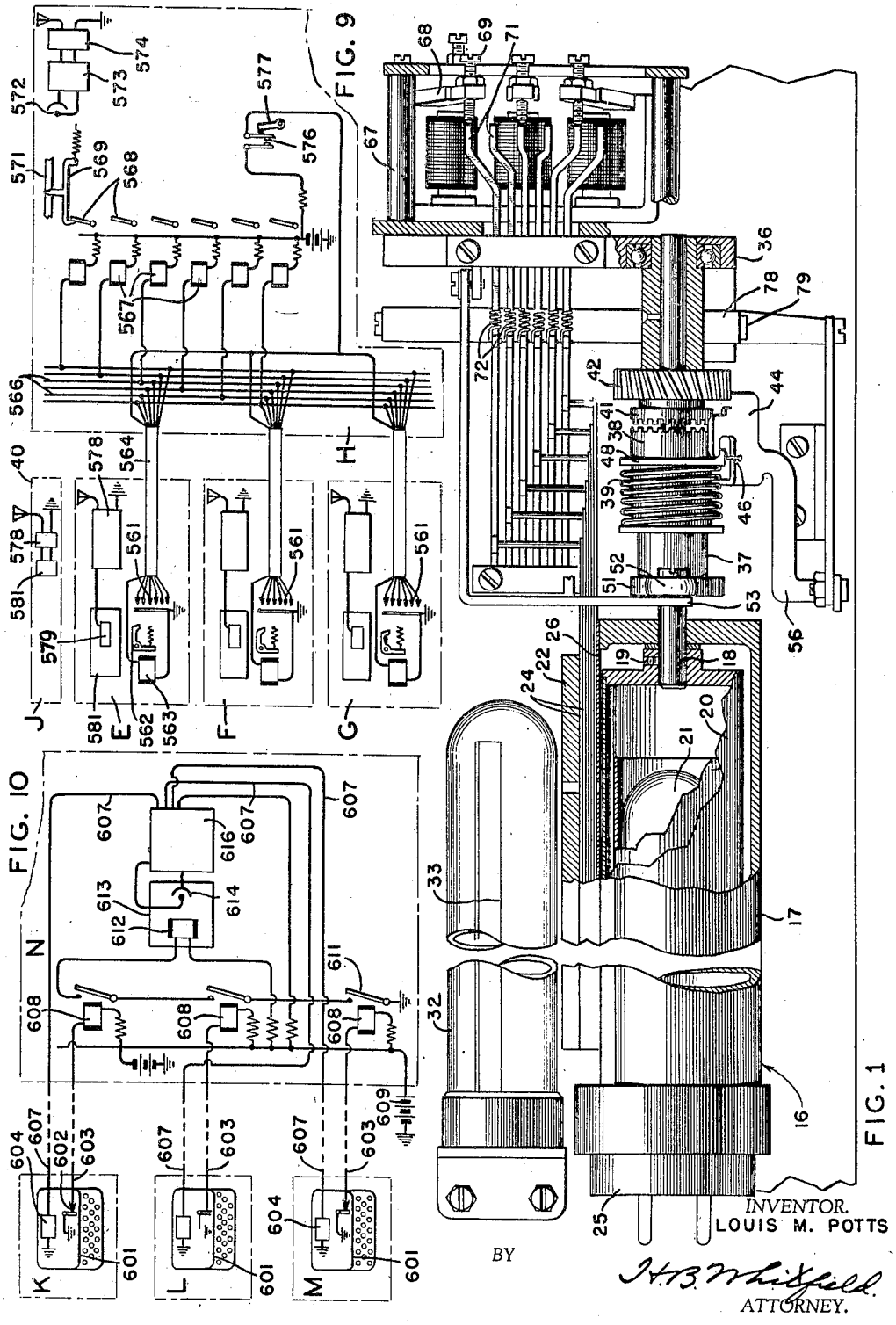
Aug. 24, 1943. L. M. POTTS 2,327,369

TELEGRAPH SIGNAL TRANSLATING SYSTEM AND APPARATUS

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TELEGRAPH SIGNAL TRANSLATING SYSTEM AND APPARATUS

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FIG. 2

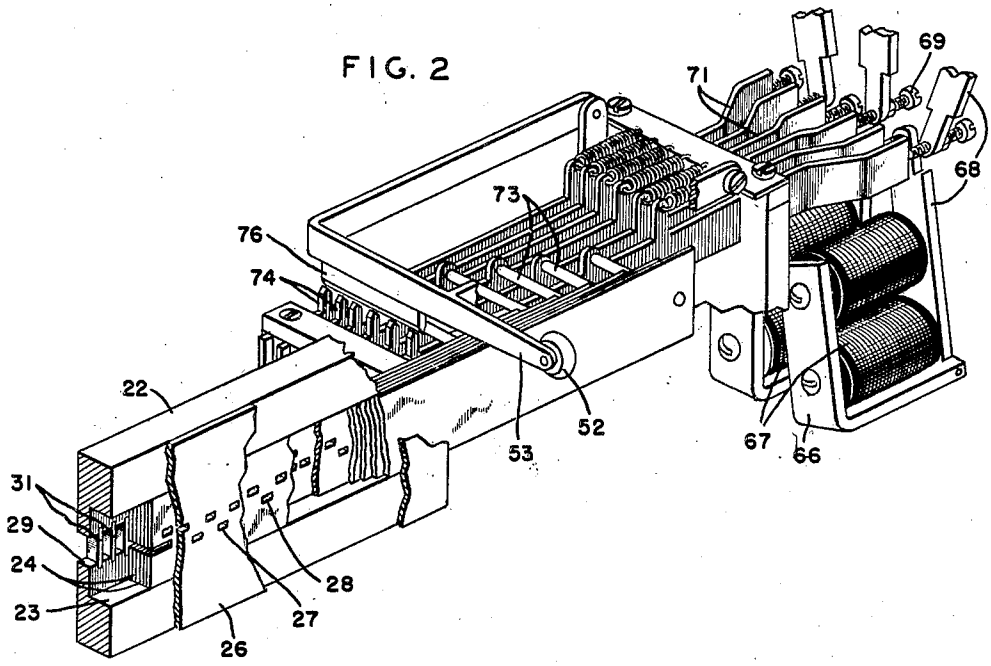
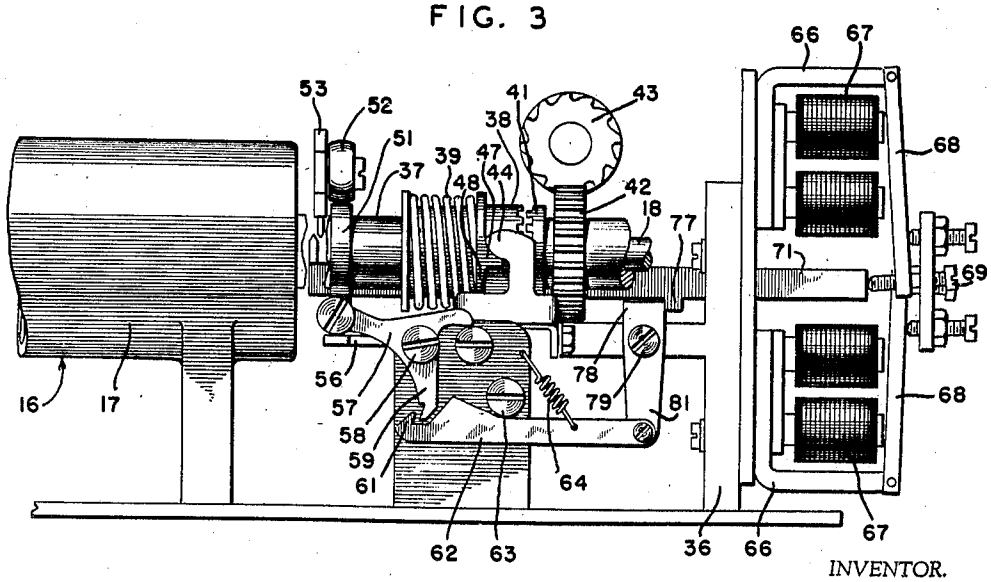


FIG. 3



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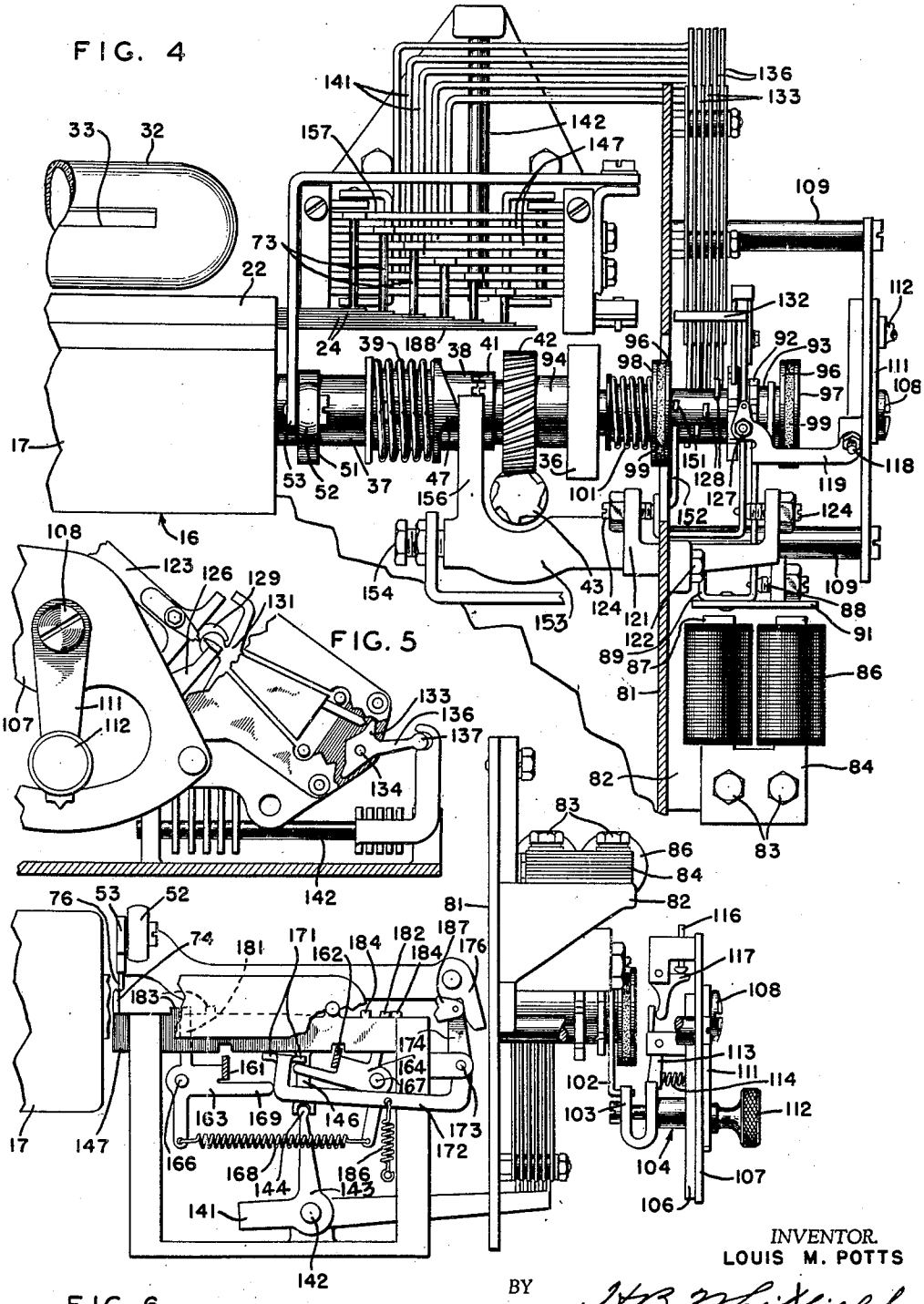
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FIG. 4



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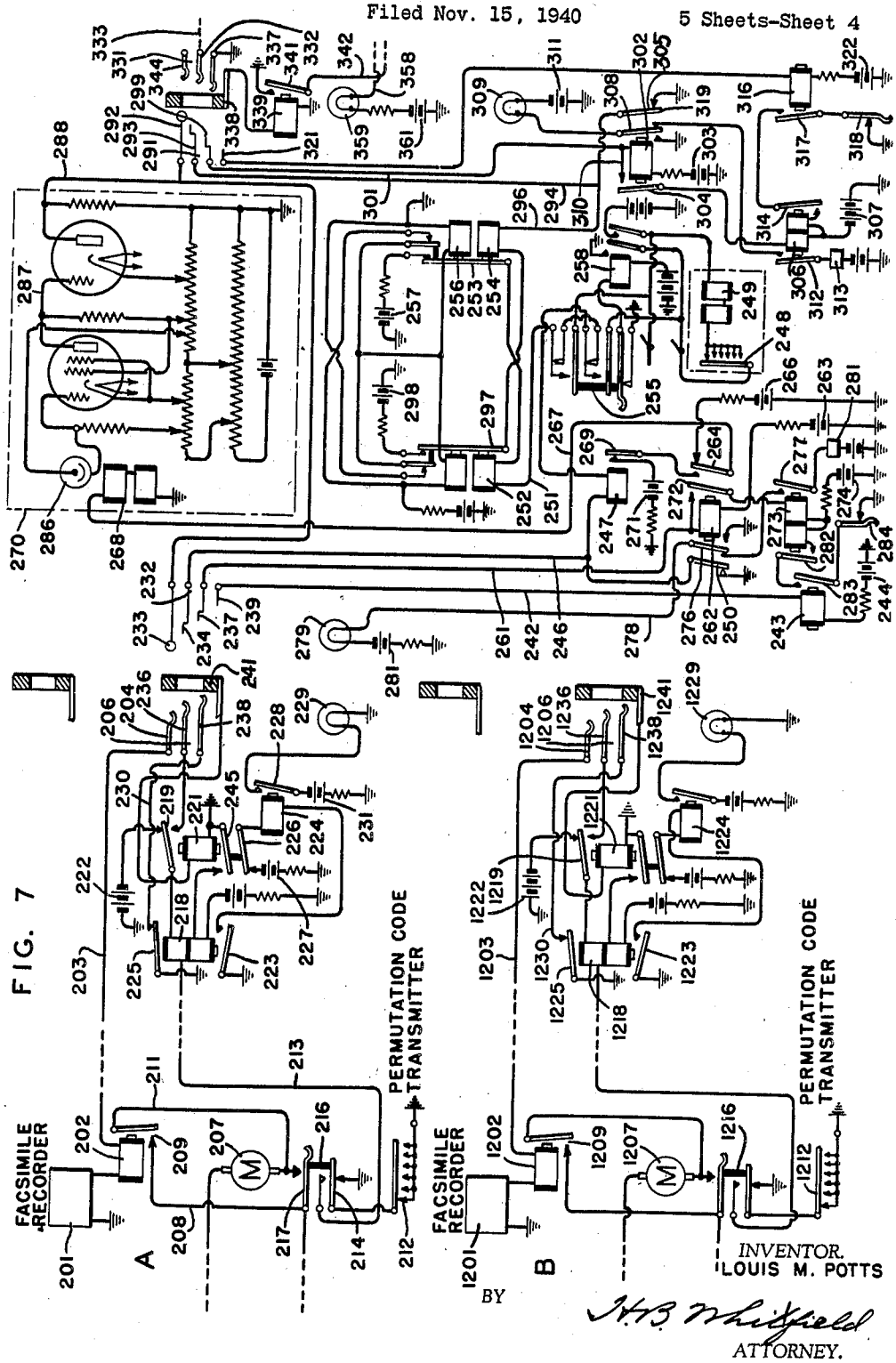


FIG. 7

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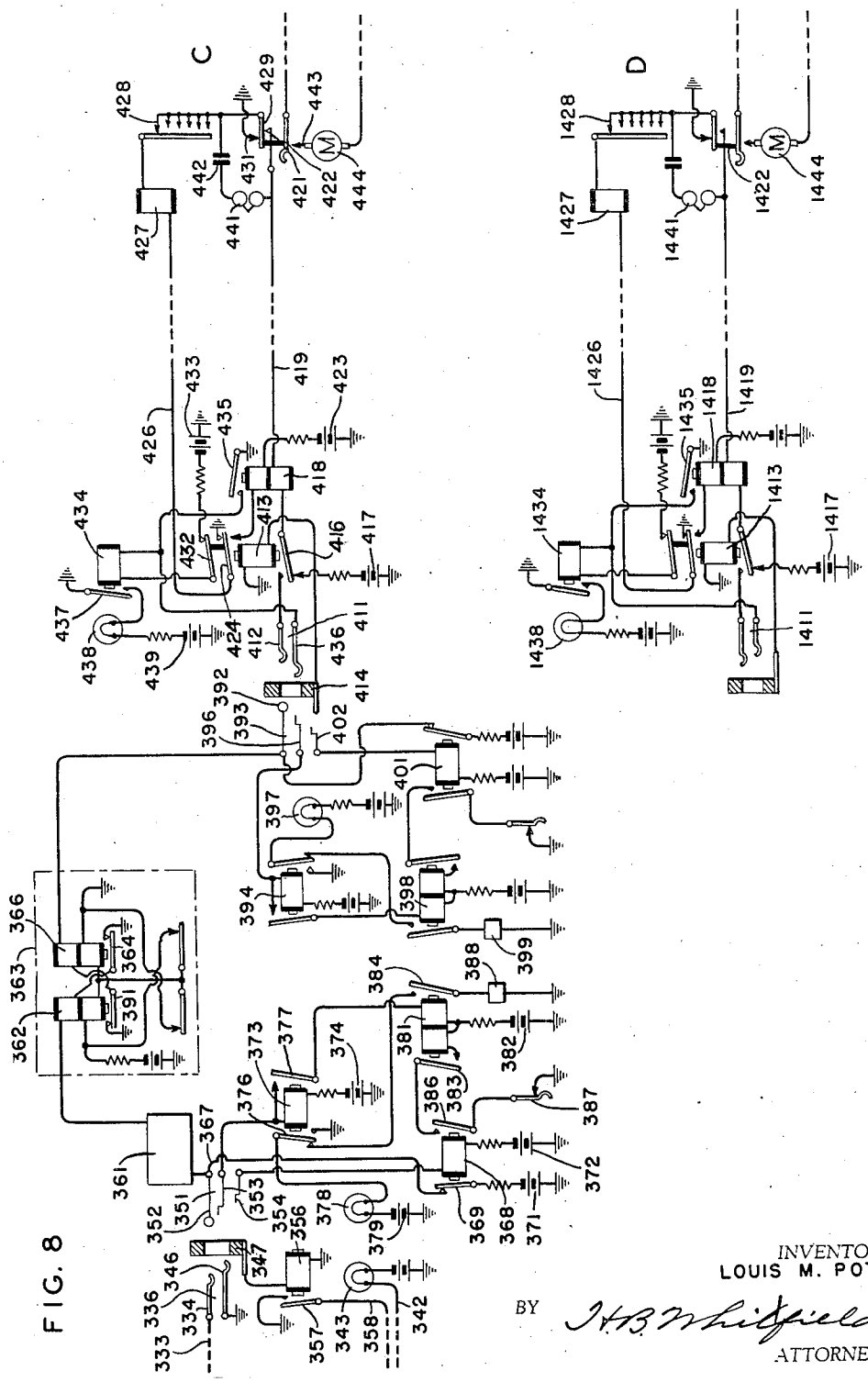


FIG. 8

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Patented Aug. 24, 1943

2,327,369

UNITED STATES PATENT OFFICE

2,327,369

TELEGRAPH SIGNAL TRANSLATING SYSTEM AND APPARATUS

Louis M. Potts, Evanston, Ill., assignor to Teletype Corporation, Chicago, Ill., a corporation of Delaware

Application November 15, 1940, Serial No. 365,730

21 Claims. (Cl. 178—17)

This invention relates to printing telegraph apparatus and systems and particularly to translating mechanisms for translating signal combinations according to one code into signal combinations according to another code.

An object of this invention is to make possible the use of a keyboard transmitter operable according to one telegraph code and a recorder operable according to a different telegraph code to produce a complete station which includes simpler components than a station having a transmitter and recorder both operable according to the same one of either of the codes.

Another object of the invention is to provide a translator whereby a printed facsimile record will be made of message material transmitted by permutation code signals.

According to one embodiment of the invention permutation code signals are received by a single magnet printing telegraph receiving selector mechanism and slides are operated permutatively in accordance with the received signal combination to produce selectively apertures between a source of light and a scanning cylinder which houses a photoelectric cell and which has circumferential combinations of light transmitting and opaque areas according to the facsimile signaling code. Upon the reception of a permutation code signal combination and the setting of the slides the scanning cylinder is set in rotation for one revolution. Facsimile telegraph signals are then generated according to the activation of the photoelectric cell under the control of the scanning cylinder.

According to another embodiment of the invention the permutation code signals are received by a multiple magnet receiving selector mechanism which has a selector magnet corresponding to each element of the code. Each of the selector magnets controls the positioning of one of the slides which co-operatively establish individual apertures for a light beam to be scanned by the scanning cylinder. As in the case of the first mentioned embodiment of the invention, the scanning cylinder is set in rotation for one revolution upon the reception of a permutation code signal combination by the multiple magnet receiving selector mechanism.

In the practice of the invention a communication system is featured which includes translating devices of the single magnet or multiple magnet controlled type whereby intercommunication may be had between a subscriber having a permutation code transmitter and facsimile recorder and a subscriber having permutation code transmitter and recorder, or between two subscribers having permutation code transmitters and facsimile recorders. Also featured are communication systems for providing intercommunication between a central station and a plurality of subordinate stations and operable over metallic conductors or radio channels, said communication systems including translating devices as hereinbefore described generally and to be described hereinafter in detail for translating permutation code signals into facsimile signals.

For a complete understanding of the invention reference may be had to the following detailed description to be interpreted in the light of the accompanying drawings wherein,

Fig. 1 is a plan view partly broken away showing a signal translating device operable under the control of magnets individual to each impulse of a received signal combination;

Fig. 2 is a perspective view partly broken away showing structural details of the signal translating device shown in Fig. 1;

Fig. 3 is an elevational view of the translating device shown in Fig. 1;

Fig. 4 is a plan view partly broken away showing a modified form of signal translating device which is operable under the control of a single receiving magnet;

Fig. 5 is an elevational view partly broken away taken at the right-hand side of Fig. 4;

Fig. 6 is an elevational view taken at the lower edge of Fig. 4;

Figs. 7 and 8, when placed end to end with Fig. 8 at the right of Fig. 7, show a complete communication system including signal translating devices according to the previously identified figures;

Fig. 9 is a schematic wiring diagram of a communication system including signal translating devices and having a metallic communication channel in one direction and a radio channel in the other direction; and

Fig. 10 is a schematic wiring diagram of a communication system similar to that of Fig. 9 but having metallic channels in both directions.

Referring now to the drawings and particularly to Figs. 1 to 3, inclusive, the reference numeral 15 indicates generally the signal generating mechanism of a photoelectric facsimile transmitter such as that shown in application Serial No. 261,418 filed March 13, 1939, by L. M. Potts, which matured Nov. 25, 1941, into Patent No. 2,263,592. The patent discloses a keyboard controlled transmitter and keyboard control is not of interest in connection with the present inven-

tion. However, reference may be had to the patent for a detailed description of the photoelectric scanning and facsimile signal generating mechanism.

The signal generating mechanism 16 includes a housing 17 into which extends from one end a rotatable shaft 18. The end of shaft 18 presented inside cylindrical housing 17 supports and has secured thereto by means of set screw 19 a rotatable scanning cylinder 20. As shown in the patent, cylinder 20 has circumferential rows of light transmitting apertures or windows arranged according to the facsimile code of impulses for letters, figures, and symbols. The opposite ends of scanning cylinder 20 and housing cylinder 17 from that where shaft 18 enters is open and the base 25 of a photoelectric cell 21 is stationarily supported in the open end of the housing cylinder 17. Photoelectric cell 21 is of the elongated cylindrical type and has its cathode and anode at least coextensive with the portion of scanning cylinder 20 which has circumferential bands of scanning apertures.

At a point just clear of the surface of scanning cylinder 20 the housing cylinder 17 is cut away on a vertical plane and to the flat surfaces resulting from the cutting away of the portion of the cylinder a guide frame 22 for shutter slides is secured, as shown in Fig. 1. The guide frame 22 is shown in detail in Fig. 2 by reference to which it will be noted that the frame has a channel 23 in which a plurality of shutter slides 24 are slidably supported. The slides 24 are confined in channel 23 by plate 26 which is secured to the inner faces of frame 22, and when the frame is secured to housing cylinder 17 plate 26 is disposed between the frame and the flat surfaces provided by cutting away a portion of the cylinder 17. Retainer plate 26 is provided with light transmitting apertures 27, there being an aperture 27 in alignment with each of the circumferential rows of light transmitting windows or apertures of rotatably scanning cylinder 20. The apertures 27 are arranged in two rows in staggered formation in order to minimize the space required for the full set of apertures.

The slides 24 are movable endwise individually into either of two positions which may be designated as a marking and spacing position. They are provided with apertures 28 arranged in two rows spaced according to the spacing of the rows of apertures 27, and the spacing of the apertures 28 from each other in each row is such that certain of the apertures will register with apertures 27 when the slide is in the marking position and others will register with apertures 27 when the slide 24 is in spacing position. The arrangement of apertures 27 in all of the slides 24 is such that for each permutational setting of the slides 24 an alignment of apertures 28 will register with one only of the apertures 27 in the plates 26.

At the opposite side of frame 22 from that which supports apertured plate 26 there is a longitudinally extending slot 29 across which is disposed a plurality of vertically positioned partitions 31. The spacing of the partitions 31 corresponds to the spacing of apertures 27 longitudinally of plate 26 so that the partitions 31 define the entrances of light passages which may be completed through alignment of apertures 28 in slides 24 and through apertures 27. A lamp 32 having a long filament 33 is mounted in close proximity to the slot 29 in frame 22 (Fig. 1) and serves as a source of light to be scanned by the rotatable cylinder 20 for activating the photoelectric cell 21 in accordance with the facsimile code of apertures in the cylinder 20 which may be exposed to the light as a result of the permutational positioning of slides 24.

Shaft 18 which carries scanning cylinder 20 is rotatably supported in one end of stationary cylinder 17 and remotely therefrom in bracket 36. Shaft 18 has secured thereto sleeve 37 to which is slidably splined driven element 38 of a positive clutch mechanism. Driven clutch element 38 is urged by compression spring 39 to move longitudinally of shaft 18 to engage driving element 41 which is sleeved on shaft 18. A gear 42 is secured to driving clutch element 41 and a motor driven pinion 43 meshes with and imparts continuous rotation to gear 42 and through it to driving clutch element 41.

Driven clutch element 38 is normally restrained from engagement with driving element 41 by clutch throwout lever 44 urged by tension spring 46 into the path of clutch throwout cam 47 associated with flange 48 of driven clutch element 38.

Sleeve 37 has secured thereto a cam 51 which is engaged by a roller 52 carried by a lever arm 53 which is spring biased to maintain roller 52 in engagement with cam 51. When the clutch mechanism is in rest condition the roller 52 is resting upon cam 51 near the top of a descending slope thereof, and thus imparts a torque to the cam and thus to sleeve 37 and driven clutch element 38 to hold them in such angular position that clutch throwout lever 44 pulls driven clutch element 38 entirely out of engagement with driving element 41, and rubbing of the teeth of one clutch element upon those of the other is avoided.

Clutch throwout lever 44 is provided with a leftwardly extending arm 56 which terminates below and in the path of one arm of a clutch tripping lever 57 pivoted at 58. A downwardly extending arm 59 of clutch tripping lever 57 is disposed in the path of a hooked portion 61 of a link 62 which is movable rightwardly to rock clutch tripping lever 57 counterclockwise to effect the withdrawal of clutch throwout lever 44 from engagement with clutch throwout cam 47 whereby compression spring 39 may move driven clutch element 38 into engagement with driving element 41 to receive rotation therefrom and thus impart rotation to shaft 18 and scanning cylinder 20. Shaft 18 is rotated through one revolution whereupon driven clutch element 38 is disengaged from driving element 41 by the reengagement of clutch throwout lever 44 with cam 47 and shaft 18 and scanning cylinder 20 are brought to rest. The co-operation of link 62 with clutch tripping lever 57 is of the nonrepeat species due to the downward camming of link 62 as it is moved rightwardly by virtue of engagement of an upwardly sloping cam portion of the upper edge of link 62 with the head of screw 63. A tension spring 64 maintains the upper edge of link 62 in engagement with the head of screw 63. The apparatus thus far described is fully disclosed in the hereinbefore identified patent.

The bracket 36 which supports the right-hand end of shaft 18 also supports on the right-hand side thereof the mounting brackets 66 for a plurality of selector magnets 67. The number of selector magnets 67 is equal to the number of impulses in the permutation code combination that the selector mechanism is adapted to re-

ceive and each selector magnet is provided with a pivoted armature 68. Each of the armatures 68 is provided at its free end with an adjustable abutment screw 69 which is aligned with the right-hand end of an associated slide 71. Slides 71 are slidably supported in bracket 36 and each is urged to its rightward or spacing position by a tension spring 72.

Each of the slides 71 is connected by a rod 73 to a shutter slide 24 so that when any one of the slides 71 is moved to its left-hand or marking position its associated shutter slide 24 is correspondingly positioned. The slides 71 are provided with locking projections 74 and arm 53 which carries cam follower roller 52 supports a locking bail blade 76 which spans the slides 71 adjacent to the locking projections 74. Slides 71 which are in spacing or right-hand positions have their locking projections 74 presented to the right of locking bail blade 76, and those that are presented in their marking or left-hand position have their locking projections presented to the left of the locking bail blade 76. When shaft 13 begins to rotate, cam 51 lowers arm 53 so that the locking blade 76 is presented between those of the locking projections 74 that are to the right of it and those that are to the left of it. Thus, the slides 71 are blocked against movement until near the end of a cycle of rotation of shaft 13 when cam 51 lifts arm 53 to lift locking bail blade 76 clear of the top of locking projection 74.

Each of the slides 71 has a lug 77 on the lower edge thereof (Fig. 3), and disposed in the path of the lugs 77 is a bail 78 pivoted at 79. Bail 78 has a depending arm 81 to which the right-hand end of clutch tripping link 62 is pivotally connected. When any of the slides 71 is moved to its marking position by its associated selector magnet 67 the lug 77 will engage bail 78 and rock the bail in counterclockwise direction, thus shifting link 62 to the right to effect the tripping of the clutch comprising driven element 39 and driving element 41. From this it will be apparent that all of the selector magnets 67 that are to be energized for any given permutation code signal combination must be energized substantially simultaneously rather than in succession from a receiving distributor. The reason for this is that the first slide 71 to be operated would effect the tripping of the clutch for driving shaft 13 through the operation of bail 78, link 62, clutch tripping lever 57, and clutch throwout lever 44, and the slides 71 would become locked by the lowering of locking bail blade 76 before the remaining marking impulses in the code combination could be received and perform their selective functions. The translating device shown in Figs. 1 to 3, inclusive, particularly adapted to operate in a system in which each of the selector magnets 67 is connected by an individual conductor to one of the transmitting contacts of the transmitter mechanism. A system so arranged will be described later.

Figs. 4 to 6, inclusive, show that form of the invention which includes a single magnet receiving selector mechanism for controlling the operation of the photoelectric permutation code transmitter. The photoelectric scanning and facsimile signal generating mechanism is identical with that shown in Figs. 1 to 3, inclusive, and the same reference characters have been applied thereto. Also, the driving mechanism for the scanning drum and the combined clutch anti-singing device and lock bail for the slides which control the light valve slides are identical with those heretofore described and are identified by the same reference numerals.

The receiving selector mechanism for controlling the operation of the light valve slides 24 is similar to that shown in Patent No. 1,937,376 granted November 28, 1933, to W. J. Zenner. The reference numeral 81 designates a mounting plate for the selector mechanism. A selector magnet assembly comprises a bracket 82, to which is secured by means of screws 83 a magnet core 84. Core 84 has two arms, each of which supports a winding 86, which is connected to a telegraph line. At their outer end, the arms of core 84 terminate in pole faces 87. Bracket 82 supports opposed pivot screws 88, which in turn pivotally support an armature lever 89. Armature lever 89 has rigidly secured thereto armature 91 which is disposed in alignment with the pole faces 87. The other end of armature lever 89 terminates in a cam follower portion (not shown), which co-operates with an armature lever cam 92 included in a receiving selector cam assembly 93. Selector cam assembly 93 is driven from gear 42 through a sleeve 94, which has a reduced portion rotatably supported in bracket 36. Cam assembly 93 is sleeved on sleeve 94 and is provided at its opposite ends with discs 96. To the right of cam assembly 93 sleeve 94 has disc 97 secured thereto, and to the left of cam assembly 93 disc 98 is splined on sleeve 94 and is slidable thereon. A friction disc of resilient material, such as felt, is interposed between the disc 96 and the disc 97 at the right of receiving cam assembly 93, and another friction disc is interposed between the discs 94 and 96 at the left of cam assembly 93, the friction discs being identified by the numeral 99. A compression spring 101 urges disc 98 rightwardly of sleeve 94 and compresses friction discs 99, between their adjacent discs. Discs 96, 97, 98 and 99 form a friction clutch through which rotation may be imparted to cam assembly 93 from continuously driven sleeve 94.

Selector cam assembly 93 includes a stop arm 102 which is arranged to be arrested and released for rotation alternatively under the control of a stop gate 103 included in stop gate assembly 104. Stop gate assembly 104 has as its foundation a plate 106, which is pivoted below a plate 107 by means of pivot screw 108, carried by plate 107, which is supported by posts 109 mounted on mounting plate 81. An arm 111, mounted on pivot screw 108 above plate 107, has extending thereto the shank of a knurled-headed screw 112 which threadedly engages stop gate mounting plate 106. Plate 106 may be adjusted pivotally for orientation adjustment about pivot screw 108 and may be clamped in any desired position of adjustment by drawing plate 106 and arm 111 into clamping engagement with plate 107 by means of screw 112.

Stop gate 103 is pivotally mounted on a stud carried by plate 106 and is biased into the path of stop arm 102 by a spring (not shown). Stop gate 103 may be latched in blocking relation to stop arm 102 by shouldered latch lever 113. Lever 113 is pivotally mounted on the underside of plate 106 and is urged by spring 114 into latching engagement with stop gate 103.

Latch lever 113 is rocked against the resistance of compression spring 114 to lift its shoulder out of latching engagement with the stop

gate by a plunger pin 116, in the operating path of which is disposed one arm of a bell crank lever 117, the other arm of which engages latch lever 113. A plunger operating screw 118, carried by extension 119 of armature lever 89 in alignment with plunger pin 116, shifts the pin to effect the release of the stop gate when selector magnet 86 is de-energized and armature 91 is retracted. Plunger pin 116 is retracted by spring 114 and permits latching lever 113 to latch stop gate 103 when armature 91 is in engagement with pole faces 87.

The selector lever assembly comprises a mounting bracket 121, secured to mounting plate 81 by screws 122, and a selector lever 123 pivotally supported by bracket 121 by means of pivot screws 124. The selector lever 123 becomes locked in extreme counterclockwise or clockwise position (Fig. 5), which are the marking and spacing positions respectively, by a lock lever 126 (Fig. 5), which is released by a cam included in receiving cam assembly 93 in timed relation to the reception of each impulse of a signal combination. As timed by the operation of lock lever 126, the selector lever 123 follows the movement of armature lever 89, being shifted to spacing position by an abutment screw 127 carried by armature lever 89 and being shifted to marking position by a tension spring (not shown) by which selector lever 123 is connected to armature 89.

Selector cam assembly 93 is provided with cam projections 128, equal in number to the number of impulses in a code combination for individually actuating sword lever bell cranks 129 (Fig. 5) to move sword levers 131 individually articulated to the sword lever bell cranks 129 leftwardly as viewed in Fig. 5. Adjacent to the point of articulation to bell cranks 129, sword levers 131 are provided with oppositely extending arms which terminate in projections extending laterally from the arms in the plane of the sword lever and toward the right-hand end of the selector lever 123. The free end of selector lever 123, which is the right-hand end, as shown in Fig. 5, is provided with depending arms 132, one or the other of which is always in the path of the laterally extending arms of the sword levers 131, depending upon whether the selector lever 123 is in the marking or spacing position. Upon the retraction of a sword lever 131 by its bell crank 129 and engagement of the laterally extending arm with one of the depending arms 132 of selector lever 123 before the sword lever has reached the limit of its travel, it will be rocked in clockwise or counterclockwise direction, depending upon whether the selector lever 123 is in marking or spacing position. The end of each sword lever 131, opposite to that which is engaged by the sword lever bell crank 129, is pointed and normally engages a T-lever individual to the sword lever at one side or the other of a divide between two sloping surfaces of the T-lever. The T-levers, identified by the reference numeral 133 in Fig. 5, are pivotally supported upon a spindle 134. The sword levers 131 actuate their associated T-levers 133 to extreme clockwise or counterclockwise position, depending upon whether the sword lever is in extreme counterclockwise or extreme clockwise position respectively, when they are restored to engagement with their associated T-levers after having been retracted to co-operate with selector lever 123. Each T-lever is provided with an arm 136 for articulation to a permutation member to be controlled by the T-lever. The single magnet receiving selector mechanism, as described up to this point, is substantially identical with that shown in Patent 1,937,376.

The T-levers 133 control intermediate or transfer levers 141 that are bail-shaped. The levers 141 are nested and are pivotally mounted upon pivot rod 142. One of the arms of each of the levers 141 is bent outwardly, as shown at the top of Fig. 4 and at the right of Fig. 5, at right angles to the arm and then upwardly, and near the extremity of the upwardly bent portion is a recess in which is disposed the disc-shaped extremity 137 of arm 136 of T-lever 133. The other arm of each of the bail-shaped levers 141, shown near the middle of Fig. 4 and at the left of Fig. 5, has an upwardly extending projection 143 which terminates in a disc-shaped portion 144. Each of the disc-shaped extremities 144 of the upstanding arms 143 of levers 141 is disposed in a socket at the lower end of a depending arm 146 integral with one of the slides 147 similar to the slides 71 of Figs. 1 to 3, inclusive, and similarly connected by rods 73 to light valve slides 24.

Upon the reception of a start-stop permutation code signal combination, the receiving selector mechanism is operated, as fully disclosed in Patent 1,937,376, to effect the permutational setting of the T-levers 133 in accordance with the code combination. As the T-levers 133 are rocked to extreme clockwise or counterclockwise position, the right-hand ends of the outer arms of levers 141, as viewed in Fig. 4, are rocked downwardly or upwardly, respectively, and the levers 141 are rocked clockwise or counterclockwise, respectively, as viewed in Fig. 6, to shift the slides 147 to extreme right-hand or left-hand position, respectively.

In addition to the cam projections 128 for operating the sword lever bell cranks 129, the selector cam assembly 93 is provided with a clutch tripping cam projection 151, which, near the end of a cycle of operation of selector cam assembly 93, engages arm 152 of clutch throwout lever 153, pivoted at 154, to lift its clutch controlling arm 156 out of engagement with clutch throwout cam 47 to permit compression spring 39 to move driven clutch element 38 into engagement with driving element 41. Thus, rotation is imparted to the light beam scanning cylinder contained in cylindrical housing 17 to effect the transmission of a facsimile code signal combination corresponding to the character represented by the received permutation code combination. As cam 51 is rotated with the scanning cylinder, locking bail 76 is lowered into blocking relation to the locking projections 74 of the slides 147. Upon the completion of one revolution of the scanning cylinder, locking bail 76 is lifted to permit the resetting of the slides 147 according to a new code signal combination and the clutch comprising elements 38 and 41 may be disengaged momentarily by arm 156 of clutch throwout lever 153 to arrest correspondingly the scanning cylinder.

It will be noted that in the embodiment of the invention shown in Figs. 1 to 3, inclusive, six receiving selector magnets and six slides 71 controlled thereby are provided. This apparatus is operable upon a six unit code which affords a maximum of sixty-four signal combinations, which is adequate for letters, figures, punctuation marks and other symbols. However, it will be noted that in the embodiment of the invention shown in Figs. 4 to 6, inclusive, referring particularly to Fig. 4, only five T-levers 133 and five bail-shaped levers 141 have been

provided, which indicates that the apparatus is operable in response to the very commonly employed five unit permutation code. This code affords a maximum thirty-two primary selective combination. However, as is well known, by allotting two of the code combinations to shift and unshift function, the code may be expanded to accommodate all necessary letters, figures, punctuation and other symbol selections. Accordingly, a sixth slide bar, designated by the reference numeral 157, and similar to the slide bars 147 is provided. The slide bar 157 is connected to the sixth one of the light valve slides 24 by a rod 73 in the same manner as are the other slides designated 147. The sixth light valve slide in the embodiment of the invention shown in Figs. 4 to 6, inclusive, functions in exactly the same manner, as far as the transmission of facsimile combinations is concerned, as does the sixth light valve slide in Figs. 1 to 3. The difference is only in the method of controlling the sixth light valve slide and this difference is that in Figs. 1 to 3, the sixth slide is presented in one or the other of its two positions in accordance with the presence or absence in a signal combination of an impulse to operate the sixth magnet, whereas in the embodiment of the invention shown in Figs. 4 to 6, inclusive, the sixth light valve slide is presented in one or the other of its two positions under the control of shift and unshift permutation code signal combinations.

Referring to Fig. 6, it will be noted that in the lower edge of the foremost of the slide bars 147 controlled by the bail-shaped levers 141 two notches are provided. Each of the other of the five slide bars 147 is notched and the positioning of the notches on the bars is according to the permutation code so that when slide bars 147 have been positioned under the control of the receiving selector mechanism in accordance with a shift code combination, an alignment of notches will result in one position and, when the slide bars 147 have been set in accordance with the unshift code combination, an alignment of notches will result in the other position. Below the slide bars 147, and in registry with the position in which the alignments of notches may result, are selectable bails 161 and 162 carried by levers 163 and 164, respectively, pivoted at 166 and 167, respectively. Each of the levers 163 and 164 has a downwardly extending arm and the extremities of the two arms are interconnected by a tension spring 168 which biases lever 163 in counterclockwise direction and lever 164 in clockwise direction. The levers 163 and 164 have fingers 169 extending toward each other and the extremities of the fingers 169 are disposed under oppositely extending flanges 171, carried by a retracting lever 172, pivoted at 173. Retracting lever 172 has an arm 174 extending upwardly from the point of the pivotal mounting, with its extremities disposed in the path of arm 176 of locking bail lever 53.

When cam 51 operates lever 53 to lift locking bail 76 out of locking position, it accomplishes this by rocking lever 53 clockwise, and arm 176 thereof rocks retracting lever 172 counterclockwise, with the result that the flanges 171 engage fingers of 163 and 164 and draw the selectable bails 161 and 162 clear of the lower edges of the slide bars 147. Thus, the selectable bails 161 and 162 are prevented from interfering with the setting of the slide bars 147 according to received signal combinations. When locking bail lever 53 returns to normal position, which is the extreme counterclockwise position, as viewed in Fig. 6, it permits lever 172 to rotate in clockwise direction, this rotation being imparted by spring 166 operating through levers 163 and 164 and their opposed fingers upon flanges 171. If the setting of the slide bars 147 represents neither the shift nor the unshift combination, both of the selectable bails 161 and 162 will come to rest against the lower edges of the slide bars 147. However, if either of the selectable bails finds an alignment of notches, it will enter the alignment of notches, thus moving lever 172 farther in clockwise direction than it is moved when neither of the selectable bails finds an alignment of notches.

Lever 163 is provided with an upwardly extending arm 181 and lever 164 is provided with a similar upstanding lever 182. The arms 181 and 182 of levers 163 and 164, respectively, are positioned adjacent to the sixth slide 157, and each of the lever arms has a laterally bent portion at its upper end which overlies the slide 157. Slide 157 is provided on its upper edge with a pair of spaced lugs 183 at its upper edge between which the laterally extending portion of arm 181 of lever 163 is disposed. Similarly, slide 157 is provided with spaced lugs 184 between which the laterally extending portion of arm 182 of lever 164 is disposed. When lever 163 occupies its extreme counterclockwise position with its sensing bail 161 in an alignment of notches in the five slides 147, the laterally extending portion of its arm 181 has engaged the left-hand of the lugs 183 and has shifted slide 157 to its left-hand position, whereby the associated light valve slide is shifted to extreme left-hand position to block out light from one entire set of circumferential rows of code apertures on cylinder 23, such set of rows of apertures being those assigned either to figures characters or to letters characters. However, when lever 164 is in extreme clockwise position with its sensing bail 162 disposed in an alignment of notches in the slides 147, the transversely extending portion of its arm 181 will have engaged the right-hand one of the lugs 184 and will have shifted slide 157 to its extreme right-hand position, whereby the sixth light valve slide will be presented in extreme right-hand position to block out light from all of the circumferential rows of apertures which were unblocked when the slide 157 was in extreme left-hand position and to unblock those sets of apertures which were then blocked.

Lever 172 is biased in counterclockwise direction by a light tension spring 186 so that when locking bail lever 53 is in extreme counterclockwise position, as viewed in Fig. 6, and its depending arm 176 at the right-hand end has released the upper end of lever 172, the right-hand end of lever 172 will be under the control of fingers 169 of levers 163 and 164 and will not rise higher than either of those fingers move it, it being understood that spring 168 is stronger than spring 186 so that spring 168 will control the movement of lever 172.

At the upper end of the arm at the right-hand end of lever 172 a slide 187 is pivotally connected thereto. Slide 187 is connected to a seventh light valve slide 188. Thus, when lever 172 is rocked counterclockwise by locking lever 53, slide 187 and light valve slide 188 are moved to the left. Conversely, when lever 172 is rocked clockwise by spring 168, slides 187 and 188 are moved to the right, and depending on whether or not one of

the sensing bails 161 and 162 enters an alignment of notches in slides 147, slide 187 and associated slide 188 will be presented in extreme or intermediate right-hand position.

The purpose of light valve slide 183 is to nullify the effect of rotation of the scanning cylinder 20 in response to the shift and unshift signal combinations. Since, as is well known, a facsimile signal is a combination of impulses representing a character pattern and causes the character pattern to be traced on the receiving medium, there is no case shift function corresponding to that which is employed when characters are printed by typed elements. Accordingly, no signal is to be transmitted in a cycle of operation of scanning cylinder 20 initiated as a result of the reception of a shift or unshift permutation code combination.

As disclosed in the copending application hereinbefore identified, the scanning cylinder 20 is provided with a light transmitting slot for the generation of a start signal located in an area on the periphery of the cylinder which includes no portion of any of the character signal transmitting code slots. Upon release of the scanning cylinder 20 for the transmission of any facsimile signal, the starting signal slot first scans the light beam and causes the photoelectric cell to generate a signal for starting the receiving printer. Since no signal is to be transmitted in response to the shift and unshift permutation code combinations, it is preferred that the scanning cylinder, which is released for rotation in response to the shift and unshift signal combinations in the same manner as for any other permutation code combinations, shall not effect the generation of a start signal, since this would set the printer in operation and effect spacing of the receiving tape without recording anything in the space. The function of the slide 187 and its associated light valve slide 183 is to block the light path in registry with the start signal slot of the scanning cylinder 20 when either of the selectable bails 161 or 162 is in the selected position. The blocking occurs when lever 172 is in extreme clockwise position, thus presenting slide 187 and light valve slide 188 in extreme right-hand position. At the points where apertures in the light valve slides 24 align when the slides are set according to the shift and unshift permutation code signals, there are no circumferential rows of apertures in the scanning cylinder 20. Thus, light is prevented from passing through the alignment of apertures in the light valve slides 24 when the slides are set in accordance with the shift and unshift signals and no impulses are generated in the photoelectric cell, the rotation of the scanning cylinder 20 being merely an idle operation applying no signals to the telegraph line and, therefore, having no effect on the receiving printer.

Referring now to Figs. 7 and 8, which, fitted together with Fig. 8 placed at the right of Fig. 7, show a complete telegraphic communication system, the reference letters A and B indicate subscribers' stations. Subscribers' stations A and B are identical and only one will be described in detail, which is the A station. At the subscriber's station a facsimile recorder 201 is connected through the winding of relay 202 local to the station A to one end of telegraph line 203, the other end of which is connected to tip contact spring 204 of answering jack 206 at a central office.

At the station A, a motor 207 is provided for driving the facsimile recorder 201. One terminal of the motor 207 is connected directly to one side of a power line and the other terminal may be connected to the other side of the power line through conductor 208, contact and tongue 209 of relay 202 and conductor 211. Thus, when relay 202 is energized due to the transmission of facsimile signals from the central office over telegraph line 203, the circuit of motor 207 will be closed and facsimile recorder 201 will be driven. Relay 202 is preferably of the slow-to-release type so that its contact tongue will not operate in accordance with facsimile signals but will remain closed during the reception of signals to apply steady current to motor 207.

Station A is provided with a permutation code transmitter 212 which may be connected to a telegraph line 213 through tongue 214 of key 216. Tongue 217 of key 216 completes the circuit for motor 207 which drives permutation code transmitter 212 as well as facsimile recorder 201.

The other end of telegraph line 213 is connected to one end of one winding of a differential relay 218 and this winding will be described for the sake of convenience as the upper winding. The other end of the upper winding of relay 218 is connected to tongue 219 of a relay 221. The relays 218 and 221 are located at the central station. When the system is idle, relay 221 is deenergized and its contact tongue 219 engages its back contact which is connected to one end of battery 222, the other end of which is connected to ground. Battery 222 supplies power for energizing the upper winding relay 218 upon the closure of key 216 at subscriber's station A. Key 216 is closed manually when the subscriber desires to operate permutation code transmitter 212 to transmit a message.

Upon the energization of the upper winding of relay 218, its tongue 223 which is connected to ground is brought into engagement with its front contact which is connected to one end of the winding of relay 224, the other end of which is connected to outer tongue 226 of relay 221. Tongue 226 normally engages a back contact which is connected to a grounded battery 227. Upon the closure of energizing circuit for relay 224 at tongue 223 of relay 218, relay 224 attracts its contact tongue 228 which engages its front contact and completes a circuit for lamp 229 from battery 231.

Lamp 229 is associated with jack 206 and indicates to an operator at the central office that the subscriber at station A desires to transmit a message. The answering operator thereupon inserts plug 232 into jack 206. It will be understood that the operator could answer station B by inserting the same plug 232 into the jack associated with station B had the subscriber at station B closed his key 1216 to effect the illumination of his jack lamp 1229.

Upon the insertion of plug 232 into jack 206, plug tip 233 engages tip spring 204, outer ring 234 engages ring contact spring 236 of jack 206, inner ring 237 engages ring contact spring 238 of jack 206, and sleeve 239 engages bushing 241 of jack 206.

The bushing 241 of jack 206 is connected to one end of the winding of relay 221, the other end of which is connected to ground. Sleeve 239 of the plug, which engages bushing 241, is connected by a conductor 242 to one end of the winding 243, the other end of which is connected to one terminal of a grounded battery 244. Thus, upon the insertion of plug 232 into jack 206, relays 221 and 243 are energized in series. Relay 221 attracts

its contact tongue 219 from engagement with back contact to engagement with front contact, attracts contact tongue 226 out of engagement with its back contact, thus interrupting the circuit for jack lamp controlling relay 224, and attracts its contact tongue 245 into engagement with a front contact. Contact tongue 245, upon engaging its front contact, completes the energizing circuit for the lower winding of 218 which neutralizes the effect of the upper winding and releases contact tongue 223.

A further effect of the energization of relay 221 is that permutation code transmitter 212 is disconnected from battery 222 and is connected instead to outer ring contact spring 236 of jack 206. Since contact spring 236 is engaged by the outer ring 234 of plug 232, the circuit of the permutation code transmitter is extended to the operator's cord circuit. This circuit includes conductor 246, winding of relay 247, key 255, conductor 251, winding of repeater relay 252, contact tongue 253 of repeater relays 254 and 256, front contact with which tongue 253 is normally engaged since relay 254 is normally energized, and grounded battery 257.

Key 255 normally connects conductor 251 directly to the winding of relay 247 and holds relay 253 energized to complete a circuit from grounded local holding battery through operator's keyboard transmitter 248 and permutation code printer magnet 249 to ground. Upon the operation of key 255, the circuit of relay 253 is opened so that the relay releases its armatures and thus disconnects transmitter 248 and printer magnet 249 from the local holding battery. In make-before-break manner with respect to the circuit of relay 247, the key 255, when operated, also connects transmitter 248 and printer magnet 249 in series with relay 247 and with the repeater to which conductor 251 extends. With this arrangement the operator may cut the transmitter 248 and 249 into the permutation code communication circuit for setting up circuits desired by subscribers or for monitoring message transmission. Under normal conditions, when plug 232 is not inserted into any jack, the ground connection for maintaining holding current upon relay 252 of the repeater is obtained through the outer left-hand contact tongue 259 of a relay 262. This holding circuit includes the winding of relay 247, which as will presently appear, controls the operation of a translator mechanism, such as that shown in Figs. 4 to 6, inclusive. Upon the energization of relays 221 and 262 the ground connection at the subscriber's permutation code transmitter is substituted for the ground connection at the contact tongue 259 of relay 262 so that permutation code signal transmission is initiated and the transmitter 212 will correspondingly energize and de-energize relay 247, operator's receiving magnet 249 and repeater relay 252.

In addition to the tongue 223, differential relay 218 has a contact tongue 225 connected to ground and engageable with a back contact when neither or both of windings of relay 218 are energized. The back contact is connected by conductor 239 to the jack spring 238 which is engaged by inner ring 237 of plug 232 from which conductor 261 extends to one end of the winding of relay 262, the other end of which is connected to battery 263. An energizing circuit for relay 262 is completed when both windings of relay 218 become energized and neutralize it to cause the release of tongue 225, and the relay 262 attracts its two left-hand and two right-hand tongues. The outer right-hand contact tongue 264 of relay 262 normally engages its back contact, to which is connected one pole of battery 266, the other pole being connected to ground. The contact tongue 264 is connected by conductor 267 to one end of the winding of magnet 268, the other end of which is connected to ground. The broken lined rectangle in the upper right-hand corner of Fig. 7, designated 270, is intended to represent diagrammatically a signal translating mechanism such as that shown in Figs. 4 to 6, inclusive, for translating from permutation code signals into facsimile signals. The magnet 268 corresponds to the signal receiving selector magnet 86 of Figs. 4 to 6, inclusive. Magnet 268 is normally held energized by current supplied from battery 266. However, upon the energization of relay 262, contact tongue 264 moves into engagement with its front contact which is connected to the contact tongue 269 of relay 247. The front contact with which contact tongue 269 is engageable is connected to a grounded battery 271. Since in a static condition with the operator's set rendered operative through the actuation of key 255 relay 247 is continuously energized, it being included in the holding circuit for operator's receiving magnet 249, whether the holding circuit be extended from the ground at the contact tongue 259 of relay 262 or from the ground at the permutation code transmitter of a subscriber's station, battery 271 will be connected to the front contact of contact tongue 264 of relay 262 through contact tongue 269 of relay 247. From this it will be apparent that receiving selector magnet 268 is not responsive to oscillation of tongue 269 of relay 247 except when relay 262 is energized to connect magnet 268 to the tongue 269 through contact tongue 264.

Upon the energization of relay 262 its inner right-hand tongue 272 engages its front contact which is connected to conductor 261 and therefore is connected to the same ground as the winding of relay 262. Contact tongue 272 of relay 262 is connected to one end of one of the windings of a double wound relay 273, the other end of which is connected to grounded battery 274. Relay 273 is thus energized in parallel with relay 262, the circuit for the former extending through one of the contact tongues of the latter however, and the energizing circuit of both includes the retracted contact tongue 225 of relay 218.

The inner left-hand contact tongue 276 of relay 262 normally engages a back contact which is connected to the front contact associated with the right-hand contact tongue 277 of relay 273. When contact tongue 276 is attracted into engagement with its front contact, a connection is established from ground to a conductor 278 at the other end of which one terminal of lamp 279 is connected, the other terminal of the lamp being connected to battery 281. The right-hand tongue 277 of relay 273 is connected to a source of interrupted current indicated diagrammatically at 281. Thus, when relay 273 is energized, the interrupted current is available at the back contact associated with the inner left-hand contact tongue 276 of relay 262. When contact tongue 276 engages the back contact and relay 273 is energized, lamp 279 will be illuminated intermittently or, in other words, will flash for directing the attention of the operator to a particular operating condition. When contact tongue 276 engages its front contact, lamp 279 will be illu-

minated steadily. The left-hand contact tongue 262 of relay 273 completes a locking circuit through the left-hand winding of that relay, said circuit also including contact tongue 263 of relay 243 and normally closed key 264.

Considering now the operation of the portion of the system in Fig. 7 thus far described, upon the closure of key 216 by subscriber A, the motor 207 for driving his transmitter 212 will be operated and the transmitter 212 will be connected to battery 222 at the central office through one of the windings of relay 218. Relay 218 will be energized and will disconnect ground from conductor 230 and close the circuit of relay 224 to connect battery 231 to lamp 229 which will become illuminated to indicate to the operator in charge of transmitter 248 and receiving printer 249 at the central office that subscriber A desires to transmit a message. The operator thereupon inserts plug 232 into jack 206 and actuates key 255 placing the operator's set in a circuit with relay 247. Relays 221 and 243 thus become energized in series to complete the energizing circuit for the second winding of 218, to open the energizing circuit for relay 224, and to connect transmitter 212 through the upper winding of relay 218 in series with relay 247 and thus to operate receiver 249 and interrupt the connection to battery 222, these being the functions of relay 221. Relay 243 prepares the locking circuit for relay 273.

Relay 218 being a differential relay which is in neutral condition when both windings are energized, releases its contact tongues, the lower of which has no immediate effect as the circuit of relay 224 is already opened at contact 226. The release of the upper contact tongue 225 results in the connection of ground to conductor 261, whereby relay 262 becomes energized. The relay 262 operates to remove the local ground connection at contact tongue 250 from relay 247, thus placing the relay under the control of transmitter 212 and subscriber's station A, to complete a circuit for the steady illumination of lamp 279, to place the receiving selector magnet 268 in the translator mechanism under the control of relay 247 and to complete the energizing circuit for relay 273. The relay 273 upon being energized completes its own holding circuit and prepares for the flashing of lamp 279 by making connection to the source of interrupted current.

The circuits are now completed for subscriber A to communicate to the operator at the central office the identity of the connection which he wishes and the operator answers subscriber A by operating transmitter 248. The characteristic answer will be recorded on the printer represented by the receiving magnet 249 and will be repeated by the relay 247 to actuate correspondingly the receiving selector magnet 268 of the translator mechanism.

The translator device, such as that shown in Figs. 4 to 6, inclusive, is represented schematically by the selector magnet 268 and the photoelectric cell 286. The photoelectric cell 286 is connected to the control grid of the first electron tube of an amplifier shown schematically and indicated generally by the reference numeral 287. The plate electrode of the last electron tube of the amplifier 287 is connected by conductor 288 to the tip 233 of plug 232. Thus, signals originating at the subscriber's transmitter 212 or at the operator's transmitter 248 are received not only by the operator's receiving device 249 but also by the receiving mechanism 268 of the translator unit and are therein translated into facsimile signals which are impressed upon the conductor 288 and are transmitted through plug tip 233 and plug tip contact spring 204 of jack 206 to facsimile recorder 201 by way of telegraph line 203 and winding of relay 202, which is energized by the facsimile signals but has no direct effect since the motor circuit has previously been closed by contact spring 217 of key 216.

When the subscriber A has informed the operator at the central office by means of permutation code signals, the identity of the station with which he desires to communicate, which information is recorded by the operator's permutation code printer as a typed message and by the subscriber's facsimile recorder as a facsimile message, the operator then makes the connection to the called subscriber. This is done by means of the cord plug 291. The tip 292 of plug 291 is connected to conductor 288 in the same manner as tip 233 of plug 232 so that facsimile signals will be available at that element of the plug. The outer ring 293 of plug 291 is connected by conductors 294 and 296 to the winding of repeater relay 254 and then through the armature 297 of repeater relay 252 to battery 298.

The inner ring 299 of plug 291 is connected by conductor 301 to one end of the winding of supervisory circuit relay 302. The other end of the winding of relay 302 is connected to grounded battery 303. The left-hand contact tongue 304 of relay 302 is connected to one end of one of the windings of a double wound relay 306 and the other end of the winding of the relay 306 is connected to grounded battery 307. The inner right-hand contact tongue 308 of relay 302 is connected to one of the terminals of lamp 309, the other terminal of which is connected to grounded battery 311. Contact tongue 308 of relay 302 is operable between a front contact which is connected to ground and a back contact which is connected to the front contact engageable by the left-hand contact tongue 312 of relay 306. The contact 310 of relay 302 is connected to conductor 301, whereby the circuit of conductor 301 may be extended not only to the winding of relay 302 to battery 303 but also through the left-hand winding of relay 306 to battery 307. As will presently appear, inner ring 299 of plug 291 which is connected to conductor 301 is engageable with a jack contact spring which is connected to ground so that relays 302 and 306 will be energized upon insertion of plug 291 into a jack. The outer right-hand contact tongue 305 of relay 302 is connected to conductor 296 and its back contact is connected to ground, these connections being comparable with those of contact tongue 250 and its back contact. Relay 302 corresponds in function to relay 262 and relay 306 corresponds in function to relay 273.

The contact tongue 313 of relay 306 is connected to a source of interrupted current indicated diagrammatically at 313 so that when relay 306 is energized and contact tongue 308 of relay 302 is in engagement with its back contact as a result of relay 302 being de-energized, interrupted current will be applied to lamp 309 to cause the lamp to flash to indicate to the operator a predetermined operating condition.

The right-hand contact tongue 314 of relay 306 is connected to the front contact of relay 316 and the front contact with which contact tongue 314 is engageable is connected to one end of the

holding winding of relay 306, the other end of which is connected to grounded battery 307. The contact tongue 317 of relay 316 is connected to a key 318 which may be operated manually to interrupt the holding circuit of relay 306. Relay 316 has one end of its winding connected to the sleeve 321 of plug 291 and the other end connected to battery 322. Relay 316 corresponds to relay 263. Its purpose is to prepare a holding circuit for relay 306.

The plug 291 serves as means for connecting a subscriber, such as A, to whatever station to which he may desire to transmit a message. For example, he may desire to transmit a message to subscriber's station B, which is identical with his own station. This is accomplished by inserting plug 291 into jack 1206 at subscriber's station B. Upon the insertion of plug 291 into jack 1206, plug tip 292 connects the output 269 of translator 270 to the tip spring 1204 of jack 1206 which is connected by conductor 1203 through relay 1202 to facsimile recorder 1201 at station B. As soon as impulses begin to be transmitted over telegraph line 1203 relay 1202 becomes energized to close its contact 1209, thus completing the circuit of operating motor 1207 which is set in operation to drive facsimile recorder 1201. Sleeve 321 of plug 291 contacts with bushing 1241 of jack 1206, whereby relays 316 and 1221 are energized in series. The insertion of plug 291 into jack 1206 also results in the connection of relay 302 to the back contact of relay 1218 through inner ring 293 of plug 291 and ring contact spring 1238 of jack 1206 and the connection of permutation code signaling conductor 296 and its extension 294 through outer ring 293 of plug 291 and ring contact spring 1236 of jack 1206 to the upper front contact of relay 1221. Relays 316 and 1221, upon becoming energized, attract their several contact tongues. Contact tongue 1219 of relay 1221 becomes disconnected from battery 1222 and engages its front contact, thereby becoming connected to permutation code signaling conductor 294. The circuit of conductor 294 is thus extended through the upper winding of differential relay 1218 to the key 1216 of subscriber's station B which is open, so that the upper winding of relay 1218 does not become energized. The attraction of the two lower contact arms of relay 1221 as the relay becomes energized results in the closure of the circuit of the lower winding of relay 1218 and the disconnection of battery from the winding of relay 1224. Since only the lower winding of differential relay 1218 is energized, the relay will attract its contact tongue 1223 to connect ground to the winding of relay 1224. However, since battery has been disconnected from that relay by the lowermost contact tongue of relay 1221, the relay 1224 will not become energized and lamp 1229 will not become illuminated.

The energization of only one winding of relay 1218 and attraction of its contact tongues results in the disconnection of ground from jack spring 1238 and thus from the winding of relay 302 at the central office. Thus, the relay 302, whether or not it may have been momentarily energized as the plug 291 was inserted into jack 1206, remains deenergized during the time the connection is up. In all probability it will have become energized momentarily because relay 1218 is of the slow-to-operate variety and its circuit does not become closed until relay 1221 has become energized which operation occurs substantially instantaneously upon the insertion of the plug into the jack. Relay 302 also operates substantially instantaneously and attracts its contact tongue 304 to complete the energizing circuit for relay 306, thereby establishing contact with the source 313 of intermittent current for lamp 309 and also preparing the circuit of the holding winding of relay 306. Since relay 316 became energized in series with relay 1221, its contact tongue 317 has been attracted to complete the holding circuit for relay 306 and that relay remains energized.

Lamp 309 will be illuminated steadily during the transient interval that relay 302 remains energized due to the connection of the lamp to ground through contact tongue 303. When relay 1218 opens the energizing circuit of relay 302 and also of the relay 306, lamp 309 will be transferred to connection with the source 313 of interrupted current and will flash as long as plug 291 remains in jacks 1206 and subscriber's station B is conditioned for message reception. The connection to the source 313 of interrupted current is maintained by the holding winding of relay 306 after the operating winding of that relay becomes de-energized.

The apparatus is now conditioned for the transmission of message material from subscriber's station A to subscriber's station B and the operator may actuate key 255 to remove the operator's set from the communication circuit. The permutation code signals generated by the transmitter 212 will be repeated by the relay 247 to actuate the selector magnet 268 of the facsimile translator 270 and the facsimile signals generated in the photoelectric cell 286 and amplified in the vacuum tube amplifier 287 will appear at the output circuit 288 of the amplifier and will be impressed upon plug tip 292, jack spring 1204, and telegraph line 1203 to operate facsimile recorder 1201 at subscriber's station B. The facsimile signals, in reaching the recorder 1201, traverse the relay 1202 and this relay is preferably slow to release in order that the contact 1209 shall not be opened and closed corresponding to the facsimile signals to interrupt the circuit of motor 1207.

When the subscriber at station A has completed the transmission of his message, it is only necessary for him to open key 216. This opens the circuit of the upper winding of relay 218 which is the signaling circuit and includes relay 247 and repeater relay 252, all of which become de-energized. The contact tongues of relay 218 are, therefore, attracted due to the relay's becoming unbalanced and although the attraction of contact tongue 223 has no immediate effect, since the circuit of relay 224 is interrupted at contact tongue 226 of relay 221, the attraction of the other contact 225 results in the de-energization of relay 262 whereby lamp 279 is connected to the source of interrupted current 281 and flashes until plug 232 is removed from jack 206. The operator should also remove plug 291 from jack 1206, whereupon all of the relays in the supervisory circuit will become de-energized.

However, if at any time before the subscriber A releases key 216, the subscriber at station B desires to transmit a reply he will close his key 1216, thus completing the permutation code communication circuit from his station through the upper winding of relay 1218, which will become neutralized and will release its contact tongues 1223 and 1225, completing the circuit of relay 302 to cause it to attract its contact tongue 308 and switch lamp 309 from condition of intermit-

tent illumination to condition of steady illumination. This will indicate to the operator at the central station that plug 291 should not be removed from jack 1336 but that the connection to subscriber's station B should be maintained to permit the subscriber to transmit a reply to subscriber's station A. It is to be noted that with the plugs 232 and 291 in service in the jacks as hereinbefore identified, the closure of keys 215 and 1215 will result in the disconnection of the local ground from the windings of repeater relays 252 and 254, respectively, due to the energization of the relays 232 and 392, respectively, and extension of the circuit to the respective subscribers. Since the subscriber's station B is identical with subscriber's station A, the station B may initiate communication with station A in the same manner that station A initiates communication with station B, as previously described. In this case the operator at the central station will answer the call of station B by inserting plug 232 into jack 1236 and by operating key 255 to place transmitter 248 and receiving magnet 249 in communication station B and will complete the call by inserting plug 291 into jack 256. Provision is made within the contemplation of the invention for the initiation of communication by station A or B with subscribers whose stations include permutation code apparatus only, and such stations may initiate communication with the station A or B.

At the extreme right-hand of Fig. 7 is shown a jack 331 which is included in the section of the central office previously described and which has its outer plug ring contact spring 332 connected by an office trunk 333 to the plug tip contact spring 334 of a three-circuit jack 336. The inner plug ring contact spring 337 of jack 331 is connected to ground and the bushing 338 of jack 331 is connected to one end of the winding of a relay 342, the other end of which is connected to ground.

The contact tongue 341 which is operated by relay 339 is engageable with a front contact which is connected to ground and is connected by conductor 342 to a lamp 343 associated with jack 336 in the section of the central office which handles the switching of permutation code telegraph messages only and is shown in Fig. 8. The plug tip contact spring 344 of jack 331 is left unconnected because there is no occasion to transmit facsimile signals into the section of the central office which handles permutation code messages only.

Upon the insertion of plug 291 into jack 331 the permutation code signaling conductor 294 is extended through jack spring 332 and office trunk 333 to spring 334 of jack 336. The circuit of relay 392 is extended through jack spring 337 to ground to cause relays 392 and 396 to become energized, the former to disconnect the local ground from permutation code signaling conductor 296 and the latter to prepare its own holding circuit and also the circuit for supplying interrupted current to lamp 369. As a result of the engagement of plug sleeve 321 with jack bushing 338 the relay 339 is energized in series with the relay 346, the former to complete the circuit for lamp 343 associated with jack 336 in the permutation code message switching section of the central office and the latter to complete the holding circuit for the relay 396.

When lamp 343 becomes illuminated the operator in charge of the section of the central office, shown in Fig. 8, inserts plug 351 into jack 336 preparatory to answering the call indicated by lamp 343 for the purpose of completing the communication channel. Plug 351 is a three-circuit plug having tip 352, ring 353, and sleeve 354.

In addition to the plug tip contact spring 334, jack 336 is provided with ring contact spring 346 and bushing 347. Spring 346 is connected to ground and sleeve 347 is connected to one end of the winding of a lamp controlling relay 356, the other end of which is connected to ground. The contact tongue 357 associated with relay 356 is engageable with a grounded front contact and is connected by conductor 358 to one of the terminals of a lamp 359 associated with jack 331. The other terminal of the lamp is connected to a grounded battery 361.

The tip 352 of plug 351 is connected through an operator's set 361, which may be identical with the operator's set in Fig. 7 which, as previously described, consists of transmitter 248 and receiving printer 249 controlled by key 255, to one of the relays 362 of a telegraph repeater 363 and through the relay 362 and the contact tongue 364 of relay 366 to ground. The plug tip 352 is also connected by conductor 367 to the back contact of a relay 368. The left-hand contact tongue 369, which is engageable with the back contact, is connected to a grounded battery 371. The winding of relay 368 has one end connected to battery 372 and the other end connected to sleeve 354 of plug 351 in the same manner that the winding of relay 316 is connected to sleeve 321 of plug 291. The purpose of relay 368 is to disconnect from the operator's set 361 and from the relay 362 of repeater 363 the local battery 371 which holds the operator's receiving printer and repeater relay 362 energized when plug 351 is not in active service in a jack. The relay 368 also prepares a locking circuit for a double wound relay, as will presently appear.

The ring 353 of plug 351 is connected to one end of the winding of a relay 373, the other end of which is connected to grounded battery 374. The contact tongue 376 is connected to one terminal of a lamp 378, the other terminal of which is connected to grounded battery 379. The front contact with which contact tongue 376 is engageable is connected to ground and the back contact is connected to one of the front contacts of a double wound relay 381 which has been previously mentioned. When relay 373 is energized, which condition obtains as long as plug 351 remains inserted in jack 336 whereby plug ring 353 engages grounded jack spring 346, contact tongue 376 will engage the grounded front contact to complete the circuit of lamp 378 whereby the lamp will be steadily illuminated. The front contact with which contact tongue 377 is engageable is also connected to plug ring 353 and receives ground connection when the plug is inserted into jack 376. Contact tongue 377 is connected to one end of the operating winding of relay 381, the other end of which is connected to grounded battery 382. Thus, when relay 373 is energized, relay 381 is energized in parallel with it.

The relay 381 is provided with two contact tongues identified by the reference numerals 383 and 384. Contact tongue 383 is connected to a front contact of relay 368 which is engageable by a contact tongue 386. The contact tongue 386 is connected through a normally closed key 387 to ground.

The front contact with which contact tongue 383 of relay 381 is engageable is connected to one

end of the holding winding of relay 381, the other end of which is connected to battery 382. The contact tongue 384 of relay 381 is connected to a source of intermittent current 388.

From the foregoing paragraphs it will be seen that the supervisory circuits contained in the section of the central office, which handles the switching of the permutation code messages only, are similar to the supervisory circuits in the previously described portions of the central office.

Since the circuits for the relays 373, 368, and 381 are completed at the contacts of jack 336 and plug 351, all of the relays become energized upon insertion of the plug into the jack and become de-energized upon withdrawal of the plug from the jack. The holding circuit of relay 381 may be interrupted by the opening of the manually operable key 387 but this will have no effect upon the relay 381 and it will remain energized through its operating winding, since when the relay 368 is energized so that the holding circuit of relay 381 is completed through the contact tongue 386, the relays 373 and 381 are also energized, the latter through its operating winding. Also, it is not possible for the source of interrupted current 388 to be connected to lamp 378 when plug 351 is inserted into jack 336. The circuit conditions necessary for lamp 378 to be operated from source of interrupted current 388 are that relay 381 be energized through its holding circuit and relay 373 be de-energized to permit its contact tongue 376 to engage the back contact. When plug 351 is used in establishing connection between two subscriber stations having permutation code apparatus only, the relays 368, 373, and 381 and the lamp 378 are operable differently, as will be described later.

The permutation code communication circuit and the opposite side of repeater 363 from that to which operator's set 361 is connected extends from ground through the contact tongue 391 of relay 362 and through the winding of relay 366 to the tip 392 of a plug 393. Associated with the plug 393 is a supervisory system that is identical with the supervisory system associated with the plug 351. It includes a relay 394 connected to the ring 396 of plug 394 and arranged like the relay 373 to control the continuous or intermittent illumination of a lamp 397 and the energization of a double wound relay 398. The relay 398 is energizable in parallel with the relay 394 and like the relay 381 is arranged to prepare a circuit from source of intermittent current 399 to lamp 397. The relay 398 also completes its own holding circuit which is prepared by a relay 401, the circuit of which extends from the sleeve of plug 393. The relay 401 also has a contact tongue which normally engages a back contact to connect battery to plug tip 392 and thus to the winding of repeater relay 366 to hold the repeater relay energized when plug 393 is not in use.

Plug 393 is adapted to co-operate with the subscriber's jack 411 by which connection may be made to a subscriber's station, such as the station C. Between the subscriber's jack 411 and the subscriber's station C, certain supervisory circuits are needed which will now be described.

Plug tip contact spring 412 of the jack 411 is connected to the front contact of a relay 413 which corresponds to the relay 221 of Fig. 7. The relay 413 has one end of its winding connected to ground and the other end of the winding connected to the jack bushing 414 so that when plug 393 is inserted into jack 411, relay 413 becomes energized in series with relay 401. Contact tongue 416 of relay 413 normally engages the back contact which is connected to grounded battery 417. Contact tongue 416 of relay 413 is connected to one terminal of one of the windings of the differential relay 418, the other terminal of which is connected to conductor 419 which is one of a pair of conductors forming a metallic circuit for communication between subscriber's station C and the central office at the station C the conductor 419 is connected to one of the stationary contacts 421 of a key 422 which is open when station C is idle.

The other winding of differential relay 418 has one end connected to grounded battery 423. The other end of the second winding of differential relay 418 is connected to a front contact of relay 413 with which contact tongue 424 co-operates. Contact tongue 424 is connected to a conductor 426 which is the other one of the pair forming the communication circuit between subscriber's station C and the central office. At the subscriber's end of conductor 426 the conductor is connected to one end of the winding of the receiving selector magnet 427 of a receiving printer. The other end of the winding of magnet 427 is connected through transmitter 428 to a movable contact member 429 of key 422. When subscriber's station C is idle, movable contact 429 of key 422 engages a fixed contact 431 which is connected to ground.

The back contact with which contact tongue 424 of relay 413 co-operates is connected to ground so that when relay 413 is de-energized and key 422 is open, the conductive path comprising contact tongue 424, line conductor 426, receiving selector magnet 427, transmitter 428, and movable contact 429 of key 422 is grounded at both ends.

Relay 413 is also provided with a contact tongue 432 which co-operates with a back contact only. The back contact is connected to grounded battery 433. Contact tongue 432 is connected to one end of the winding of relay 434, the other end of which is connected to jack spring 436 of jack 411 and is also connected to a single front contact associated with differential relay 418. The single contact tongue 435 controlled by differential relay 418 is connected to ground.

Relay 434 has a single contact tongue 437 and front contact which is engaged by the contact tongue. Contact tongue 437 is connected to ground. The front contact with which contact tongue 437 co-operates is connected to one terminal of a lamp 438, the other terminal of which is connected to grounded battery 439.

The operation of the subscriber's stations A and B and of the central office equipment has been described up to the point where repeater 363 and operator's set 361 have been placed in condition to receive permutation code signals from the operator's set comprising transmitter 248 in Fig. 7 or from the subscriber's transmitter stations A or B, this being accomplished by insertion of plug 351 into jack 336. Upon communication to the operator's set 361 of the identity of the permutation code station with which station A or B desires to communicate and, it being assumed that such station is the subscriber's station C, the operator inserts plug 393 into jack 411. Plug tip 392 engages jack spring 412 and extends the communication circuit to the front contact with which contact tongue 416 of relay 413 co-operates. Plug sleeve 402 engages jack bushing 414 and places relay 413 in series with relay 401, whereupon both relays become energized. Relay 401 removes local battery from plug tip 392 and prepares locking circuit for double wound relay 398.

Relay 413 moves its contact tongue 416 into engagement with its fixed contact, thus extending the communication circuit through one of the windings of differential relay 418 and through conductor 419 to the open key 429. The relay 413 also attracts its contact tongues 424 and 432. The contact tongue 424 completes a circuit from ground through battery 423, the upper winding of differential relay 418, front contact and contact tongue 424, line conductor 426, receiving selector magnet 427, and transmitter 428 at the subscriber's station C to ground through the key 422. Thus, a circuit is completed through the upper winding of relay 418 and through the selector magnet 427 at subscriber's station C.

Since the relay 418 is a differential relay, and only one of its windings is now energized, the contact tongue 435 will be attracted to connect ground to one end of the winding of relay 434 and also to the plug sleeve contact spring 436 of jack 411. Since the circuit from battery 433 to the other end of the winding of relay 434 is open at this time due to the fact that contact tongue 432 of relay 413 is attracted out of engagement with its back contact, relay 434 will not become energized and the lamp 438 will not become illuminated.

With the connection of ground to jack spring 436 through the contact tongue 435, the circuit of relay 394 is completed and relay 394 attracts its contact tongues, thus completing the energizing circuit for the double wound relay 398 which becomes energized and completes its holding circuit. The relay 394 also connects lamp 397 to ground so that the lamp becomes continuously illuminated.

The subscriber's station C is provided with a ringer 441 connected across the normally open key 422 and having in series therewith a condenser 442 so that the ringer will be responsive to alternating current only. Well-known means may be provided at the central office for applying alternating current between the line conductors 419 and 426 for operating ringer 441 to attract the attention of the subscriber at station C so that he may place his printing telegraph apparatus in operating condition to receive a message. The subscriber does this by closing the key 422. Movable contact 429 is thus disengaged from grounded fixed contact 431 and is engaged with contact 421. Also, a movable contact 443 completes the circuit of motor 444 which is set in operation to drive the receiving printer represented by the selector magnet 427 and the transmitter mechanism 428.

As the result of closure of the key 429, a communication circuit is completed from battery 423 through the upper winding of relay 418, contact tongue 424, line conductor 426, receiving selector magnet 427, transmitter 428, movable contact 429 and fixed contact 421 of key 422, line conductor 419, lower winding of relay 418, contact tongue 416, spring 412 of jack 411, tip 392 of plug 393, winding of relay 366 of repeater 363, and contact tongue 391 of relay 362 to ground. It will be observed that the communication circuit includes both windings of the relay 418. Since this is a differential relay, it will release its contact tongue 435 and the tongue will remain released as long as key 422 is closed and plug 393 is in the jack 411, regardless of changes in the line from marking to spacing or spacing to marking condition.

The release of contact tongue 435 results in the removal of ground connection from relay 434 and relays 394 and 398, the latter remaining energized due to its holding winding. The release of the contact tongues of relay 394 will result in connection of the source of interrupted current 399 to lamp 397 through the attracted contact tongue of relay 398 and the released right-hand contact tongue of relay 394. This will indicate to the operator at the permutation code switching portion of the central office, shown in Fig. 8, that station C is in condition to receive a message. The operator thereupon notifies the subscriber at station A by operation of the operator's receiving and transmitting set 361 that he may proceed with the transmission of the message. The message will traverse the repeater in Fig. 7 and the repeater 363 in Fig. 8 in reaching the subscriber's station C and will be transmitted back to subscriber's station A for home record purposes as a facsimile message, conversion taking place in the translator 270.

When the subscriber at station A has completed the transmission of the message, he opens his key 216 and as previously described, lamp 229 becomes illuminated due to removal of energizing current from one of the windings of differential relay 216. Thereupon, the operator at the combined permutation and code facsimile switching portion of the central office withdraws the plugs 232 and 291. The withdrawal of plug 291 results in de-energization of relay 339 and extinguishment of lamp 343 associated with jack 336. Thereupon, the operator at the permutation code switching portion of the central office, which is that shown in Fig. 8, withdraws the plugs 351 and 393 from the jacks 336 and 411, respectively. The circuit of the relays 363 and 491 are thus interrupted and these relays release the holding circuits of the double wound relays 331 and 398, respectively. Also the circuit of relay 373 is interrupted due to the withdrawal of plug 351. The circuits of lamps 397 and 378 are thus interrupted and the lamps are extinguished.

The withdrawal of plug 393 from jack 411 opens the circuit of relay 413 which releases its contact tongues 416, 424, and 432. The contact tongue 416 upon release moves into connection with the battery 417 and the contact tongue 424 moves out of connection with the upper winding of differential relay 418, and into connection with ground. Thus, a circuit is completed from battery 417 through contact tongue 416, lower winding of relay 418, line conductor 419, closed key 422, transmitter 428, receiving selector magnet 427, line conductor 426, and contact tongue 424 of relay 413 to ground. The lower winding of relay 418 is thus energized and since the circuit of the upper winding is interrupted at the contact tongue 424, the relay will attract its contact tongue 435 to connect ground to one end of the relay 434. The other end of the winding of relay 434 will be connected to battery 433 due to the release of the contact tongue 432 by relay 413. Thus, the relay 434 will become energized and will connect ground to its contact tongue 437 to the lamp 438, thus completing the circuit of the lamp which will become illuminated. This will indicate to the operator at the portion of the central office, shown in Fig. 8, that the subscriber at station C has not yet opened his key 422. If the lamp 438 does not become extinguished within a reasonable time, the operator may reinsert plug 393 into jack 411 and inquire as to whether the subscriber at station C desires to transmit a message. However, should the subscriber at station C open the key 422 promptly upon the

termination of the received message, the lower winding of relay 418 will become de-energized, the contact tongue 435 will be released, thus interrupting the circuit of relay 434 which will release its contact tongue 437 and extinguish lamp 438.

It may happen that during reception of a message at station C the subscriber may wish to interrupt the message being transmitted to him, such as to enable him to transmit a question or comment concerning the message, or a reply to a question contained therein. Also, he may desire to interrupt the message in order to transmit a message to another station which will necessitate the changing of connections at the central office to connect station C with the desired other station which may, for example, be the station D.

The interruption of message reception at station C may be accomplished by momentary opening of key 422. Fixed contact 421 and the lower winding of differential relay 418 is thus disconnected from movable contact 429 and the grounded fixed contact 431 is contacted by the movable contact 429, thus causing the upper winding only of the relay 418 to be energized and to attract contact tongue 435. Ground is thus connected through jack spring 436 and plug ring 396 to relay 394 which becomes energized and attracts its right-hand contact tongue out of engagement with the contact to which the source of interrupted current 399 is connected and into engagement with a grounded contact, thus changing lamp 397 from intermittent illumination to momentary steady illumination. This indicates to the operator at the central office that key 422 has been opened whereupon the operator actuates set 361 to make injuiry of the subscriber at station C as to the reason for his interruption of the transmission or the identity of the station with which he desires to communicate.

For purposes of illustration, it is convenient to assume that the subscriber at station C desires to communicate with station D. The operator at the central office completes the connection by removing plug 351 from jack 336 and inserting it into jack 1411. This causes relays 368, 373, and 381 at the central office to be energized in the same manner that relays 394, 398, and 401 were energized when plug 393 was inserted into jack 411, and causes relays 1413 and the upper winding of relay 1418 to be energized. The operator then applies ringing current between the line conductors 1419 and 1426 to operate ringer 1441 for the purpose of notifying the subscriber at station D to close his key 1422. Upon the closure of the key 1422 relay 1418 releases its contact tongue 1435 due to the placing of its two windings in series and relay 373 is released to cause its contact tongue 376 to move into its engagement with its back contact, whereby lamp 378 is connected to the source of interrupted current 388 and will flash for the duration of the transmission between stations C and D. From this it will be observed that the source of interrupted current 388 which does not become effective at any time during communication between one of the combined stations, such as A or B, with one of the permutation code stations C or D, does become effective during communication between two permutation code stations, such as the stations C and D.

It is also possible for a permutation code station, such as the station D, to initiate communication with one of the combined stations, such as the station B. The subscriber at station D closes the key 1422 which completes the circuit of the motor 1444 and also completes a circuit from the battery 1417 through the lower contact tongue of relay 1413, through the lower winding of relay 1418, conductor 1419, key 1422, transmitter 1423, receiving selector magnet 1427, line conductor 1426, and innermost upper contact tongue of relay 1413 to ground. Differential relay 1418 having only one of its windings energized attracts its contact tongue 1435 to complete the circuit of relay 1434 whereby lamp 1438 is illuminated. The lamp 1438 serves as a signal to the operator to answer the station D by inserting either the plug 351 or the plug 393 into jack 1411, the two plugs having identical supervisory circuits associated therewith. It will be assumed that the operator answers with the plug 393. Relays 394, 398, and 401 are energized, as is also relay 1413, whereupon the lamp controlling relay 1434 is released and relay 394 is released to cause lamp 397 to be illuminated intermittently. When the operator has ascertained from the subscriber at station D the identity of the station with which he wishes to communicate, which will be assumed to be station B, plug 351 is inserted into jack 336, thus causing the supervisory relays 376, 368, and 381 to become energized and also the relay 366 whereby lamp 359 is steadily illuminated.

The lamp 359 serves as a signal to the operator who has the receiver 249 to answer the call available at jack 331. This is accomplished by inserting plug 232 into jack 331, whereupon the supervisory relays 262, 273, and 243, associated with plug 232, operate and the operator's receiving printer, represented by the magnet 249, and the transmitter 248 are connected to the permutation code communication circuit which has been extended to plug 291. The operator at the central office of Fig. 7, upon being informed that the subscriber at station B is the called subscriber, inserts plug 291 into jack 1206. The supervisory circuits associated with the plug 291 respond to the insertion of the plug into jack 1206 and the supervisory circuits associated with the jack respond in the same manner as previously described for transmission of a message from station A to station B. The permutation code signals repeated by the repeater in Fig. 7 from the signal transmitted from station D will terminate at the ground engaged by contact tongue 319 of relay 302, due to the fact that relay 302 does not remain energized because the contact tongue 1225 of differential relay 1218 at station B will be out of engagement with its back contact as a result of the energization of the lower winding only of relay 1218. Should the subscriber at station B close his key 1216, which he has no occasion to do unless he desires to break in on the message being transmitted to him, the relay 1218 will release its contact tongue and ground connection will be extended to the relay 302 to cause it to be energized, thus attracting its contact tongue 319 and disconnecting ground from the permutation code signaling circuit at that point, the terminal of the circuit then being the ground at the transmitter 1212 of subscriber's station B. Since there is no apparatus at the station B responsive to permutation code signals, those signals will have no effect at that point. Facsimile signals for actuating the facsimile recorder 1201 will be generated in the photoelectric cell

286 of the translator and will be impressed upon the conductor 283 and the plug tip 292 from which point they will traverse the jack spring 1204, telegraph line 1203, and relay 1202 terminating at the facsimile recorder 1201. The energization of relay 1202 will cause the motor circuit to close and remain closed, thus causing the motor 1207 to be actuated for driving the facsimile recorder 1201.

When the subscriber at station D concludes the transmission of the message, he opens the key 1422. This opens the circuit of one of the windings of the relay 1418 which thus becomes unbalanced and attracts its contact tongue 1435, connecting ground through jack 1411 to the winding of relay 394 which becomes energized and attracts its right-hand contact spring into engagement with the grounded front contact, thus causing lamp 397 to be illuminated steadily. Thereupon, the operator withdraws plug 393 from jack 411 and withdraws plug 351 from jack 336. All of the supervisory relays associated with jack 1411, with plug 393, with plug 351, and with jack 336 become de-energized, whereupon lamp 359 will be extinguished. This is the signal to the operator at that portion of the central office, shown in Fig. 7, to withdraw plug 232 from jack 331 and to withdraw plug 291 from jack 1206. Upon the withdrawal of the plugs, all of the supervisory circuits, namely, those associated with the plug 291, the plug 232, and the jack 1206, return to normal.

Referring to Fig. 9, which shows a complete communication system that might be used in an industrial organization or hotel between the various departments thereof, or in a police intercommunication and broadcast system involving fixed and mobile stations, the reference numeral 561 designates a keyboard transmitter at each of the fixed stations E, F, and G. Keyboard transmitter 561 may be of very simple form, such as the one disclosed in Patent 1,135,613 granted April 13, 1915, to L. M. Potts, having no transmitting distributor, but having merely transmitting contacts to be closed substantially simultaneously in permutational code combinations under control of a keyboard mechanism. The keyboard is provided with a lock lever 562 controlled by a magnet 563 for locking the keyboard when a key lever has been depressed. The transmitting contacts are connected to conductors contained in a cable 564. The cable terminates in a central office H where the transmitting contact conductors of all of the cables 564 are connected to bus bars or other common conductors 566.

The common conductors 566 are connected to the individual selector magnets 567 of a translator mechanism which may be similar to or identical with that shown in Figs. 1 to 3, the magnets 567 corresponding to the magnets 67 of Figs. 1 to 3. The armatures 568 of the magnets 567 are arranged to operate the slides 569 which control the shutter slides 571 and also effect tripping of a clutch, such as that shown in Figs. 1 and 3, to impart rotation to the scanning drum. Through the rotation of the scanning drum, signals are generated in photoelectric cell 572, which signals are amplified by amplifier 573 and are transmitted by radio transmitter 574.

The facsimile translator shown in Fig. 9 is provided with a pair of normally open contacts 576 that are closable by a cam operated lever 577. Lever 577 may be operated by a cam (not shown) driven along with the scanning cylinder and arranged to close the contacts at the beginning of rotation and to permit them to open near the end of the cycle. One of the contacts is connected to battery and the other is connected to a seventh conductor contained in each of the cables 564. At the stations E, F, and G, the seventh conductors are individually connected to the keyboard lock controlling magnets 563.

Each of the stations E, F, and G is provided with a radio receiver 578 for receiving facsimile telegraph signals transmitted by the transmitter 574, and the output of the radio receiver is connected to the signal responsive magnet 579 of a facsimile printer 581 for recording facsimile messages received by the radio receiver 578. There may also be stations, such as the station J, from which there is no occasion to transmit messages, which are provided only with a radio receiver 578 and a facsimile recorder 581. The station J may, for example, be a police motor vehicle equipped only for one-way communication, as is a common custom; namely, for the reception of information or instructions.

In the system shown in Fig. 9, message transmission from any of the stations E, F, or G may be effected by depressing the keys to control the permutative closure of contacts 561. Upon the depression of any key, certain of the contacts 561 at that station will be closed to complete the circuits of corresponding ones of the magnets 567. This will result, as disclosed in Figs. 1 to 3, in the generation of facsimile signals at the photoelectric cell which will be amplified at 573 and broadcast by transmitter 574. At the beginning of the generation of the facsimile signal, contacts 576 are closed, thus completing the circuits of magnets 563 at all of the stations E, F, and G, whereby the magnets become energized and the locks 562 are operated to lock all of the keyboards.

As the facsimile signal corresponding to the permutation code is transmitted by radio transmitter 574, it is received by the radio receivers 578 at stations E, F, G, and J and is recorded on the facsimile printers 581. Toward the end of the facsimile signal contacts 576 are opened and the magnets 563 are released, whereby locks 562 are disabled and a key may be depressed at any of the keyboards. By providing for the locking of all of the keyboards, one keyboard may not be operated to interfere with the registering, upon magnets 567, of a code combination initiated at another keyboard.

Another communication system employing apparatus according to the present invention is shown in Fig. 10. Referring to that figure, the reference numeral 601 designates a keyboard transmitter which may be of the type shown in Patent No. 1,595,472 granted August 10, 1926, to H. L. Krum, and which may be considered the equivalent of the transmitters shown in Figs. 7 and 8 having transmitting contacts 602 connected to ground and to a communication conductor 603. The keyboard transmitter 601, and a facsimile recorder 604 which may be similar to the facsimile recorders 201 and 1201, shown in Fig. 7, make up a subscriber's station, such as the station K. The facsimile recorder 604 is connected to one end of a communication conductor 607.

Other subscribers' stations L and M are similarly provided with keyboard transmitters 601 and facsimile recorders 604.

Each of the conductors 603 is connected to one

terminal of an individual line relay 608 at a central office station N and the other terminal of the winding of each relay 608 is connected to battery 609. A series circuit beginning at ground at the central office station N includes the line relay contacts 611 of the line relays 608, and the selector magnet 612 of a signal translator 613 which may be similar to that shown in Figs. 4 to 6, inclusive, the series circuit then extending from the selector magnet 612 to battery 609. The photoelectric cell 614 corresponds to the cell 32 in Fig. 4 and generates facsimile signals corresponding to permutation code signals impressed upon the selector magnet 612. The facsimile signals generated in the cell 614 are amplified in amplifier 615 and are applied to the communication conductors 607 over which they are transmitted to the facsimile recorders 604 at the stations K, L, and M.

Upon the operation of any one of the keyboard transmitters at stations K, L, and M, its transmitting contacts 602 are operated in accordance with permutation code combinations, and the signals are repeated by the line relays 608 to control correspondingly the circuit of the selector magnet 612 of the translator 613. The facsimile signals are generated at 614 and are transmitted over the conductors 607 to the station which originated the message to provide a home record and also to all of the other stations connected to central office station N. Thus, any one of the stations K, L, and M may communicate with each of the other stations in the system. As distinguished from the communication system shown in Fig. 9, the system shown in Fig. 10 involves metallic conductors throughout for interconnecting the several stations and is particularly applicable to industrial installations, hotels, and other business organizations where it is desirable to provide intercommunication between several locations with the recording of all transmitted material at all stations.

Although certain specific embodiments of the invention have been shown and described herein, it is to be understood that the invention is not limited to such specific embodiments but is capable of modification and rearrangement without departing from the spirit of the invention and within the scope of the appended claims.

What is claimed is:

1. In a telegraph apparatus, a permutation code signal receiving mechanism, permutation members positionable by said signal receiving mechanism, permutationally apertured slides individually controlled by said permutation members, a source of light and a photoelectric cell associated with said slides, a rotatable cylinder associated with said slides, said source of light and said photoelectric cell, said cylinder having circumferential rows of apertures arranged according to a facsimile signaling code, means for rotating said cylinder, and means operated by said signal receiving mechanism for controlling the connection of said cylinder to said rotating means.

2. In a telegraph apparatus, a permutation code signal receiving mechanism, permutationally apertured slides positionable by said signal receiving mechanism, a source of light and a photoelectric cell associated with said slides, a rotatable cylinder associated with said slides, said source of light and said photoelectric cell, said cylinder having circumferential rows of apertures arranged according to a facsimile signaling code, means for rotating said cylinder, and means operated by said signal receiving mechanism for controlling the connection of said cylinder to said rotating means.

3. In a telegraph apparatus, a code signal receiving mechanism, signal responsive members positionable by said signal receiving mechanism, apertured slide members individually controlled by said signal responsive members, a source of light and a photoelectric cell associated with said slides, a rotatable cylinder associated with said slides, said source of light and said photoelectric cell, said cylinder having circumferential rows of apertures arranged according to a facsimile signaling code, means for rotating said cylinder, and means operated by said signal receiving mechanism for controlling the connection of said cylinder to said rotating means.

4. In a telegraph apparatus, a code signal receiving mechanism, signal responsive members positionable by said signal receiving mechanism, light shutter members individually controlled by said signal responsive members, a source of light and a photoelectric cell associated with said light shutter members, a rotatable cylinder associated with said light shutter members, said source of light and said photoelectric cell, said cylinder having circumferential rows of apertures arranged according to a facsimile signaling code, means for rotating said cylinder, and means operated by said signal receiving mechanism for controlling the connection of said cylinder to said rotating means.

5. In a telegraph apparatus, a code signal receiving mechanism, signal responsive members positionable by said signal receiving mechanism, light shutter members individually controlled by said signal responsive members, a source of light and a light sensitive impulse generator associated with said light shutter members, a rotatable cylinder associated with said light shutter members, said source of light and said light sensitive impulse generator, said cylinder having circumferential rows of apertures arranged according to a facsimile signaling code, means for rotating said cylinder, and means operated by said signal receiving mechanism for controlling the connection of said cylinder to said rotating means.

6. In a telegraph apparatus, a code signal receiving mechanism, signal responsive members positionable by said signal receiving mechanism, light shutter members individually controlled by said signal responsive members, a source of light and a light sensitive impulse generator associated with said light shutter members, a rotatable scanning member associated with said light shutter members, said source of light and said light sensitive impulse generator, means for rotating said scanning member, and means operated by said signal receiving mechanism for controlling the connection of said scanning member to said rotating means.

7. In a telegraph apparatus, a plurality of signal responsive electromagnets, a light shutter member individual to and operable by each of said electromagnets, said light shutter members being apertured to establish various single light paths according to the energization of said electromagnets, a rotatable member having signal combinations of light blocking and transmitting areas in registry with the light path positions, a source of light and a light sensitive impulse generator associated with said light shutter members and said rotatable member, means for driving said rotatable member, and means actuated by any of said electromagnets upon the energi-

zation thereof for connecting said rotatable member to said driving means.

8. In a telegraph apparatus, a plurality of signal responsive electromagnets, light shutter means selectively operable according to the energization of said electromagnets for establishing various single light paths, a rotatable member having signal combinations of light blocking and transmitting areas in registry with the light path positions, a source of light and a light sensitive impulse generator associated with said light shutter means and said rotatable member, means for driving said rotatable member, and means actuated by any of said electromagnets upon the energization thereof for connecting said rotatable member to said driving means.

9. In a telegraph apparatus, a plurality of signal responsive electromagnets, light shutter means selectively operable according to the energization of said electromagnets for establishing various single light paths, cyclically operable scanning means having signal combinations of light blocking and transmitting areas in registry with the light path positions, a source of light and a light sensitive impulse generator associated with said light shutter means and said scanning means, means for driving said scanning means, and means actuated by any of said electromagnets upon the energization thereof for connecting said scanning means to said driving means.

10. In a telegraph apparatus, a plurality of signal responsive electromagnets, shutter means selectively operable according to the energization of said electromagnets for establishing various single radiant energy paths, cyclically operable scanning means having signal combinations of radiant energy blocking and transmitting areas in registry with the radiat energy path positions, a source of radiant energy and a radiant energy responsive impulse generator associated with said shutter means and said scanning means, means for driving said scanning means, and means actuated by any of said electromagnets upon the energization thereof for connecting said scanning means to said driving means.

11. In a telegraph apparatus, a plurality of signal responsive electromagnets, shutter means selectively operable according to the energization of said electromagnets for establishing various single radiant energy paths, cyclically operable scanning means having signal combinations of radiant energy blocking and transmitting areas in registry with the radiant energy path positions, a source of radiant energy and a radiant energy responsive impulse generator associated with said shutter means and said scanning means, means for driving said scanning means, means actuated by any of said electromagnets upon the energization thereof for connecting said scanning means to said driving means, and means operable with said scanning means for locking said shutter means during a scanning operation.

12. In a telegraph apparatus, a start-stop single magnet signal receiving selector mechanism including a set of primary selectors and a system of transfer levers, means for positioning said transfer levers in accordance with the setting of said primary selectors, a set of light shutter members positionable by said transfer levers in correspondence with said selectors, a start-stop scanning member associated with said light shutter member having rows of apertures in arrangements representing signal combinations, a source of light and a photoelectric cell associated with said light shutter members and said scanning member, means for driving said scanning member, means for connecting said scanning member to said driving means for the duration of a cycle of said scanning member, and means controlled by said selector mechanism for activating said connecting means.

13. In a telegraph apparatus, a single magnet signal receiving selector mechanism including a set of selectors, means for positioning said selectors in accordance with received signals, a set of light shutter members positionable by said selectors and in correspondence with said selectors, a scanning member associated with said light shutter members having rows of apertures in arrangements representing signal combinations, a source of light and a photoelectric cell associated with said light shutter members and said scanning member, means for driving said scanning member, means for connecting said scanning member to said driving means, and means controlled by said selector mechanism for activating said connecting means.

14. In a telegraph apparatus, a single magnet permutation code signal receiving selector mechanism including a set of selectors, means for positioning said selectors in accordance with received signals, a set of light shutter members positionable permutationally in correspondence with said selectors, a scanning member associated with said light shutter members having rows of apertures in arrangements representing facsimile signal combinations, a source of light and a photoelectric cell associated with said light shutter members and said scanning member, means for driving said scanning member, means for connecting said scanning member to said driving means, and means controlled by said selector mechanism for activating said connecting means.

15. In a telegraph apparatus, a single magnet signal receiving selector mechanism including a set of selectors, means for positioning said selectors in accordance with received signals, light shutter members operable under the control of said selectors, an optical scanning mechanism associated with said light shutter members for generating facsimile signals according to the locations of light paths established by said light shutter members, and means for driving said scanning mechanism.

16. In a telegraph apparatus, a single magnet signal receiving selector mechanism including a set of selectors, means for positioning said selectors in accordance with received signals, light shutter members operable under the control of said selectors, an optical scanning mechanism associated with said light shutter members for generating facsimile signals according to the locations of light paths established by said light shutter members, and means controlled by said selector mechanism for driving said scanning mechanism.

17. In a signal translating mechanism, a single receiving magnet, a start-stop receiving distributor controlled by said magnet, a set of selectors positionable according to permutation code telegraph signals under the joint control of said magnet and said receiving distributor, a plurality of light shutter members individual to and individually controlled by said selectors for establishing pairs of light paths, a light shutter element controlled by all of said selectors jointly for selectively blocking either of the light paths of any pair, a start-stop rotatable scanning member

associated with said shutter members and element having sets of scanning areas representing start-stop facsimile signal combinations, a source of light and a photoelectric cell associated with said shutter members and element and said scanning member, a further light shutter element, and means for rendering said further light shutter element operable concurrently with the first mentioned light shutter element for blocking the light path associated with the start signal area of said scanning member.

18. In a signal translating mechanism, a permutation code signal receiving mechanism, a set of selectors positionable by said signal receiving mechanism according to permutation code telegraph signals, a plurality of light shutter members individual to and individually controlled by said selectors for establishing pairs of light paths, a light shutter element controlled by all of said selectors jointly for selectively blocking either of the light paths of any pair, a start-stop rotatable scanning member associated with said shutter members and element having sets of scanning areas representing start-stop facsimile signal combinations, a source of light and a photoelectric cell associated with said shutter members and element and said scanning member, a further light shutter element, and means for rendering said further light shutter element operable concurrently with the first mentioned light shutter element for blocking the light path associated with the start signal area of said scanning member.

19. In a signal translating mechanism, a permutation code signal receiving mechanism, a set of selectors positionable by said signal receiving mechanism according to permutation code telegraph signals, a plurality of light shutter members individual to and individually controlled by said selectors for establishing pairs of light paths, a light shutter element, means for rendering said element selectable for operation in response to certain permutational settings of said selectors for selectively blocking either of the light paths of any pair, a start-stop rotatable scanning member associated with said shutter members and element having sets of scanning areas representing start-stop facsimile signal combinations, a source of light and a photoelectric cell associated with said shutter members and element and said scanning member, a further light shutter element, means for rendering said further light shutter element operable concurrently with the first mentioned light shutter element for blocking the light path associated with the start signal area of said scanning member.

20. In a signal translating mechanism, a permutation code signal receiving mechanism, a set of selectors positionable by said signal receiving mechanism according to permutation code telegraph signals, a plurality of light shutter members individual to and individually controlled by said selectors for establishing pairs of light paths, a light shutter element, means for rendering said element selectable for operation in response to certain permutational settings of said selectors for selectively blocking either of the light paths of any pair, a rotatable scanning member associated with said shutter members and element having sets of scanning areas representing facsimile signal combinations, and a source of light and a photoelectric cell associated with said shutter members and element and said scanning member.

21. In a signal translating mechanism, a permutation code signal receiving mechanism, a set of selectors positionable by said signal receiving mechanism according to permutation code telegraph signals, a plurality of light shutter members controlled by said selectors for establishing pairs of light paths, a light shutter element, means for rendering said element selectable for operation in response to certain permutational settings of said selectors for selectively blocking either of the light paths of any pair, a scanning member associated with said shutter members and element having sets of scanning areas representing facsimile signal combinations, and a source of light and a photoelectric cell associated with said shutter members and element and said scanning member.

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