Feb. 5, 1946. W. A. DERR ET AL 2,394,045

CONTROL SYSTEM

Filed Dec. 22, 1944 4 Sheets-Sheet 1

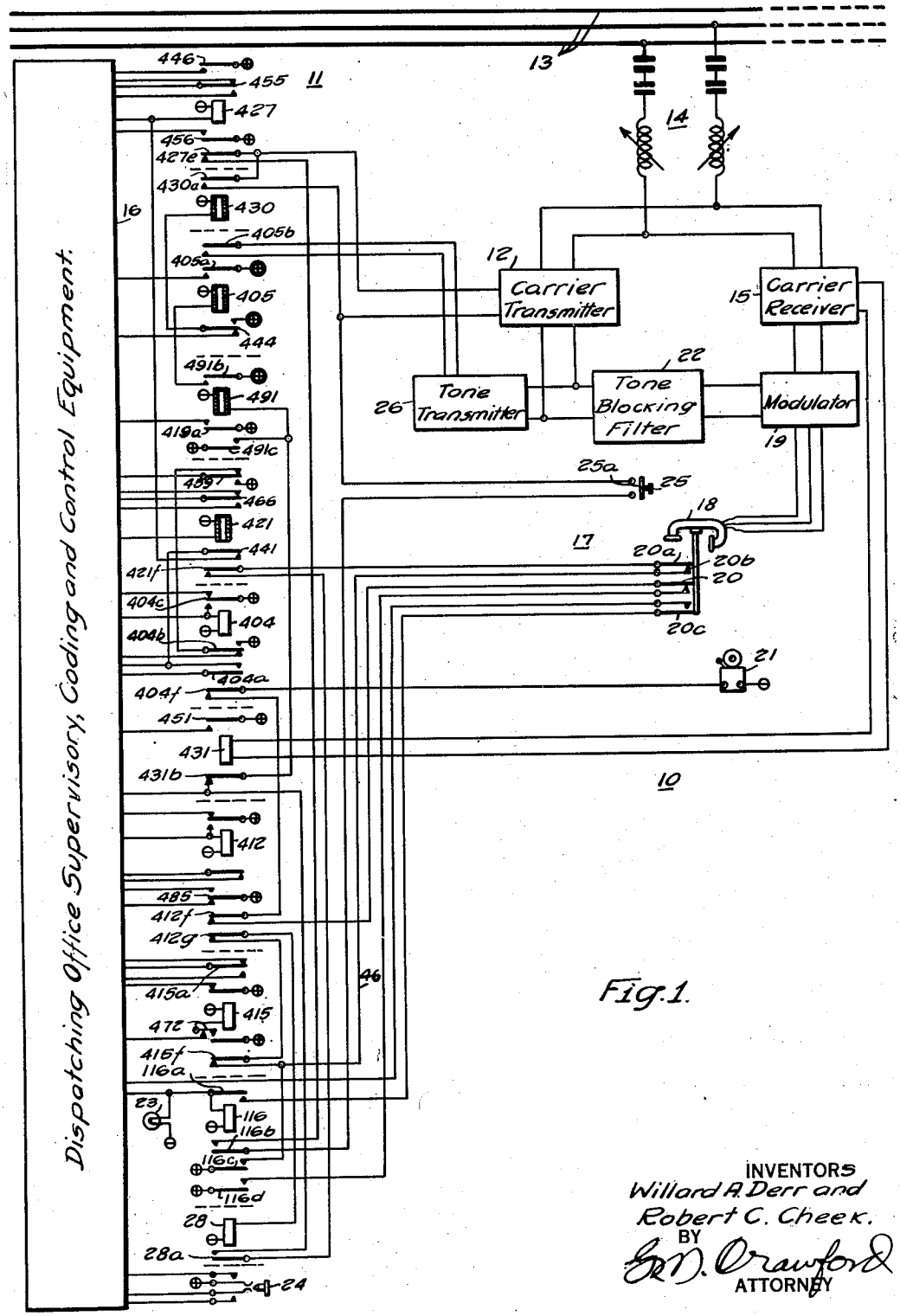


Fig. 1.

INVENTORS
Willard A. Derr and
Robert C. Cheek.
BY
G. D. Crawford
ATTORNEY

Feb. 5, 1946. W. A. DERR ET AL 2,394,045

CONTROL SYSTEM

Filed Dec. 22, 1944 4 Sheets-Sheet 2

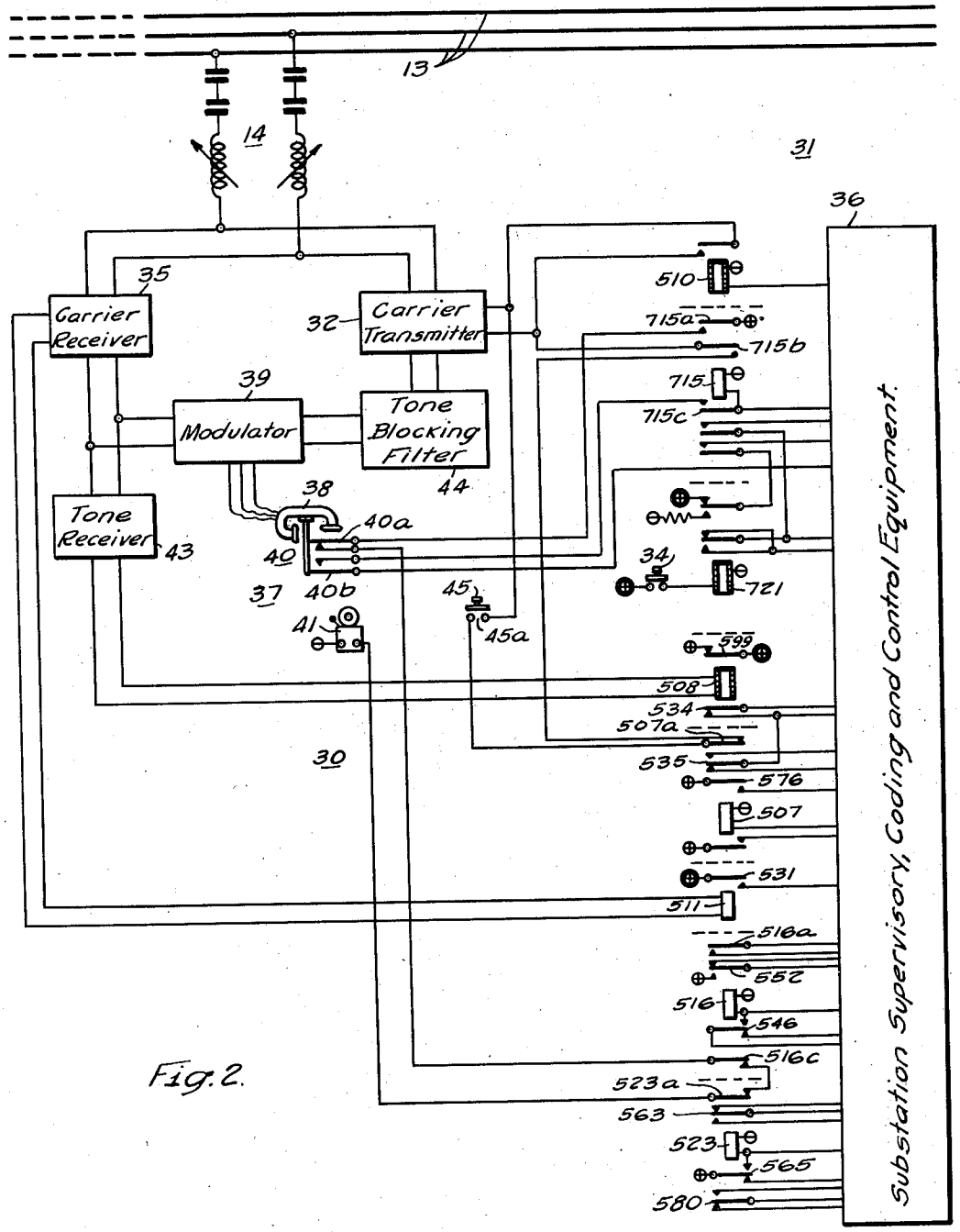


Fig. 2.

WITNESSES:

E. A. McCloskey.

E. V. Giolma

INVENTORS

Willard A. Derr and

Robert C. Cheek.

BY

G. D. Crawford

ATTORNEY

Feb. 5, 1946. W. A. DERR ET AL 2,394,045

CONTROL SYSTEM

Filed Dec. 22, 1944 4 Sheets-Sheet 3

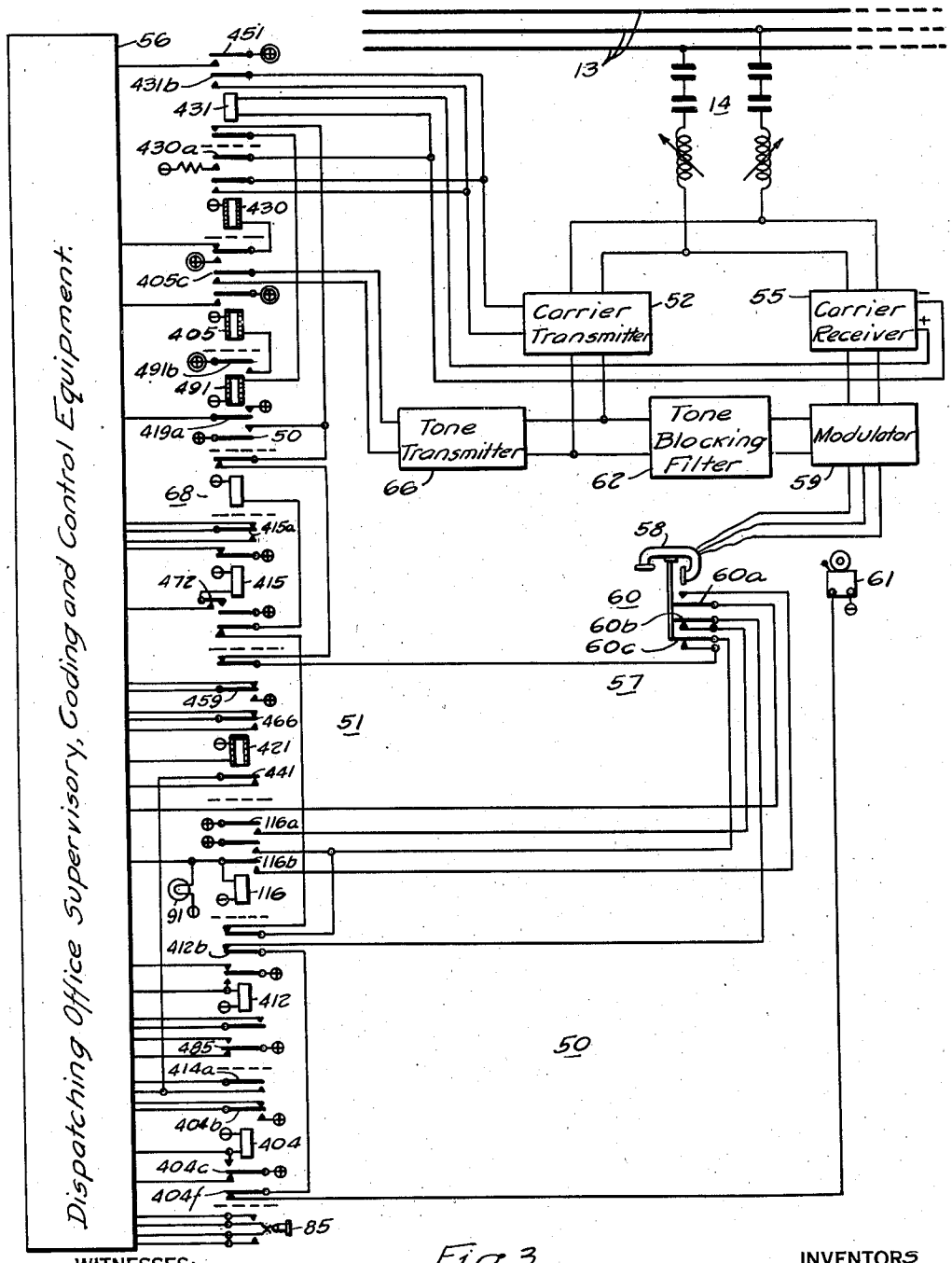


Fig. 3.

WITNESSES:
E. A. McCloskey.
F. V. Fiolma

INVENTORS
Willard A. Derr and
Robert C. Cheek.
BY
Crawford
ATTORNEY

Feb. 5, 1946. W. A. DERR ET AL 2,394,045

CONTROL SYSTEM

Filed Dec. 22. 1944 4 Sheets-Sheet 4

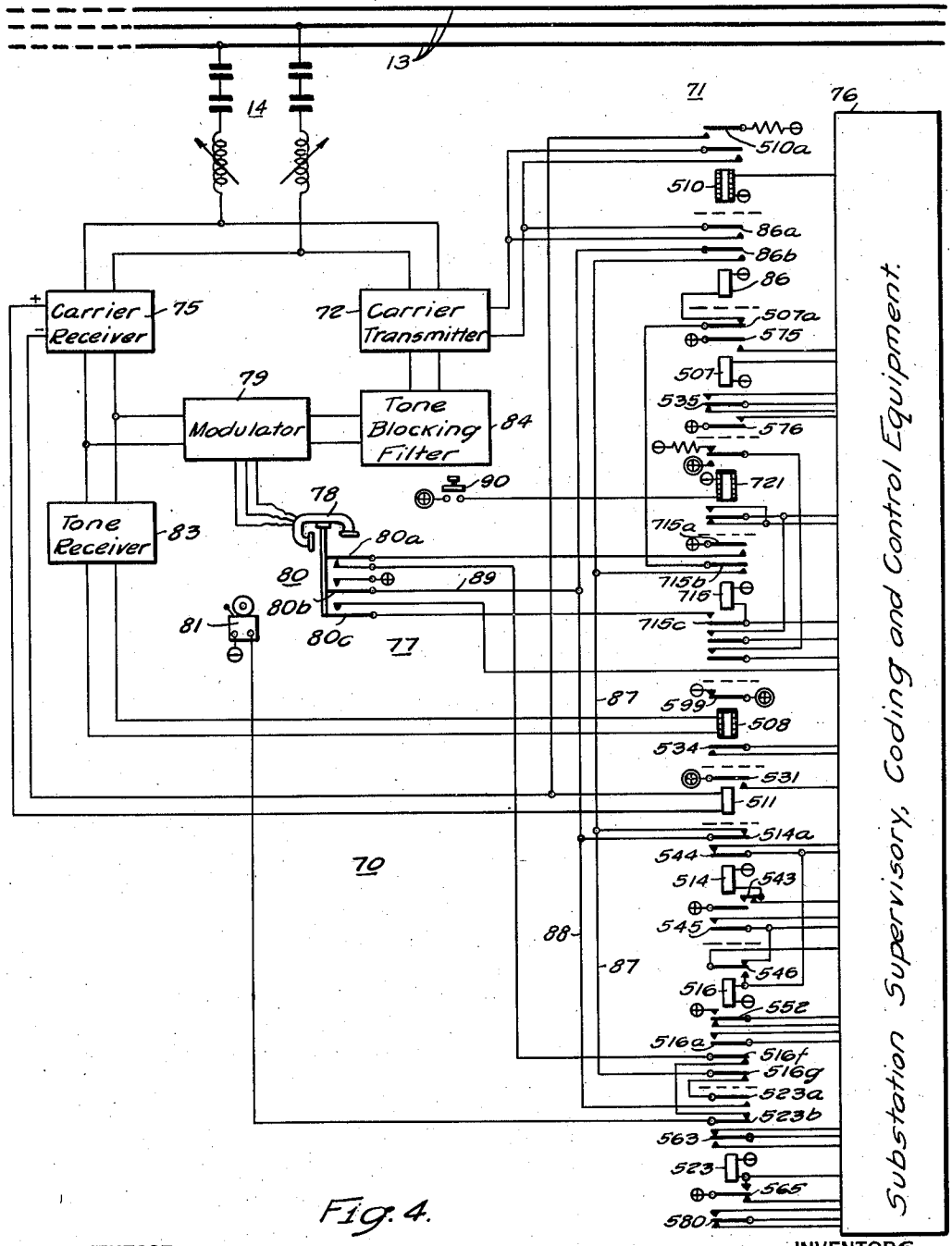


Fig. 4.

WITNESSES:

E. A. McCloskey.

F. V. Siolma

INVENTORS

Willard A. Derr and

Robert C. Cheek.

BY

G. M. Crawford

ATTORNEY

Patented Feb. 5, 1946 2,394,045

UNITED STATES PATENT OFFICE

2,394,045

CONTROL SYSTEM

Willard A. Derr, Wilkinsburg, and Robert C. Cheek, East Liberty, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 22, 1944, Serial No. 569,355

12 Claims. (Cl. 179—2)

Our invention relates, generally, to remote control and communication systems, and has reference in particular to supervisory control and telephone carrier communication systems.

Generally stated, it is an object of our invention to provide a supervisory control and telephone communication system which is simple and inexpensive to manufacture and is easy to operate.

More specifically, it is an object of our invention to provide for communicating in either direction between a dispatching office and a plurality of remote stations by means of telephone over the carrier channel of a supervisory control carrier system of the multistation type through a point of the supervisory control system.

It is also an object of our invention to provide for communicating by telephone over a supervisory control channel, using the same carrier transmitters and receivers used in connection with the supervisory control equipment.

An important object of our invention is to provide for automatically resetting the supervisory control equipment at the end of a telephone communication over a telephone circuit established through a point on the supervisory control equipment.

Another object of our invention is to provide for transmitting a point selection check code when setting up a telephone circuit between a dispatching office and a remote station, only when the operator at the point with which it is desired to communicate answers the telephone.

Yet another object of our invention is to provide for transmitting coded impulses over a common carrier channel in a supervisory control and telephone carrier system by keying the transmitter to produce impulses, and to provide for resetting the supervisory control equipment at the end of a communication by means of a tone transmitter in order to distinguish from a relatively long interval of carrier operation during a telephone communication.

Still another object of our invention is to provide for placing the carrier frequency on the communication channel for a telephone communication only when the supervisory point selection functions are completed.

A further object of our invention is to provide for operating the line relay in a supervisory control system directly from the carrier frequency receiver.

It is also an important object of our invention to provide for synchronizing the operation of the line relays at the dispatching office and at each of a plurality of remote stations in order to provide for effectively locking out the stations with which it is not desired to communicate.

Other objects will in part be obvious, and will in part be described hereinafter.

In accordance with our invention, a carrier supervisory control system is operated by keying the carrier transmitters at the dispatching office and at the remote stations to produce coded carrier impulses, and operating carrier receiving relays as line relays in response to said impulses for selectively performing operational and supervisory functions at the dispatching office or at any one of a number of remote stations.

Telephone communication is selectively effected between any one of the remote stations and the dispatching office in either direction over the carrier channel by means of the supervisory transmitters and receivers through points of the supervisory control system by operating the appropriate telephone point keys. Sending of the point selection check code from the called station is prevented until the operator answers, so that the operator calling may then proceed without delay. As soon as the checking operation is completed, the carrier frequency may be maintained for conversation purposes. Replacement of the telephone at the dispatching office automatically resets the supervisory equipment by transmitting a tone over the carrier channel, and releases the supervisory equipment at the office and at the remote stations for subsequent supervision or communication purposes.

For a more complete understanding of the nature and scope of our invention, reference may be made to the following detailed description, which may be read in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic view of the dispatching office supervisory control and telephone equipment in a single frequency supervisory communication carrier system embodying the invention in one of its forms;

Fig. 2 is a diagrammatic view of the supervisory control and telephone equipment at any one of a plurality of remote stations in single frequency supervisory communication carrier system embodying the invention in the same form and corresponding to the office equipment of Fig. 1;

Fig. 3 is a diagrammatic view of the supervisory control and telephone equipment at the dispatching office in a two-frequency supervisory control communication system, embodying the invention in another of its forms; and

Fig. 4 is a diagrammatic view of the supervisory control and telephone equipment at any number of remote stations in a two-frequency supervisory control communication system, corresponding to the office equipment shown in Fig. 3.

Referring to Fig. 1, the reference numeral **10** may denote, generally, the dispatching office equipment of a supervisory control communication system. The supervisory control equipment **11** may comprise sending equipment for operating a carrier transmitter **12** to transmit coded impulse signals over the conductors **13** of a transmission line or the like, through coupling means **14** comprising, for example capacitors and inductances. The supervisory equipment **11** may also comprise the necessary receiving equipment for operation from a carrier receiver **15**, which may be also coupled to the conductors **13** through the coupling means **14**.

The supervisory control equipment **11** may be of the multistation type, which is described in detail and shown in Figs. 1 through 4 of Reissue Patent No. 21,284, issued on December 5, 1939, to H. P. Boswau. Since the principal portion of the dispatching office supervisory control equipment in the present invention is identical with the equipment shown and described in the Boswau patent, it has been represented by the boxed enclosure **16** marked "Dispatching office supervisory coding and control equipment." For the purposes of simplification, the only equipment shown in Fig. 1 of this application is that which departs from the showing in Figs. 1 through 4 of the Boswau patent. For example, in the vertical column of relays to the right of the enclosure **16** are those of the Boswau patent to which additional connections or changes of the circuits thereof have been made, as well as any new relays which have been added. The relays which appear in the Boswau patent bear the same designations as in the Boswau patent and have the additional contacts and circuits designated by numerals different from any appearing in the Boswau patent. Equipment added to that of the Boswau patent is designated by numerals not appearing in the Boswau patent.

Instead of having the impulsing or sending relay **430** connect the supervisory conductors to a source of direct current, as in the system of the Boswau patent, the impulsing relay **430** may be used to key the transmitter **12** for sending carrier frequency impulses over the conductor **13**. Front contact of armature, **430***a*, of the impulsing relay may be used for this purpose.

The receipt of supervisory signals from a remote station may also be effected in a different manner from that described in the Boswau patent. The line relay **431**, instead of being energized by direct-current impulses, may be energized directly from the carrier receiver **15**, thus operating both as a line relay and as the receiving relay of the carrier system.

In order to provide for telephone communication in either direction between the dispatching office and any one of the remote stations, telephone equipment **17** may be provided comprising, for example, a handset **18** which may be connected to the carrier transmitter and receiver through a modulator **19** of a type well known in the art. Means such as the hook switch **20** may be provided in connection with the handset **18** for controlling different auxiliary telephone circuits. A bell **21** provides a signal for calling the operator.

For the purpose of preventing interference between the supervisory control equipment and the telephone equipment, provision may be made for connecting the handset **18** with the telephone equipment of any one of the remote stations over the conductors **13**, through a point of the supervisory control equipment **11**. For example, the point relay **116** of the Boswau patent may be used as illustrative of any number of telephone point relays, and the supervisory lamp associated therewith designated in the present instance by the numeral **23** may be used to indicate a call over the supervisory control equipment from a telephone at one of the remote stations. The operate key associated with the point relay **116** and designated by the numeral **24** may be representative of the telephone selection key for any one of the remote stations.

In order to provide for ringing the bell **21** in response to an incoming call from a remote station, it may be connected to a suitable source of operating potential such as the usual indirect positive bus through a front contact of armature **116***d* of the telephone point relay **116**. Back contact and armature **20***b* of the hook switch **20** may be used to open the bell circuit as soon as the operator answers. Ringing of the bell when the handset **18** is replaced on the hook may be prevented by using contacts of one or more of the supervisory control relays responsive to sending and receiving operations, such as, for example, back contact and armature **412***f* of the point check code stop relay **412**, and front contact and armature **404***f* of the start relay **404**.

In order to indicate to the operator at a remote station that the operator at the dispaching office is ready the sending of a point selection check code from the dispatching office may be prevented until the operator answers the telephone. For this purpose, normally open front contact and armature **20***c* of the hook switch **20** may be used in the operating circuit of the point check code start relay, which would otherwise be set up through front contact and armature **116***a* of the point relay **116** for initiating the point seelction check code. This enables the calling operator to proceed with his conversation as soon as he receives the check code signal, with the assurance that the operator at the called station has lifted the handset from the hook and is ready.

During a conversation, since this is a single frequency system, a "push-to-talk" switch **25** may be used to energize the carrier transmitter **12**. In order to prevent interruption with the supervisory control functions during station selection, by inadvertent operation of the "push-to-talk" switch, means may be provided for rendering the switch **25** inoperative until the supervisory functions are completed. For example, front contact and armature **116***b* of the point relay **116**, which operates upon receipt of the point check code when the dispatcher is calling a remote station, and upon termination of the point selection code upon an incoming call, and back contact and armature **427***e* of the sending start relay **427**, which operates upon the initiation of an outgoing call from the dispatching office, may be connected in series circuit relation with the "push-to-talk" switch **25**.

In order to distinguish from the long impulse caused by the maintenance of carrier during a telephone conversation, resetting of the supervisory control equipment at the termination of a communication may be provided in a somewhat different manner than in the system of the Boswau patent. A reset relay **491**, which is similar to that shown in the Boswau patent, may be used to

operate a tone transmitter 26 used with the transmitter 12 for transmitting a reset tone.

In order to provide for automatically resetting the supervisory control equipment, an auxiliary reset relay 28 may be provided for normally maintaining the operating circuit of the reset relay 491 open when the point selection relay 116 picks up and closes front contact and armature 116c, until the telephone is picked up, and then providing for closing this circuit as soon as the handset at the dispatching office is returned to its hook. Operation of the auxiliary reset relay 28 in response to operations initiated at the dispatching office is prevented by means of normally closed back contact and armature 415f of the point selection code stop relay 415, which is energized upon the completion of a point selection code sent from the dispatching office. A break contact and armature 412g of the point selection check code stop relay 412 may be used in the operating circuit of the auxiliary reset relay 28 so that the relay will be energized on operations initiated at a remote station, and then deenergized when the dispatching office telephone is picked up. A break contact and armature 421f of the receiving drive relay 421 may be used to prevent simultaneous operation of relays 491 and 28 upon operations initiated at a remote station. Operation of the reset relay through any other supervisory circuit while the carrier is on the line is prevented by back contact and armature 431b of the line relay 431. A tone blocking filter 22 may be used to block from the line voice frequencies of the reset tone frequency.

Referring to Fig. 2, the reference numeral 30 may denote, generally, the equipment at any one of the remote stations of a single frequency carrier supervisory control communication system, comprising supervisory control equipment 31 including sending equipment for operating a carrier transmitter 32 coupled to the conductors 13 through coupling means 14. A carrier receiver 35 may be connected to the conductors 13 for receiving impulses transmitted from the dispatching office or other remote stations for operating supervisory control receiving equipment including a line relay 511 directly. The line relay in this instance functions as a carrier receiving relay and also operates into the counting chain of the supervisory control equipment in a manner of a line relay as described in detail in the Boswau patent hereinbefore referred to. A principal portion of the supervisory control equipment is identical with that described in detail in the Boswau patent and has been represented generally by the boxed enclosure 36. The line relay 511 and the sending or impulsing relay 510 operate in connection with the carrier receiver and transmitter in a manner similar to that described in connection with the dispatching office equipment shown in Fig. 1. The supervisory equipment of Fig. 2 corresponds to the station equipment shown in Figs. 5, 6 and 7 of the Boswau patent.

Telephone equipment 37 comprising, for example, a handset 38 may be connected to the carrier transmitter 32 and carrier receiver 35 through a modulator 39 of a type well known in the art for operation through a point of the supervisory control equipment. For example, in place of the auxiliary switch 735 of the Boswau patent the supervisory control relay 721 may be provided with a telephone call key 34 for initiating a supervisory code to the dispatching office to indicate a telephone call from the remote station.

The telephone handset 38 may be provided with a hook switch 40 for controlling operation of the phone circuits and a bell 41 may be provided for calling the operator.

As in the case of the dispatching office telephone equipment, operation of the carrier transmitter may be effected by means of a "push-to-talk" switch 45. Contacts of supervisory control relays such as, for example, the point relay 715 and of the check code start relay 507 may be used in series circuit relation with the "push-to-talk" switch 45 to prevent inadvertent operation of the carrier transmitter during a supervisory operation.

Ringing of the bell 41 may be effected through front contact and armature 715a of the point relay. Break contacts and armatures of the start relay 516 and point check code stop relay 523 may be used to prevent ringing of the phone when the handset is returned to the hook, as explained in detail in connection with Fig. 1.

Resetting of the supervisory equipment at the remote station may be provided by reconnecting the reset relay 508 of the Boswau patent for operation from a tone receiver 43 in response to a reset tone transmitted from dispatching office, and which is readily distinguished from the long carrier pulse during conversation. Armatures 534 and 599 of the reset relay 508 may be changed from the arrangement shown in Fig. 5 of the Boswau patent, so as to be normally closed instead of normally open, for effecting resetting upon operation in response to a reset tone from the dispatching office. A tone blocking filter 44 may be provided for blocking the voice frequency of the reset tone from the tone receiver 43.

Since supervisory functions may be performed over other points of the supervisory control equipment in a manner similar to that described in detail in the Boswau patent hereinbefore referred to, it is necessary only to consider, in the case of the present invention, the establishment of telephone communication when initiated from a dispatching office and when initiated from one of the remote stations.

To call any one of the remote stations from the dispatching office it is only necessary for the dispatcher to pick up the telephone handset 18 and operate a telephone call key, such as the point key 24 associated with the point relay 116 of Fig. 1. When this is done, the proper station, group, and point selection relays are automatically energized for selecting the telephone point at the desired station in the manner described in connection with the selection of the circuit breaker point in the Boswau system. These circuits are not shown since they are similar to the circuits traced and described in detail in the Boswau patent, and are similar in every respect to those for any other supervisory control point.

In the course of operation of these relays, the impulsing or sending relay 430 is energized, which connects the carrier transmitter 12 for operation through and front contact and armature 430a as as to start impulsing. The signals transmitted by the carrier transmitter 12 are received by the carrier receiver 15 at the dispatching office, as well as the different carrier receives 35 at the remote stations. Accordingly, the line relay 431 at the office, and all of the line relays 511 at the remote stations, which are directly operated from their respective carrier receivers, are operated in step, in a manner similar to that described in the direct-current impulse system

of the Boswau patent, and which is necessary for multistation selection. At the completion of the station selection code, the desired station is selected and all the other stations are locked out. This arrangement of lock-out is described in detail in the Boswau patent and need not be repeated here.

When the desired station has been selected, the station check code is automatically transmitted from that station in the usual manner. Receipt of the station check code at the dispatching office initiates the transmission of the point selection code from the dispatching office. Upon the receipt of this code at the remote station, the point relay 715 is energized. Since the telephone at that location is not yet picked up and the point check code stopping relay 523 and the start relay 516 are deenergized, a circuit is provided for the telephone bell 41 at the remote station, extending from the negative terminal through the bell 41, back contact and armature 523*a* of the point check code stop relay 523, back contact and armature 516*e* of the start relay 516, normally closed back contact and armature 40*a* of the hook switch 40, and front contact and armature 715*a* of the point relay 715 to the indirect positive terminal. The telephone bell rings until the telephone is picked up, opening back contact and armature 40*a* of the telephone hook switch 40.

Operation of the hook switch 40 closes normally open front contact and armature 40*b* of the hook switch, completing a circuit through front contact and armature 715*c* of the point relay 715 for the transmission of the point check code in the usual manner. Receipt of the point check code at the dispatching office results in the telephone point relay 116 being energized, which lights the lamp 23 indicating that the operator at the called station has answered.

Immediately upon completion of the point check code, telephone conversation can be started by operation of the "push-to-talk" switch at either the dispatching office or remote station, since the point relays are both up and the start relays are down. An energizing circuit may be provided at the dispatching office for the carrier transmitter 12 from the upper terminal thereof through back contact and armature 427*e* of the check code start relay 427, front contact and armature 116*b* of the point relay 116, and contact 25*a* of the "push-to-talk" switch 25 to the lower terminal of the carrier transmitter. At the remote station a similar operating circuit is provided for the carrier transmitter 32 through contact 45*a* of the "push-to-talk" switch, back contact and armature 507*a* of the check code start relay 507, and front contact and armature 715*b* of the telephone point relay 715.

Upon the termination of a communication, the handset 18 at the dispatching office is replaced on the hook, and an energizing circuit is provided for the reset relay 491, extending from the positive terminal through front contact and armature 116*c* of the point relay 116, conductor 46, back contact and armature 20*a* of the hook switch 20, back contact and armature 421*f* of the receiving drive relay 421, back contact 28*a* of the auxiliary reset relay 28, back contact and armature 431*b* of the line relay 431 through the operating coil of the reset relay 491 to the negative terminal of the source. A holding circuit is provided through front contact and armature 491*c*.

Operation of the reset relay 491 provides an obvious energizing circuit for the reset control relay 405 through front contact and armature 419*a*, thereby providing an operating circuit for the tone transmitter 26 through front contact and armature 405*b* of the control relay. Since the impulsing relay 430 is energized through armature 444 and front contact of the reset control relay 405 the carrier transmitter 12 is set into operation and the reset tone is transmitted over the conductors 13. At the remote station the reset relay 508 is operated from the tone receiver 43, disconnecting the armature 599 and the source of indirect positive from the positive terminal of the source, thereby releasing the supervisory control equipment at the remote station in a manner similar to that described in detail in the Boswau patent.

When a communication is initiated from a remote station the handset 38 is picked up and the telephone call key 34 is operated. The supervisory relay 721 picks up and a supervisory signal is sent out in the usual manner so that the proper station, group and point selection relays at the dispatching office are energized, and all other remote stations lock out in the manner described in the Boswau patent.

Receipt of the telephone point selection code results in the point relay 116 at the office being energized, lighting the telephone call lamp 23. A circuit is prepared for sending the point selection check code, but which is held open by front contact and armature 20*c* of the hook switch until the handset 18 is picked up. The bell 21 is energized by a circuit extending through front contact and armature 116*d* of the point relay, front contact and armature 20*b* of the hook switch, back contact and armature 412*f* of the point check code stop relay and back contact and armature 404*f* of the start relay. It continues to ring until the handset is picked up.

When the handset is picked up the bell circuit is opened and front contact and armature 20*c* of the hook switch complete the circuit for sending the point check code. When this code is terminated conversation may be commenced since the point relay 715 picks up and sets up an operating circuit for the carrier transmitter through front contact and armature 715*b* and back contact and armature 507*a*, which may be completed by operating the "push-to-talk" switch 45. At the office the transmitter circuit is likewise completed through contacts 25*a* of the "push-to-talk" switch 25, front contact and armature 116*b* of the point relay, and back contact and armature 427*e* of the sending start relay 427.

Reset may be effected exactly as described in connection with a communication originating from the office, since reset is initiated from the office in both instances.

Referring to Fig. 3, the reference numeral 50 may denote, generally, supervisory control and communication equipment for a dispatching office having supervisory control equipment 51 including an impulsing relay 430 for operating a carrier transmitter 52 for transmitting coded impulses of a carrier frequency F_1 over conductors 13 of a transmission line or the like. Receiving equipment including a line relay 431 may operate from a carrier receiver 55 operating on a different frequency F_2.

The supervisory control equipment may comprise, in part, equipment identical with that described in detail in the reissued Patent No. 21,284, dated December 5, 1939, to H. P. Boswau, and represented by the enclosure 56 and other equipment shown in the Boswau patent but which has been changed in some respect. Additional equip-

ment bears designations different from any numbers used in the Boswau patent, and may thus be distinguished therefrom.

Telephone communication may be effected between the office and any of the remote stations by means of telephone equipment 57 including a handset 58, which may be connected to the transmitter 52 and receiver 55 by a modulator 59 for communication in one direction on the one frequency and in the other direction on the other frequency. A hook switch 60 and a bell 61 may be provided in the usual manner.

The telephone equipment may, as in the case of the system shown in Fig. 1, be connected for communication over the conductors 13 by the supervisory control equipment 51, and for the purposes of illustration is shown as connected through the same point of the Boswau system as in the case of the single frequency system of Figs. 1 and 2.

The bell 61 may, as shown in Fig. 1, be connected through make contact and armature 116*a* of the point relay 116, back contact and armature 404*f* of the start relay 404, and back contact and armature 412*b* of the check code stop relay 412, as well as back contact and armature 60*b* of the hook switch 60, for the same reasons hereinbefore set forth in connection with the description applied to the system of Fig. 1.

Resetting may be effected in a manner similar to that described in connection with the system of Fig. 1, by means of a reset relay 491, control relay 405, and an auxiliary reset relay 68 which provide for automatically operating a tone transmitter 66 to transmit a reset tone. A tone blocking filter 62 keeps voice frequencies corresponding to the reset tone from the transmitter.

The carrier receiver 52 may be connected for directly operating the line relay 431 in a manner similar to that described in connection with the system shown in Fig. 1 of the drawings. In most other respects, including the selection and checking of station, group and point, the supervisory control and telephone equipment at the dispatching office may be substantially similar to that described in connection with the single-frequency system shown in Fig. 1.

However, in order to provide for synchronizing the operations of the line relays at the dispatching office and at the remote stations, since, in this instance, they are responsive to different operating frequencies, provision may be made for operating the line relay 431 in response to operations of the impulsing relay 430. For example, an operating circuit may be provided for the line relay 431 which is in parallel with the operating circuit through the receiver 55. The negative terminal of the carrier receiver 55 may, for example, be connected to the negative terminal of the source through front contact and armature 430*a* of the impulsing relay 430. The line relay 431, which is normally energized from the carrier receiver, may thus be directly energized by the impulsing relay 430.

The line relay 431 therefore operates, interrupting the energizing circuit for the impulsing relay 430 by providing an energizing circuit for the control relay 429 (not shown) through armature 451 in the same manner as described in the Boswau patent. Accordingly, the counting chain at the dispatching office is operated whether the office is sending or receiving, so that the line relays at all of the remote stations operate in step with the line relay at the dispatching office. In this manner synchronization of the line relays may be secured, in effect internally, thus enabling operation of the two-frequency system to lock out all of the stations but the desired station in a manner which is described in detail in the Boswau patent.

Referring to Fig. 4, the reference numeral 70 may denote, generally, the supervisory control communication system of a two-frequency supervisory control communication system at any one of the remote stations thereof. The supervisory control equipment 71 may be represented, in part, by a boxed enclosure 76 which represents, in general, the principal portion of the supervisory control equipment, which is similar in every respect to that described in detail in the hereinbefore mentioned Boswau patent, while the additional equipment and that which has been changed or to which additions have been made is shown outside the boxed enclosure but adjacent thereto.

As in the case of the dispatching office equipment shown in Fig. 3, the supervisory control equipment is adapted for operation in connection with a carrier transmitter 72, which may be operated by the impulsing relay 511 to transmit a frequency F_2 corresponding to that of the dispatching office receiver, whereas the carrier receiver 75 operates on a carrier frequency F_1 corresponding to the frequency of the dispatching office carrier transmitter.

Synchronization of the line relays at the dispatching office and remote stations may be effected in the manner described in connection with the description of the dispatching office equipment of Fig. 3. For example, the line relay 511 may be operated every time the impulsing relay 510 operates by providing an auxiliary front contact and armature 510*a* for completing the connection of the operating winding of the line relay 511 to the negative terminal of the source independently of the carrier receiver 55. The line relay 511 thus operates each time the impulsing relay operates and terminates the impulse directly, thus insuring operation of the counting chain on sending as well as receiving operations.

The telephone equipment 77 may be represented by the handset 78 which may be disposed to operate through the carrier transmitter and receiver by means of a modulator 79 over a circuit which may be selected through a point on the supervisory control equipment. A hook switch 80 and a bell 81 may also be provided as described in connection with the station equipment shown in Fig. 2.

Reset may be effected at the end of an operation by means of a reset relay 508 operated from a tone receiver 83 operated from the carrier receiver 75 in response to a reset tone transmitted by the tone transmitter 66 at the office, in a manner similar to that described in connection with the system of Figs. 1 and 2. A tone blocking filter 84 keeps voice frequencies from the tone receiver.

In order to maintain the carrier frequency during conversation means such as the carrier control relay 86 may be provided for operating the transmitter 72. The carrier control relay 86 may be energized through front contacts and armature 715*b* of the point relay 715, a back contact and armature 507*a* of relay 507, and a front contact and armature 80*b* of the hook switch in conjunction with contacts of other of the supervisory relays. Relay 86 is prevented from picking up when an operation is commenced from the dis-

patching office until the termination of the point check code by front contact and armature 523a of the point check code stop relay 523 and back contacts and armature 516g. A holding circuit is provided through contacts and armature 866. When an operation is initiated from the remote station the receiving relay 514 provides an energizing circuit. The receiving relay 431 at the office responds to the carrier frequency F_2 and places F_1 on the line.

Since the operation of the supervisory control equipment in itself is described in detail in connection with the Boswau patent, it is necessary only to describe a telephone operation initiated at the dispatching office and at a remote station in connection with the two-frequency system.

When a communication is initiated from the dispatching office, the station selection code is initiated when the telephone handset is picked up and when the telephone call key 85 is operated. Since this is a two-frequency system, the carrier frequency F_1, which is placed on the channel at the dispatching office by the operation of the impulsing relay 430, does not operate the carrier receiver 55 or the line relay 431 at the dispatching office. However, line relay 431 is energized directly through front contact and armature 430a of the impulsing relay 430, thus causing the counting chain of the dispatching office supervisory control equipment to operate in step with the counting chains at the remote stations, which are driven by the line relays 511 responding to the receipt of the carrier frequency F_1 through the carrier receivers 75. Receipt of the carrier frequency F_1 at all stations causes the proper station to be selected and all other stations to be locked out.

The selected station then returns the station check code in the usual manner by the impulsing relay 510 at the remote station placing the carrier frequency F_2 on the carrier channel which causes the line relay 431 at the dispatching office to be energized. The line relays at the remote stations are driven by their respective impulsing relays through contact and armature 510a. The dispatching office then transmits the telephone point selection code which results in the point relay 715 being operated at the called station. An energizing circuit similar to that described in connection with the system of Figs. 1 and 2 is provided through contacts and armatures 523b, 516f and 80a for the telephone bell which rings until the handset is picked up. Thereupon the bell is cut off by back contacts and armature 80a of the hook switch and an energizing circuit is provided through contact and armature 80c and contact and armature 715c for sending the point check code in a manner similar to that described in connection with the single-frequency system of Figs. 1 and 2.

At the conclusion of the point check code from the remote station, relay 523 is energized and relay 507 releases. This allows the carrier control relay 86 to be energized through a circuit extending from the relay 86 through back contact and armature 507a, front contact and armature 715b, conductor 87, back contact and armature 516g, front contacts and armature 523a, conductors 88 and 89, and contact and armature 80b to indirect positive. Contacts 86a close and the carrier frequency F_2 is thereby placed on the channel. A holding circuit for the carrier control relay 86 is provided through contacts 86b. The line relay 431 at the office picks up on carrier F_1 and front contact and armature 431b places carrier F_1 on the line.

At the termination of the conversation, reset of the supervisory control equipment is initiated at the dispatching office when the telephone hand-set is restored through the energization of the reset relay 491 through a circuit similar to that described in connection with the system of Fig. 1.

When a communication is initiated from a remote station by picking up the telephone handset and operating the telephone call key 90, the supervisory relay 721 is energized and the impulsing relay 510 is energized to place the carrier frequency F_2 on the channel to start the first impulse. Front contact and armature 510a connects the operating winding of the line relay 511 to negative and picks it up to terminate the impulse. Receipt of frequency F_2 at the dispatching office energizes the line relay 431, which operates into the counting chain at the dispatching office in the usual manner, and also places carrier frequency F_1 on the channel. Carrier frequency F_1 is then received at all remote stations, including the station initiating the impulsing, this enabling synchronization of the line relays 511 despite the use of two different frequencies, so that the station selection code locks out all other remote stations and causes the dispatching office to return the code in the usual manner.

The remote station then transmits the point selection code, the impulsing relay 510 driving the line relay 511 which results in the point relay 116 being energized at the dispatching office, thus lighting the telephone call lamp 91 and setting up an energizing circuit for the telephone bell 61 at that location, through front contact and armature 116a, back contact and armature 60b, back contact and armature 412b and back contact and armature 404f. When the telephone handset 58 at the dispatching office is picked up, the energizing circuit for the bell is interrupted through the opening of normally closed contact and armature 60b of the hook switch 60, and the point check code is initiated through closure of normally open contacts and armature 60a of the hook switch in connection with front contacts and armature 116b.

Receipt of the point check code at the remote station picks up the point relay 715 causing the control relay 86 to be energized, by the circuit extending from relay 86 through armatures 507a, 715b, 514a, and contacts and armature 80b. Contact and armature 86b provide a holding circuit. The control relay 86 puts the carrier frequency F_2 on the channel by energizing the transmitter 72 through contact and armature 86a, thus energizing the line relay 431 at the dispatching office which results in carrier frequency F_1 also being placed on the channel by the closure of contact and armature 431b. Thus the communication circuit is established for talking in both directions without interference. Resetting of the supervisory equipment is effected from the dispatching office in exactly the same manner as described hereinbefore when the handset 60 at the dispatching office is replaced on the hook.

From the above description and the accompanying drawings, it will be apparent that we have provided, in a simple and effective manner, for operating a telephone communication system of a supervisory control system. This arrangement insures there being no interference

between the communication and supervisory functions, and requires a minimum of alteration of a supervisory control system in order to actuate telephone communication over the same channel.

Since certain changes may be made in the above described construction, and different embodiments may be provided without departing from the spirit and scope thereof, it is intended that all of the matter contained in the above description and shown in the accompanying drawings shall be considered as illustrative and not in a limiting sense.

We claim as our invention:

1. A communication system for a dispatching office and a plurality of remote stations having a common communication channel comprising, telephone sending and receiving equipment at the office and stations, a carrier transmitter and receiver at the office and each station for operating over said channel, supervisory control sending and receiving equipment of the multi-station type at the office and stations for operation with the transmitter and receiver for selecting and checking any of a number of operating points including one point for establishing telephone circuits over the channel through the transmitter and receiver, and means preventing the sending of a point selection check code in response to the selection of a particular telephone point until the operator at the selected point answers the phone.

2. A communication system for a central dispatching office and a plurality of remote stations having a common communication channel comprising, a carrier frequency transmitter at the office and at each station for transmitting over the channel, a carrier frequency receiver at the office and at each station for receiving from the channel, telephone equipment at the office and at each station including a hook switch operative in response to the lifting of a telephone receiver, supervisory control equipment of the multi-station type including sending equipment at the office and stations for operating the carrier transmitters and receiving equipment operated by the carrier receivers, said supervisory control equipment including a point for establishing a telephone communication circuit between the office and any one of the stations, means for maintaining the carrier transmitter during a telephone communication, and means for resetting the supervisory equipment from the dispatching office at the termination of a communication.

3. A supervisory control and telephone communication system for a dispatching office and a plurality of stations each having a carrier frequency transmitter and receiver for operating over a common communication channel comprising, telephone transmitting and receiving equipment for operation through the carrier frequency transmitters and receivers at the office and stations, supervisory control apparatus of the multi-station type at the office and stations including sending and receiving apparatus for operating the transmitters and for operation from the receivers and having a plurality of control points including one for setting up a telephone circuit between the office and each station through said carrier transmitters and receivers, means for preventing the supervisory sending equipment at a called station from sending a point selection check code until the operator at the called station answers, and means for resetting the supervisory equipment at the office and station when conversation is ended at the office.

4. For use in a supervisory control system of the multi-station type having a central office and a plurality of remote stations connected by a common communication channel with supervisory control transmitting and receiving equipment operating over the channel through carrier frequency transmitters and receivers, telephone transmitting and receiving equipment at the office and stations for operating through the carrier frequency transmitters and receivers between points selected by the supervisory control system, means for maintaining the carrier frequency on the channel during a telephone communication, and means including a tone transmitter at the office and a tone receiver at each station for resetting the supervisory control equipment at the office and station from the office when the telephone communication ends.

5. In a signalling system for a dispatching office and a plurality of remote stations, a single communication channel extending between the office and stations, a carrier frequency transmitter and receiver at the office and at each station for transmitting and receiving a carrier frequency over the channel, supervisory control sending and receiving apparatus of the multi-station type including a plurality of operation and supervision points at the office and at each station for operating said transmitter and operating from said receiver, respectively, telephone equipment including a modulator associated with the transmitter and receiver at the office and at each station, connections for said telephone equipment between particular points being selected through selection of one of the points of the supervisory system, and means for preventing the transmission of a point selection code until the receiver at the called station is lifted from its hook.

6. A supervisory control and telephone communication system for a dispatching office and a plurality of remote stations each having a carrier frequency transmitter and receiver operating over a common communication channel, telephone apparatus including transmitting and receiving apparatus operating over the channel through the carrier transmitter and receiver and provided with a hook switch for the telephone receiver, supervisory control equipment of the multi-station type including sending and receiving equipment having a plurality of supervisory control points including a point for establishing a telephone circuit between the office and any station from either the office or station, circuit means including hook switch contacts of each telephone equipment preventing the sending of a point selection check code for the particular point until the receiver is lifted off the hook, and additional circuit means including additional contacts of the hook switch for initiating reset of the supervision equipment when the office receiver is returned to the hook.

7. The combination in a supervisory control system for a plurality of remote stations from a central office over a single carrier communication channel, of telephone sending and receiving equipment operating over the single channel through a point on the supervisory system, of means responsive to the lifting of the receiver from the receiver hook at a called point for sending a point selection check code, means including a reset relay at the dispatching office for resetting the supervisory equipment at the office

and station, said means including a control relay at the dispatching office responsive to supervisory operations commenced at a remote station only for preventing reset operations from commencing during an incoming signal before the receiver is picked up.

8. For use with a supervisory control system of the multi-station type having supervisory control sending and receiving equipment at a dispatching office and a plurality of remote stations with a plurality of points operating through carrier transmitters and receivers over a common channel, telephone sending and receiving equipment at the office and stations operating through points selected on the supervisory control equipment, control means associated with the telephone equipment for maintaining the carrier transmitter in operation at a transmitting point during a conversation, and means responsive to the selection of a point with which it is desired to communicate for preventing operation of the carrier transmitter by the control means until the selection of the desired point has been completed.

9. The combination with a supervisory control system for a dispatching office and a plurality of remote stations each having supervisory control sending and receiving equipment of the multi-station type operating over a common carrier frequency communication channel, of telephone sending and receiving equipment at the office and stations for communicating over said channel through a point on said supervisory equipment; said equipment including a bell at each point, means including a supervisory point relay responsive to selection of a particular point for providing an energizing circuit for the bell at the selected point, means responsive to the lifting of the receiver from its hook for interrupting the bell circuit, and means responsive to a supervisory signal for interrupting the bell circuit to prevent ringing the bell when the receiver is returned to its hook.

10. A carrier operated supervisory control system for a dispatching office and a plurality of remote stations having a common communication channel comprising, supervisory control sending and receiving apparatus at the office and each station including an impulse sending relay and a line relay, a carrier frequency transmitter controlled by the impulse sending relay for transmitting coded impulses over the channel, and a carrier frequency receiver responsive to impulses of the carrier frequency on the channel operating the line relay.

11. In a two-frequency carrier supervisory control and communication system for a dispatching office and a plurality of remote stations, supervisory control sending and receiving equipment of the multi-station type at the office and stations including an impulsing relay and a line relay, a carrier transmitter of one frequency at the office controlled by the office impulsing relay, a carrier receiver responsive to said one frequency for operating the line relays at each remote station, a carrier transmitter of another frequency at each station operated by the station impulsing relay, a carrier receiver at the office responsive to said other frequency for controlling the office line relay, and circuit means at the office and stations for effecting operation of each line relay each time its associated impulsing relay operates.

12. In a supervisory control system for a dispatching office and a plurality of remote stations having a single common communication channel, a carrier frequency transmitter and receiver at the office and each of the stations, supervisory control equipment of the multi-station type at the office and each of the stations including an impulsing relay operating the transmitter to send coded impulses and a line relay operated in response to impulses received by the receiver, telephone sending and receiving equipment at the office and stations operating over the channel through points of the supervisory system including means to maintain the carrier transmitter operating during a telephone communication, and means for resetting the supervisory equipment including a reset relay at the dispatching office operable in response to return of the office receiver to its hook to reset the office supervisory equipment, a tone transmitter operated by the office reset relay, a tone receiver at each station and a reset relay at each office operated from the tone receiver for resetting the station supervisory equipment.

WILLARD A. DERR.
ROBERT C. CHEEK.