April 4, 1939. L. M. POTTS 2,152,772

TRANSLATING REPEATER

Filed Oct. 10, 1936 3 Sheets-Sheet 1

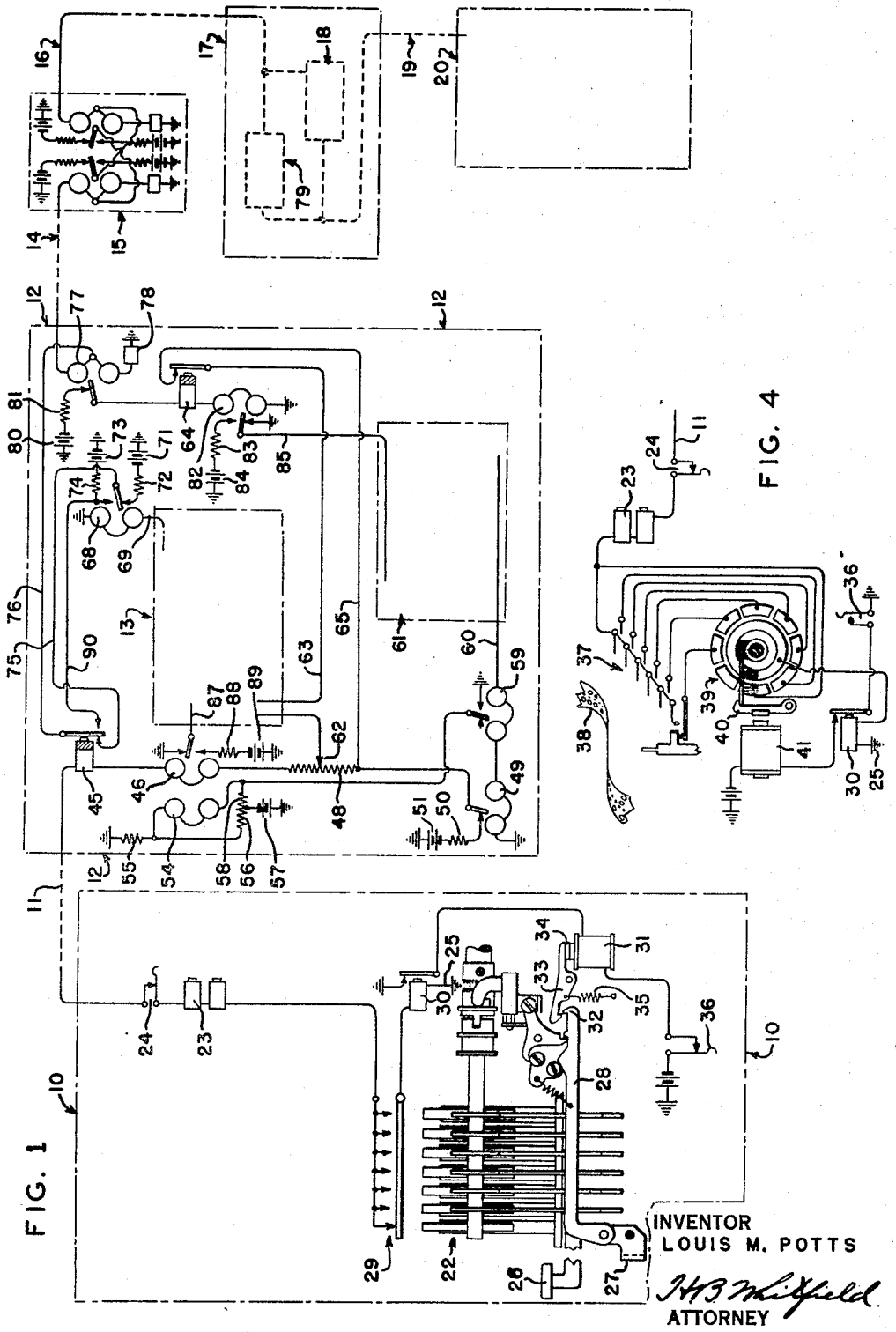


FIG. 1

FIG. 4

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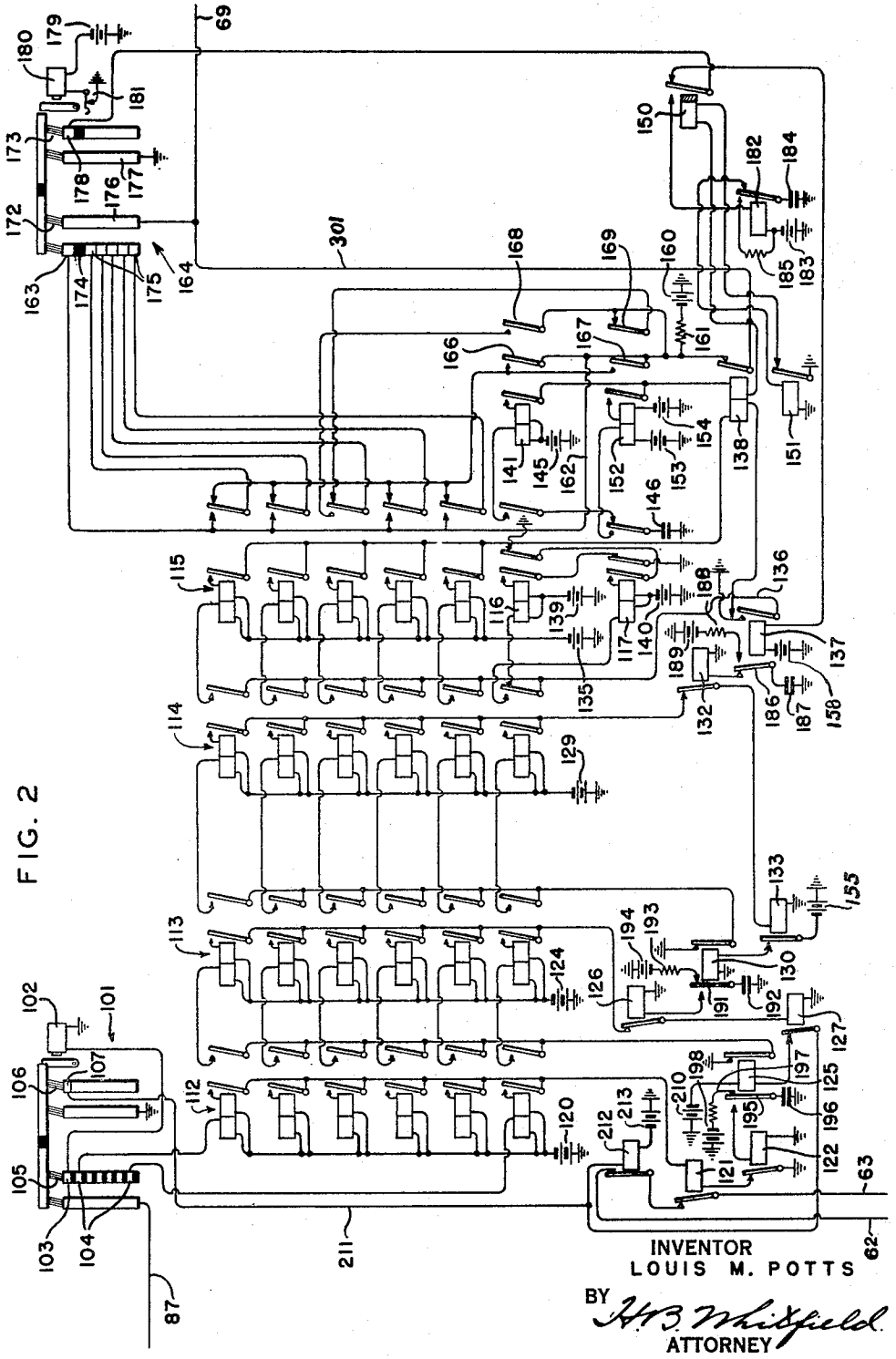


FIG. 2

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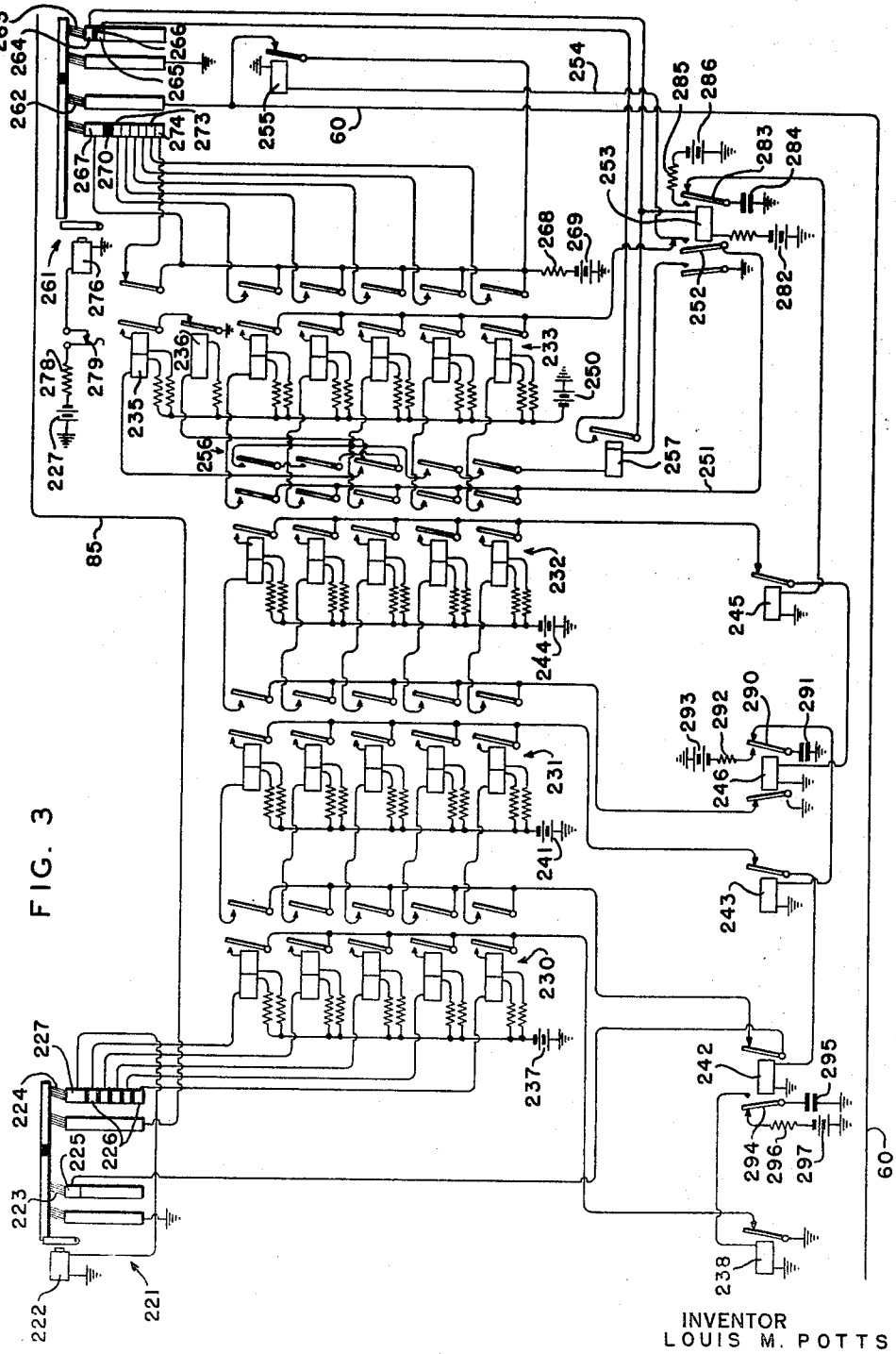


FIG. 3

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2,152,772

TRANSLATING REPEATER

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Application October 10, 1936, Serial No. 104,968

27 Claims. (Cl. 178—2)

This invention pertains to start-stop telegraph systems involving repeating mechanisms in which code signals are repeated from line section to line section, and more particularly to regenerative repeater mechanisms for start-stop telegraph systems in which a start-stop code utilized for communication in one line section is different from the start-stop code used in its associated line section.

In start-stop systems, keyboard transmitters are adapted for the transmission either a five-unit permutation code or a similar six-unit permutation code. Key layouts of six-unit telegraph keyboard transmitters resemble keyboards of standard office typewriters more closely than do keyboards of five-unit telegraph transmitters, and for that reason the six-unit telegraph transmitter may be preferred for service in a telegraph office of low traffic volume and for service in any office where the duties of any person require at times the operation of a telegraph keyboard transmitter and at other times the operation of a typewriter. While six-unit transmission thus will be found preferable in some telegraph offices, five-unit transmission will remain preferable upon telegraph transmission lines because a larger traffic volume can be transmitted over a line by utilization of five-unit transmission in comparison with the utilization of six-unit transmission.

It is the salient object of the present invention to provide means for operating telegraph substations and telegraph lines connecting such substations to central offices, according to one code system, and for operating telegraph trunk lines interconnecting telegraph central offices according to another code system, with automatic transfer of code signals from either system to the other.

A further object is to provide regenerative repeaters embodying translation of code signals from one code system to another code system.

A feature is to provide break-signal means operable independently of the regenerative repeater.

A further feature is to provide a break-signal system operable to effect mechanical stopping of a remote transmitter under control of a key at a receiving station.

A still further feature is to provide a break-signal system operable by control of a key at the receiving station independently of intermediate repeating and translating means.

A further feature is to provide means for locking a transmitter automatically when associated with a receiving device which is not in condition to receive.

The foregoing and other objects are attained, in a repeater for translation from five-unit code system to a six-unit code system, by providing a receiving distributor, a set of relays for registering and accumulating individual impulses into a complete code signal, relay storage means for storing code signals to compensate for the difference in speeds of received and retransmitted code signals, two sets of relays into which code signals are transmitted alternatively in successive code signal cycles and jointly from which a resultant code signal is transmitted in a single code signal cycle, and a distributor for retransmitting the resultant code signal.

In a repeater for translation from six-unit code system to five-unit code system, the objects of the invention are obtained by providing a receiving distributor and a plurality of sets of transferring and storing relays in each set of which two codes of two classes are stored and transferred concurrently, with further provision of a definitive distributor operable first to transmit one of the said stored code signals and then the other of said stored code signals.

For compensation between the speeds of the receiving and retransmitting distributors, when retransmission is slower than reception, means is provided for stopping the operation of the remote controlling transmitter, thereby stopping incoming code signals at the repeater.

For signaling a break condition, slow-operating relays are arranged to by-pass the break signal around the regenerative repeater at the central station.

A better understanding of the invention may be had from the following description, taken in conjunction with the accompanying drawings, wherein,

Fig. 1 illustrates a general circuit arrangement according to the principles of the invention;

Fig. 2 illustrates a device for repeating and translating from six-unit system to five-unit system;

Fig. 3 illustrates a device for repeating and translating from five-unit system to six-unit system, and

Fig. 4 illustrates a modified substation equipment including an automatic tape controlled transmitter.

Description of apparatus

Referring to Fig. 1, a substation 10 is provided with equipment to transmit according to six-

unit code over a line conductor 11 to a central station 12 where a regenerating and translating repeater 13 converts the six-unit code signals into code signals of five-unit code which are transmitted as five-unit code signals over a trunk line 14 through a repeating but non-translating station 15 and over a further trunk line 16 to a further central station 17, and there through a regenerating and translating repeater 18 which converts the five-unit code signals into signals of a six-unit code, the six-unit code signals then being retransmitted over line conductor 19 to a definitive substation 20.

Equipment at substation 10 comprises a manual keyboard telegraph transmitter 22, a recording receiver or printer 23, and a break key 24, connected in series with a line circuit from line conductor 11 to ground 25. The transmitter 22 is illustrated according to the type disclosed in Patent 1,595,472, granted August 10, 1926, to Mr. H. L. Krum in which any manual key 26 engages a universal bar 27 to operate a pull bar 28 to trip a clutch, thereby causing complete transmission of a code signal by operation of contacts 29. Added to the transmitter of this type are marginal relay 30 connected in the line circuit above mentioned, control magnet 31, a tooth 32 integral with bar 28, a pivoted latch lever 33 carrying an armature 34 for magnet 31 and tensioned by a spring 35 to rotate upon its pivot to engage the tooth 32. A substation local circuit includes a battery, a manual key 36, winding of magnet 31, and contacts of relay 30.

An alternative form of transmitter for substation 10 is illustrated in Fig. 4 in which transmitting contacts 37 are controlled by a perforated tape 38 and in which a transmitting distributor 39 driven by a motor (not shown) is controlled by a stop latch 40 operable by a control magnet 41. Other items of equipment for Fig. 4 are the same as in Fig. 1 and are designated by the same numerals.

At the central station 12, the line conductor 11 is completed through winding of slow-to-release break signal relay 45, an operating winding of a polarized code-signal line relay 46, a resistor 48, contacts of a polarized repeating relay 49, a resistor 50, and battery 51 to ground.

The code-signal line relay 46 has a biasing winding 54, one terminal of which is connected through resistor 55 to ground, also through resistor 56 to battery 57, the other terminal being connected through resistor 58 to battery 57, also through contacts of polarized anti-reflection relay 59 to ground in one position of armature of relay 59, the windings of relays 49 and 59 being connected to ground in series with conductor 60 extending from the repeater equipment 61 illustrated in detail in Fig. 3. Resistor 48 has an adjustable contact 62 and is provided with a shunting path including the said contact 62, contacts of relays in the repeater 13, illustrated in detail in Fig. 2, conductor 63, contacts of relay 64, and conductor 65.

A polarized repeating relay 68 has its operating winding connected to ground and to conductor 69 extending to a distributor in repeater 13 illustrated in detail in Fig. 2.

A retransmitting line circuit extends from battery 71 and resistor 72 or through reversed battery 73 and resistor 74 to alternative contacts of repeating relay 68 and thence through conductor 75, contacts of energized break signal relay 45, conductor 76, one winding of duplexing differential relay 77, to line conductor 14 with a differential branch through artificial line 78 to ground and extends further from line conductor 14 through repeating station 15, line wire 16, central station 17, and line conductor 19 to substation 20.

Circuit for trunk line signals received at central station 12 from line conductor 14, extends from substation 20 through line conductor 19, repeater 79 of central station 17, line conductor 16, repeater station 15, line conductor 14, and windings of relays 77 to ground. A local circuit for received trunk line signals extends through battery 80, resistor 81, contacts of duplex relay 77, winding of slow-to-release break signal relay 64 and winding of polarized receiving relay 82 to ground. Contacts of relay 82 are connected severally to ground, to battery 84, through resistor 83 and to conductor 85 leading to repeater 61 illustrated in detail in Fig. 3. Contacts of relay 46 are connected to conductor 87, to ground, and through resistor 88 to battery 89 severally. A contact of relay 45 is connected by conductor 90 to resistor 74.

A repeating and translating device designated by the rectangle 13 in Fig. 1 and illustrated in detail in Fig. 2 comprises receiving distributor 101 of start-stop six-unit type having control conductor 87, starting magnet 102, start segment 103, signal segments 104, brushes 105, 106, and rest segment 107.

Storage relays comprise sets 112, 113, and 114 of six relays in each set and a set 115 of five relays, also separate relays 116 and 117. Operating windings of relays of set 112 are connected to battery 120 and to segments 104, while the holding windings of such relays are connected in a holding circuit through winding of shunting relay 121 and contacts of unlocking relay 122. Relays of set 113 have their operating windings connected in a transfer circuit through battery 124, right-hand contacts of relays of set 112, and contacts of transfer relay 125 to ground, and have their holding windings connected in a holding circuit through battery 124, contacts of unlocking relay 126, and winding of stop relay 127 to ground. Similarly, relays of set 114 have their operating windings connected in a transfer circuit through battery 129, right-hand contacts of relays of set 113, and right-hand contacts of transfer relay 130 to ground, and also have their holding windings connected in a holding circuit including battery 129, contacts of unlocking relay 132, and winding of stop relay 133 to ground. Relays of set 115 have their operating windings connected in a circuit including battery 135, right-hand contacts of relays of set 114, and conductor 136 to contact of transfer relay 137 where the circuit may be completed to ground. Holding windings of relays of set 115 are connected in a holding circuit including battery 135, a winding of idle-signal relay 138, and contacts of relay 137 to ground. An associated pair of code signal registering relays 116 and 117 have their operating windings connected from batteries 139 and 140 to back and front contacts respectively in sixth relay of relay set 114, whence a circuit extends from the relay armature through conductor 136 and contacts of relay 137 as described above. Holding circuits for the relays 116 and 117 are respectively from battery 139, through winding and front contact of relay 116, and back contact of relay 117 to ground, and from battery 140, through winding and front contact of relay 117 and back contact of relay 116 to ground.

An operating circuit for code signal translating

relay 141 extends through battery 145, left-hand winding of relay 141, extreme right-hand contact and armature of relay 116, extreme right-hand contact and armature of relay 117 and condenser 146 to ground, while a holding circuit for relay 141 extends through battery 145, winding and front contact and armature of relay 141, a winding of relay 138, winding of slow-to-release relay 150, and back contact and armature of relay 151 to ground. An operating circuit for code signal translating relay 152 extends through battery 153 of reversed polarity, winding of relay 152, extreme right armature and front contact of relay 117, and condenser 146 to ground, while a holding circuit for relay 152 extends through battery 154, winding and front contact and armature of relay 152 to the right-hand winding of relay 138, and winding of relay 150, as described above to ground.

Battery 160 and resistor 161 are connected directly by conductor 162 to right-hand front contacts of relays of set 115 and to segment 163 of retransmitting distributor 164, also may be connected through armatures 166 and 167 and contacts of relays 141 and 152 to back contacts of relays of set 115, also through armature 168 and front contact of relay 141 to front contact of third relay of set 115, also through armature 169 and back contact of relay 152 to back contact of third relay of set 115, and also through contacts of relay 138 to conductor 69.

Continuously operating retransmitting distributor 164 has continuously rotating brushes 172 and 173, stop-signal segment 163 connected to battery 160 through resistor 161, insulated start-signal segment 174, code signal segments 175 connected to contacts of relays of set 115, collector ring 176 connected to conductor 69, grounded ring 177, and home segment 178 which is connected through contacts of slow-to-operate relay 150, and winding of transfer relay 137 to battery and ground.

In a circuit containing battery 179 and a stop magnet 180, a manual switch 181 is provided for stopping the distributor 164 manually, if desired.

Relay 182 is connected in a circuit through battery 183, winding of relay 182 to front contact of relay 150, whence it may be extended further through segment 178, and brush 173 to ground connected to segment 177. Armature of relay 182 is connected through condenser 184 to ground, the front contact thereof being connected through resistor 185 to grounded battery 183 and its back contact being connected through winding of relay 151 to ground whereby circuits may be formed alternatively for charging and discharging condenser 184 to energize momentarily relay 151.

Relay 137 has armature 186 connected through condenser 187 to ground, a front contact connected through resistor 188 to grounded battery 189, and a back contact connected through relay 132 to ground whereby charging and discharging circuits for condenser 187 may be formed to energize momentarily relay 132.

Transfer relay 130 has armature 191 connected through condenser 192 to ground with a front contact connected through resistor 193 to grounded battery 194, and through a back contact to winding of relay 126 to ground whereby charging and discharging circuits for condenser 192 may be formed for energizing momentarily relay 126.

Transfer relay 125 has armature 195 which when attracted forms a charging circuit for condenser 196 through resistor 197 to grounded battery 198 and which when restored forms a discharge circuit for condenser 196, through winding of unlocking relay 122 for energizing relay 122 momentarily.

An energizing circuit for relay 125 extends through battery 210, winding of relay 125, back contact and armature of relay 127, conductor 211, segment 107, and brush 106 to ground, and an associated circuit for energizing relay 212 extends through battery 213, winding of relay 212, conductor 211, segment 107 and brush 106 to ground.

Fig. 3 illustrates in detail a repeating and translating device, 61 of Fig. 1. The device comprises a receiving distributor 221 of five-unit type having an incoming signal circuit conductor 85, a control magnet 222, brushes 223, 224, a rest segment 225, signal segments 226, and a start segment 227.

Code signal storage relay sets 230, 231, 232, and 233 of five relays each are supplemented by a code signal storing relay 235 and its associated unlocking relay 236. Operating circuits for relays of set 230 extend from battery 237 to signal segments 226 and the holding circuits extend from battery 237 through the back contact and armature of unlocking relay 238 to ground. Relays of set 231 have operating circuits through battery 241, contacts of relays of set 230, contacts of stop relay 242, rest segment 225, and brush 223 to ground, with holding circuits through battery 241, back contact and armature of unlocking relay 243 and winding of stop relay 242 to ground. Relays of set 232 have similar operating circuits through battery 244, contacts of relays of set 231 and contacts of unlocking relay 246 to ground, with holding circuits through battery 244, back contact and armature of unlocking relay 245, and winding of holding relay 246 to ground.

Relays of set 233 have operating circuits through battery 250 and contacts of relays of set 232 and conductor 251 to armature 252 of relay 253, whence by operation of the relay it may be extended over conductor 254 and through winding of distributor shunting relay 255 to ground. A holding circuit for relays of set 233 extends through battery 250, contacts controlled by relay 253, conductor 254, and winding of relay 255 to ground. Further contacts 256, in relays of set 232 are connected to form selectively an energizing circuit for relay 235 through battery 250, operating winding of relay 235 and all front contacts 256 of relays of set 232, thence through winding of slow-to-release relay 257 and contacts of transfer relay 253 to ground, or alternatively an energizing circuit for relay 236, through battery 250, winding of relay 236, back contact 256 of third relay of set 232 and front contacts 256 of first, second, fourth, and fifth relays of set 232, thence through winding of relay 257, and contacts of relay 253 to ground. A holding circuit for relay 235 extends through battery 250 and back contact and armature of relay 236 to ground.

A retransmitting distributor 261 of six-unit type has a retransmission output circuit conductor 60, continuously rotating brushes 262, 263, a local-signal segment 264, a further segment 265 separated from the segment 264 by an insulating segment 266, a stop-signal segment 267 connected directly through resistor 268 to battery 269, an insulated start-signal segment 270, a set of code signal segments 273 connected through contacts

of relays of set 233 to resistor 268 and battery 269, and a further segment 274 connected through back contact and armature of relay 235 to resistor 268 and battery 269. An energizing circuit for magnet 276 including battery 277 and resistor 278 is provided with a manual key 279 to stop distributor 261 if desired.

Relay 253 has operating circuits through battery 282, winding of relay 253, segment 264, and brush 263 to ground, and alternatively through contacts of relay 257, segment 265, and brush 263 to ground. Armature 283 is connected through condenser 284 to ground, its front contact being connected through resistor 285 to grounded battery 286 and its back contact being connected through winding of unlocking relay 245 to ground to form charging and discharging circuits for condenser 284 to energize momentarily relay 245.

In like manner and for like purposes, relay 246 has armature 290 connected to grounded condenser 291 and has contacts connected through resistor 292 to grounded battery 293 and to winding of unlocking relay 243 respectively, also relay 242 has armature 294 connected to grounded condenser 295 and has contacts connected through resistor 296 to grounded battery 297 and to winding of unlocking relay 238.

Description of operation

Upon starting all motors and closing all battery supply paths at central offices and substations, all line circuits are closed for currents of marking or "stop" signal nature, and the following relays, magnets, and condensers are energized in preparation for transmission of code signals: In Fig. 1, relays 30, 45, 46, 49, 59, 64, 68, 77, 82, and magnets 23 and 31. In Fig. 2, relays 125, 130, magnet 180, condensers 192, 196, and relay 212 energized with magnet 102 deenergized and brush 106 stopped. In Fig. 3, the magnet 276. In Fig. 2 a relay 116 and a condenser 146 also are to be energized by a preliminary operation before transmission of code signals.

Referring to Fig. 1, a circuit of an operative but non-operating line 11, is closed through battery 51, resistor 50, contacts of relay 49, resistor 48, operating winding of line relay 46, winding of slow-release relay 45, line conductor 11, break key 24, receiver magnet 23, contacts 29 of transmitter 22 and winding of relay 30 to ground. Relays 46, 45, 30 and magnet 23 are energized by current in this circuit. A part of resistance 48, is shunted by contacts of relay 212, Fig. 2, energized and relay 121, Fig. 2, unenergized, permitting a current of high operating value in the line circuit described, the high value being required to operate the marginal relay 30. A substation local circuit, through winding of magnet 31 and contacts of energized relay 30 to ground, maintains the locking transmitter magnet 31 energized.

Referring to Fig. 2, line control relay 212 is energized through battery 213, winding of relay 212, conductor 211, segment 107 and brush 106 in stop position to ground, while transfer relay 125 is energized through battery 210, winding of relay 125, back contact and armature of relay 127, conductor 211, segment 107 and brush 106 to ground, and transfer relay 130 is energized through battery 155, contact of unenergized relay 133 and winding of relay 130 to ground.

Condenser 196 is charged through battery 198, resistor 197, contact of energized relay 125, and condenser 196 to ground, while condenser 192 is charged through battery 194, resistor 193, contact of energized relay 130 and condenser 192 to ground.

Distributor control magnet 180 is energized through battery 179, switch 181 and winding of magnet 180 to ground, attracting its armature and releasing for operation the distributor 164 in which brushes 172 and 173 rotate continuously.

At first engagement of brush 173 and segment 178, transfer relay 137 is energized through battery 158, winding of relay 137, contact of unenergized relay 150, segment 178, and brush 173 to ground.

Relay 137 operates its contacts and closes an energizing circuit for relay 116, through battery 139, winding of relay 116, contacts of unenergized sixth relay of relay set 114, and right-hand front contact and armature of relay 137 to ground, energizing relay 116 which operates its contacts and closes its holding circuit through back contact and armature of relay 117 to ground, also closes an energizing circuit for relay 141 through battery 145, contacts of unenergized relay 117 and condenser 146 to ground, whereupon relay 141 operates its contacts and closes its holding circuit through a winding of relay 138, winding of slow-to-operate relay 150, and contacts of relay 151 to ground, thus energizing relay 138 which opens its contacts and also energizing relay 150 which does not operate instantly.

Brush 173 now disengages segment 178 and deenergizes relay 137 which restores its contacts, opening the operating winding of relay 116 which remains energized by current through its holding circuit.

Relay 150 now operates its contacts, disconnects segment 178 from winding of relay 137 and connects segment 178 through winding of relay 182 to battery 183, the circuit thus prepared for energization of relay 182 being now open at segment 178.

Prior to engagement of brush 173 with segment 178, a circuit through battery 160, resistor 161, contacts of unenergized relay 138, conductor 69, and retransmitting relay 68 had energized relay 68 whose contacts close alternative paths through battery 71 and resistor 72 or battery 73 and resistor 74 to conductor 75, and through contacts of relay 45 and conductor 76, to duplexing relay 77. After energization of relay 138, current is supplied through battery 160, resistor 161, conductor 162, segment 163, brush 172, and ring 176 to conductor 69 and relay 68. Brush 172 now transmits a code signal "letter shift" to retransmitting relay 68 (Fig. 1) as follows: A start signal impulse is transmitted by engagement of brush 172 with insulated segment 174, then five signal impulses of marking nature by engagement of brush 172 with five code signal segments 175, each of which is connected through contacts of relays of set 115 and contacts of relay 141 to resistor 161 and battery 160. Thereafter, brush 172 engages segment 163 again, at which time brush 173 makes its second engagement with segment 178, energizing relay 182 over a circuit traced above. Relay 182 operates its contacts and closes a circuit which charges condenser 184 through resistor 185. Brush 173 now disengages segment 178, deenergizing relay 182 whose contacts form an obvious circuit over which condenser 184 discharges through the winding of relay 151 energizing the relay 151 momentarily to interrupt momentarily the holding circuit of relays 141, 138, and 150. Relay 141 opens all of

its contacts and relay 138 recloses its contacts thereby connecting battery 160 through resistor 161 and contacts of relay 138 to conductor 69 and relay 68 to ground, energizing relay 68 to maintain continuously a marking signaling condition on line conductor 14. After disengagement of brush 173 from segment 178, the slow relay 150 restores its contacts and connects segment 178 to winding of transfer relay 137.

Brushes 172 and 173 are in continuous rotation due to the continued energization of magnet 180 when switch 181 is closed and relay 137 is repeatedly operated momentarily and in turn operates relay 132 momentarily without effect, by segment 178 at every revolution of brush 173.

Apparatus illustrated in Fig. 2 now is in condition for receipt and retransmission of code signals, and line 14 extends to a recorder whose shift condition now has been controlled as described above to be adjusted for recording "letters."

As long as code signals of letters nature are received and retransmitted, each having a sixth impulse of spacing nature, relay 117 will not be energized, and with distributors 101 and 164 operating uniformly at the same speed measured in cycles per minute, transmittion will proceed as follows:

Substation 10, Fig. 1, operates transmitter 22 to transmit a code signal comprising eight elemental impulses of which the first, seventh, and eighth impulses are spacing, spacing, and marking, respectively. The first spacing impulse deenergizes line relay 46 which energizes start magnet 102, Fig. 2, through battery 89, resistor 88, conductor 87, brush 105, distributor segment 103, and winding of magnet 102, thus starting the distributor 101, after which the second to sixth impulses operate relay 46 to energize the first to fifth relays of set 112, at least one of the signal impulses being of marking nature, and the eighth or definitive marking impulse energizes line relay 46 to permit magnet 102 to stop the distributor 101.

Distributor brush 106 on disengaging segment 107 has interrupted current in relays 212 and 125, deenergizing them. Relay 212 has released its contacts into open condition and has interrupted the shunt of resistance 48 thereby including all of resistance 48 in circuit with line 11 thus decreasing the permissible current in the line 11 to a value suitable for reenergization and operation of line relay 46 and home recording magnet 23 and to a value too low for reenergization of marginal relay 30, which had been deenergized by opening of transmitter contacts 29. Operation of contacts of any one of the first to fifth relays of set 112 has closed a holding circuit for those relays through battery 120, winding of relay 121, and contacts of unenergized relay 122, thereby energizing relay 121, which by operating its contacts, opens a second break in the shunt conductor of resistance 48.

Upon reaching its stop position, brush 106 reenergizes relay 212 without effect since the shunt of resistance 48 remains open at contacts of relay 121, and reenergizes transfer relay 125, which by its armature 195 energizes condenser 196 and by its further contacts completes a transfer circuit through right-hand contacts of the operated first to fifth relays of set 112 and left-hand windings of the first to fifth relays of set 113 to battery 124, thus transferring the registered code signal to relays of set 113 which without delay transfer the code signal to relays of set 114 whence it is transferred to retransmitting relays of set 115 at first engagement of brush 173 with segment 178 to energize transfer relay 137.

Left-hand contacts of operated relays of set 113 close a holding circuit through battery 124, windings of relays of set 113, left-hand contacts of relays of set 113, contacts of unenergized relay 126 and winding of stop relay 127 to ground, energizing relay 127 whose contacts open the energizing circuit of relay 125 whose released and restored armature 195 closes an obvious circuit, permitting discharge of condenser 196 through winding of relay 122, thus energizing relay 122 momentarily, opening the above described locking circuit of relays of set 112, effecting deenergization of all relays of set 112 and deenergizing relay 121 whose restored contacts close the shunt conductor of resistor 48, reducing the resistance of the circuit of line 11 and permitting resumption of the above described high value of current required to operate relay 30, Fig. 1. In turn relay 30 closes a circuit to reenergize magnet 31 and thus to unlock the mechanism of the transmitter 22. Substation 10 now may initiate transmission of a subsequent code signal.

Meanwhile, right-hand contacts of operated first to fifth relays of set 113 close transfer circuits prepared by right-hand contacts of energized transfer relay 130 and extending through left-hand winding of first to fifth relays of set 114 to battery 129, energizing without delay after engagement of brush 106 and segment 107 a code combination of first to fifth relays of set 114 whose left-hand contacts close a holding circuit through battery 129, windings and contacts of operated relays of set 114, contacts of unenergized relay 132 and winding of relay 133 to ground, energizing relay 133 whose contacts break the energizing circuit of relay 130 which thus releases its right-hand armature and opens a transfer circuit to prevent a subsequent code signal from entering relay set 114 and also releases armature 191 whose contacts form an obvious circuit for discharge of condenser 192 through winding of relay 126 which is momentarily energized to break the holding circuit to deenergize all relays of set 113 and to deenergize relay 127 whose restored contacts permit reenergization of relay 125. Relay 133 and relays of set 114 remain energized, in condition of storage for the registered code signal.

In due course of rotation, and prior to completion of transmission of a second code signal from substation 10, brush 172 in distributor 164 engages segment 178 which closes a circuit to energize and operate transfer relay 137, which by armature 186 energizes condenser 187 and by its further contacts closes a transfer circuit from battery 135 through left-hand windings of first to fifth relays of set 115 and right-hand contacts of first to fifth relays of set 114 to conductor 136 and contacts of relay 137 to ground. Relays of set 115 operate in a code combination and by their left-hand contacts prepare their holding circuit, at the same time by their right-hand contacts preparing segments 175 in distributor 164 to retransmit the registered code.

At disengagement of brush 173 from segment 178, relay 137 becomes deenergized and by its make-before-break contacts completes the prepared holding circuit through battery 135, operated relays of set 115, a winding of relay 138 and restored contacts of relay 137 to ground, and simultaneously relay 137 by its armature 186

closes an obvious circuit to energize relay 132 by discharge of condenser 187, the contacts of relay 132 momentarily interrupting the holding circuit of relays of set 114 and deenergizing all relays of set 114 and also deenergizing relay 133, thus permitting reenergization of relay 130. Operation of contacts of relay 138 has opened the shunt conductor 301 of distributor 164 and brush 172 now transmits the code signal registered upon relays of set 115 and upon segments 175 through contacts of those relays. During the transmission cycle of distributor 164, a subsequent code originating at substation 10 may be transferred to relay set 114.

Receipt of a six unit code signal including a figure shift signal will be manifested by a marking signal upon sixth relay of set 114, and the next operation of relay 137, will not only transfer the five-unit code to relays of set 115 but will transfer the marking shift signal to relay 117 whose energization will deenergize relay 116, will close a holding circuit through restored contacts of relay 116 and will close an operating circuit for translating relay 152 through battery 153 of reversed polarity compared with battery 145, contacts of operated relay 117 and condenser 146. Relay 152 operates its contacts and closes its holding circuit from battery 154 through a winding of relay 138, winding of relay 150 and contacts of relay 151, operating the relay 138 which opens the shunt conductor 301. Brush 173 disengages from segment 178, restoring the relay 137 to its unenergized condition. Relay 150 now operates its contacts, connecting segment 178 to winding of relay 182. A character code signal now is registered upon relays of set 115 but is ineffective because a figure shift code is registered upon relay 152 which controls circuits of retransmitting contacts of relays of set 115, and brush 172 now transmits to conductor 69 a five-unit figure shift code signal as follows: From segment 174 an open circuit starting signal impulse, from first, second, fourth, and fifth segments 175 closed circuit marking signal impulses, through armature contact and front contact of each operated relay to resistor 161 and through armature contact and back contact of each unoperated relay and through contacts 167 of operated relay 152 to resistor 161, also an open circuit signal impulse from third segment 175 which is connected to armature contact of third relay of set 115, circuits of both front and back contacts being open, at contact 169 of relay 152 and at contact 168 of relay 141 respectively. When brush 173 again engages and disengages segment 178, relay 182 is operated to unlock and restore relays 150 and 152, restoring battery connection to front contact of third relay and removing battery connection from back contacts of first, second, fourth, and fifth relays of set 115, thus electrically registering upon segments 175 the code signal registered upon relays of set 115, relay 138 being held by the described holding circuit of relays of set 115 after interruption of the holding circuit of relay 152, and brush 172 then upon its second revolution transmitting to conductor 69 the five-unit code registered upon relays of set 115.

A subsequent six-unit code signal including a letter shift signal manifested by a spacing condition upon sixth relay of set 114 will energize relay 116 when transferred to relays of set 115 which in turn will energize relays 141 and 138. Brush 172 then will transmit a five-unit letter shift code signal, since all front and all back contacts of relays of set 115 will be connected to resistor 161 and battery 160, front contact of third relay through contacts 169 of unenergized relay 152, back contact of third relay through contacts 168 of energized relay 141, front contacts of other relays of set 115 by direct connection to resistor 161 and back contacts through contacts 166 of relay 141, after which brush 173, segment 178, relays 182, 151 cooperate to release relay 141, when brush 172 will transmit the character code stored on relays of set 115.

Since two revolutions of distributor 164 are required to retransmit separately by means of two code signals a shift signal and a character signal which are received by distributor 101 in one code signal, an accumulation of stored code signals may occur. While a code signal is stored in relay set 114, the holding circuit of set 114 energizes stop relay 133, deenergizing transfer relay 130 and preventing transfer of a code signal from relay set 113 into relay 114. Likewise while a code signal is stored in relay set 113, stop relay 127 holds open the energizing circuit of relay 125 so that relay 125 cannot be energized by brush 106 and segment 107 to transfer a code signal from relay set 112 to set 113. A code signal stored in relay set 112 closes a holding circuit through stop relay 121 whose continued energization prevents shunting of resistor 48 and thereby prevents increase of current in line 11 necessary to operate marginal relay 30 and keyboard unlocking magnet 31. The substation transmitter thus is rendered inoperable by central station control when the central station apparatus is not conditioned to respond thereto.

Referring to Fig. 3, distributor control magnet 276 is energized continuously, brushes 262 and 263 of distributor 261 will rotate continuously and transfer relay 253 will be momentarily energized cyclically by battery 282 through segment 264 and brush 263 to ground. Speed of rotation of distributor 261, as measured in revolutions per minute, is slightly greater than maximum speed of distributor 221. Code signals originating at substation 20, Fig. 1, are propagated through line conductor 19, central office 17, including translating repeater 79 according to Fig. 2, line conductor 16, repeater station 15, line conductor 14, winding and contacts of relay 77, winding of relay 64, winding and contacts of relay 82, and conductor 85 to start-stop distributor 221, Fig. 3.

A first code signal comprising five significant impulses accompanied by start and stop impulses received at distributor 221 has its five significant impulses registered upon relay set 232 for temporary storage as follows: A start impulse deenergizes line relay 82 which closes a circuit through battery 84, resistor 83, conductor 85, brush 224, segment 227, and controlling magnet 222 to ground, energizing the magnet 222 whose operated armature permits brush 224 to rotate and to distribute the significant signaling impulses to windings of relays of set 230 whose left-hand contacts form a holding circuit through contacts of unenergized relay 238 to ground. The impulse signals of the first received code signal are accumulated upon relays of set 230 during the cycle of distributor 221 and at the end of its cycle the brush 223 closes a transfer circuit through battery 241, left-hand winding of relays of set 231, right-hand contacts of relays of set 230, contacts of unenergized relay 242, segment 225, and brush 223 to ground, energizing relays of set 231. Right-hand contacts of relays of

set 231 close a transfer circuit through battery 244, left-hand winding of relays of set 232, right-hand contacts of relays of set 231, and contact of unenergized relay 246 to ground, and at the same time left-hand contacts of energized relays of set 231 close a holding circuit through battery 241, windings and contacts of relays of set 231, contacts of unenergized relay 243 and winding of relay 242 to ground, energizing relay 242 whose right-hand contacts open an above described transfer circuit and whose left-hand contacts close an obvious circuit for discharge of condenser 295 through winding of relay 238, energizing the relay 238 whose contacts open momentarily the holding circuit of energized relays of set 230, deenergizing all relays of set 230. Operation of relays of set 232 in a code signal combination closes a locking circuit through battery 244, windings and contacts of relays of set 232, contacts of unenergized relay 245 and winding of relay 246 energizes and operates relay 246 to open an above described transfer circuit and to close an obvious circuit for charging condenser 271 through resistor 292, thus maintaining registration of the received code signal upon relays of set 231 and set 232. Registration of a second received code signal immediately may be begun in overlap manner upon relays of set 230.

According to the above description of operation of the structure of Fig. 2, the first code signal received from substation 20 upon relay 82 will be "letters shift," energizing all relays of set 232, whose right-hand contacts accordingly will close a circuit to energize relays 235 and 257, through battery 250, left-hand winding of relay 235, contacts in series of energized relays of set 232, winding of relay 257, and to ground through contacts of relay 253 if then energized. In due course, brush 263 will engage segment 264, closing a circuit to energize and operate relay 253 whose right-hand contacts provide a circuit to charge condenser 284, whose left-hand contacts close the energizing circuit of relays 257 and 235 and whose middle contacts close a transfer circuit from battery 250, left-hand windings of relays of set 233, middle contacts of relays of set 232, middle contacts 252 of energized relay 253 and winding of relay 255 to ground, transferring the code signal to relays of set 233 and operating the relay 255. When brush 263 disengages from segment 264, relay 253 will become deenergized, its middle contacts opening the transfer circuit just described and forming a holding circuit through battery 250, right-hand windings of relays of set 233, contacts of deenergized relay 253 and winding of relay 255 to ground, also the right-hand contacts of relay 253 connect condenser 284 to energize the winding of relay 245 to open momentarily the holding circuit of relays of set 232 and of relay 246 which when deenergized forms a circuit through which condenser 291 energizes relay 243 momentarily to open the locking circuit of relays of set 231, thus deenergizing relays of sets 232, 231 and relays 243, 246. Restoration of contacts of relay 253 and operation of relay 245 have occurred during the time period when brush 263 has been traversing an insulated segment 266 and during which time period the brush 262 in distributor 261 has disengaged from segment 267 and thereby has begun transmission of a starting impulse to conductor 60.

While brush 263 has traversed the insulated segment 266, relay 257, whose energizing circuit has been continued open by restoration of contacts of all relays of set 232, has retained its contacts closed due to its slow-to-release characteristic.

Accordingly, brush 263 engages segment 265 and energizes relay 253 through battery 282, winding of relay 253, contacts of slow-to-release relay 257, segment 265, and brush 263 to ground. By operation of middle contacts of relay 253, the described holding circuit for relays of set 233 is opened and relays of set 233 as well as relay 255 are denergized and their contacts restored, thus connecting battery 269 and resistor 268 to conductor 60 through contacts of relay 255 and interrupting the transmission of brush 262 by shunting the brush and its segments.

At disengagement of brush 263 from segment 265, relay 253 becomes deenergized and its contacts cause condenser 284 to energize relay 245 momentarily without effect.

In response to the received "letters shift" code signal, relay 235 has been energized and electrically locked to control a "letters shift" condition upon segment 274.

A subsequently received character code signal will be accumulated upon relay set 230 and transferred through relay set 231 to relay set 232, where contacts 256 do not close a circuit for relay 257 because of the character nature of the code signal. At engagement of brush 263 with segment 264, relay 253 operates to transfer the registered code to relays of set 233 and to energize relay 255, to remove the shunt from brush 262 and to prepare brush 262 and segments 273 to retransmit the significant character code accompanied by a starting signal from segment 270, a shift signal from segment 274, and a stop signal from segment 267. Upon disengagement of brush 263 from segment 264, the relay 253 is restored to complete the described holding circuit for relays of set 233 and for relay 255 and to operate relay 245 momentarily to clear relays of set 232.

Brushes in distributor 261 are timed to retransmit code signals at a speed faster than code signals can be received by distributor 221, hence there is a gain of hunting nature between the two sets of brushes and at intervals the relay 253 will be operated and restored with all relays of set 232 in unenergized condition, in which case, upon deenergization of relay 253, all relays of sets 232 and 233 and relay 255 will be in deenergized condition and contacts of relay 255 will shunt the brush 262 and its segments during the remainder of the cycle of distributor 261.

Should a succeeding received code signal be transferred from relay set 230 by segment 225 and brush 223 during the time period when relay 253 is energized by segment 264 and brush 263, the code signal is transferred to set 233 without waiting.

Upon receipt of a "figure shift" code signal, and upon energization of relay 253 by segment 264, first, second, fourth, and fifth relays of set 232 are energized, closing a circuit to energize relays 236 and 257 through battery 250, winding of relay 236, right-hand contacts in series of unenergized third relay and energized second, first, fourth, and fifth relays of set 232, winding of relay 257, contacts of unenergized relay 253 to ground. Relay 236 operates its contacts and deenergizes relay 235 which by restoring its contacts changes the electrical condition of segment 274 from "letters shift" to "figures shift." Immediately, brush 263 engages segment 265 and operates relay 253

to deenergize relay 255 and relays of set 233. Subsequent received code signals will be retransmitted with "figures shift" condition as now stored on segment 274 until receipt of a "letters shift" code signal whose operation has been described above.

Referring to Fig. 1, general operation of the system of the invention may be seen. In transmission from substation 10 to substation 20, code signals of six-unit type, each comprising a character code signal combined with a shift code signal, are generated at substation 10, and are received by translator 13 according to Fig. 2, wherein the character code signals and shift code signals are separated and are separately regenerated each as a code signal of five-unit type. The code signals of five-unit type thus generated are transmitted, with repetition in successive shift code signals suppressed, through trunk line 14, repeating station 15, and trunk line 16 to a further central office and there are received by a translator 18 according to Fig. 3, wherein the shift code signals are stored and the character code signals of five-unit type are retransmitted each combined with the then stored shift code signal to comprise a regenerated code signal of six-unit type. The regenerated code signals of six-unit type are retransmitted over line 19 to substation 20, equipped as substation 10 in Fig. 1, where a six-unit receiver 23 records the transmitted intelligence. In like manner, code signals of six-unit type originated in a transmitter 22 at substation 20 are transmitted through line 19 to central station 17, are translated into code signals of five-unit type by translator 79 according to Fig. 2, are retransmitted through line 16, repeating station 15 and line 14 to central station 12 where they are translated into code signals of six-unit type by translator 61 according to Fig. 3, and are retransmitted through line 11 to substation 10 to be recorded by the receiver 23.

In response to a break signal of spacing nature, generated by manual key 24 at station 10, the translator 13 as disclosed would transmit to line 14 a series of start-stop codes each having a stop signal of marking nature. To effect transmission of a break signal of spacing nature and of indefinite duration, relays 45 and 64 are provided, of slow-to-release type to retain contacts in operated condition as illustrated throughout all current changes produced by the telegraph code signal transmitter 22, and to restore their contacts only in response to operation of the manual break key 24. Operation of key 24 and restoration of right hand contacts of relay 45 connects the spacing battery 73 and resistor 74 through conductor 90 and contacts of relay 45 to conductor 76 and to line 14, thus retransmitting a continuous breaking signal of spacing nature to restore 64. The equipment illustrated at repeating station 15 is suitable for retransmission of the continuous breaking signal and when the signal is received at central station 17 with equipment as shown in central station 12, the regenerative repeater 61 (or 18) operates its retransmitting relay 49 to transmit code signals embodying stop signals of marking nature, while relay 64 concurrently releases its contacts to disengage conductors 63 and 65, thus opening the shunt conductor of resistor 48 and reducing the maximum current in line 19. At substation 20, an interruption of current by a relay 49 in central station 17 will deenergize relay 30 and magnet 31 after which the resistor 48 now unshunted will restrain current in line 19 to a volume insufficient to reoperate relay 30, resulting in permanent mechanical locking of the keyboard of transmitter 22 during the continuance of the breaking signal.

Referring to Fig. 4, the line circuit extends from line conductor 11 through breaking key 24, receiving magnets 23, home segment, brush and ring of distributor 39, and winding of relay 30 to ground. Should current in line 11 be insufficient to energize and operate the marginal relay 30, the consequent deenergization of control magnet 41 will release latch 40 to engage the brush arm to stop the operation of distributor 39, producing the effect of mechanically locking the keyboard of Fig. 1.

The present invention, having been described above in connection with illustration of a specific embodiment thereof, now will be considered more generally and from a contemplation of its broader scope, and will be definitely pointed out in the claims without limitation to the specific illustration utilized herein for teaching the invention and its application to the prior art.

What is claimed is:

1. In a telegraph system, a transmitter, means in said transmitter for transmitting character code signals embodying a predetermined number of impulses, a plurality of line sections, a repeater intermediate such line sections, relay means in said repeater for transmitting directly therefrom to its line section code signals embodying a lesser number of impulses, and means in said repeater responsive to a particular impulse of the first code signals for transmitting invariably directly to its line section a single code signal indicative of the particular impulse when there is a variation in the character of the particular impulse.

2. In a telegraph system, a transmitter, means in said transmitter for transmitting character code signals embodying a predetermined number of impulses, a plurality of line sections, a repeater intermediate such line sections, means in said repeater for transmitting directly therefrom to its line section code signals embodying a lesser number of impulses, and means in said repeater responsive to a particular impulse of the first code signals for transmitting to its line section prior to the transmission thereto of the code signal for the character a single code signal indicative of the particular impulse when there is a variation in the character of the particular impulse.

3. In a telegraph system, means to transmit a combination code signal combining either one of two case shift code signals and a character code signal, a repeating device including means in which said combination code signal is stored, and means for transmitting from said repeating device an isochronous code signal representing one of said two case shift signals and a subsequent isochronous code signal representing a character.

4. In a telegraph system, means to transmit a combination code signal combining either one of two case shift signals and a character code signal, a repeating device including means in which said combination code signal is stored, means for retransmitting from said repeating device a complete code signal representing case shift signal and a subsequent complete code signal isochronous therewith representing a character, and means for thereafter omitting the said case shift code signal.

5. In a telegraph system, a transmitter, stop means therefor, means in said repeater for storing signals, a repeater, a transmission conductor connecting said transmitter and said repeater, and means in the repeater operative when a full

accumulation of stored signals has occured to generate a signal in said conductor for actuating said stop means to stop said transmitter.

6. In a telegraph system, a repeating device, two sets of relays in said repeating device, means for storing in said relays two received permutation code signals concurrently, and retransmitting means for retransmitting a single permutation code signal from said two sets of relays jointly.

7. In a telegraph system, a repeating device, two sets of relays in said repeating device, means for storing in said relays two successively received permutation code signals concurrently, and retransmitting means by which a single permutation code signal is retransmitted under joint control of said two sets of relays.

8. In a telegraph system, a repeating device having two sets of storage relays, means responsive to a received case shift code signal to register the nature of the said signal in one of said sets of storage relays, means responsive to a received character code signal to register the received character code signal in the other of said sets of storage relays, and transmission means in said repeating device responsive to registration of a character code signal to transmit a combination code signal.

9. In a telegraph system, a repeating device having two sets of storage relays, means responsive to a received case shift code signal to register the nature of the said signal in one of said sets of storage relays, means responsive to a received character code signal to register the received character code signal in the other of said sets of storage relays, and transmission means in said repeating device responsive to registration of a character code signal to transmit a combination code signal, and subsequently to cancel said registration of said character code signal and to retain said registration of said case shift code signal.

10. In a telegraph system, a repeating device having two storage means, means responsive to a received case shift code signal to register the nature of the said signal in one of said storage means, means operable thereafter repeatedly in response to successive received character code signals to register successively the said received character code signals in the other of said storage means, and transmission means in said repeating device responsive to registration of each said character code signal to transmit a combination code signal embodying the currently registered character code signal and the currently registered case shift code signal.

11. In a telegraph system, a tape-controlled transmitter, a telegraph transmission line conductor, a continuously operating distributor cooperating with said transmitter to transmit signals in said line, a signal receiving storage device of limited capacity connected to said line for receiving and storing said transmitted telegraphic signals, and means at said distributor responsive to means in said storage device for stopping said distributor.

12. In a telegraph system, a start-stop transmitter, a remote receiver, a break signal key at said receiver, and locking means at said transmitter responsive to said break signal key for arresting said transmitter.

13. In a telegraph system, a start-stop transmitter, a remote receiver, a line connecting said transmitter and receiver, a break signal key at said receiver, a telegraphic repeater connected in said line, and locking means at said transmitter responsive to said break signal key and effective independently of said repeater for arresting said transmitter.

14. In a telegraph system, an isochronous code signal transmitter, a repeater connected to said transmitter for repeating isochronous code signals, a break key, and means independent of said repeater and responsive to the operation of said break key for repeating a break signal of greater length than said isochronous code signal.

15. In a telegraph system, a keyboard transmitter, locking means therefor, a signal storage device separate from said transmitter having capacity for a limited plurality of code signals, and means in said device effective when said device is full of stored signals to control said locking means for locking said transmitter.

16. In a telegraph system, a transmitter, disabling means therefor, a signal storage device having capacity for a limited plurality of code signals, a single transmission line connecting said transmitter and said storage device, and means in said device effective when said device is full of stored signals to transmit a signal over said line to control said disabling means for disabling said transmitter.

17. A method of operating an automatic motor driven telegraphic signal transmitter which comprises driving the transmitter continuously by mechanical power and automatically shunting the electrical transmitting contacts of the transmitter when signals are not to be sent.

18. A method of operating an automatic motor driven telegraphic signal transmitter which comprises driving the transmitter continuously by mechanical power to transmit signals when desired and at other times sending a stop signal to line through a shunt circuit.

19. In a telegraph system, a continuously operating automatic transmitter, a normally closed shunt for transmitting contacts of said transmitter, and a relay responsive to a stored code signal to interrupt said shunt during transmission of said stored code signal by said transmitter.

20. In a telegraph system, a continuously operating automatic transmitter, a normally closed shunt for transmitting contacts of said transmitter, and automatic means to interrupt said shunt during transmission of code signals.

21. In a telegraph system, a transmitting device to transmit a code signal combining a case identification signal and a character signal, a set of storage devices to store said code signal, a translating repeating means for translating said stored case identification signal into another code signal and for retransmitting said resultant code signal, and repeating means for retransmitting said stored character signal and for annulling said stored character signal in said storage device after retransmission, said translating repeating means operative in response to a change in said case identification signal in a succeeding code signal.

22. In a telegraph system, a substation, means to transmit from said substation code signals of six-unit type, each comprising a character signal portion combined with a shift signal portion, a translator, means in said translator wherein said character signal portion and shift signal portion are separated and are separately regenerated each as a code signal of five-unit type, means for transmitting the code signals of five-unit type with repetition of successive shift code signals

suppressed, and means for combining said character and shift codes into a single combined code signal of the six-unit type.

23. The method of transposing telegraph signals from a code having a predetermined number of selecting conditions into a code having a lesser number of conditions which consists in identifying one of said predetermined selecting conditions by a code signal of the lesser number of conditions, establishing said last mentioned code signal of the lesser number of conditions, and thereafter transmitting with each code signal a selective condition indicative of said code signal until a change occurs in said one of said conditions.

24. In a telegraph system, a transmitter, means in said transmitter for transmitting character code signals and case code signals uniform in length with said character code signals, a repeater, means in said repeater for transmitting character code signals each composed of a uniform plurality of elemental impulses and each having a case indicating impulse, and means in said repeater responsive to a received case code signal and effective to transmit thereafter in each of a plurality of contiguously received and retransmitted character code signals an embodied case indicating impulse indicative of said received case code signal.

25. In a telegraph system utilizing letters shift code signals, figures shift code signals, and character code signals, means to transmit a combination code signal combining one of said shift code signals and one of said character code signals, a repeating device, means in said repeating device for storing said combination code signal, and means for transmitting from said repeating device one of said shift code signals and for establishing a shift code signal suppression circuit which will prevail until a shift code signal of alternative nature is received.

26. In a telegraph system utilizing letters shift code signals, figures shift code signals, and character code signals, means to transmit a combination code signal combining one of said shift code signals and one of said character code signals, a repeating device, means in said repeating device for storing said combination code signals, means for transmitting from said repeating device one of said shift code signals followed by the character code signal of said stored combination signal, and means for receiving and storing further combination signals embodying the same shift code signal and for transmitting responsively only the embodied character code signal.

27. In a telegraph system, a plurality of line sections, a repeater intermediate said line sections, means for transmitting in succession over one of said line sections to said repeater code signals of a first code each such code signal embodying a predetermined number of signal impulses, relays in said repeater, means in said repeater for transmitting directly from contact points of said relays over another of said line sections code signals of another code embodying in each code signal a lesser number of signal impulses, and means in said repeater responsive to a particular signal impulse of said first mentioned code signals for transmitting directly over said other line section a single complete code signal of said other code indicative of the particular impulse invariably when there is a variation in the character of the particular impulse compared with the analogous impulse of the immediately preceding code signal.

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