

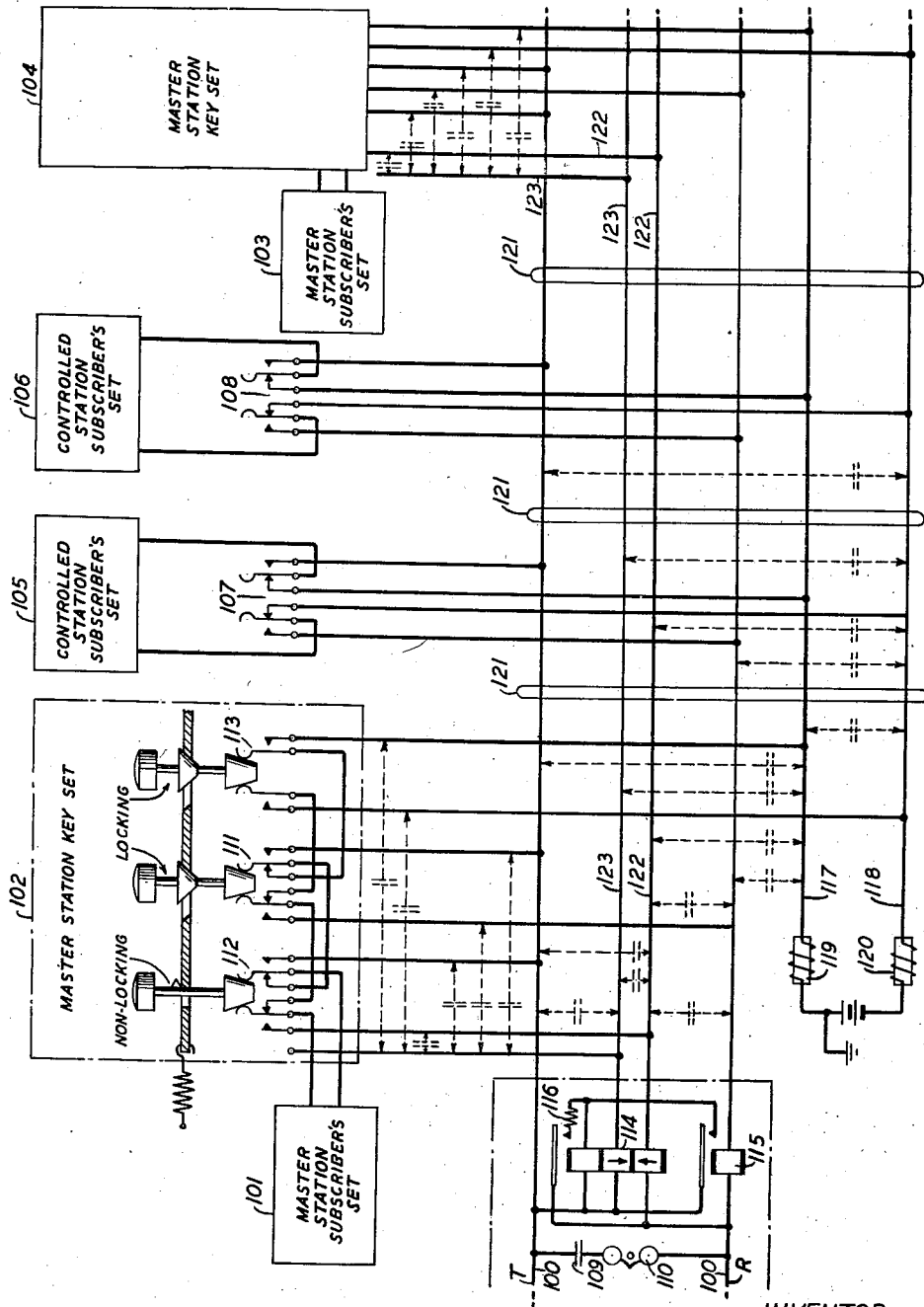
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W. M. BEAUMONT

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INTERCOMMUNICATING TELEPHONE SYSTEM

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INVENTOR
W.M. BEAUMONT
BY *J. H. Krizman*
ATTORNEY

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INTERCOMMUNICATING TELEPHONE
SYSTEM

William M. Beaumont, Summit, N. J., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

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This invention relates to telephone systems and more particularly to intercommunicating systems whereby any two stations of a particular group may signal and converse with each other and wherein one or more trunk circuits extend to a telephone central office to which any station in the group may connect by operating a proper key, thus obtaining central office service.

An object of the invention is to permit a trunk circuit to be "held" by an answering station while disconnected from the trunk for the purpose of communicating with another station of the group and to insure removal of the holding condition when any station of the group is again connected to the trunk.

Another object is to preserve a balanced condition across the trunk at all times and to prevent inductive disturbances such as cross-talk in the system from affecting conversation over the trunk.

A feature of the invention whereby the first object is obtained resides in a holding bridge comprising a multi-wound relay, one winding of which is connected in series with the answering station telephone across the trunk at the will of the subscriber whereupon the relay operates and locks itself operated across the trunk over its contacts and a second one of its windings, in series with a resistance, under control of a relay serially connected in the trunk which series relay operates to cause the first relay to release when any station of the system again connects to the trunk.

Another feature, whereby the second object is obtained, resides in a third or compensating winding on the relay which opposes the first winding with respect to inductive disturbances, and is connected to a conductor which parallels and is exposed to the same inductive disturbance as the conductor to which the first winding is connected.

The invention will be understood from the following description when read in connection with the accompanying drawings which illustrate an intercommunicating telephone system consisting of a plurality of subscribers' stations, both master and controlled, a trunk circuit associated with these stations and extending to a central office or to a private branch exchange; and a trunk holding circuit which embodies the features of this invention.

Two master stations are shown, one being represented by the subscriber's set 101 and associated key-set 102 while the other is represented by subscriber's station 103 together with the as-

sociated key-set indicated by block 104. Two controlled stations are shown, one being represented by subscriber's set 105 and the second by subscriber's set 106. The master station key-set 102 is provided with three keys: a talking key 111 for establishing talking connections between the subscriber's set 101 and the trunk 100; a holding key 112 for holding an incoming trunk call while communicating with other stations of the group, if desired; and an intercommunicating key 113 for establishing talking connections between station 101 and other stations of the group. Block 104 represents a key-set identical with key-set 102 and associated with the master station subscriber's set 103. Keys 107 and 108, which are associated with the controlled station subscribers' sets 105 and 106, respectively, provide means for connecting sets 107 and 108 to trunk 100 for communication.

On an incoming call, ringing current applied to trunk 100 at the central office or private branch exchange, not shown, causes ringer 110 in series with condenser 109 to sound. Assuming that the subscriber at master station set 101 answers the call, the talking key 111 of the associated key-set 102 is depressed and the receiver at subscriber's set 101 is removed from the switch-hook. The talking key 111 is of a locking type well-known in the art and upon its operation completes a circuit from the trunk 100 to the subscriber's set. This circuit is traceable from the upper or tip conductor of trunk 100, right front contact of key 111, right back contact of key 112, subscriber's set 101, left back contact of key 112, left front contact of key 111, winding of relay 115, to the lower or ring conductor of trunk 100. Relay 115 operates in this circuit from battery and ground supplied over the trunk from the central office or the private branch exchange but performs no useful function at this time. Conversation between the calling subscriber (not shown) and the answering subscriber at station 101 may now ensue.

Should it be desired to transfer the call to some other station of the intercommunicating group, this is accomplished as follows: The talking key 111 of key-set 102 is, at this time, in its operated position and locked as previously set forth. The subscriber at station 101 now momentarily depresses holding key 112 of key-set 102. This holding key is of the "non-locking" type and the construction of key-set 102 is such that the depression of holding key 112 releases the associated locking type talking key 111 or intercommunicating key 113 if either of these latter keys are in

their operated and locked position. Since talking key 111 was previously operated and locked, the depression of holding key 112, therefore, causes talking key 111 to release and restore to its normal position. The release of key 111 opens the circuit between subscriber's set 101 and the conductors of trunk 100 through the winding of relay 115 thereby causing relay 115 to release. The trunk circuit, however, is not opened at this time as an alternate bridge circuit across the trunk was substituted by the operation of key 112 which can be traced from the upper conductor of trunk 100, outer right contacts of key 112, through the subscriber's set 101, outer left contacts of key 112, conductor 122 and lower winding of relay 114 to the lower conductor of trunk 100 at a point between the relay 115 and the central office or private branch exchange, whereupon relay 114 operates and locks in a circuit from the upper conductor of the trunk, through the upper winding of the relay, resistance 116, front contact of the relay, to the lower trunk conductor.

The release of the holding key 112 by the subscriber at station 101 opens the operating circuit through the lower winding of relay 114 which relay, however, remains locked through its upper winding as set forth above and thereby, due to the bridge placed across trunk 100 by the upper winding of relay 114 in series with resistance 116, causes the connection on the trunk to be held. The restoration of holding key 112 to its normal position also opens the circuit between subscriber's set 101 and trunk 100.

The subscriber at station 101 now depresses the intercommunicating key 113 which locks in its operated position and connects station 101 to the local intercommunicating line conductors 117 and 118 over the back contacts of keys 112 and 111 and the front contacts of key 113. Potential for local transmission between stations of the intercommunicating group is supplied to conductors 117 and 118 through the windings of retardation coils 119 and 120. Having connected set 101 to conductors 117 and 118 by the operation of intercommunicating key 113 of the associated key-set 102, the subscriber at station 101 now signals the particular controlled station or other master station at which it is desired that the incoming call be taken up. This signaling system (not shown) is independent of the talking conductors 117 and 118 and may consist of any type of system, either audible or visual, an audible system using buzzers on a code signaling basis usually being employed. As this signaling system forms no part of the present invention, no further reference to it will be made.

Assuming that the subscriber at station 101 signals the subscriber at the controlled station 106 and this latter subscriber, in response to the signal, removes his receiver from the switch-hook, he is thereupon in communication with the subscriber at station 101 over intercommunicating line conductors 117 and 118. Upon being advised that an incoming call is waiting, the subscriber at station 106 operates the associated locking type key 108. The operation of key 108 transfers subscriber's station 106 from its normal connection with the intercommunicating line conductors 117 and 118 to the tip and ring conductors of trunk 100 in series with trunk relay 115 which relay again operates on the current supplied over the trunk from the central office or private branch exchange. The operation of relay 115 short-circuits the upper winding of holding relay 114 which thereupon releases. The

release of relay 114 removes the holding bridge consisting of the upper winding of relay 114 in series with resistance 116 from across trunk 100. The calling subscriber and the subscriber at station 106 are now in direct communication.

At the conclusion of conversation, the subscriber at station 106 replaces his receiver on the switch-hook and restores key 108 to its normal position. Trunk relay 115 thereupon releases and opens the short-circuit around the upper winding of relay 114 thereby restoring the trunk holding circuit to normal.

Should it be desired that the incoming call, originally answered by the subscriber at master station 101, be taken up by some other subscriber than the one at controlled station 106 as set forth above, the subscriber at station 101 communicates with the proper station and the call is taken up and the trunk holding circuit restored in the manner identical with that hereinbefore described. If the call is taken up at station 105, trunk relay 115 operates in series with the subscriber's set at station 105 when the receiver at that station is removed from the switch-hook and the associated key 107 is operated. If the call is taken up at station 103, trunk relay 115 operates in series with the subscriber's set at station 103 when the receiver at that station is removed from the switch-hook and the talking key of the associated key-set 104, similar to key 111 of key-set 102, is operated. In either case, the operation of relay 115 causes the release of relay 114 and restores the trunk holding circuit as already described.

The keys associated with each of the master and controlled subscribers' stations of the intercommunicating group are usually interconnected with each other, with the central office or private branch exchange trunk 100 and with the associated trunk holding circuit by means of a multiple conductor cable 121. Since the lower or operating winding of relay 114 is permanently connected to the lower conductor of trunk 100 and the other end of that same winding is connected by multiple conductor 122 to a front contact of the holding keys, such as key 112, of the key-set associated with each master subscriber's station, an unbalanced condition of the trunk would normally exist as a result of which the trunk would be susceptible to any inductive disturbances occurring in any of the various cable conductors adjacent to the multiple conductor 122.

To prevent the interference of inductive disturbances from affecting conversation over the trunk, the holding relay 114 is provided with a third or compensating winding in addition to the lower or operating winding and the upper or holding winding. One end of this compensating winding, the middle winding of relay 114, is permanently connected to the upper or tip conductor of the trunk. The other end of this winding is connected, by means of multiple conductor 123 of cable 121 to the key-set of each master subscriber's station, such as key-sets 102 and 104, at which point the conductor is either looped or dead-ended depending upon whether the key-set is associated with the first or an intermediate station or with the last station of the group. Conductor 123, therefore, closely parallels conductor 122 and, as indicated by the dotted capacities shown between the various conductors of cable 121, both of these conductors are equally exposed to any inductive disturbance on any of the conductors of the cable. The middle or compensating winding and the lower or operating wind-

ing of relay 114 have the same number of turns each and are of equal resistance. These two windings, however, are wound in opposite directions on the core of the relay. Any inductive disturbance on the multiple connections between the various stations of the group is, therefore, neutralized since it sets up opposing currents of equal intensity in both the lower and middle windings of relay 114. The balanced condition across trunk 100 is thus maintained thereby eliminating the possibility of cross-talk or other inductive disturbances from affecting conversation over the trunk.

What is claimed is:

1. In an intercommunicating telephone system, a plurality of subscribers' stations, a trunk line from a central office multiplied at each of said stations, a telephone set at each station, means at each station for connecting the respective telephone set to the trunk line, a multi-winding relay associated with the trunk, switching means at one of said stations for connecting one winding of said relay in series with the telephone set across said trunk to cause operation of the relay, contact means associated with said relay and closed when the relay is operated to connect a second winding of said relay in a holding bridge, including a resistance, across said trunk to hold said relay operated when said switching means is released, a series relay in said trunk line adapted to be operated whenever any of said telephones are connected to the trunk, said relay being arranged, when operated, to short-circuit said second winding to cause the multi-wound relay to release and remove the holding bridge from the trunk.

2. In an intercommunicating telephone system, a plurality of subscribers' stations, a trunk line from a central office multiplied at each of said stations, a telephone set at each of said stations, means at each station for connecting the respective telephone to the trunk, a multi-winding relay associated with the trunk, switching means at one of said stations for connecting one winding of said relay in series with the telephone across said trunk to cause operation of the relay, contact means associated with said relay responsive to its operation to connect a second winding of said relay across said trunk to hold said relay operated when said switching means is released, a series relay in said trunk adapted to be operated when any of said telephones is connected to the trunk and when operated to cause said second winding bridge across the trunk to be removed.

3. In an intercommunicating telephone system, a plurality of subscribers' stations, a trunk line from a central office multiplied at each of said stations, a telephone set at each of said sta-

tions, means at each station for connecting the respective telephone set to the trunk line, a multi-winding relay associated with the trunk, switching means at each station, a first winding on said relay having one terminal multiplied to all of said switching means, any one of said switching means when operated being adapted to connect said first winding across the trunk in series with the telephone to operate the relay, a second winding on said relay having one terminal connected to a terminal of the first winding and having its other terminal extended to closely parallel the multiple connection of said first winding to all of said switching means, said second winding being of the same resistance and having the same number of turns as the first winding, but so connected that any current flowing in the first winding caused by inductive disturbances effecting the multiple connection to the switching means will be neutralized in the relay due to an equal opposing current set up by the disturbance in the parallel extension of the second winding, contact means associated with said multi-wound relay and closed when the relay is operated to connect a third winding thereof in a holding bridge across said trunk and hold said relay operated when said switching means is released, a series relay in said trunk circuit adapted to be operated whenever any of said telephones is connected to the trunk, said series relay being adapted when operated to cause said multi-wound relay to release and disconnect said holding bridge.

4. In an intercommunicating telephone system, a plurality of subscribers' stations, a telephone set at each station, a cable connecting all stations, a trunk line from a central office contained in said cable and multiplied to each of said stations, a multi-winding relay associated with the trunk line, a first winding on said relay having one terminal connected to a conductor of said trunk line and the other terminal connected to a holding conductor in said cable which is multiplied at each station, switching means at each station for connecting the respective telephone across the trunk line in series with said holding conductor and first winding, a second winding on said relay of the same characteristics as the first winding and having one terminal connected in multiple with the first winding terminal to the trunk line and the other terminal connected to another conductor of said cable, said second winding being connected differentially with respect to the first winding whereby cross-talk currents flowing in said holding conductor and first winding will be neutralized in the relay by similar currents flowing in the other cable conductor and second winding.

WILLIAM M. BEAUMONT.