

May 18, 1943

L. M. POTTS

2,319,263

MULTIPLEX EXTENSOR

Filed Aug. 13, 1941

2 Sheets-Sheet 1

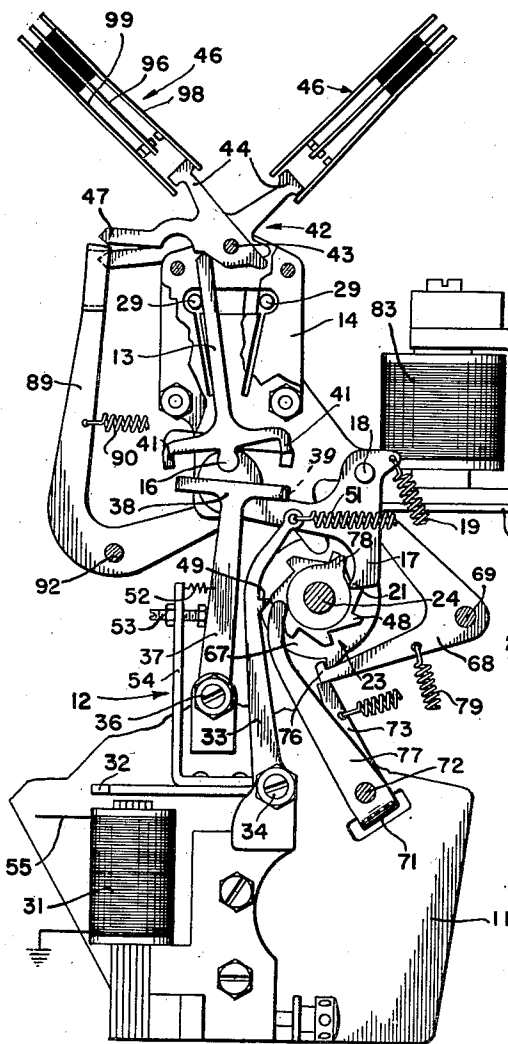


FIG. 1

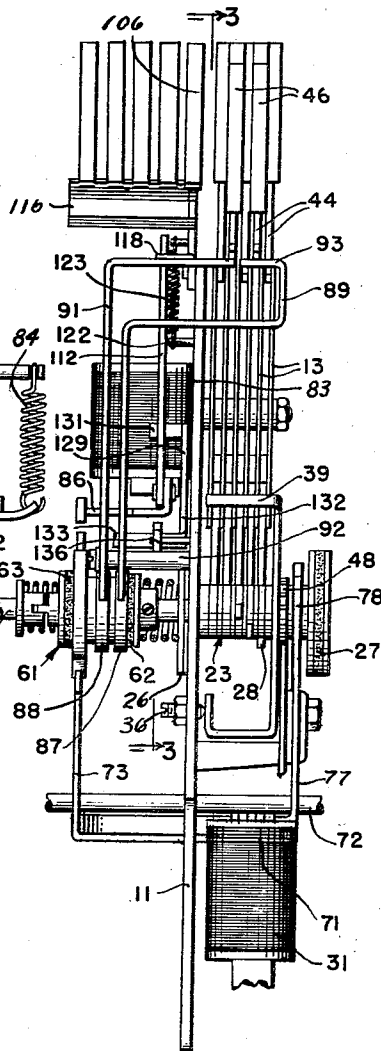


FIG. 2

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FIG. 3

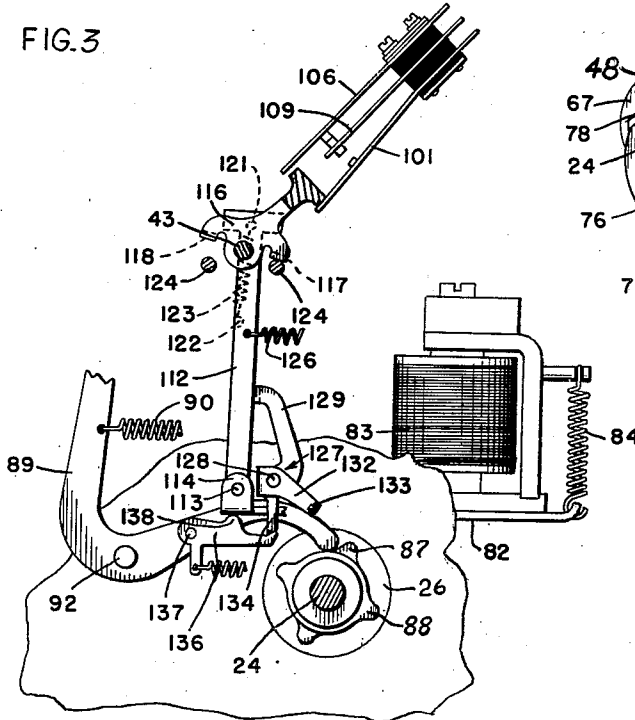
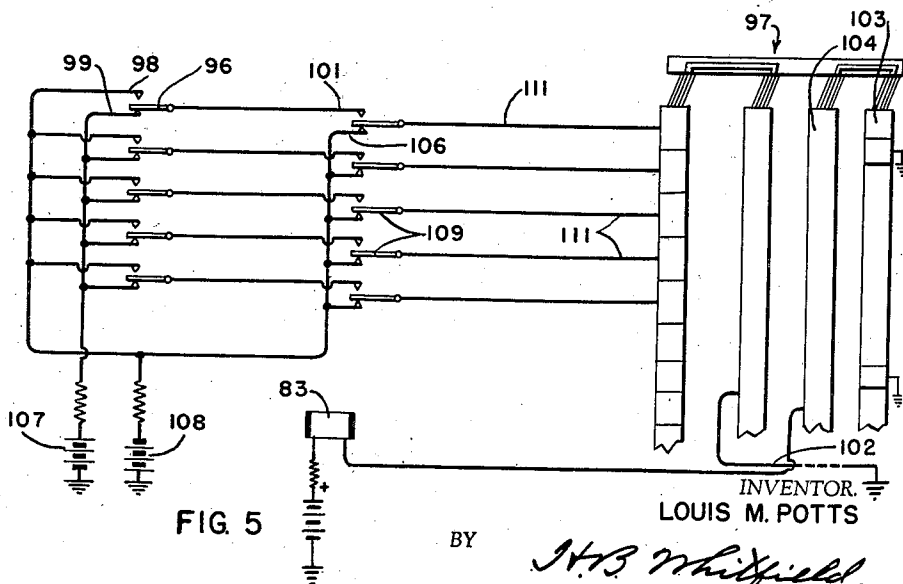
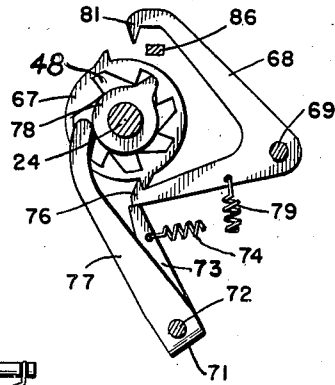


FIG. 4



UNITED STATES PATENT OFFICE

2,319,263

MULTIPLEX EXTENSOR

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Application August 13, 1941, Serial No. 406,700

15 Claims. (Cl. 178—70)

This invention relates to synchronous multiplex telegraph systems and more particularly to a system in which a start-stop telegraph system may be operated in conjunction with a synchronous multiplex telegraph system.

An object of this invention is to simplify mechanical extension apparatus which receives telegraph signal combinations from a simplex telegraph system and transfers those signal combinations for retransmission over a synchronous multiplex system.

Another object of this invention is to provide simplified mechanism in the extension apparatus for establishing an all-spacing condition in the associated multiplex system upon cessation of signal reception over the simplex line.

This invention features mechanical extension apparatus in which received code signal combinations are transferred directly from a selector mechanism to a set of storage levers that operate a set of contacts to condition a multiplex retransmitting distributor in accordance with the received code signal combinations. In order to increase the speed of transmission, a partial signal overlap is permitted in the mechanical extension apparatus by transferring the impulses of a received code signal combination in groups from the selector mechanism to the set of storage levers.

As a further feature of this invention, a special contact operating lever conditioned by an extension on the armature of the sixth pulse magnet is provided and upon cessation of signal transmission over the start-stop simplex line the armature extension is effective to operate the special contact operating lever and place spacing potential on all of the segments of the multiplex retransmitting distributor associated with the transmitting extension apparatus to hold the receiving start-stop extension apparatus inoperative.

In accordance with one embodiment of this invention, the mechanical extension apparatus comprises a selector mechanism of the sword and T-lever type which operates upon the reception of a start impulse of a code signal combination received over the start-stop simplex line. After the third impulse of the instant code signal combination has been received, a special cam in the selector mechanism operates an escapement to release a transfer cam assembly for rotation. A sixth pulse magnet permits the transfer cam assembly to continue its rotation if the associated retransmitting multiplex distributor is in a condition to receive the instant code signal combi-

nation. A cam operates early in the cycle of the transfer cam assembly to release a locking bail from the T-levers associated with swords Nos. 1, 2, and 3, so that the setting of those swords may be transferred to and stored in the T-levers. The T-levers are directly associated with contacts connected to the segments of the retransmitting multiplex distributor and operate those contacts immediately upon the transfer so that while the fourth and fifth impulses are being received, the first three impulses are being retransmitted in the multiplex line. After the fifth impulse has been received, a second cam in the transfer cam assembly operates a second locking bail to permit the transfer of the fourth and fifth impulses to their associated T-levers and segments of the multiplex retransmitting distributor. Then, as the fourth and fifth impulses are being retransmitted, the selector mechanism may be receiving the first set of impulses of the next succeeding code signal combination.

The invention in this embodiment also provides a special contact operating lever controlled dually by the first locking bail and the armature of the sixth pulse magnet to place an all-spacing condition on the retransmitting multiplex distributor upon cessation of signal reception over the simplex line. An extension on the armature of the sixth pulse magnet tends normally to operate the special contact operating lever to all-spacing position but when a code signal combination has been received from the start-stop simplex line, the first bail operates causing the armature extension to be latched out of its normal position to render the T-levers effective on the segments of the multiplex retransmitting distributor. When no signal has been received from the simplex line, however, the armature extension is effective to operate the special contact operating lever to place an all-spacing condition on the multiplex retransmitting distributor.

For a more complete understanding of the features of this invention, reference may be had to the following detailed description which is to be interpreted in the light of the accompanying drawings, wherein:

Fig. 1 is a plan view, partially broken away, of a mechanical extension set including the features of this invention;

Fig. 2 is a side elevational view of the apparatus illustrated in Fig. 1;

Fig. 3 is a sectional view taken on lines 3—3 of Fig. 2;

Fig. 4 is a detailed view of the transfer cam assembly escapement mechanism; and

Fig. 5 is a circuit diagram indicating the electrical circuits extending between the extensor set and the retransmitting multiplex distributor.

In accordance with the illustrated embodiment of the invention, there is mounted upon a mounting plate 11 a selector mechanism of the sword and T-lever type illustrated and described with particularity in U. S. Patent 1,937,376 to W. J. Zenner, in which Fig. 1 illustrates in detail the selector mechanism contemplated to be employed in the improved mechanical extension apparatus which is the subject of this invention and reference may be had to that patent, which is incorporated herein by reference, for the purpose of determining the mechanical details and mode of operation of the selector mechanism which will be described herein only briefly.

The selector mechanism comprises a set of selector elements in the form of thin flat fingers or swords 13, which are arranged in superposed relation between suitable guide plates 14. The circular rear ends 16 of the fingers 13 occupy corresponding sockets provided in thin flat bell cranks 17 pivoted upon a common pivot stud 18. Individual springs 19 hold the bell cranks 17 and selector fingers 13 in the position shown in Fig. 1; that is, in a position in which the downwardly extending projections 21 of the bell cranks 19 are in contact with a cam barrel 23 mounted on a shaft 24 which is driven continuously through any suitable motor, the driving connection between the shaft 24 and cam barrel 23 being established through friction clutch 26-27, Fig. 2. In the patent to Zenner there is provided a selector mechanism including six sets of swords and bell cranks to accommodate a six-unit code. In the present embodiment, however, it is contemplated to employ a five-unit code and for that reason there are provided but five sword and bell crank sets. It is to be understood that the number of code elements employed is no limitation but is chosen to accommodate the particular operative requirements of the telegraph system in which the selector mechanism is to be put into use and that any other number of code elements may be used.

The cam barrel 23 (see Fig. 2) is provided with a series of cams 28 assembled in a helical arrangement. One cam 28 is provided for each of the bell cranks 17 and the cam assembly rocks the bell cranks in succession and thus reciprocates longitudinally the succession of selector fingers 13. In addition to the longitudinal movement, the selector fingers 13 have a lateral swinging movement about their disc articulation 16 between a pair of limiting stops 29.

The positioning of any selector finger 13 either to its right-hand or left-hand limiting stop 29 is determined by a selector magnet 31 which is adjustably mounted upon mounting plate 11. The magnet armature 32 is fixed to a flutter cam lever 33 which is pivoted on a shaft 34 fixed in the mounting plate 11. Mounted on a pivot stud 36 adjustably positioned adjacent to and in cooperative relation with the flutter lever 33 is a selector lever 37. Lever 37 terminates in a substantially U-shaped portion 38 having laterally extending arms 39 (see Fig. 2) which constitute abutments adapted to cooperate with abutting projections 41 extending from the rear extremities of the selector fingers 13 and act to position the latter in either a right-hand or left-hand position. The several fingers 13 act, through a corresponding number of contact controlled levers 42 arranged between the guide plates 14 and

pivotaly mounted on a stud 43, to position a plurality of sets of contacts 46 associated with the segments of a multiplex retransmitting distributor in a manner to be hereinafter set forth. Each control lever 42 is provided with a contact operating extension 44 designed for an associated contact pair 46 and a horizontally extending locking projection 47 provided to enable a locking means, to be described hereinafter, to maintain the setting of the control levers for a predetermined period of time; namely, the time required to transmit the code signal combination set up in said levers by the operation of the selector mechanism.

For the purpose of providing assisted armature action, a flutter cam 48 is included in the cam assembly 23 and cooperates with a cam following projection 49 integral with the flutter cam lever 33. A spring 51 secured to one extremity of lever 33 tends to urge the follower 49 against the cam 48. As the cam assembly 23 rotates, the effect of the cam portions of flutter cam 48 against the follower 49 is to restore the armature 32 by mechanical power into its attracted position near or against the electromagnet 31 in timed relation with the speed of code pulsing.

As shown in Fig. 1, the selector lever 37 is not integrally formed with the flutter cam lever 33 and armature 32 but is yieldably connected therewith through a spring 52 and an adjustable set screw 53 carried on an extension 54 of the flutter lever 33. The levers 33 and 37 being so connected are enabled to move as a unit since the spring 52 functions normally to hold lever 37 against the stop screw 53. However, lever 33 is free to respond to the camming action of flutter cam 48 despite lever 37, if that lever should be restrained momentarily by a locking device illustrated specifically in Fig. 6 of the patent to Zenner, whereupon the spring 52 will be distended and as soon as the restraint upon the lever 37 has been removed, it will instantly be drawn against the stop 53 by spring 52. The purpose of this flexible connection of flutter lever 33 and selector lever 37 is to compensate for the difference in operation between the accurately timed operation of flutter lever 33 and the slower mechanical operation of selector lever 37 by providing an intervallic overlap; that is, an overlap of the signal intervals of a code and the mechanical operation pursuant thereto, whereby a preceding code impulse causes the operation of signal storing devices which continue action after the termination of the preceding signal interval and which extend action into the succeeding signal interval.

A stop arm not disclosed in the drawings of the present application but disclosed in the drawings of the Zenner patent is provided for the purpose of controlling the rotation of the cam assembly 23 in the selector mechanism in accordance with signal reception by the electromagnet 31. The operation of the stop gate will not be described herein inasmuch as it does not form a part of the present invention.

The operation of the selector unit of the mechanical extension set which is the subject of this invention is as follows: The normal stop condition of the simplex line 55 is marking and this condition holds the selector magnet 31 energized. During the first line impulse or start interval of a code signal combination the selector magnet 31 is de-energized and the movement of armature 32, which is effected by spring 51, causes the release of cam assembly 23 for rotation in a manner described in the above-identified patent to Zen-

ner. The cam assembly 23 is thus released to rotate continuously until a cessation of signal reception over the simplex line which is effective to cause the stop gate to be locked and interrupt the rotation of the cam assembly.

With the cycle of operation of the cam assembly 23 initiated, the first cam projection on flutter cam 48 engages follower 49 on flutter lever 33 to rock that lever counterclockwise and move the armature 32 toward the electromagnet 31, and thereafter the cam projection passes the follower 49 and releases the lever 33. If at this time a marking impulse is impressed on the line, the selector magnet 31 will be energized and in consequence the armature 32 will be held by selector magnet 31. When the signal impulse is of a spacing nature, the electromagnet will not be energized and the armature will in that case merely be oscillated by cam 48 into close proximity to the magnet and returned immediately by the action of spring 51.

Assuming that the first impulse after the starting impulse is of marking nature, the armature and associated flutter lever will be held in their counterclockwise positions and selector lever 37 will be correspondingly actuated through its flexible connection with flutter lever 33. While the selector lever 37 is in this position, the locking device, referred to above but not disclosed in the drawings, operates to lock it in such position until the first cam 28 has actuated its associated bell crank 17 to move the first selector finger 13 to its marking or left-hand position due to the alignment of the right-hand arm 39 of selector 37 and right-hand projection 41 of the selecting finger 13.

Had the first impulse condition after the starting impulse been of a spacing nature, the armature 32 and flutter lever 33 would not have been held by selector magnet 31 but instead lever 33 would merely have been oscillated and would have conditioned selector lever 37 in its clockwise position. This would have resulted in an alignment of the left-hand arm 39 of selector lever 37 and left-hand projection 41 of finger 13 to position the finger 13 in its rightward position as its cam 28 operated upon its associated bell crank 17. The selector mechanism under the control of the selector magnet 31 responds to the received code signal combinations and in accordance with the permutations of marking and spacing impulses, the swords 13 are conditioned either rightwardly or leftwardly under the control of the selector lever 37.

The setting established in the fingers 13 of the selector mechanism by the impulses of a code signal combination received from the simplex telegraph line is transferred to storage levers under the control of a transfer mechanism also supported by mounting plate 11 comprising a transfer cam assembly 61 mounted on shaft 24 to be driven thereby through friction clutch 62-63 when released for rotation. An escapement mechanism controlled jointly by the simplex telegraph line 55 through its control of the selector mechanism and by the multiplex retransmitting line through its energization of a sixth pulse magnet is provided to permit shaft 24 to rotate the transfer mechanism.

The escapement mechanism includes an escapement cam 67 (see Fig. 4) and a cooperating escapement lever 68 pivotally supported upon a stud 69 carried by the mounting plate 11. A locking lever 71 which is of a U-shape is pivotally supported upon a shaft 72 carried by mounting

plate 11 and one arm 73 thereof is normally held by means of a spring 74 in blocking relation with respect to one arm of the escapement lever (see Fig. 4) holding a stopping projection 76 thereof in the path of a stop projection on escapement disc 67 to restrain the rotation of the transfer cam assembly. The other arm 77 of locking lever 71 acts as a cam follower for release cam 78 included within the cam assembly 23 of the selector mechanism. Through this linkage, a predetermined period of time after the cam assembly 23 starts its rotation, cam 78 thereof through its operation upon follower 77 rocks lever 71 and its arm 73 in a counterclockwise direction as viewed in Fig. 4, removing arm 73 from blocking relationship with respect to the escapement lever 68, permitting a spring 79 to rock escapement lever 68 in a counterclockwise direction about its pivot 69 and release the transfer cam assembly 61 for rotation.

The counterclockwise rotation of escapement lever 68 brings the depending portion 81 of its upper arm into the path of a cam projection on escapement disc 67. As disc 67 rotates, it engages the projection 81, rocks the escapement 68 in a clockwise direction and permits spring 74 to rock blocking arm 73 in a clockwise direction restoring it into blocking relationship with respect to the escapement lever 68. At this point, however, one tooth of the escapement disc 67 will have escaped beyond the blocking projection 76 on the lower arm of the escapement lever 68, and accordingly, the transfer cam assembly will have been released for rotation so far as the start-stop simplex line is concerned.

If at the time the selector mechanism, in response to a received code signal combination from a start-stop simplex line, releases the escapement mechanism and the transfer cam assembly for rotation, and the retransmitting multiplex distributor 97 is in a condition to receive the code signal combination, the rotation of the transfer mechanism will continue for approximately 180° until a stop projection engages the locking projection 76 of the escapement lever which is held by lever 73 in its blocking position. However, if the retransmitting multiplex distributor is not ready to receive this new code signal combination, the armature 82 of a sixth pulse magnet 83 will not be attracted and its biasing spring 84 will be effective to present a projection 86 of the armature into blocking relation with respect to the stop projections on escapement disc 67 to impede the rotation of the transfer cam assembly 61. When the retransmitting multiplex distributor is conditioned to receive the code signal combination, sixth pulse magnet 83 is energized, retracting the extension 86 from the path of the stop projection on disc 67 to permit the transfer cam assembly to continue its cycle of rotation. Accordingly, the transfer mechanism including the transfer cam assembly 61 is released for a rotation of approximately 180° for each revolution of the selector cam assembly 23, through the action of the release cam 78 and for a cycle of the retransmitting multiplex distributor through the operation of the sixth pulse magnet 83.

Included in the transfer cam assembly are transfer cams 87 and 88 (see Fig. 2) which operate a pair of locking bails 89 and 91, respectively, which are pivotally supported upon a stud shaft 92 secured to the mounting plate 11. Locking bail 89 is provided with a locking blade portion 93 which extends transversely of the Nos.

1, 2, and 3 controlling levers 42 and which under the control of cam 87 may be moved into and out of locking relation with respect to these T-levers. Similarly, locking bail 91 is provided with a locking blade portion 94 extending transversely of the Nos. 4 and 5 controlling levers 42 and this locking blade 94 is moved into and out of locking relation under the control of transfer cam 88 for which the locking bail 91 operates as a follower. The locking bails 89 and 91, due to the orientation of transfer cams 87 and 88 within the transfer cam assembly 61, operate successively and in timed relation with respect to the rotation of the transfer cam assembly 23 in the selector mechanism so that the bail 89 operates first releasing the Nos. 1, 2, and 3 levers 42 which may assume the positionment of the corresponding swords 13 under the restoring force of the individual springs 19 associated with the fingers 13 in the selecting mechanism. As soon as the group of code impulses represented by the setting of the first three fingers 13 of the selector mechanism has been transferred to the associated levers 42, bail 89 is passed by its associated cam 87 permitting a biasing spring 90, Fig. 3, to draw the blade 93 of the bail 89 into locking relation with respect to the Nos. 1, 2, and 3 levers to hold them in their set position until bail 89 is operated again by cam 87 to transfer another group of code impulses. Similarly, in timed relation to the operation of bail 89, bail 91 operates, permitting the transfer of a second group of code impulses represented by the setting of the Nos. 4 and 5 fingers of the selecting mechanism to the Nos. 4 and 5 levers and thereupon locks up to hold the Nos. 4 and 5 levers in their set position until bail 91 is operated again.

The contact sets controlled by the levers 42 are, for the purpose of providing a compact structure, disposed in two rows defining a V as illustrated in Fig. 1. Each contact set 46 includes a central spring 96 connected to a segment of a multiplex retransmitting distributor 97 (see Fig. 5) and a pair of cooperating spring contact elements 98 and 99 connected with marking and spacing batteries 107 and 108, respectively. Each of the five contact sets 46 is connected through an associated contact 101 to one segment of the conventional multiplex retransmitting distributor 97 for the purpose of conditioning the segments thereof in accordance with a code signal combination received from the start-stop simplex line for retransmission into a common multiplex line 102 connected to the distributor 97. A pair of rings 103 and 104 in distributor 97 periodically close an obvious circuit to energize the sixth pulse magnet 83 to afford the above-described control of the transfer cam assembly to time the transfer of received code signal combinations from the selecting fingers 13 to the levers 42 into which they are stored for retransmission by the multiplex distributor.

In operation, the selector magnet 31 is connected into line 55 of a start-stop simplex system which is to be extended through the mechanical extension set into the multiplex line 102 through the operation of the multiplex distributor 97. The start impulse of a code signal combination releases selector cam assembly 23 for rotation and as the cam assembly rotates, the received code signal impulses condition the selecting fingers 13 of the selector mechanism in either their rightward or leftward position, as viewed in Fig. 1, in accordance with the nature of the impulses;

that is, whether the impulses are marking or spacing. Due to the orientation of the transfer mechanism release cam 78 in the cam assembly 23, locking lever 73 is rotated in a counterclockwise direction by cam 78 at approximately the end of the number 3 impulse received by the selector mechanism. Escapement lever 68 is thereby permitted to be rocked releasing the transfer cam assembly 61 for rotation and if the multiplex transmitting distributor 97 is in a condition to receive this code signal combination, the sixth pulse magnet 83 will be energized and its blocking projection 86 will permit a continued rotation of the transfer cam assembly 61. Almost immediately after the cam 67 passes the resetting projection 81, transfer cam 87 operates locking bail 89 to an unlocking position and permits the Nos. 1, 2, and 3 levers to assume the position of the Nos. 1, 2, and 3 fingers of the selector mechanism. Immediately after the first three impulses of the code signal combination have been stored in the first three levers, locking bail 89 is again moved into locking relationship therewith to hold the levers in this setting. The setting of the Nos. 1, 2, and 3 levers conditions the Nos. 1, 2, and 3 segments of the retransmitting distributor 97 through the above-described circuits so that the retransmitting distributor which is operating in synchronism with the transfer may transmit into the multiplex line 102 the Nos. 1, 2, and 3 impulses of the received code signal combination as the selector mechanism is receiving the Nos. 4 and 5 impulses of the same code signal combination. After the fifth impulse has been received by the selector mechanism, transfer cam 88 operating on bail 91 permits the Nos. 4 and 5 levers to receive the setting of the Nos. 4 and 5 fingers of the selector mechanism. Through the conditioning of the contact sets associated with the Nos. 4 and 5 levers, the remaining impulses of the code signal combination are conditioned on the Nos. 4 and 5 segments of the retransmitting distributor 97, which transmits the Nos. 4 and 5 impulses of the instant code signal combination to the multiplex line 102 during the time the selector mechanism is receiving the first three impulses of the succeeding code signal combination.

If transmission should cease over the simplex line, selector cam assembly 23 will be arrested and the rotation of the transfer cam assembly 61 will be interrupted by blocking projection 76 of the escapement lever 68 in the above-defined manner. So long as signal transmission is continued over the simplex line, the extension apparatus will continue to operate and transfer the impulses of received code signal combinations in groups onto the segments of the distributor 97, for retransmission into the multiplex line 102. During this continuous operation of the mechanical extension set the sixth pulse magnet 83 maintains synchronism between the transfer mechanism and the operation of the retransmitting multiplex distributor 97.

By providing the two locking bails 89 and 91 to effect the transfer of a received code signal combination to the levers, the transfer is accomplished in two operations, the first of which transfers to the levers one group comprising the first three impulses of a code signal combination and the second operation transfers the remaining impulses of the code signal combination as another group. This method of transferring affords a partial signal overlap by which the distributor 97 is able to retransmit or to start the

retransmission of the first three impulses of the received code signal combination into the multiplex line while the selector mechanism is receiving the final impulses of that same code signal combination. It is, of course, to be understood that the transfer may be carried out in any convenient group arrangement and is not restricted to a transfer of first three and then two impulses of the five-unit code employed in the present embodiment.

In the operation of synchronous multiplex telegraph systems, wherein extension apparatus is employed to extend telegraphic communication from a simplex line into a multiplex line and thence into a receiving simplex line, there is included an extension apparatus which transmits the code signal combination into the multiplex line and a second apparatus which transmits from the multiplex line into the simplex line. The so-called receiving extension apparatus, that is, the one which extends the system from the multiplex line to the receiving simplex line, is customarily arranged to be held inoperative upon reception of an all-spacing signal combination from the multiplex line, and accordingly, it is desirable to condition the sending extension apparatus, that is, the one which extends the simplex line into the multiplex line with an all-spacing condition upon the cessation of signal transmission over the originating simplex line. With such an arrangement upon cessation of signal transmission in the originating line, all-spacing code signal combinations are transmitted on the multiplex line and accordingly, the receiving extensor is maintained in an inoperative condition during periods of nontransmission over the originating simplex line. For this purpose, a set of contacts 106 is provided which may in alternation with contacts 101 be connected with the segments of the associated multiplex retransmitting distributor to place spacing battery on all of those segments upon cessation of signal transmission over the simplex telegraph line. The circuits associated with the transmitting distributor 97 are illustrated in Fig. 5. The circuits to the transmitting distributor 97, whether they be from marking or spacing battery, are through contact elements 109 and conductors 111.

For the purpose of establishing an all-spacing battery condition on the segments of the multiplex retransmitting distributor, the armature 82 of the sixth pulse magnet operates a lever 112 which is pivotally articulated thereto by means of a pivot pin 113 mounted in a vertical projection 114 of armature 82. A special contact operating lever 116 is provided and may be pivotally supported upon pivot stud 43. Contact operating lever 116 is substantially T-shaped and is provided with rearwardly extending projections 117 and 118 which may be engaged by the horizontal portions of T-lever 112 for the purpose of rocking operating lever 116 about its pivot to condition through a contact operating extension 119 the contacts 101 and 106 with central element 109 which is connected as shown in Fig. 5 to the segments of the multiplex transmitting distributor. Although a single contact pile-up is indicated in Fig. 3 as being under the control of the special contact operating lever 116, it is to be understood that this showing represents a plurality of contact sets so that the lever 116 may operate all of the contacts 101 and 106 indicated in the circuit diagram of Fig. 5.

A spring post 121 is secured centrally in the contact operating lever 116 and a second spring

post 122 is mounted in plate 11 and they support a spring 123 which affords an overcenter device to hold the contact operating lever 116 in the condition in which it is set and serves to accelerate the movement of lever 116 from one of its extreme positions to the other as it moves past its central position. A pair of stop abutments 124 is associated beneath the projections 117 and 118 of lever 116 to limit the movement of lever 116 about its pivot.

A spring 126 tends to rock the T-lever 112 in a clockwise direction and into alignment with projection 117 of the operating lever 116 so that as the sixth pulse magnet periodically becomes energized and reciprocates the T-lever 112, that lever will engage projection 117 to position lever 116 in a position indicated in Fig. 3, closing the circuits between contacts 106 and 109 to place an all-spacing condition upon the segments of the multiplex retransmitting distributor. In order to disable these circuits and close the circuits from contacts 101 to contacts 109 to permit the segments of the distributor to be conditioned in accordance with received code signal combinations which are to be extended into the multiplex line, a three arm lever 127 pivoted on a stud 128 is provided. A vertically extending arm 129 of lever 127 is provided with a horizontally extending portion 131 extending transversely of T-lever 112 (see Fig. 2), arm 132 of lever 127 depends in a rearward direction, see Fig. 3, and is provided with a horizontally extending portion 133 which extends transversely of the cam following portions of locking bails 89, and depending portion 134 of lever 127 is provided to cooperate with a locking pawl 136 which is pivotally supported upon a stud 137 secured to mounting plate 11 and normally biased into locking relationship with respect to lever arm 134.

When, in response to the reception of a code signal combination by the selector mechanism, the transfer cam assembly is released, one of the locking bails 89 is operated by its associated cam 87 or 88 in a counterclockwise direction and in moving in this direction through the overlapping engagement of horizontally projecting portion 133 of the arm 132, the bail rotates lever 127 in a counterclockwise direction and lever arm 134 moves to the right-hand side of locking pawl 136 which under the influence of its spring, pulls up and locks lever 127 in this counterclockwise position. The movement of lever 127 is transferred through the horizontally extending portion 131 of its arm 129 to T-lever 112, positioning T-lever 112 in a corresponding counterclockwise position so that in response to the de-energization of sixth pulse magnet 83, T-lever 112 will engage projection 118 of lever 116 and rock lever 116 in a counterclockwise direction disabling the all-spacing circuits of contacts 106 and restoring the circuits to the segments of the retransmitting distributor 97 through contacts 101 and 106.

Lever 116 through the overcenter locking arrangement described above is held in the position to which it is placed by T-lever 112. As the armature 82 moves into its extreme retracted position upon the de-energization of magnet 83, it engages a projection 138 and rocks pawl 136 to release lever 112. Spring 126 tends to rock lever 112 in a clockwise direction but the overcenter spring 123 will retain lever 116 in the position in which lever 112 placed it as the lever 112 and armature 82 moved toward their extreme retracted positions. At the completion of the cycle of retransmitting distributor 97, magnet 83 is again ener-

gized and elevates lever 112 which is moved into its extreme clockwise position under the influence of spring 126. If transmission is continuous, ball 89 will be effective, as described above, to move lever 112 into its counterclockwise position and maintain the circuits from contact pile-ups 46 to the distributor to extend communication therethrough into multiplex line 102.

If signal reception over the simplex line should cease, the locking ball 89 will not be rocked in a counterclockwise direction because the transfer cam assembly will be arrested and consequently spring 126 will be effective to hold T-lever 112 in its extreme clockwise position so that upon the de-energization of sixth pulse magnet 83, the T-lever will engage the projection 117 of lever 116 and condition lever 116 into the position shown in Fig. 3 restoring the circuits which establish the all-spacing condition on the segments of the associated retransmitting distributor 97 from spacing battery 108.

With this construction, so long as signal transmission is continued over the simplex line, it will result in the continuous rotation of the selector mechanism 23 and the transfer cam assembly 61. At each reciprocation of the sixth pulse magnet armature and T-lever 112, the ball 89 will be effective through its engagement with lever 127 to condition the T-lever in a counterclockwise position and render the all-spacing circuits disabled. At the same time upon cessation of signal transmission over the simplex line, spring 126 is effective at the completion of signal transmission of the last received code signal combination to rock T-lever 112 to an extreme clockwise position and, in response to the de-energization of the sixth pulse magnet, condition the operating lever 116 to operate the contact pile-ups and again close the circuits which place an all-spacing condition on the transmitting distributor 97.

The operation of the special contact operating lever 116 takes place at the end of the impulse received by the sixth pulse magnet rather than at the beginning of this impulse and this arrangement prevents clipping of the previous code signal combination which is being transmitted from the multiplex retransmitting distributor whereas if the T-lever 112 were operated at the beginning of the sixth pulse it would be possible to interrupt transmission of the previous code signal combination from the retransmitting distributor before that signal combination had been completely transmitted.

For the purpose of completing the extension circuit, a unit adapted to extend communication from the multiplex channel to a simplex line, is required. A suitable unit for cooperation with the start-stop to multiplex unit which is the subject of this invention may be found in U. S. Patent No. 2,270,339 issued Jan. 20, 1942, to L. M. Potts. That unit forms no part of the present invention and will not be described herein. Reference should be had to the copending application, pages 18 to 22, for a description of the multiplex to start-stop extension set.

Although a specific embodiment of this invention has been disclosed in the drawings and described in detail hereinbefore, it is to be understood that the invention is not to be limited by such disclosure but is capable of many modifications and rearrangements. The scope of this invention is accordingly to be determined by the appended claims.

What is claimed is:

1. In a telegraph system including a start-stop

simplex line, a multiplex line, a multiplex retransmitting distributor connected to said multiplex line, and a telegraph extension apparatus to extend communication from said simplex line into said multiplex line through said distributor, said mechanical extension apparatus including a selector mechanism responsive to code signal combinations received over said simplex line, a plurality of storage levers to be conditioned by said selector mechanism, a plurality of contacts connected to said distributor and operated directly by said storage levers to condition said distributor in accordance with code signal combinations received from said simplex line, and means to transfer the condition of said selector mechanism to said storage levers in succeeding groups.

2. A telegraph extension apparatus for extending telegraphic communication signals from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over the simplex line, a plurality of storage levers to be conditioned by said elements, a plurality of contacts associated with the retransmitting distributor and operated by said storage levers, means for transferring the setting of said elements to said storage levers, and means for operating said transfer means in steps in timed relation to the operation of said selector mechanism whereby the impulses of a received code signal combination are transferred in groups to said storage levers.

3. A telegraph extension apparatus for extending telegraphic communication signals from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line, comprising a selector mechanism including a plurality of elements operated synchronously with the impulses of a code signal combination received over said simplex line and in accordance therewith, a plurality of storage levers to be conditioned by said elements, a plurality of contacts associated with the retransmitting distributor and operated directly by said storage levers, and means for transferring the settings of the individual selector elements to said plurality of storage levers in groups and in timed relation to the operation of said selector mechanism.

4. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising, a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over said simplex line, a plurality of storage levers to be conditioned by said elements, a plurality of contacts associated with the retransmitting distributor operated directly by said storage levers, and means for transferring the setting of said elements to said storage levers in successive steps and in timed relation to signal reception over said simplex line.

5. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising, a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over said simplex line, a corresponding plurality of storage levers associated with said elements to be conditioned thereby, a plurality of contacts associated with the retransmitting distributor operated directly by said storage levers,

transfer means individual to each element, and means for operating said transfer means in groups and in timed relation to the operation of said elements.

6. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising, a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over said simplex line, a corresponding plurality of storage levers associated with said elements to be conditioned thereby, means for retaining said storage levers as conditioned, a plurality of contacts associated with the retransmitting distributor operated directly by said storage levers, transfer means individual to each element, and means for operating said retaining means cyclically and in timed relation to the operation of said elements whereby the components of received code signal combinations are established on said contacts in succeeding groups.

7. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising, a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over said simplex line, a corresponding plurality of storage levers associated with said elements to be conditioned thereby, a plurality of locking mechanisms for said levers, a plurality of contacts associated with the retransmitting distributor operated directly by said storage levers, transfer means individual to each element, and means for operating said locking mechanisms in succession and timed relation to the operation of said elements whereby the components of a received code signal combination are transferred to said contacts in succeeding groups.

8. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising, a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over said simplex line, a corresponding plurality of storage levers associated with said elements to be conditioned thereby, a plurality of contacts associated with the retransmitting distributor operated directly by said storage levers, transfer means individual to each element, a plurality of locking levers operable cyclically to render said storage levers responsive to said transfer mechanisms, and a transfer cam assembly controlled by said selector mechanism to operate said locking levers in succession and in timed relation with the operation of said selector mechanism.

9. In a telegraph system including a simplex line, a multiplex line, and a retransmitting distributor connected to said channel, a telegraph extension apparatus to extend communication from said simplex line to said multiplex channel through said retransmitting distributor, said mechanical extension apparatus comprising a selector mechanism including a plurality of elements to be set in accordance with code signal combinations received over said simplex line, a corresponding plurality of storage levers associated with said elements to be conditioned thereby, a plurality of contacts associated with the retransmitting distributor operated directly by said storage levers, transferring means to transfer the

setting of said elements to said storage levers, a plurality of locking levers operable cyclically to render said storage levers responsive to said transfer means, and a transfer cam assembly controlled dually by said selector mechanism and the retransmitting distributor to operate said locking levers successively and in timed relation to the operation of said selector mechanism and the retransmitting distributor whereby a partial signalled overlap is accomplished.

10. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex line comprising a selector mechanism, a first set of contacts conditioned by said selector mechanism in accordance with received code signal combinations, a second set of contacts, said first set of contacts being associated with the retransmitting distributor through said second set of contacts to condition the retransmitting distributor in accordance with received code signal combinations, and means including said second set of contacts responsive to cessation of signal reception over said simplex line to interrupt said association of said first set of contacts with the retransmitting distributor and to establish a predetermined current condition on the segments of said retransmitting distributor.

11. A telegraph extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex channel comprising a selector mechanism, a first set of contacts conditioned by said selector mechanism in accordance with received code signal combinations, a second set of contacts, and means responsive to the joint control of said selector mechanism and the retransmitting distributor to associate said first set of contacts to the retransmitting distributor through said second set of contacts to condition the retransmitting distributor in accordance with received code signal combinations.

12. A mechanical extension apparatus for extending communication from a simplex line to a multiplex retransmitting distributor for transmission into a multiplex channel comprising a selector mechanism, a first set of contacts conditioned by said selector mechanism in accordance with received code signal combinations, a second set of contacts, means tending to maintain a predetermined condition on the retransmitting distributor through said second set of contacts, and means controlled jointly by said selector mechanism and the retransmitting distributor to overcome said last-mentioned means in response to a code signal combination received over said simplex line to condition the retransmitting distributor through said first and second sets of contacts in accordance with the received code signal combination.

13. A telegraph extension apparatus for extending communication from a simplex telegraph line to a multiplex retransmitting distributor for transmission into a multiplex channel comprising a selector mechanism, a first set of contacts conditioned by said selector mechanism in accordance with received code signal combinations, a second set of contacts, means to associate said first set of contacts with the retransmitting distributor through said second set of contacts, a magnet energized periodically by the retransmitting distributor, an armature for said magnet,

and a contact operator controlled by said armature to interrupt the association of said first set of contacts with the retransmitting distributor and to establish a predetermined condition on the retransmitting distributor through said second set of contacts.

14. A telegraph system including a simplex line, a multiplex channel, a retransmitting distributor connected to said channel, means in said retransmitting distributor for generating synchronizing impulses, a telegraph extension apparatus for continuing signal transmission from said simplex line through said retransmitting distributor to said multiplex channel, said extension apparatus comprising a selector mechanism responsive to code signal combinations received over said simplex line, means for establishing a condition on said retransmitting distributor in accordance with the setting of said selector mechanism, means for establishing a predetermined electrical current condition on said retransmitting distributor upon cessation of signal trans-

mission over said simplex line, and an electromechanical mechanism responsive to said synchronizing impulses for operating one of said establishing means.

15. In a synchronous multiplex telegraph system including a start-stop simplex line and a channel of a multiplex, a multiplex transmitting distributor having a plurality of segments associated with said channel, a first plurality of contacts, means to set said first plurality of contacts in combinations according to signals received over the simplex line, a second plurality of contacts all associated permanently with a spacing condition, means effective when a signal is received over the simplex line to associate the first plurality of contacts with corresponding segments of the distributor, and means effective when no signals are received over the simplex line to associate the second plurality of contacts with corresponding segments of the distributor.

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