Jan. 29, 1929. 1,700,180

L. C. ROBERTS

SELECTIVE TELEGRAPH SYSTEM

Filed Jan. 19, 1928 2 Sheets-Sheet 1

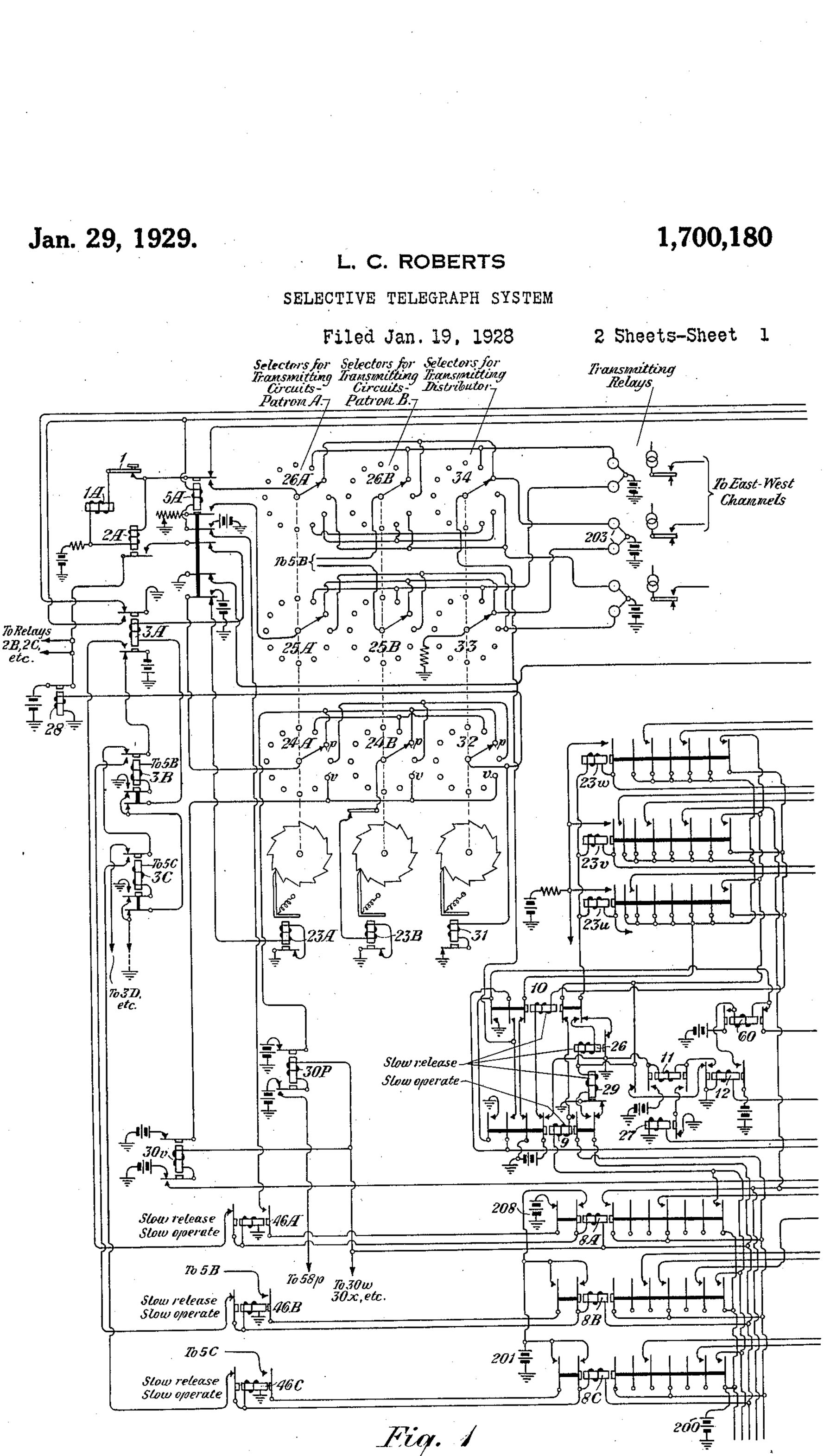

Fig. 1

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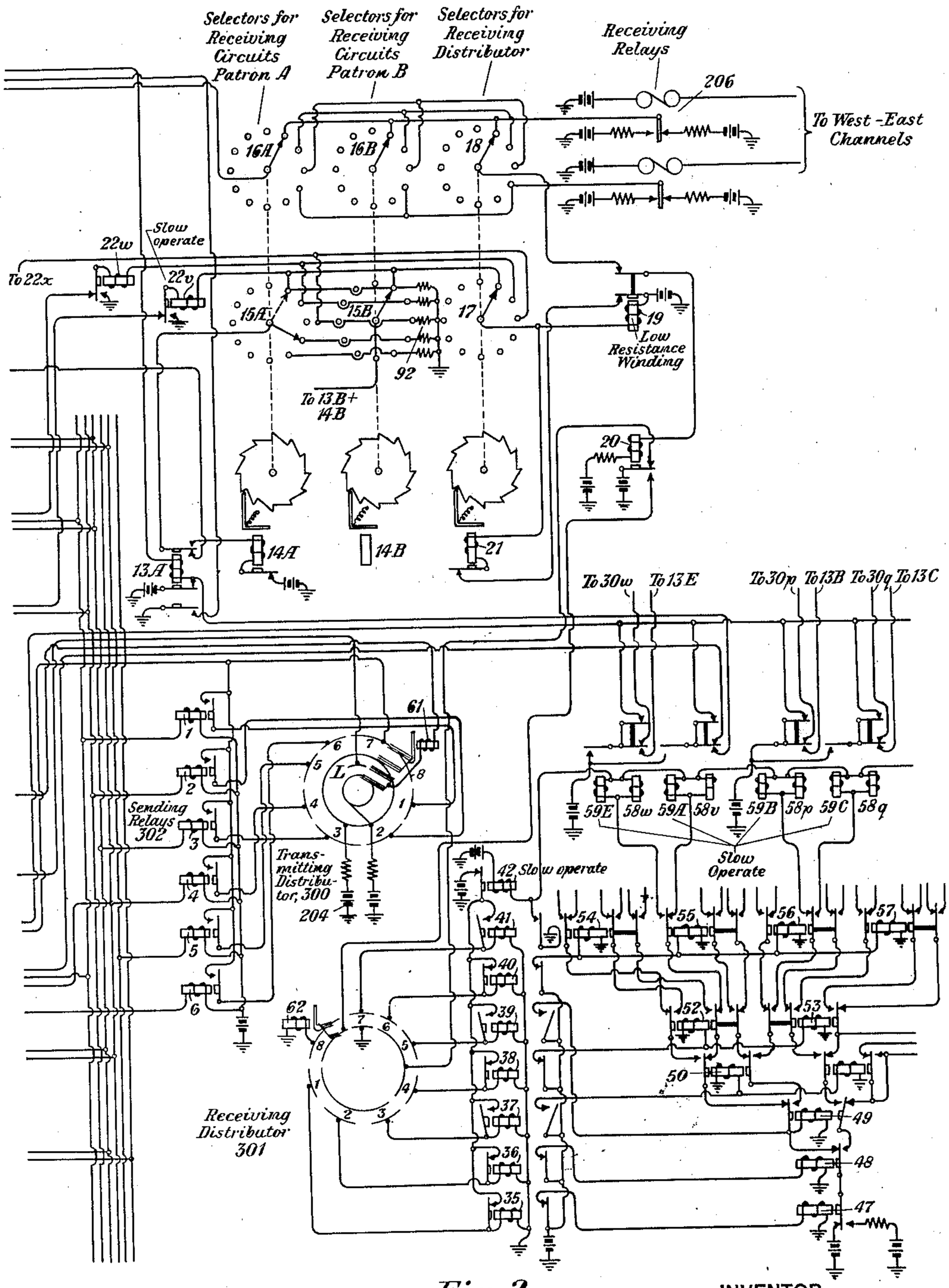

Fig. 2

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UNITED STATES PATENT OFFICE.

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SELECTIVE TELEGRAPH SYSTEM.

Application filed January 19, 1928. Serial No. 247,886.

This invention relates to improvements in telegraph systems.

The primary object of the arrangements of the invention is to greatly increase the telegraph facilities between two points without increasing the number of channels existing between such stations.

A telegraph system to which the invention might be applicable would be one wherein a large number of circuits existed between two stations. These circuits might be furnishing "leased wire" service and ordinarily a pair of circuits, or one two-way circuit, for transmission in opposite directions might be set aside for each pair of distant subscribers. It is obvious that many of these circuits would be idle a great part of the time particularly if the service was of the half duplex type and there was a preponderance of transmission in one direction. It is the purpose of the arrangements of the invention to utilize these channels during their idle periods to furnish additional telegraph facilities to new subscribers.

In the arrangements of the invention a designated pair of circuits, or a single two-way circuit, will not be set aside for the sole use of a pair of distant subscribers. All of the channels existing between the two stations will be subjected to the control of selecting apparatus common to each terminal station whereby an idle line in either direction will be provided available to any subscriber as soon as he desires to send. With the selecting arrangements of the invention it will be possible to serve a greater number of subscribers than the number of existing circuits thus affording an increase in telegraph facilities without increase in existing channels. Further features and objects of the invention will appear more fully from the detailed description hereinafter given.

To further illustrate the general features of operation of the invention let it be assumed that there exists a telegraph system comprising a large number of channels interconnecting New York and Chicago and service over this system has been leased to pairs of subscribers in the distant cities. The arrangements of the invention are so designed that it will not be necessary to reserve two one-way channels for each of said half duplex service contracts. The arrangements of the invention will connect an existing idle one-way telegraph channel for transmission in the desired direction between the terminals of a half duplex service contract and will substitute an existing idle channel for transmission in the opposite direction whenever it is desired.

In a system interconnecting two points, such as New York and Chicago, and comprising a large number of channels, it is pointed out that at a certain time some of the channels might be busy transmitting from east to west, other channels might be busy transmitting from west to east and some of the channels might be idle. In accordance with the arrangements of the invention there would be connected at New York to a preselected one of the idle channels a code sending device with a corresponding code receiving device connected to said channel at Chicago. Also a second preselected idle channel will have a code sending device connected thereto at Chicago and a code receiving device connected thereto at New York. Assume that a patron at New York, who is receiving, now opens his key and sends a break signal. This will cause the code sending apparatus at New York to transmit over the first preselected idle channel the patron's code signal. The code receiving device at Chicago in response to the code signal from New York will cause selecting mechanism to connect to this first preselected idle circuit the patron's partner at Chicago. At the same time, the patron at New York would be connected to this first preselected idle channel for transmission from New York to Chicago. Selecting mechanism at Chicago also operates to pick out at Chicago a third idle channel and will connect thereto the local code receiving apparatus which was previously connected to the first mentioned idle channel. Code sending apparatus at Chicago now operates over the previously mentioned second idle channel in the direction from Chicago to New York to send thereover the code signal for the third selected idle channel. This code signal will operate the code receiving device at New York and cause selecting apparatus thereat to connect the code sending apparatus at New York, which was previously connected to the

first mentioned idle channel, to the third selected idle channel, so that said third selected idle channel will be in readiness to be connected to the next New York patron to send a break signal. A similar cycle of operations will take place should the break signal originate in Chicago.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1 and 2 of which when taken together is shown a circuit diagram embodying the invention.

In Figs. 1 and 2 of the drawing with Fig. 2 at the right of Fig. 1 is shown a circuit diagram of the equipment to be found at one of the terminals of the telegraph system. Similar equipment would be provided at the other end of the group of circuits involved. In the drawing, capital letters refer to the portions of the selecting system of the invention which are associated with the circuits of individual patrons, and small letters denote equipment which is associated with a particular telegraph channel.

In the drawing is shown the code sending apparatus, the code receiving apparatus, and selecting mechanism at one end of a group of channels in the system, such as at the east or New York end. The code sending apparatus comprises a transmitting distributor 300 and the sending relays 302. Various code combinations designating different patrons may be set up on these relays over the contacts of a series of relays, such as 8^A, 8^B, 8^C, etc. These latter relays are controlled by each individual patron's key. There will also be provided a series of transmitting selector switches such as 26^A, 25^A, and 24^A for patron A, a series of transmitting selector switches such as 26^B, 25^B and 24^B for patron B, and other selector switches for each other patron. A series of selector switches such as 34, 33, and 32 will be provided for the code sender apparatus. The code receiving apparatus comprises a receiving distributor 301 and a plurality of relay arrangements associated therewith to be described in more detail hereinafter. A series of receiving selector switches such as 16^A, and 15^A will be provided for patron A, with similar arrangements for other patrons. A series of selector switches such as 18 and 17 will be provided for the receiving distributor. A series of transmitting relays are shown connected to east-west channels and a series of receiving relays are shown connected to west-east channels.

The invention may be more fully understood from the following detailed description of its operation.

The drawing shows the equipment of patron A at the east station in the condition for receiving signals. Assume that patron A now opens his key 1 to break the incoming signals. Accordingly, the next incoming marking signal will operate relay 2^A. The operation of relay 2^A will have the following effect: Battery will be connected over the contact of relay 28, contact of relay 2^A, and contact of relay 5^A through the winding of relay 3^A to ground, thereby operating relay 3^A.

The operation of relay 3^A will have the following effect:

The upper contact will open a normally closed circuit through relay 13^A releasing this relay. This will operate relay 14^A which will cause 15^A to rotate to a contact where 14^A will be released by battery through the low resistance winding of relay 19. The wiper of 15 is shown in dotted lines as arrived at such contact. The lower contact of relay 3^A will close a circuit from battery through the windings of relays 46^A and 8^A to ground over the contacts and armature of relay 29, thereby operating relays 46^A and 8^A. The lower contact of relay 3^A also removes battery from the corresponding contacts of all other series 3 relays, such as 3^B and 3^C, thus preventing the operation of any other of the series 8 relays, such as 8^B and 8^C, below this in alphabetical chain.

The operation of relay 8^A has the following effect:

The first contact from the left opens the circuit from battery 208, over the back contact of relay 5^A, thus preventing relay 5^A from operating when relay 46^A is pulled up. The relay 46^A is slow operate and slow release. The second contact from the left causes relay 8^A to lock up from battery 201 through back contacts of relays 9 and 29, and after the operation of 9, through the winding of 29 and through back contacts of 11 and 12. The third to eighth contacts set up a code combination on the six sending relays 302 after the operation of relay 9. The ninth contact connects battery 200 through the winding of relay 9 and back contacts of 10, 11 and 12 to ground, thereby operating relay 9.

The operation of relay 46^A has the following effect:

The left-hand contact breaks the connection between the winding of 8^A and the contact of 3^A. The right-hand contact makes connection between the back contact of 8^A and the winding of relay 5^A (through the back contact of 5^A), thereby preparing a circuit for the operation of relay 5^A upon the release of 8^A.

The operation of relay 9 has the following effect:

The first armature at the right switches the winding of relay 8^A to ground through the winding of 29 and the back contacts of 11 and 12, thus keeping relay 8^A operated. The second armature from the right connects ground from the back contacts of 11 and 12 and a contact of 10 and over the contacts of 8^A

to the windings of one or more of the sending relays 302, thereby causing a definite number of these relays to operate in accord with the code combination as expressed by the contacts of relay 8^A. The third armature of 9 disconnects the winding of relay 10 from battery, preventing its operation, and connects battery to the winding of 11, which does not operate until the operation of 12. The fourth armature disconnects ground through the front contact of relay 10 from the combination contacts of the relays in series 23, thereby preventing any of them from operating the sending relays 302. The fifth armature connects the segments of the transmitting distributor 300 through the contacts of the combination of operated sending relays 302 to one of the transmitting relays, such as 203, to which the rotating switch 34 happens to be connected. The sixth armature connects ground to a circuit completed over the contact of relay 60 and through the winding of relay 61 and inner brush arm to the distributor battery connected to the inner solid ring. This will operate relay 61 which will release the arm of the distributor and allow it to rotate over the segments. This will cause the code signal set up by 8^A on the sending relays 302 to be sent out by the transmitting relay 203 to the distant station.

When the arm of the transmitting distributor 300 reaches segment L, a circuit will be closed to operate relay 12.

The operation of relay 12 has the following effect:

The relay 60 will operate and open the circuit for the distributor start relay 61, thereby releasing 61 so that the rotating arm may be halted upon completion of one revolution. The operation of 12 will cause relay 11 to operate. The operation of 11 will open the circuit previously closed and release relays 8^A, 9, 46^A and the relay of series 30 which is operated. It may be assumed that relay 30_p has been operated. It is pointed out that the relays of series 30 are controlled over the contacts of relays of series 58 and that these relays are controlled from the distant station. The operation of these series of relays will be described in more detail hereinafter. It is also pointed out at this point that relay 5^A will be in operated condition at this time. Relay 29 is a slow release relay, its purpose being to prevent the first back contact of 9 from being connected to ground until 8^A has been released. Relay 11 locks up and removes ground from windings and contacts of series 8 and series 23 relays and also from the windings of relays 9 and 10, thus preventing the operation of any of these relays. Relay 11 may be released by the operation of relay 27 as will be pointed out hereinafter.

The release of relay 30_p has the following effect:

It connects battery to the p contacts of rotary switches 32 and series 24. Rotary switch 32 and all switches of the series 24, which are associated with patron's circuits whose number 5 relays are not operated, that is, which are associated with patrons in the receiving positions, all begin to rotate and continue to rotate until a signal from the west station arrives designating a new E—W circuit. This signal operates a relay of series 30, say 30^v, which removes battery from the v contacts of switches 32 and the 24 series, and causes the arms of the rotating switches to stop on the v contacts. Relay 30^v stays operated until a relay of series 8 is operated and released, that is, until a patron breaks and initiates a chain of operations similar to those heretofore described. Relay 28 remains operated during the rotation of 32, preventing the operation of any of the series 3 relays.

Relay 5^A, which was operated by the release of 8^A, will lock up. The operation of relay 5^A will have the following effect:

The first and second armatures switch the loop of patron A to the E—W circuit, which had previously been selected (namely p), and connect a balancing loop to the telegraph repeater of circuit p (if it is the type of set using a balanced loop). The third armature provides battery for the locking circuit. The fourth armature prevents operations of 3^A by the operation of 2^A. The fifth armature removes ground from the front contact of 13^A which acts as a busy signal through the 15^A wiper when patron A is receiving. The sixth armature puts battery on the wiper of 24^A which serves as a busy signal for this circuit.

If several patrons break simultaneously, say, patrons A, D and G, relays 3^A, 3^D and 3^G will operate and lock up. The fourth contact of relay 3^A removes battery by its operation from contacts of relays 3^D and 3^G. Therefore, only relay 8^A of the series 8 relays will operate. As soon as 3^A is released, 8^D will operate and as soon as 3^D is released, 8^G will operate. Thus, the patrons must wait their turns alphabetically.

The above description shows in detail how the patron, such as A, at the east or New York station, who is receiving, may open his key and send a break signal. It shows the sequence of operations whereby the code sending apparatus at New York may transmit over the aforementioned first preselected idle channel the code signal for patron A. It also describes how at the same time the patron A at New York will be connected to this first preselected idle channel for transmission from New York to the west, or Chicago station. The following detailed description will now tell how in response to this code signal the code receiving device at the west,

or Chicago station, will cause selecting mechanism to connect to this first preselected idle circuit the partner at Chicago of patron A. It will also show in detail how selecting mechanism at Chicago operates to pick out at Chicago a third idle channel and connects thereto the local code receiving apparatus which was previously connected to the first mentioned idle channel. It will also show how code sending apparatus at Chicago will now operate over the previously mentioned second idle channel in the direction from Chicago to New York to send thereover the code signal for the third selected idle channel. It will show how this code signal will operate the code receiving device at New York and cause selecting apparatus thereat to connect the code sending apparatus at New York, which was previously connected to the first mentioned idle channel, to the third selected idle channel, so that said third selected idle channel will be in readiness to be connected to the next New York patron to send a break signal.

In considering the equipment at the west station the Figs. 1 and 2 of the drawing may be applied to the equipment thereat. However, in referring to equipment located at the west station the designation prime will be added to the reference characters in the description.

The incoming signal at the west station designating the patron, such as A, who is breaking at the east station will operate one of the receiving relays, such as relay 206′. This relay will operate relay 20′ in accordance with the incoming code signal. This will first operate the start relay 62′ of the receiving distributor and allow the brush to start rotating. The operation of relay 20′ in accordance with the incoming code signal and the operation of the distributor will then cause the code signal to be set up on relays 35′ to 40′. This operation will in turn operate a combination of the groups of relays 47′ to 59′. This last mentioned combination of relays will be operated over one path to ground through all of the groups of relays. When the distributor in its rotation reaches segmet 7 it causes the operation of relay 41′, which causes the operation of relay 42′ and of relays $59^{A'}$ and $58^{v'}$. The operation of 42′ will release relays 35′ to 41′.

Regarding relays $59^{A'}$ and $58^{v'}$, it is pointed out that the windings of this group of relays are connected in parallel in pairs. One relay of each pair (58′) must be a sensitive relay operating on comparatively small current and the other relay (59′) an insensitive one operating on a much larger current. If relay 47′ is released, a series resistance allows the operation of the sensitive relay of the pair which is connected to the contacts of this relay through the contacts of relays 48′ to 53′, but the inclusion of this resistance prevents the operation of the insensitive relay. In the case shown on the drawing, however, relay 47′ is operated and therefore both $58^{v'}$ and $59^{A'}$ are operated. The operation of these two relays will cause the operation of relay $13^{A'}$.

The operation of relay $13^{A'}$ has the following effect:

It will lock itself up. It will break the stepping circuit of selecting switches $15^{A'}$ and $16^{A'}$. At its lower contact it will open the locking circuit of relay $5^{A'}$ and release relay $5^{A'}$. Relay $13^{A'}$ will remain operated until released by the operation of relay $3^{A'}$ when the A′ patron breaks.

The release of relay $5^{A'}$ has the following effect:

It puts ground on the rotating wiper of selector $15^{A'}$ through the contacts of $13^{A'}$. All 15′ switches at the west station of all patrons whose equipment is in the condition for transmitting in the west-east direction are resting on contact "*p*′". This ground causes all except $15^{A'}$ to step forward and also causes selector 17′, which is associated with the receiving distributor, to step forward. The release of relay $5^{A'}$ also connects patron A′ at the west station to the receiving end of the east-west channel *p* to which patron A at the east end is connected.

Selector 17′ continues to step forward until it reaches a contact (*v*′) not grounded through a solid ground but through one of the resistances 92′. At this point relays 19′ and 21′, which are insensitive relays, release thus stopping the rotation of 17′. At the same time relays $22^{v'}$ and $23^{v'}$, which are high impedance sensitive relays, are operated by the battery through the winding of relay 19′.

The 15′ switches rotate until they reach a cotact *v*′ where they stop due to battery through the winding of relay 19′. The stepping relays numbered 14′ are of high impedance and will operate through resistances 92′, but will not operate when battery is connected to a 92′ resistance through the winding of 19′.

The operation of relay $23^{v'}$ has the following effect:

It closes a locking circuit for itself to ground over the contact of relay 26′ from battery connected to its left-hand armature. Its farthest right-hand armature causes the operation of 10′ through the contact of 9′ if 9′ is not operated. This prevents interference with a "patron selecting signal" when it is being sent by the distributor. If relay 9′ is operated, relay 10′ operates as soon as 9′ releases. As soon as 10′ operates, ground is connected through the contacts of 10′ and $23^{v'}$ to a combination of the sending relays 302′. The operation of 10′ will also operate

the start magnet 61′ and allow the distributor arm to rotate. This will cause the signal combination for circuit *v* to be sent out to the east station.

The operation of relay 10′ will also have the following effect:

In addition to functions of other armatures already described, the first armature to the right opens the winding of the circuit of relay 9′, preventing its operation while 10′ is operated, thus preventing interference with the outgoing circuit selecting signal by the outgoing patron-selecting signal. The second contact to the left connects battery 204′ over the distributor segments to the loop of the west-east channel to which the receiving distributor is connected at the east end, thus allowing the selecting signal for circuit *v* to be transmitted to the east. When the distributor in its rotation reaches segment L′, relay 12′ is operated momentarily, releasing $23^{v\prime}$ and 10′. Relay 11′, however, is not operated. The operation of 12′ will operate 60′ which will release the start magnet 61′ to stop the distributor. To prevent this cycle of operations from being repeated, a slow-operating relay $22^{v\prime}$ is inserted in the lead which connects the winding of $23^{v\prime}$ to the contacts of rotating switch 17′, opening this circuit until a new cycle is started.

At the east end of the system circuit-selecting signals for the *v* east-west channel come in over the west-east channel to which the east receiving distributor is connected (shown as channel *p* in the drawing). The components of this signal combination operate relay 20 which operates a definite combination of relays 35 to 41. These set up a combination of relays 47 to 59 which causes relay 30^{v} to operate.

The operation of relay 30^{v} has the following effect:

It locks up and disconnects battery from the *v* contact of rotary switches 32 and series 24. Rotary switch 32 and all of the switches of series 24 which are associated with patrons in the receiving position, i. e., whose relays of series 5 are released, have been stepping around since 5^{A} operated at the time of patron A's break signal. All of these rotating switches now stop on contact *v* where they wait until another patron breaks. Relay 30^{v} is released by the operation of relay 11 after the next patron breaks.

The principles of the various cycles of operation heretofore described in detail may be applied to cycles of operation between other patrons of the system.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A telegraph system comprising two stations, a plurality of channels interconnecting said stations, a plurality of subscribers at said stations arranged to communicate in pairs, and means for establishing over any of said channels connections solely between the individual subscribers of a pair, said means comprising selective mechanism at each station responsive to the taking of a subscriber's set for use for choosing an idle one of said channels and connecting the subscribers of a pair thereto.

2. A telegraph system comprising two stations, a plurality of channels interconnecting said stations, a plurality of subscribers at said stations arranged to communicate in pairs, means for establishing over any of said channels connections solely between the individual subscribers of a pair, said means comprising mechanism at each station responsive to the taking of a subscriber's set for use for connecting the subscribers of a pair to a preselected idle channel, and selective means controlled by said mechanism for preparing another idle channel for the next desired connection.

3. The method of providing telegraph service between a plurality of sets of subscribers at different stations over a lesser number of channels interconnecting said stations which comprises subjecting all of the channels between said stations to the control of selecting apparatus common to each station whereby an idle channel in either direction will automatically be provided available for sending by any subscriber to said subscriber's partner at the distant station upon the taking of his set for use.

4. A telegraph system comprising two stations, a plurality of subscribers at each station, a plurality of channels interconnecting said stations, one of said channels in an idle condition having been preselected, code sending mechanism connected to said preselected channel at one station, code receiving mechanism connected to said preselected channel at the other station, means individual to each subscriber at one station and controlled by the taking of a subscriber's set for use for actuating said code sending mechanism to transmit over said preselected idle channel to the code receiving mechanism at the other end thereof the individual code signal for the subscriber's set taken for use, and means controlled by the transmission and reception of said code signal for connecting said preselected idle channel to the subscriber's set taken for use and to the subscriber's partner at the other station.

5. A telegraph system comprising an "east" station and a "west" station, a plurality of subscribers at each station, a plurality of channels interconnecting said stations, a first channel for east-west transmission and

in an idle condition having been preselected, a second channel for west-east transmission and in an idle condition having been preselected, code sending mechanism at said east station and code receiving mechanism at said west station connected to said first preselected channel, code receiving mechanism at said east station and code sending mechanism at said west station connected to said second preselected channel, means individual to each subscriber at said "east" station and controlled by the taking of a subscriber's set for use for actuating said east code sending mechanism to transmit over said first preselected channel to the west code receiving mechanism the individual code signal for the subscriber's set taken for use, selecting mechanism at said "west" station controlled by the operation of said west code receiving mechanism in response to said transmitted code signal for selecting a third one of said channels in an idle condition for east-west transmission, means controlled by the operation of said "west" selecting mechanism for actuating said west code sending mechanism to transmit over said second selected channel to the east code receiving apparatus the code signal for said third selected idle channel for east-west transmission, means controlled by the operation of said "west" selecting mechanism for connecting said "west" code receiving mechanism to said third selected idle channel, means controlled by the operation of said "east" code receiving mechanism for connecting said "east" code sending mechanism to said third selected idle channel, and means controlled by the transmission and reception of said first mentioned subscriber's code signal for connecting said first preselected channel to the "east" subscriber's set taken for use and to the subscriber's partner at the "west" station.

6. A telegraph system comprising an "east" station and a "west" station, a plurality of subscribers at each station, a plurality of channels interconnecting said stations, a first channel for east-west transmission and in an idle condition having been preselected, a second channel for west-east transmission and in an idle condition having been preselected, code sending mechanism at said east station and code receiving mechanism at said west station connected to said first preselected channel, code receiving mechanism at said east station and code sending mechanism at said west station connected to said second preselected channel, means individual to each subscriber at said "east" station and controlled by the taking of a subscriber's set for use for actuating said east code sending mechanism to transmit over said first preselected channel to the west code receiving mechanism the individual code signal for the subscriber's set taken for use, said means comprising a plurality of relays, each one individual to a subscriber and each having a combination of contacts so arranged that each combination of contacts will form a code combination signal individual to a subscriber's line, means controlled by each of said relays when operated for preventing the operation of the others of said plurality of relays, and circuits whereby the contacts of each of said relays may control said code sending mechanism, selecting mechanism at said "west" station controlled by the operation of said "west" code receiving mechanism in response to said transmitted code signal for selecting a third one of said channels in an idle condition for east-west transmission, means controlled by the operation of said "west" selecting mechanism for actuating said west code sending mechanism to transmit over said second selected channel to the east code receiving apparatus the code signal for said third selected idle channel for east-west transmission, means controlled by the operation of said "west" selecting mechanism for connecting said "west" code receiving mechanism to said third selected idle channel, means controlled by the operation of said "east" code receiving mechanism for connecting said "east" code sending mechanism to said third selected idle channel, and means controlled by the transmission and reception of said first mentioned subscriber's code signal for connecting said first preselected channel to the "east" subscriber's set taken for use and to the subscriber's partner at the "west" station.

In testimony whereof, I have signed my name to this specification this 13th day of January, 1928.

LELAND C. ROBERTS.