dial office area will be shown connected to another subscriber in the community dial office area, and the arrangement will include means whereby the operator may verify the busy condition on the already established connection. While the conversation between the parties continues the operator may manipulate a switch, for example, and then dial an additional digit over the line to the called party to connect her own telephone set to the called party's line. The "overriding" circuit is completed without in any way interfering with or otherwise affecting the conversation over the busy line.

It is, therefore, another object of this invention to provide arrangements for enabling an operator to dial a community dial office subscriber whose line is connected to another line and finds it busy and then, while holding the train of equipment she has established to the busy line, to permit the operator to complete her own connection to the busy line by dialing another digit, so that the operator may then monitor the circuit or converse with the parties to the conversation.

These and other objects of this invention will be better understood from the more detailed description hereinafter following when read in connection with the accompanying drawings in which Figures 1 and 2, when placed adjacent to each other with Fig. 1 above Fig. 2, will illustrate one embodiment of the invention in which a single conductor extending between the master office and the community dial office may serve to control an "overriding" circuit for a busy line.

Referring to Figs. 1 and 2, there is shown a manual office MO connected to a community dial office CDO at which there may be a plurality of connector circuits only two of which are shown, and are designated CON₁ and CON₂. The arrangements of Figs. 1 and 2 will now be described with reference to the connection of a calling party's telephone set, such as TS₁, which may be in the area of a community dial office CDO, to a called party's telephone set, such as TS₂, which may also be in the area of the community dial office CDO.

When the calling party TS₁ removes his receiver from its switchhook the apparatus at the community dial office CDO, generally designated CDE, will act in a well-known manner to seize one of the various connectors such as, for ex-

ample, CON₁ at the community dial office CDO. Apparatus suitable for this purpose is shown and described in the patent to E. D. Butz, No. 2,021,286, dated November 19, 1935. Immediately after the connector CON₁ is seized, the relay A will become operated over a circuit which includes battery, the lower winding of relay A, conductor 21, the make-before-break contact associated with armature T₁ of relay D, conductor 22, the ring conductor R which extends to the calling party's set TS₁, and through that set to the tip conductor T, then over conductor 23, the make-before-break contact of armature T₂ of relay D, the upper winding of relay A, and ground. The operation of relay A will complete an obvious circuit for operating relay B. The operation of relay B will cause ground to be applied to the sleeve conductor S which extends to the line finder-selector of the equipment MOE in a well-known manner, the grounding circuit extending from ground at the armature T₃ of relay B and its make contact, conductor 24, to the sleeve terminal S. This ground applied to the sleeve conductor will guard the connector CON₁ from seizure by any other selector and hold the preceding selectors and line finder in the community dial office CDO. The operation of relay B will open the operating circuit of the release magnet RLS which controls the release of all of the equipment at the connector CON₁, the release magnet RLS having previously been connected to the back contact of armature T₁ of relay B through conductor 25 and the back contact of armature L₃ of relay K. The relay B also prepares a circuit for operating the vertical magnet VM as will now be described.

After the calling party's telephone set TS₁ has been connected to the connector CON₁ at the community dial office CDO by dialing a digit (or digits), the next digit dialed by the calling party's telephone set TS₁ will provide a train of pulses for releasing and reoperating relay A, relay A being operated and released once for each of the various pulses of the digit dialed by the calling party. The vertical magnet VM is connected to the back contact of the armature of relay A over a circuit which includes battery, the winding of the vertical magnet VM, the armature T₃ and back contact of relay H, contacts 27 and 28 of the off-normal switch VON, conductor 36, the make contact associated with armature T₁ of relay B to the back contact of the armature of relay A which is grounded. The vertical magnet VM is connected in parallel to the winding of the relay C over a circuit including conductor 29, the back contact and armature L₄ of relay K and conductor 30. The parallel arrangement of the vertical magnet VM and relay C will cause both of those devices to be operated simultaneously. However, relay C as well as relay B are of the slow-release type and hence, they will be held in their operated positions during the pulsing of the first digit. The vertical magnet VM, however, will step its shaft (not shown) in a vertical direction through a number of steps which correspond to the digit dialed.

As soon as the shaft of the vertical magnet VM has moved up one vertical step, the off-normal switch VON will be moved to its operated position. However, the circuit to the vertical magnet VM will now be completed through the back contact and armature T₃ of relay H, conductor 29, the back contact and armature L₄ of relay K, conductor 30, conductor 32, conductor 33, the make contact and armature T₁ of relay C,

conductor 34, contacts 35 and 28 of the switch VON, conductor 36, the make contact and armature T₁ of relay B and the back contact and armature of relay A. At the end of the pulses corresponding to the first dialed digit, the relay C will release and in releasing it will prepare a circuit to operate the rotary magnet ROT₁, as will now be described.

In response to the next set of pulses corresponding to the third (or next) digit dialed by the calling party's set TS₁ after connector CON₁ is seized, the relay A will again release and re-operate once for each of the pulses transmitted as in the case of the previous dial pulses received. This will cause the rotary magnet ROT₁ and the relay E to be operated in series over a circuit which includes battery, the rotary magnet ROT₁, the winding of relay E, the back contact and armature T₄ of relay H, conductor 38, the back contact and armature T₂ of relay C, conductor 34, contacts 35 and 28 of switch VON, conductor 36, the make contact and armature T₁ of relay B, the back contact and armature of relay A, and ground. The subsequent pulses of the third (or next) digit will step the shaft of the rotary magnet ROT₁ in a rotary direction in a well-known manner. The relays B and E, however, will remain operated during these received pulses because these relays are of the slow-release type. The relay E when operated holds open the path to the vertical magnet VM, the path to the vertical magnet VM being operated at the back contact of the armature T₃ of the relay E. Relay E also completes a path for operating relay H, the operating circuit including battery, the winding of relay H, the armature T₂ of relay E and its make contact, conductor 40, the armature T₄ of relay B and its make contact, and ground. The relay H is then locked in its operated position through the make contact of its own upper armature T₁ and hence relay H is held operated even after relay E releases. The opening of the back contact of armature T₃ of relay H will open the operating circuit to the release magnet SRLS. The relay H also opens the operating path for relay E at the back contact of the armature T₄ of relay H. Moreover, the operation of relay H completes a path to the rotary selector magnet ROT₂ at the make contact of armature T₃ of relay H, this path being connected in parallel with the winding of relay C by conductor 29, the armature L₄ of relay K and its back contact, and conductor 30.

As soon as relay E releases, it provides a path for operating relay C in parallel with the selector rotary magnet ROT₂ upon the subsequent release of relay A. This circuit may be traced from battery and the winding of relay C, conductor 32, the armature T₁ of relay G and its back contact, the armature T₃ of relay E and its back contact, the make contact and armature T₂ of relay H, conductor 34, contacts 35 and 28 of switch VON, conductor 36, the make contact of armature T₁ of relay B, the back contact of the armature of relay A, and then to ground. During the next series of pulses, relay C operates along with the rotary stepping magnet ROT₂ to control relay G which serves to test the called party's line to determine whether or not it is busy, as will now be described.

Upon the operation of relay C and magnet ROT₂ in response to the reception of the pulses of the fourth (or next) dialed digit, a circuit will be completed from the winding of relay G to the sleeve terminal S extending to the called

party's line. This circuit may be traced from battery, the winding of relay G, the make contact and armature T₃ of relay C, contacts 42 and 43 of the switch RON, conductor 44, to the sleeve terminal S. Switch RON is, of course, controlled by rotary magnet ROT₂. If ground is found on the latter sleeve terminal S at any time during the pulsing of the fourth (or next) digit, the relay G will become operated. Relay C is of the slow-release type and will remain operated during the remaining pulses of the digit. During this period relay G tests the called line's sleeve terminal S. Should battery be connected to the sleeve terminal S, the relay G will remain unoperated, thereby indicating an idle line condition. Upon the operation of relay G due to the presence of ground on the sleeve terminal S, a source of busy tone will be connected through the make contact and armature T₄ of relay G to the calling party's set TS₁, the busy tone being transmitted to the set TS₁ over the ring conductor R and returned over the tip conductor T. Should relay G become operated, it will open the operating path to relay C at the back contact of the armature T₁ of relay G. Once relay G becomes operated it will remain operated until the connector CON₁ is released by reason of the calling party hanging up.

If the called party's line is idle the relay G remains unoperated. During the received pulses of the fourth (or next) digit, rotary magnet ROT₂ will be stepped once in accordance with each of these pulses. The rotary magnet ROT₂ may serve to select any one of a number of codes in a well-known manner for ringing the called party's line, but only one ringing current will be referred to hereinafter for ringing the called party's line. At the end of the received pulses of this digit, relay C will release.

If the called party's line is idle the relay K will become operated over a circuit which includes the ground at the sleeve terminal S, conductor 44, contacts 43 and 42 of the switch RON, the armature T₃ and back contact of relay C, the upper winding of relay K, the armature T₂ and back contact of relay G, the armature T₂ and make contact of relay B, and ground. The operation of relay K will connect ground through its armature T₃ and its make contact and through conductor 44 to the sleeve terminal S to guard the called party's line against seizure by other connectors such as CON₂. The relay K becomes locked in its operated position over a circuit which includes battery, the lower winding of relay K, the armature L₁ and make contact of relay K, conductor 46, conductor 40, the armature T₄ of relay B and its make contact, and ground. The relay K will lock the connector CON₁ in its operated position by opening the circuit to its release magnet RLS at the back contact of its armature L₃ and the connector CON₁ will remain locked until the relay K becomes released. The relay K will connect the called party's telephone line to its own armatures T₂ and L₁ and in turn to the armatures T₃ and T₂ of relay F so that the called party's line may become connected to the calling party's line immediately after relay F becomes operated.

The operation of relay K will close a circuit for operating relay J over a path which includes battery, the winding of relay J, conductor 47, the armature T₄ and back contact of relay F, conductor 48, the make-before-break contact of armature T₁ of relay J, conductor 49, the armature T₄ of relay K and its make contact, and

ground at GP which is completed through a contact PU on a ringing machine (not shown). The relay K connects battery 75 to the called line over a circuit including the back contact and armature T₂ of relay J, conductor 55, back contact and armature T₃ of relay F, conductor 62, armature T₂ of relay K and its make contact, conductor 53, and over conductor R to the called subscriber's set TS₂, then back over conductor T, over the make contact and armature L₁ of relay K, conductor 52, armature T₂ of relay F and its back contact, conductor 51, armature T₄ of relay J and its back contact, conductor 73, the lower winding of relay F, to ground at GD. This circuit applies pre-trip battery to the called line to cause connector CON₁ to cut through and allow the parties to converse immediately if the called party removes his receiver before his bell rings. The operation of relay J will cause ringing current to be supplied from the ringing generator RG to the called party's line over a circuit which includes the ringing generator RG, conductor 50, the armature T₃ and its make contact, conductor 51, the armature T₂ of relay F and its back contact, conductor 52, the armature L₂ of relay K and its make contact, over the tip conductor T to the called party's set TS₂, then back over the ring conductor R, conductor 53, the armature T₂ of relay K and its make contact, conductor 62, the armature T₃ of relay F and its back contact, conductor 55, the armature T₂ of relay J and its make contact to the ringing ground GD. This ringing current may be transmitted to the called party until the call is answered.

When the called party answers in response to the ringing signal the receiver of the called party's set TS₂ will be removed from its switchhook, thereby causing relay F to become operated. The operating circuit for relay F will include ground at GD, the lower winding of relay F, conductor 74, the make contact and armature T₂ of relay J, conductor 55, the back contact and armature T₃ of relay F, conductor 62, armature T₂ of relay K and its make contact, conductor 53, conductor R, set TS₂, conductor T, the make contact and armature L₂ of relay K, conductor 52, armature T₂ of relay F and its back contact, the make contact and armature T₂ of relay J, the ringing apparatus RB, the lower winding of transformer TR₁, battery and ground. The operation of relay F will cause this relay to become locked, the locking circuit including battery, the upper winding of relay F, the make contact and armature T₁ of relay F, conductor 56, make contact and armature T₄ of relay B, and ground. The relay F will then connect the calling party's set TS₁ to the armatures T₃ and T₂ of relay F which were previously traced to the called party's set TS₂ upon the operation of relay F.

The operation of relay F will also connect talking battery to tip conductor T of the line extending to the called party's set. The two parties may then converse with each other. This battery will be supplied through the lower winding of relay D, conductor 58, conductor 59, the make contact and armature T₂ of relay F, conductor 52, the armature L₂ of relay K and its make contact over the tip conductor T to the called party's set TS₂. Ground will simultaneously be supplied to the ring conductor R extending to the called party's set over a circuit which includes the upper winding of relay D, conductor 60, conductor 61, the armature T₃ of relay F and its make contact, conductor 62, the armature T₂ of

relay K and its make contact, and the ring conductor R which extends to the called party's set TS₂. The connection of battery and ground to the called party's set will operate relay D which in turn will release the relay J. The relay D will also reverse the application of battery and ground to the calling party's set TS₁ so that ground will now be applied from the upper winding of relay A to the ring conductor R extending to the calling party's set TS₁, and battery will be connected from the lower winding of relay A to the tip conductor T of the calling party's set TS₁.

It has been shown hereinabove that dial pulses corresponding to the called station TS₂ and emanating from the calling party's station TS₁ may operate the connector CON₁ at the community dial office CDO for interconnecting the two stations so that the parties may converse with each other. Should another party (not shown) seek to reach the same called party TS₂, the additional party's telephone set will be connected to another one of the connectors such as CON₂ at the community dial office CDO. However, the sleeve SS will then be grounded due to the busy condition of the called line and the additional party will not obtain access to the line of the called party. In that case the relay GG of Fig. 2 will be operated over a circuit which includes battery, the winding of relay GG, the armature T₃ and make contact of previously operated relay CC, the contacts 42 and 43 of the switch RON₂ and ground at the sleeve terminal SS. It will be observed that the circuit of Fig. 2 is the same as that of Fig. 1 so far as the connector CON₂ is concerned but only the essential parts of the connector CON₂ have been shown to explain the features of the "overriding" circuit of this invention.

The operator at the manual office MO may connect her telephone set TS₃ across the tip and ring conductors TT and RR to determine whether or not the called party's line is busy or out of order, or for other purposes. This may be done by the operator inserting a calling cord in a trunk jack, and dialing the called party's number in a well-known manner. The operator will also insert a dialing cord (not shown) in the dial jack after she hears dial tone in the trunk. The operator then will dial the desired number and then she removes the dialing cord from the dial jack, after which she can again listen on the trunk. The operator will then actuate her key KY₀ if the line tests busy and this will complete an obvious circuit to a master control relay MC located at the community dial office CDO. The master control relay MC has a pair of contacts extending to each of the various connectors such as CON₁, CON₂, etc., for simultaneously actuating certain relay circuits of these connectors so that the operator's telephone set TS₃ will be bridged across the called party's line that appears to be "busy." While holding the connection, the operator will then dial another digit (any digit whatever) to complete the "overriding" circuit while key KY₀ is held operated. This will now be explained.

In response to the dialing of a number corresponding to the called party's line by the operator's set TS₃—which is now connected to the connector CON₂—the relay GG will become operated over the circuit which, as already noted, includes battery, the winding of relay GG, the armature T₃ of relay CC and its make contact, contacts 42 and 43 of switch RON₂ and the sleeve terminal SS which is grounded because the called party's line is busy. As the master control relay

MC becomes thereafter operated in response to the operator's closure of the key KY₀, and as the operator dials another digit, the relay AA will become released so as to ground its armature. This will cause relay KK to become operated. The circuit for operating relay KK will include battery, its lower winding, conductor 70, the armature T₃ of relay MC and its make contact, conductor 71, the armature T₃ of relay GG and its make contact, conductor 72, the back contact and armature of relay AA, and ground. The operation of the relay KK will then connect the tip and ring conductors TT and RR of the called party's line to the armatures T₂ and T₅ of relay FF through the armatures L₂ and T₂ of relay KK and their make contacts, respectively. The operation of relay KK will then cause relay FF to become operated over a circuit which includes the ground at GD, the lower winding of relay FF, the back contact and armature T₄ of relay JJ, armature T₂ of relay FF and its back contact, armature L₂ of relay KK and its make contact, conductor TT, the calling party's set TS₂, conductor RR, the armature T₂ of relay KK and its make contact, the armature T₅ of relay FF and its back contact, the armature T₂ of relay JJ and its back contact, resistor Z, battery and ground. Relay FF will be locked as already described with regard to connector CON₁. In response to the operation of relay FF the circuit to the called party's set TS₂ will now be extended to the operator's set TS₃ through the armatures T₂ and T₅ of relay FF and their make contacts. The operator's set TS₃ will now be connected to the telephone circuit previously established by connector CON₁. The operator may then determine whether or not the called party's line is busy or out of order due to the removal of the receiver from its hook. Thus the busy line may be seized and its condition tested by the operator first dialing the number corresponding to the called party's station, then operating key KY₀, and then dialing another digit to complete the connection to the busy line.

It will be observed that the master control relay MC includes a plurality of armatures each of which is assigned to but one of the various connectors and, as there would be several connectors in an ordinary community dial office, the relay MC would require as many armatures as there are such connectors in the office. The operation of the master control relay MC in response to the manipulation of the key KY₀, however, will permit the operation only of the relay such as KK of connector CON₂, which receives an additional or fifth digit dialed by the operator for the purpose of overriding a busy condition. Thus, the only subscriber's line seized will be the one which responds to the groups of dial pulses emanating from the operator's telephone set TS₃. The last of these dial pulses will operate a relay such as FF of connector CON₂, for example, to complete a path to the busy party's line. Thus the operator will be bridged across the telephone line of the particular party that is dialed by the operator and the connection will be completed only when the operator actuates her key KY₀ and dials an additional digit.

While this invention has been shown as applied to a step-by-step telephone system having an additional conductor interposed between the community dial office CDO and the manual office MO for actuating the master control relay MC, similar operation of the master control relay may be effected over a loop dial trunk, or over a com-

posite trunk dial leg, or by other means, as will be apparent to those skilled in the art.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations 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 a telephone line interconnecting two telephone stations, and means to monitor over said telephone line, said means including means responsive to dial pulses corresponding to one of said interconnected telephone stations and to an additional dial pulse to seize the busy telephone line without interfering with communication over said telephone line, the busy telephone line being seized for communication thereover only after said additional digit is dialed.

2. In a telephone system, the combination of a telephone line, a first subscriber's set connected to said line, a second subscriber's set, means responsive to predetermined dial pulses to connect said telephone line to said second subscriber's set, an operator's set, and means responsive to predetermined dial pulses transmitted from said operator's set and to an additional pulse to connect said operator's set to said second subscriber's set, the second subscriber's set being seized for communication therewith only after said additional pulse has been transmitted.

3. In a telephone system, the combination of a first telephone set, a second telephone set, a line, means responsive to predetermined dial pulses produced by said first telephone set to connect said first telephone set to the second telephone set over said line, an operator's set, and means to connect said operator's set to said line to determine whether said line is busy, said latter means including means responsive to additional pulses corresponding to said predetermined dial pulses and to an additional pulse to seize said line, said line being seized for communication thereover only after said additional pulse has been transmitted.

4. In a telephone system, the combination of a plurality of connectors each of which may serve to connect a pair of telephone stations to each other, a calling telephone station, a called telephone station, a third telephone station, means responsive to predetermined dial pulses emanating from the calling station and corresponding to the called station to connect said calling station to said called station through one of said con-

nectors, means responsive to the same dial pulses emanating from the third telephone station and corresponding to the called station to return a busy signal to the third station over another of said connectors, and means responsive to an additional dial pulse of the series of dial pulses transmitted to the latter connector to seize the circuit interconnecting the calling and called stations for monitoring said circuit.

5. In a telephone system, the combination of an attended office, an unattended office, a subscriber's circuit connected to said unattended office, means to dial said subscriber's circuit from the attended office and to determine whether said subscriber's circuit is busy, and means to dial an additional digit when said subscriber's circuit tests busy to seize said subscriber's circuit without interfering with whatever conversation may be going on over said subscriber's circuit, said busy subscriber's circuit being seized for conversation thereover only after the additional digit has been dialed.

6. In a telephone system, the combination of an attended office having an operator's set, an unattended office, a subscriber's circuit connected to said unattended office, means to monitor the subscriber's circuit from the attended office, said means including means responsive to dial pulses corresponding to said subscriber's circuit to return a busy signal to the operator's set at said attended office, and means responsive to additional dial pulses to connect said operator's set to said subscriber's circuit for communication purposes without interfering with any conversation over said subscriber's circuit.

7. In a telephone system, the combination of an unattended telephone office, two subscriber's telephone sets connected to each other through said unattended office, an attended telephone office connected to said unattended office, an operator's telephone set at said attended office having means for producing dialing pulses for signaling one of said subscriber's sets, equipment at said unattended office which may be operated by said dialing pulses, a circuit interconnecting said unattended office with said attended office, means controlled at said attended office to operate said circuit, said circuit including apparatus to partially complete a path to said dialed subscriber's set, and means responsive to the pulses of another dialed digit to complete the path between said operator's set and the dialed subscriber's set for communication purposes without interfering with communication between said subscribers' sets.

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