

**Oct. 12, 1948.**

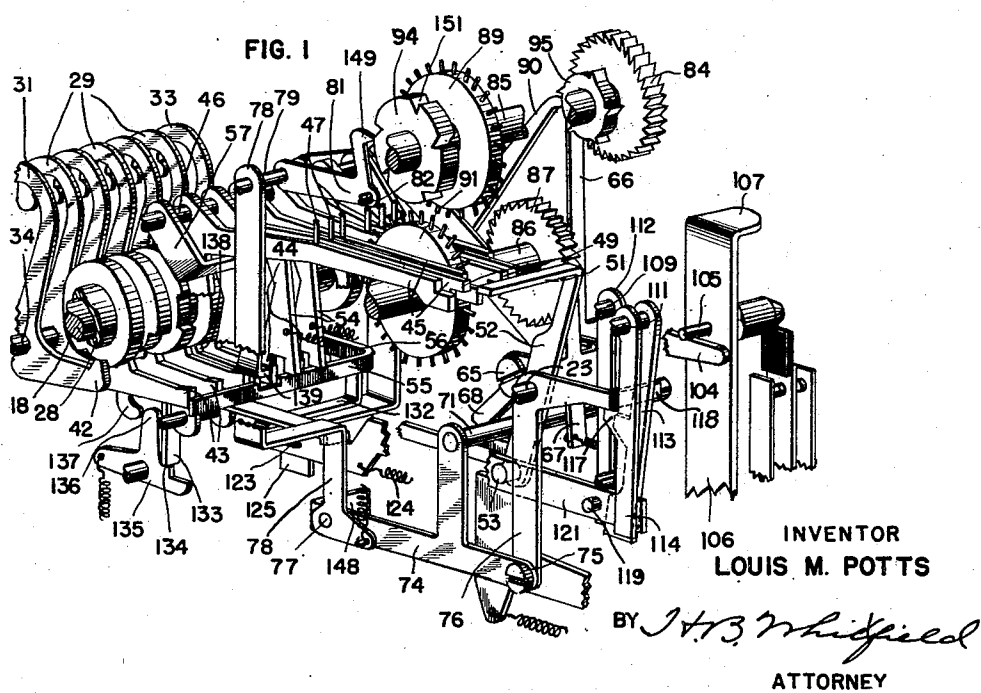
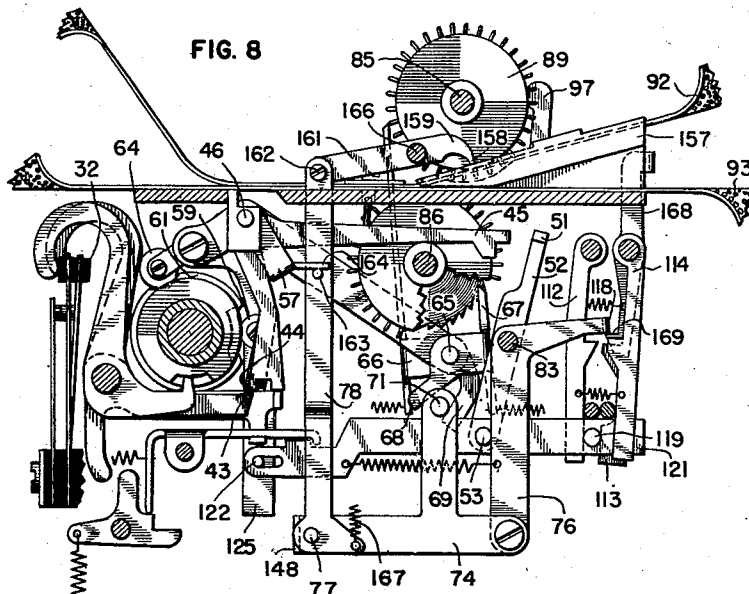
**L. M. POTTS**

**2,451,045**

# AUTOMATIC MESSAGE NUMBERING TELEGRAPH TRANSMITTER

Filed Dec. 20, 1943

3 Sheets-Sheet 1



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**Oct. 12, 1948.**

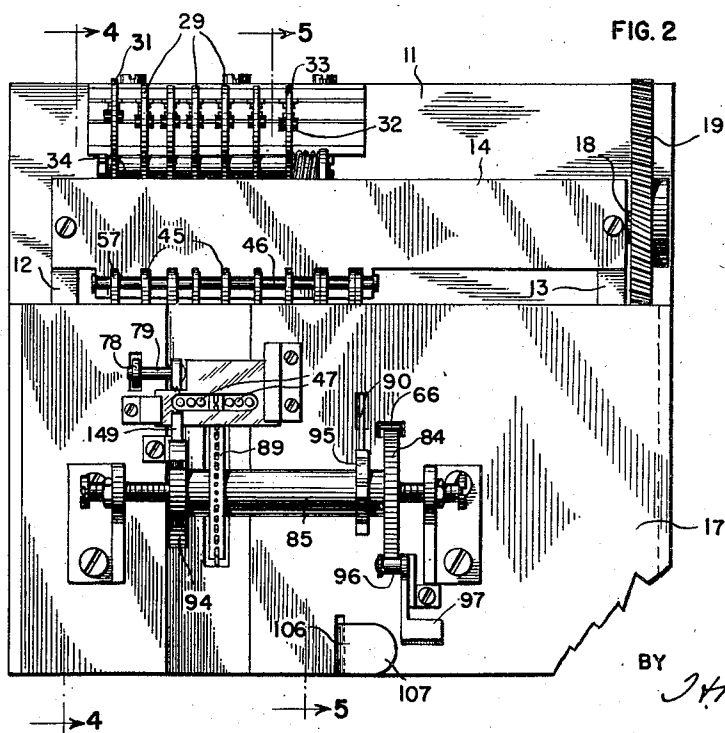
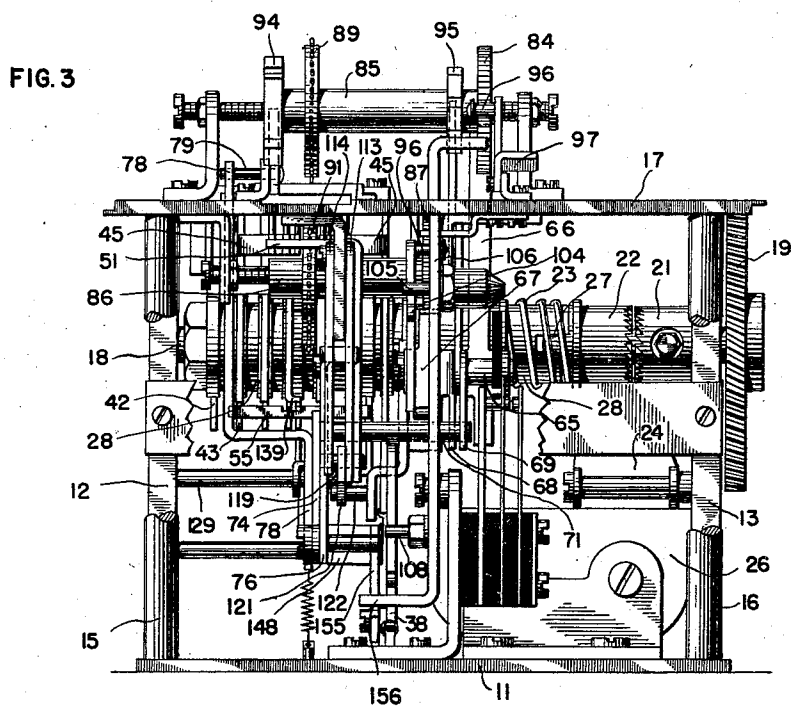
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# AUTOMATIC MESSAGE NUMBERING TELEGRAPH TRANSMITTER

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3 Sheets-Sheet 2



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AUTOMATIC MESSAGE NUMBERING TELEGRAPH TRANSMITTER

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3 Sheets-Sheet 3

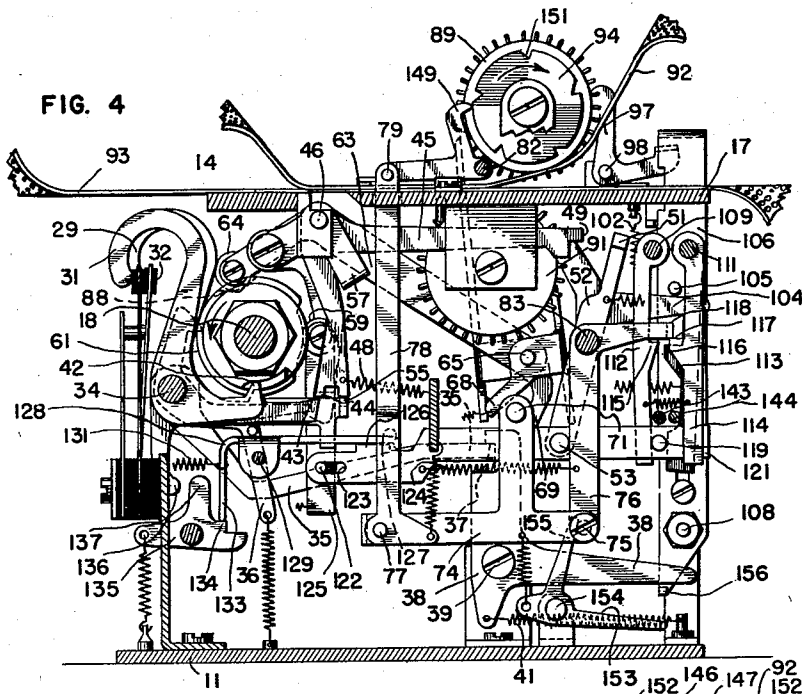


**FIG. 6**

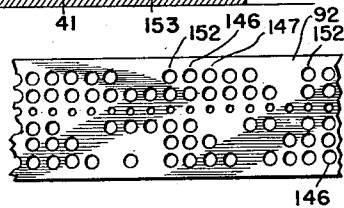


**FIG. 5**

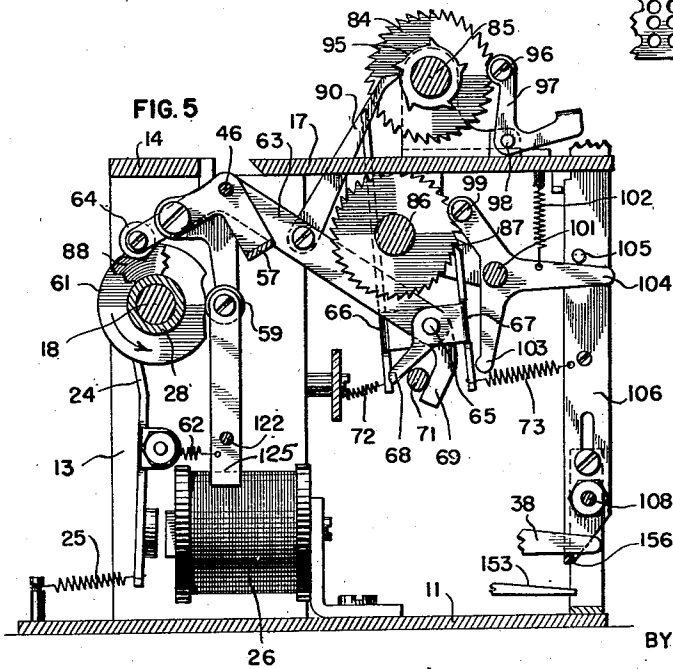
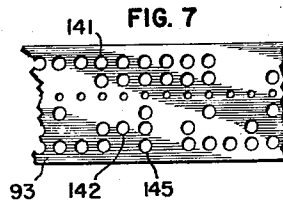


**FIG. 7**



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## UNITED STATES PATENT OFFICE

2,451,045

AUTOMATIC MESSAGE NUMBERING  
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Application December 20, 1943, Serial No. 514,888

25 Claims. (Cl. 178—17)

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The present invention relates to telegraph transmitting apparatus and more particularly to telegraph tape transmitting apparatus provided with automatic auxiliary signal control mechanism such as for introducing serial message numbering signals in accompaniment with consecutive messages.

In telegraph offices where messages are accumulated for transmission over extended or interexchange lines, the practice has been followed of manually noting serially consecutive messages in order that there may be made available a method for instantly identifying each message according to its sequence of the day and in order that periodic checking or verification may be had to determine the chronological propriety of telegraph traffic.

It is, accordingly, the principal object of the present invention to achieve the purpose by providing a consecutive message numbering operation automatically in response to a designating signal.

Another object of the invention is the provision of apparatus operative in response to an end of message signal for recording the number of said message by numbering apparatus operative automatically in response to such signal.

With the foregoing general object in view, there is proposed herewith several embodiments of automatic telegraph transmitting apparatus having incorporated therein an automatically initiated auxiliary device for transmitting signals pertaining to message identification. In each of the embodiments proposed, the objects of invention are attained by the use of two control forms passing through a single sensing apparatus. Each of the control forms is provided with its individually actuated propelling mechanism and each is advanced from one rest position to another. During the dormancy of each, the alternative form is initiated and permitted to advance until the latter attains its rest position. One embodiment presumes a practice in which one of the control forms is provided with number signals arranged in consecutive order and advanced from one position to another in accordance with the extent of messages contained on the other one of said forms. Among several novel features proposed in connection with this embodiment is the provision of local selecting apparatus responsive to certain end of message signals occurring in said form for transferring the control from one to the other at predetermined instants during the course of multiple message traffic or similar signaling condition.

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In an alternative method of achieving the above stated objects, there is proposed a method of auxiliary tape transmission to accompany a principal tape bearing a succession of messages or similar separated items of information whereby the auxiliary tape is provided with an accompanying signal for denoting the instant when supervision is restored to the principal control form. In this adaptation there is featured the further advantage of affording variable amounts of supervisory control on the part of each, the principal and auxiliary control forms, in contrast with the alternative practice in which the auxiliary form is predetermined in its extent of control.

Having declared briefly the principal objects and features of the present invention, reference will now be had to the accompanying drawings and to the detailed description following hereinafter in which like reference characters designate corresponding parts throughout, and in which;

Fig. 1 is a perspective view of one embodiment of the present invention having various portions broken away;

Fig. 2 is a plan view of the embodiment of the present invention featured in Fig. 1;

Fig. 3 is a front elevation of the apparatus illustrated in Figs. 1 and 2, from which the supervisory control forms have been omitted for the sake of clarity;

Fig. 4 is a transverse sectional view taken approximately on line 4—4 of Fig. 2 showing fragmentary portions of the principal and auxiliary supervisory forms in position for operation;

Fig. 5 is a transverse sectional view taken approximately on line 5—5 of Fig. 2;

Fig. 6 is a plan view of a control form fragment such as may be utilized in performing the auxiliary function of consecutive numbering supervision;

Fig. 7 is a plan view of a control form fragment such as may be utilized in bearing the principal message material in a system, such as that featured in Figs. 1 to 5, inclusive, and

Fig. 8 is a transverse sectional view generally resembling Fig. 4 but featuring an alternative embodiment of apparatus in which a selective and variable control is invested in the auxiliary control form as well as in the principal form.

In each of the embodiments, which will now be described in detail, a principal tape transmitting structure is contemplated having the essential details and features of that mechanism shown in U.S. Patent No. 2,296,845.

Referring now more particularly to the first mentioned embodiment featured in Figs. 1 to 5, the reference character 11 designates a base plate upon which there are supported two vertical end wall brackets 12 and 13 strengthened by a transverse bar 14. In addition to this framework structure there are also provided two supporting posts 15 and 16 and a table plate 17. The principal drive shaft 18, Figs. 3 and 4, is journaled in the end brackets 12 and 13 and has secured to it a principal driven gear 19 which receives counterclockwise rotation, Figs. 4 and 5, from a suitable driving source, not shown.

On the shaft 18 there is carried an integrally associated driving element 21 of a beveled tooth clutch coupling whose cooperating member 22 is freely rotatable on said shaft 18 except when its teeth are engaged by those of the driving element 21. Member 22 is loaded by a thrust spring 23 but may be withheld from engagement with its driving member 21 during the interposition of a clutch control armature 24 when the latter is in its unattracted position, Fig. 5, a condition urged by return spring 25 and opposed during the energization of magnet 26. Member 22 is provided with a tenon 27 slidable within an appropriate recess in a sleeve 28 and thereby the rotary motion when imparted to the driven member 22 of the tooth clutch is communicated throughout the sleeve assembly 28 including a series of cams carried thereby and more detailedly described hereinafter.

Of the several cams included on sleeve assembly 28 five relate to the supervision of the five code signal gooseneck levers 29 and one relates to the normally closed-contact gooseneck lever 31. These cams are generally similar to each other in contour and each one is provided with a notch or recess during the disposition of which, at the lowermost point in its respective cycle, the associated gooseneck lever 29 or 31 is permitted to be moved in a counterclockwise direction, see especially Figs. 4 and 8, under the influence of its contactor spring 32. The surface of each cam following its notch is beveled so as to restore the lever to the contact separating position and since the notches are arranged in a spiral succession there is effected a time distribution of the signal cycle.

A seventh gooseneck lever 33 pivoted on the shaft 34 together with the other gooseneck levers 29 and 31 differs from the general class in contour, as best indicated in Fig. 4, by reason of its downwardly and rightwardly extending tail portion 35. This member functions to suspend transmission when the end of the message bearing tape is encountered in accordance with the plan disclosed in the patent referred to above.

This gooseneck lever 33 is itself not directly affected by one of the cams on sleeve 28. Its disposition is indirectly so affected, however, through the influence of a companion lever 36, Fig. 4, and the clockwise position of lever 33 may be maintained when the extremity of its tail portion 35 is latched behind the shoulder 37 of a bell crank lever 38 pivoted at 39 in a suitable bracket on the base plate 11 and urged in a counterclockwise direction by its spring 41. The arrangement of the several transmitting cams of sleeve 28 as well as that of the cam which serves the normally closed gooseneck lever 31 is in accordance with the conventional practice well known in start-stop telegraphy. The cam (not shown) which serves the auxiliary lever 36 in association with the special gooseneck lever 33, constitutes the

subject matter disclosed in U. S. Patent No. 2,296,845.

It is to be observed from Figs. 1 and 4 that while gooseneck lever 31 terminates at its horizontal portion with a follower projection 42 which is in transverse alignment with corresponding follower projections on the transmitting gooseneck levers 29, said gooseneck levers 29 do not so terminate but extend rightwardly beyond, as seen in Fig. 4, and are each provided with a shouldered extremity 43 of which the several lie in the vertical planes of respective blocking portions 44, Fig. 4, of a set of five feeler levers 45 pivoted on a horizontal shaft 46 and having horizontally disposed feeler arms provided with tape or control form probing pins 47.

Each one of the set of five feeler levers 45 is provided with an individual spring 48, Fig. 4. Its horizontal arm terminates in a characteristic notch and lug extremity 49, Figs. 1 and 4, so that as the several feeler levers 45 assume a tape penetrating or tape blocking position as the case may be, the notched extremities 49 constitute a coded area to a transverse probing bail 51. The coded notch and lug distribution on the foremost ends of the sensing levers 45, Fig. 1, is such that during the sensing of that code combination which pertains, in accordance with an arbitrary designation, to the conventional alphabetical character J, a clearance will be afforded to the transverse bail or bar 51 permitting the lever 52 which is integrally formed therewith to move counterclockwise to its full extent of motion about pivot 53 under circumstances which will be more fully described later.

The other end 54 of the sensing levers 45 are also notched so as to provide a coded clearance to a transverse bail 55, but in this instance the code represented by the notchings relates to the figures-shift signal and under circumstances of sensing this code combination signal, a clearance is afforded which will permit the rise of the transverse bail 55 carrying with it lever arm 56 at a significant instant in the cycle as determined by a recess in one of the cams during which a lug, integral with lever 56 and generally resembling the lug 42 of gooseneck 31 enters under impetus of a spring, not shown, but urging said lever 56 in a counterclockwise direction about pivot 34.

From the foregoing it will be understood that the set of sensing levers 45 in addition to performing as conventional tape control means for conditioning the transmitter contacts, also provide through their coded portions at their opposite extremities 49 and 54 means whereby supervisory controls are achieved in response to certain individual code characteristics. Cyclically the tape sensing levers 45 are withdrawn from their tape sensing position when a restoration bail 57, see especially Fig. 4, is rocked in a clockwise direction about pivot 46 under the influence of a spring which is of sufficient tension to overpower the several springs of the feeler levers 45 collectively and timed by the follower roll 59 which follows the periphery of a cam 61 also carried by the sleeve 28 for this purpose, see Fig. 5.

The low portion of cam 61 is of comparative short angular duration so that bail 57 during its restorative position, so far as the feeler levers 45 are concerned, occupies but a brief time interval of the complete cycle as understood in terms of the rotation of shaft 18. On the other hand, its apex is of extensive duration permitting the several feelers 45 to assume their tape sensing position during the major portion of each rotary cycle

of shaft 18. This practice is conventional in printing telegraph tape transmitting apparatus and may be ascertained by referring to the above-mentioned patent. It is repeated here for the purpose of affording a ready understanding of the relative timing of the several elements in terms of the added elements which constitute the embodiment of the present invention under description as will be later explained.

Also pivoted on shaft 46 together with the feeler levers 45 and their operating bail 57 is a bell crank 63, Figs. 4 and 5, the short arm of which is provided with a follower roller 64 through which it pursues the periphery of a tape feed cam 88 also situated on the assembly 28, and having a long arm which carries a pivot shaft 65 that gives support to the feed pawls 66 and 67. Pivot ears on both the pawls 66 and 67 are bent oppositely so as to form yokes with the upright portions thereof, and opposite one another as best indicated in Fig. 5. Pawl 67 has integrally formed therewith an uppermost tail extremity 68, and in contrast therewith pawl 66 has integrally formed a lowermost tail portion 69, and between the two tails 68 and 69 there is adapted to be disposed a horizontal control transfer rod 71.

Pawl 66 is considerably longer than pawl 67 and is urged in a clockwise direction about its supporting pivot 65 through the influence of a spring 72, while pawl 67 is influenced in a counterclockwise direction about pivot 65 through the influence of a spring 73. The extent to which each pawl 66 or 67 may respond to the influence of its spring 72 or 73 respectively is determined by the point at which its tail 68 or 69 engages the control rod 71, Fig. 5. Rod 71 is shiftable laterally in correspondence with the shifting of its supporting bar 74, Fig. 1, one end of which is pivoted at 75 to a vertical arm of a bell crank lever 76 while the opposite extremity is also pivoted at 77 to a link 78 the upper end of which is pendulously supported as at 79 from a shaft carried by one arm of the bell crank lever 81.

Since the bell crank lever 81 is itself carried in a stationary pivot 82 and since the bell crank 76 is also stationarily pivoted at 83, it follows that bar 74 and hence horizontal shaft 71 will be movable laterally in a relative parallel motion, and that when rod 71 is disposed in its right-hand extreme position, tail 69 will withhold the uppermost extremity of pawl 66 from engaging a ratchet wheel 84 of an uppermost tape feed shaft 85 while the lowermost tape feed shaft 86 has its ratchet wheel 87 engaged by the pawl 67. On the other hand when shaft 71 is moved to its extreme leftward position, Fig. 5, the condition of the pawls 66 and 67 is reversed, and pawl 66 is permitted to come into engagement with its ratchet wheel 84 while pawl 67 is withheld from engagement with its ratchet wheel 87.

Cam follower roller 64 pursues the periphery of cam 88, Fig. 5, imparting to the bell crank lever 63 a brief counterclockwise movement upon encountering the comparatively short low portion of said cam 88. The apex portion of the cam's periphery is of extensive cyclic duration, hence the clockwise dormant position of bell crank 63 is of relatively long duration. During the course of a cycle, bell crank 63 describes a to and fro clockwise and counterclockwise motion causing the pivotal center 65 to be reciprocated in a generally vertical direction and causing the pawls 66 and 67 to be thrust first upwardly and then downwardly, and the one of them which happens to be engaging its ratchet 84 or 87 correspond-

ingly imparts rotation of a limited angle thereto. It is to be noted that pawl 67 imparts counterclockwise rotation to its ratchet wheel 87 and hence to shaft 86 while pawl 66 imparts clockwise rotation to its ratchet wheel 84 and hence to shaft 85. While the effects of shafts 85 and 86 turning in opposite directions appear to oppose each other, the proportions of the respective elements carried thereby are identical so that the motion imparted to a tape feed sprocket 89 carried by shaft 85 and that of a sprocket 91 carried by shaft 86 is identical so far as tape passing through the zone intermediate the two driving elements is concerned.

In Fig. 4 the reference numeral 92 represents a sequence number signal bearing perforated control form, while the one indicated 93 represents a general message matter bearing control form. The distinction between the two forms in a general sense may be disregarded or considered only in respect to the comparative frequency with which the two control forms are employed. Form 93 is contemplated to be of relatively longer operational performance while that of 92 of comparatively shorter duration. This classification is arbitrary and conceivably may be reversed in respect to the disposition of the two tape feed devices.

Shaft 85 carries, in addition to the aforementioned ratchet wheel 84 and tape feed sprocket 89, a multiple apex cam 94 and the auxiliary ratchet feed wheel 95. The afore-described elements 94 and 95 are provided with five equally spaced sections, the cam 94 having five apices and the auxiliary tape feed sprocket wheel 95 having five feed teeth. This arrangement is made to accord with the chance conditions of commercial apparatus, since sprocket feed wheels of this class are made with thirty-five feed pins and since each member, transmitting groups of signals, requires, including the four integer signals, a total of seven signals.

It may be observed from Fig. 6 that the number tape 92 is provided with two contiguous rub-out (all-marking) signals at the end of each number whereas but one might be expected to suffice so far as affording clearance to the feeler levers 45 is concerned. This precaution is suggested in order to be able to advance the cam 94 for restoring the bell crank 81 immediately following its performance, as will be explained later. Thus a pawl 90 has been provided upon arm 63, which engages the related tooth of ratchet wheel 95 causing shaft 85 to be advanced one step after the first all-marking signal has been sensed and though the control is thereby effectively transferred to the lower shaft 86.

Upon each stepped advancement of shaft 85 under impetus of the feed pawl 66, the position is retained through the influence of a detent jockey 96, Fig. 5, which consists of a bell crank lever 97 pivoted as at 98 and having a detent pin that is spring urged to rest between the ratchet feed teeth of wheel 84 as each position is attained during the reciprocal movement of pawl 66. The lowermost tape feed ratchet wheel 87 is similarly provided but in this instance the detent jockey 99 is carried by one arm of a three-armed lever pivoted at 101 and urged in a counterclockwise direction by a spring 102. Another arm 103 of the three-armed lever terminates with a lobe for engaging the lowermost extremity of pawl 67 so that when this lever is rotated clockwise against the influence of its spring 102, lobe arm 103 will engage and withdraw pawl 67 from its ratchet

wheel 87 independently of the afore-described arrangement of control under the influence of control pin 71.

From Fig. 4 it will be noted that the teeth of sprocket wheel 89 engage the perforations of uppermost control form 92 while those of sprocket wheel 91 engage the perforations of the lowermost control form 93. Since, in accordance with the supervision of control transfer shaft 71, as afore-described, but one or the other of the tape feed sprocket wheels 89 or 91 may be operated, it follows that the advancement of the tapes 92 and 93 are effective only under individual conditions and that except for the single step operation under impetus of pawl 90, the sprocket wheels never are advanced together.

The three-armed lever which carries the detent jockey 99 includes a horizontal arm 104 which is engageable by a short stud pin 105 carried as an integral part of push bar 106. The latter element is confined for vertical motion and is spring urged to maintain its uppermost position, Figs. 1 and 4, whereat the pin 105 is poised above arm 104 until said push bar 106 is depressed by the manual application of force on its over bent top portion 107.

The purpose of push bar 106 as may be understood by referring to the patent mentioned above, is primarily for restarting the transmitter apparatus after it has been brought to rest upon the occurrence of an end-of-tape signal manifest upon a special sensing lever provided for this purpose. Also in withdrawing detent 99 and permitting shaft 86 to run free, this bar constitutes a means for rethreading a new tape onto the lower feed sprocket 91. As a further consequence of its depression, another horizontally extending stud pin 108 thereon engages the arm 38 of bell crank lever 37 which may be latching the extremity 35 of gooseneck 33 and thereby releases the latter member, reinstating the relative disposition of parts as illustrated in Fig. 4, and thereby permitting the resumption of tape transmission.

Supported upon two parallel horizontal pivot shafts 109 and 111 there may be noted three pawl levers 112, 113, and 114. Of these, lever 112 is pivoted on shaft 109 and is provided with a stop shoulder or tooth 115 opposite similarly provided stop shoulders or teeth 116 and 117 on the levers 113 and 114, respectively. It is to be noted that of the three shoulders, 117 on lever 114 is of a slightly higher level than shoulder 115 of lever 112, which, in turn, is correspondingly higher than the shoulder 116 of lever 113. This arrangement is provided to regulate the performance of bell crank lever 76 having a sidewardly extending lug 118 formed on its horizontal arm. As the several levers 112, 113, and 114 are selectively actuated, they permit the passing of lug 118 downwardly as will be hereinafter more fully described.

Blocking lever 112 is provided with a spring for urging it in a counterclockwise direction about pivot 109 while levers 113 and 114 are provided with springs for urging them in clockwise direction about their common pivot 111. Levers 112 and 113 may respond to the urge of their respective springs until the lowermost extremities of the two come into abutment respectively with a limit pin 119 secured to the horizontal slide bar 121 and a fixed pin 144 carried by the frame. The mid-portion of slide bar 121 also carries the afore-mentioned pivot 53 at which the lower extremity of lever 52 is articulated thereby deter-

mining to an extent the nature of movement of said slidable bar 121.

In addition to its pivotal support at pin 53, horizontally shiftable bar 121 is also pendulously supported at its left extremity, Fig. 4, upon a pivot pin 122 which resides in an elongated horizontal slot 123 in said slide 121. Accordingly, except for the restraint which is had through bell crank lever 76, bar 121 is free to slide in a horizontal direction longitudinally of itself with its rightward end pivoting in an arc about shaft 83 as a center and its leftward end constrained to a more nearly parallel motion as defined by the slot 123 and its contained guide pin 122. A spring 124, Figs. 1 and 4, imparts a rightward pull to the slide bar 121 causing it to seek the position indicated in Fig. 4 whereat the pin 122 is disposed in the leftmost extremity of slot 123 while pin 119, integral with bar 121, assumes a relationship with respect to levers 112, 113, and 114, such as that illustrated.

Pin 122 is carried by the lower extremity of an arm 125 which is integral with the feeler lever restoration bail 57 and therefore, responds in accordance with the movements of roller 59 that rests upon the periphery of its associated cam 61 on cam assembly 28. Through this arrangement the relative position of pin 122 will vary in accordance with the contour of said control cam. As indicated in Fig. 4, follower roller 59 has assumed its leftmost condition; that is, riding the lowest portion of said cam. At other times when the roller is moved rightwardly by cam 61, pin 122 will be disposed in a position to the right of that shown in Fig. 4, permitting bar 121 to respond to the influence of its spring 124. This movement on the part of bar 121 may thereafter be restrained, however, when its integral lug 126 encounters the overhanging lip 127 of a latch lever 128 pivoted at 129 and urged in a clockwise direction by a spring 131.

When the latch lever 128 is lifted, that is, moved in a counterclockwise direction about its pivot 129 on account of the raising of horizontal arm 132, a member integral with the afore-described figures shift signal bail 55, then the lip 127 is withdrawn from the path of shoulder 126 and bar 121 is then permitted to be moved rightwardly to an extent further than that when confined by the described latching lip and lever 128.

When latch bail 128 is moved counterclockwise about its pivot 129, a downwardly disposed arm 133 thereof overrides the shoulder 134 of a secondary latch 135 and in so doing becomes disposed in front of said shoulder 134 thereby latching itself in counterclockwise position so as to hold its lip 127 poised above the shoulder 126 under restraint of the secondary latch 135. This condition is maintained by a spring that urges secondary latch 135 in a counterclockwise direction and may be released only when the upstanding lug 136 of said secondary latch is encountered by the lobed arm 137, an appurtenance formed with an auxiliary lever 138, Fig. 1. This lever is disposed adjacent the conventional No. 3 code impulse gooseneck lever 29 and is subjected to its associated feeler lever extremity 139 which is bent over as best indicated in Fig. 1, so as to be able to block both the regular No. 3 gooseneck lever as well as the special or auxiliary lever 138.

In Fig. 1 there may be noted the vertical portions 54 of the several feeler levers 45 of which the two foremost ones have been broken away revealing as whole levers those only that relate to the Nos. 1, 2, and 3 signal impulses and not those relating to the Nos. 4 and 5 impulses. Of

these vertical portions of the several feeler levers, those which are allocated to the Nos. 1, 2, 4, and 5 impulses of the five unit code are bifurcated at the lower extremity as has already been described, while the solitary central lever relating to the No. 3 impulse is bent over as at 139 so as to overlie not only the third gooseneck lever 29 whose horizontal section extends beneath this particular sensing lever, but also the special lever 138 having the afore-mentioned lobe 137 and serving the purpose of releasing the secondary latch 135.

From this, it follows that when in accordance with any code signal, the No. 3 feeler lever 45 is placed in its marking (counterclockwise, Fig. 1) position, the blocking lug 139 is removed from interposition over the horizontal sections of levers 138 and 29. However, when this particular feeler is disposed in spacing (clockwise) position, then blocking lug 139 is disposed to obstruct counterclockwise movement of both of the afore-described levers 29 and 138. When the latter condition obtains, then lever 138 fails to be moved counterclockwise when the notch in its associated cam is presented as in the manner of operating the general class of gooseneck levers 29, and its lobe 137 will fail to actuate and release catch 135. In the event, however, that this lever 138 is moved, such movement causes lobe 137 to execute the afore-described release operation of latch 135.

Attention will now again be given to the horizontally shiftable bar 121 and to the three blocking pawls 112, 113, and 114, which it controls through the agency of its integral pin 119. When the apex of cam 61 moves roller 59 rightwardly, and thereby thrusts pin 122 in the same direction, longitudinal bar 121 moves in response to its spring 124 and pin 119 thrusts against the lowermost extremity of lever 113. Meanwhile, lever 112 moves in a counterclockwise direction about pivot 109 under influence of its spring as pin 119 advances. As a result, sidewardly bent section 118 of bell crank 75 rides off the shoulder 117 of lever 114 and is immediately supported by the shoulder 115 of lever 112. The extent to which bar 121 may move to the right will depend upon whether the coded extremities 49 of the several feeler levers 45 are disposed in accordance with the code combination for the letter "J." This contingency may not now obtain for the signal which has just served in releasing bar 121 is not the letter "J" signal but instead the figures shift signal. Hence, bar 51 will at this instance be obstructed by the lugs of some of the feeler levers 45.

Incidentally, it is to be noted that the feeler pins 47 of the feeler levers 45 are of sufficient length to protrude through both thicknesses of the control forms 92 and 93. Since control form 93 has been arbitrarily disposed beneath control form 92, it will be understood that for a proper sensing operation of tape 92, the perforations in the control form 93 will necessarily be required in all positions as in the case of a conventional rub-out signal. Also, in order to properly sense variable code combinations in the tape 93, the uppermost control form 92 will need to be disposed so as to present a similar rub-out signal in the tape sensing position. Since the two control forms 92 and 93 are advanced individually, it follows that the inert one of the forms will of necessity have to be arrested with a rub-out signal disposed in the tape sensing position.

By referring now to Figs. 6 and 7, it will be noted that the message numbering control form 92 is designated as having two rub-out signals

following in succession and, thereafter, a figures shift signal having markings in the 1, 2, and 4, 5 positions. These code combinations are then followed by four numerical integer code combinations, in Fig. 6 illustrated as being for the numbers 2708 and 2709, there being shown a length of tape coextensive with two complete numbering sets of signals.

The tape fragment featured in Fig. 7 pertains to general message matter. It is provided with but a single rub-out signal followed by certain well-known signals pertaining to the preamble portion of a conventional telegraph office routed message. In the instant illustration, the code signals thus designated are "A," figures shift, number signals identifying the particular station transmitting the message, and thereafter (not shown) the signals having to do with the particular message subject matter. There will now be described briefly the manner of operating the embodiment of automatic tape transmitter featured in Figs. 1 to 5, together with such reference to the fragments of tape illustrated in Figs. 6 and 7 as is helpful to indicate the typical mode of operation.

Let it be supposed that two control forms such as are indicated 92 and 93 are disposed in the manner illustrated in Fig. 4 with suitable tape reels for supply and others for take-up for both the message subject matter as well as the sequential numbering subject matter tapes. Let it be assumed also as an arbitrary starting point that the transmitter has just completed the sensing of the last message matter character of some message on the control form 93 and that the figures shift signal 141 is instantly being sensed. This signal, as may be noted from Fig. 7, comprises marking in the Nos. 1, 2, 4, and 5 positions and spacing in the No. 3 position. Accordingly, the bar 55 will be afforded a selective clearance due to the notches in the sections 54 of the tape sensing levers 45 and it will, in response to the urge of its spring, rise carrying with it the platform 132. As an effect of the movement of platform 132 the latch lever 128 will be raised and caused to rotate in a counterclockwise direction, Fig. 4, about its pivot 129 disposing its opposite end 133 on the latching side of shoulder 134. The spring of latch 135 will thereupon hold the latch lever 128 in the described poised position so that its overhanging lip 127 will be clear of the shoulder 126.

Since, in accordance with the nature of a figures shift signal, the No. 3 impulse auxiliary lever 138 will not, at this time, be permitted to rise due to the blocking effect of sidewardly extending projection 139 of sensing lever 45, latch 135 will not be tripped and the effect of holding latch lever 128 will accordingly not be interrupted. When, thereafter, cam assembly 28 describes another cycle of rotation and cam 61 encounters roller 59 thrusting its lever rightwardly, Fig. 4, the pivotal pin 122 will be shifted to the right and then slide 121 will be permitted to respond to its spring 124 moving rightwardly until the transverse bar 51 of its selection probing lever 52 encounters one or more of the obstructions 49 that terminate the sensing levers 45.

The resulting movement on the part of pin 119 will engage and move lever 113 to the right opposing its individual spring but this extent of movement by pin 119 will not engage and move lever 114. As this figures shift cycle is completed, cam 61 restores arm 125 and the latter through pin 122 returns slide bar 121 to its left

where the mechanism remains in anticipation of a succeeding signal. At this return movement pawl 112 is withdrawn from supporting lug 118 which then drops a slight degree further until it comes to rest on shoulder 116 of pawl 113. It will be evident that pawl 114 will now be blocked by lug 118 when it seeks to return. The several elements will, accordingly, remain in the position just described at the conclusion of the figures shift signal 141 and will thereafter respond as will now be described to the succeeding signal 142, which, as mentioned above, partakes of the characteristics of the alphabetical character "J" but is more accurately termed here the end-of-message signal.

When the feelers 45 sense the end-of-message signal, the proper clearance of obstruction lugs 49 will be had to permit the sensing bar 51 to move leftwardly and hence its lever 52 to rotate counterclockwise thereby permitting the slide bar 121 during this signal an additional amount of movement to the right. When, thereafter, pin 119 moves to the right, it will engage lever 114 and rock the latter member counterclockwise about its pivot 111 removing the final supporting shoulder 117 from the sidewardly extending lug 118 of bell crank 76. As a consequence, bell crank 76 will rotate clockwise to its full extent shifting rack 74 to the left and control shaft 71 in the same manner.

Meanwhile it is to be observed that when lever 112 responds to the urge of its spring and moves in counterclockwise direction about its pivot 199 due to the movement rightwardly of pin 119, it is limited when it encounters stop 143 and that pin 119 may move to an extent beyond engagement until both of the supporting projections 117 and 116 are withdrawn from the range of the sidewardly extending lug 118.

It is to be noted that the code combination for the letter "J" which has been chosen as an end-of-message control signal has no perforation in the No. 3 position so that accordingly, as a result of its selection, the special release lever 138 for tripping the latch 135 is again ineffective, permitting the latch lever 128 to remain in its poised position.

As a result of the succeeding operation of feeler levers 45, they encounter in the tape 93 the rubout signal combination 145, Fig. 7, whose characteristics include marking in all five positions. As a consequence of this selection the special lever 138 described above is now actuated due to the withdrawal of the blocking lug 139 of the No. 3 feeler lever 45. As a consequence, its lobe 137 engages the upright arm 136 of latch 135 rocking the latter member clockwise about its pivot and releasing latch lever 128 which had been held by obstruction with the shoulder 134 through the downwardly extending arm 133. The purpose in providing the several pawls for holding the transfer control pin 71 and its associated mechanism until the second cycle after the figures shift is to prevent the transfer of control from the message tape to the number tape until the message tape has been advanced to the all-marking position.

After slide bar 121 has moved to the right, lip 127 descends on the lug 126. Pin 119 then encounters the lowermost extremity of lever 113 pushing the latter member away from its stop pin 144, shoulder 116 is withdrawn from support of the bell crank projection 118, and spring 124 becomes effective to rock bell crank 76 clockwise about pivot 83 thrusting movable bar 74

leftwardly and shifting the control pin 71 from the position illustrated in Fig. 4 to a position slightly to the left thereof effecting a transposition upon the tape feed pawls 66 and 67 so that pawl 66 thereupon comes into engagement with its ratchet wheel 84 as pawl 67 is withdrawn from engagement with its ratchet wheel 87.

As a result of this transposition of tape feed ratchet wheel actuating pawls 66 and 67, the further reciprocal movement of arm 63 under the control of the tape feed cam causes the upper tape feed shaft 85 to be actuated instead of lower tape feed shaft 86. Accordingly, the tape 93 becomes arrested in position 145, located opposite the feeler lever pins 47 while the upper tape 92 starts to be advanced in a step-by-step manner as will now be described.

Since there are provided perforations in all positions of the code combination 145 the feeler pins 47 are able to extend through the lower tape and probe for various code combination signals in the upper tape 92. The upper tape which had been at rest in the position designated 146, Fig. 6, now proceeds to be advanced so as to present the code combination of position 147 to the several feeler levers 47. Meanwhile, it is to be noted that on account of the selective operation of bell crank 76, that is, its actuation and consequent shifting of parallel bracket 74 leftwardly, the bent over extremity 148 of said bracket 74, Fig. 1, is moved to the left a distance beyond that illustrated in Fig. 4 or to an extent so as to be located within the range of arm 125 of the above-mentioned sensing lever bail assembly actuated by the follower roller 59 when the latter is thrust rightwardly by its cam 61.

Portion 148 is too low, however, to be engaged by the lowermost extremity of arm 125 at this time and the restoration of bell crank 76 which requires a thrust from the extremity of said arm 125 in the attainment of this object will await until bell crank 81 having the follower node 149 drops into one of the recesses 151 of the crown cam 94. This occurs after a certain number of steps have been imparted to the upper tape feed assembly including shaft 85 during which the code combination signals including the four numeral codes as indicated in Fig. 6 are transmitted, followed by the two rubout signals 152 and 146. Auxiliary ratchet wheel 95 which has an engageable tooth at spaced intervals only on its periphery will now become disposed so that one of its said teeth may be engaged by the special feed pawl 90 upon the latter member's next ensuing reciprocation though such movement occurs after control of tape feeding has been restored to shaft 86. This movement of one step by shaft 85 advances cam 94 so that the nose 149 of bell crank lever 81 is forced out again resuming the position in which the element is illustrated in Fig. 4.

Thus, while the lower tape 93 will be understood to advance throughout a variable distance and relinquish its supervision only after the occurrence of the significant code combination order of figures shift signal followed by an end-of-message or character "J" signal, the uppermost control form 92 advances throughout a limited distance only and is automatically suspended by a characteristic forming part of its tape feed mechanism.

The effect of the figures shift code combination signal 147 during the supervision by control form 92 is to place the printing apparatus at the remote station in condition for printing figures instead of alphabetical characters, the characters follow-

ing being of that class. Accordingly, the selector apparatus at the tape transmitter will undergo the preliminary selection as described in connection with this signal when transmitted by tape 93 and will cause the latch lever 128 to be raised and momentarily held by the latch 135. This condition of latch lever 128 will not continue for long, however, because upon the occurrence of any succeeding code combination signal having marking in the No. 3 position, latch 135 will become actuated coincident with the selective movement of lever 138 and will restore latch lever 128 to normal.

When the transmitting apparatus becomes exhausted of message matter transmitting tape 93, and as a consequence of the control mechanism described in the patent referred to above, shaft 86 is arrested and restarting of transmission must then be manually arranged by the depression of push bar 106 as already mentioned above. Since this abeyance may also find the bell crank 76 in its extreme clockwise position, means have been provided including a projection 156 which terminates the lowermost extremity of push bar 106 and a bell crank lever 153 pivoted at 154 and having an arm 155 for engaging a pin extension on pivot 75, Fig. 4. In this way, the depression of push bar 106 causes arm 155 of bell crank 153 to be rotated in a clockwise direction to effect the restoration of bell crank 76.

There will now be described a modified adaptation of the present invention featured in Fig. 8 of the accompanying drawings and characterized by the provision of a mechanism for permitting the control form 92 to maintain supervision of the transmitter for an indefinite period of time in lieu of the prescribed limited motion under control of the crown cam 94 or, otherwise stated, for supervising the transmission under the control of form 92 for a variable time or until such a time as this transmission is relinquished under the control of a special marking carried by said form 92.

Throughout the major portion of the apparatus, a general resemblance may be noted between the mechanism of Fig. 8 and that of Figs. 1 to 5. As in the preferred embodiment, there are provided three control levers 112, 113, and 114, all actuated by a pin 119 carried as an integral part of the horizontal slide bar 121. Also, as in the case of the preferred form, a bell crank member 76 giving support to a control pin 71 predetermines the relative shifting arrangement between a pair of pawls 66 and 67 by means of which step-by-step motion is alternatively communicated to one or the other of the tape feed shafts 86 and 85.

From the disclosure in connection with the preferred embodiment, it will be clear how the supervision under the control of the message matter tape 93 may be shifted to that of the auxiliary tape 92. This tape will now be referred to as auxiliary tape since in its present embodiment it may have utility other than that of supplying a fixed number of signals such as is true of a numbering system but may instead supply information of varying lengths such as addresses, names, etc.

The auxiliary tape 92 is guided through an inclined supporting table 157 giving support to the under surface of the tape 92 and particularly so in the region designated 158 whereat the nose 159 of a probing lever 161 is intermittently applied in search of a special perforation such as a sixth hole or marginal notch as may be preferred, in accordance with which the termination of supervision by form 92 is predetermined. Lever 161 is pivotally articulated as at 162 to a link 78 generally resem-

bling the corresponding member in the preferred embodiment except that in this instance link 78 is provided with a pin 163 which lies in the path of a horizontal extension 164 integrally formed with the sensing lever restoration bail 57. The feeler levers 45 are cyclically returned in a clockwise direction about their pivots 46 when the restoration bail 57 is actuated by its cam roller 59 under the supervision of a cam 61. The motion on the part of bail 57 is clockwise about shaft 46 as a pivot and accordingly, its extension 164 will be understood to describe a rotary rolling motion imparting a downward stroke to the pin 163 and accordingly to the link 78.

As a result lever 161 is rotated in a counter-clockwise direction about its pivot 166 withdrawing the feeler extremity 159 from the region 158 but after the effect of cam 61 a spring 167 restores the link 78 and lever 161 whereupon the following projection 159 is reapplied to the surface of the tape in search of the message terminating perforation. When such a perforation is encountered, lever 161 will be permitted to rotate in a clockwise direction about pivot 166 to such an extent as to raise pivot 77 and the leftward extremity 148 of bracket 74 into the path of arm 125, just as in the case of the preferred embodiment of this structure. Thereupon a succeeding rightward motion on the part of arm 125 thrusts bracket 164 to the right returning control pin 71 to its extreme right position and rocking bell crank lever 76 back to its normal, Fig. 8, position.

Supervisory control pin 71 is situated between the two tail portions 68 and 69 of the ratchet wheel feed pawls 66 and 67 just as in the case of Figs. 1 to 5. As a consequence, the rightward movement imparted by arm 125 causes the pin 71 to shift feed pawl 66 out of engagement with its associated ratchet wheel on shaft 85 while permitting feed pawl 67 to be moved into engagement with its ratchet wheel on shaft 86. This restores supervision to the principal control form 93 which undergoes continuous supervision until it in turn encounters the prescribed changeover signals as in the case of the preferred embodiment.

It is to be understood that as with the case of the preferred modification, the upper tape 92 must be spent or must be arrested in a condition in which all of the code perforations are marking in order that tape sensing pins 45 may be effective on the lower tape and that likewise the lower tape must be so effected in order that the sensing levers 45 may be under the supervision by the upper tape. Also, in connection with the modification, Fig. 8, there may be provided a method whereby the auxiliary tape 92 is withheld from control until a manually operable lever 168, having the supporting shoulder 169 which holds the bell crank 76 in the indicated position, is released. When so employed, the auxiliary tape 92 may be withheld from control and may, therefore, represent a rush message that is inserted by arresting the transmission of tape 93 at a point where all perforation signals are provided following which the auxiliary control form 92 takes over and continues until the rush message has been transmitted.

Upon the restoration of lever 76, its sidewardly extending lug 118 is replaced on the uppermost shoulder 169 and supervision may then not be taken from the tape 93 until the manual operation of lever 168 has again been effected. Under the prescribed conditions of operation, lever 161

may sense a special perforation in the control form 92 or it may sense the end of control form 92, either event having the same result of restoring supervision to the primary control form 93.

While the present invention has been explained with reference to specifically disclosed embodiments, it is to be understood, nevertheless, that changes and modifications may be invoked without departing from the essential spirit or scope thereof. It is, accordingly, not intended to be limited by the details in the accompanying drawings nor by the specific recitations in the foregoing description except as indicated in the hereunto appended claims.

The invention claimed is:

1. A transmitter apparatus comprising, a plurality of step-by-step form feeding devices, a common form sensing device, and means responsive to the signals sensed by said common form sensing device to concurrently arrest one of said form feeding devices and initiate the operation of another of said plurality of form feeding devices.

2. An automatic control apparatus comprising, a plurality of control tape feeding devices for advancing individual tapes, means associated with each of said devices responsive to certain code settings in the associated tape to suspend its own operation and to concurrently initiate the operation of another of said plurality of tape feeding devices, and a common sensing apparatus for sensing the code settings in all of the tapes associated with said plurality of control tape feeding devices.

3. In an automatic tape controlled telegraph transmitter, a pair of tape feed sprockets rotatable in opposite directions to propel respective perforated signal bearing tapes through a common sensing zone, a reciprocating power means for imparting rotation in step by step manner to one or the other of said pair of sprockets and means associated with each of said sprockets for coupling said power means to the other of said sprockets to thereby shift the control thereto and for concurrently uncoupling said power shaft from its own tape feed sprocket.

4. In an automatic transmitter for a permutation code telegraph system, a pair of independent tape feed sprockets rotatable in opposite directions, a common power source for operating each of said sprockets selectively in its direction, and means identified with each one of said sprockets and responsive to a signal carried by its tape for coupling said power source to the other one of said sprockets.

5. In a selector apparatus, an element to be selected upon the occurrence of two predetermined signals, a first latch member normally latching said element responsive to the first predetermined signal for releasing said element and thereby initiating selection thereof, a second latch member operating to latch said element upon the release of said first latch member responsive to the second predetermined signal for completing the selection of said element, and means for relatching said first latch member following its release signal when a succeeding signal is other than that for selecting said second latch member.

6. In a tape transmitter, two tape feed mechanisms, a reciprocating power member for actuating said mechanisms, a control device for coupling said power member with either one of said tape feed mechanisms selectively comprising means responsive to a tape signal for coupling said member to one of said mechanisms, and means responsive to a predetermined number of

steps of one of said mechanisms for coupling said member to the other one of said mechanisms.

7. In a tape transmitter, two tape feed mechanisms disposed in a common plane so as to direct separate corresponding tapes through a common course, a reciprocating member for actuating either of said mechanisms exclusively, a control device for coupling said member to one or the other of said mechanisms selectively comprising means responsive to a tape signal for coupling said member to one of said mechanisms, and means responsive to a predetermined number of steps of said one of said mechanisms for coupling said member to the other one of said mechanisms.

8. In an automatic tape transmitting apparatus, two independently operative tape feed mechanisms, a source of power for actuating said mechanisms, a coupling device for imparting rotary power from said source to either one of said tape feed mechanisms selectively comprising means responsive to a signal condition in a tape under the control of one of said mechanisms for coupling said power to the other one of said mechanisms, and means under the control of a sequence of operations of said other one of said tape feed mechanisms for coupling said source of power to said one of said tape feed mechanisms.

9. A tape transmitting apparatus for alternately operating from one or the other of a primary or secondary tape comprising in combination a primary tape feed apparatus, a secondary tape feed apparatus, a common tape sensing and electrical signal generating device controlled by either of said primary or secondary tapes, means responsive to a coded area on said primary tape for suspending the further operation of said primary tape feed apparatus and for concurrently initiating into operation said secondary tape feed apparatus, and means responsive to a coded area on said secondary tape for arresting the further operation of said secondary tape feed apparatus and for concurrently initiating into operation said primary tape feed apparatus.

10. A tape controlled apparatus for alternately operating from one or the other of a primary or secondary tape comprising in combination, a primary tape feed apparatus, a secondary tape feed apparatus, means responsive to a coded area in said primary tape for suspending the further operation of said primary tape feed apparatus and for initiating into operation said secondary tape feed apparatus, and means responsive to a coded area in said secondary tape for arresting the further operation of said secondary tape feed apparatus and for initiating into operation said primary tape feed apparatus.

11. In a telegraph transmitting apparatus, a set of form feelers, two form feeding mechanisms, means to arrest either one of said form feeding mechanisms in a position whereat its associated form presents an all-perforated area condition to said set of feelers, and means responsive to said all-perforated area for concurrently starting into operation the other one of said two form feeding mechanisms.

12. In an automatic telegraph transmitter, a first form feeding mechanism, a second form feeding mechanism, a sensing mechanism common to said first and said second feeding mechanisms, means to place the sensing mechanism under control of said first form feeding mechanism, automatic means to transfer the control from the first form to the second form at recur-

ring intervals, and manual means to permit or prevent the transfer.

13. In a serial numbering system for automatic telegraphs, a control tape carrying a succession of serial number code marks, a control tape carrying code marks representing messages, a single sensing mechanism, and means for causing said sensing mechanism to be controlled alternately by the message tape and by the number tape; whereby alternate message number and messages are transmitted.

14. In a transmitter, a single code sensing mechanism having a sensing locus, means to advance a control form through the sensing locus, means to arrest the motion of said control form, means to advance a second control form through the same sensing locus superimposed on the first control form, means to render said sensing mechanism operative to interpret the second control form only, and means to subsequently render said sensing mechanism operative to interpret only the first control form.

15. In a transmitter, signal transmitting means, a control form, means to advance the control form to control the transmitting means to transmit a succession of signals represented by successive coded areas on the form, means to insert a second similar control form in the transmitter and condition it for advancement, means to arrest the advancement of the first control form and transfer the transmitter control from the first control form to the second control form, and means to transfer the control back to the first control form after a predetermined interval of control by the second control form.

16. In a transmitter, a signal transmitting means, a control strip, means to advance the strip through the transmitter to control said transmitting means, means to advance a second similar control strip through the transmitter, means to control said signal transmitting means by the second strip while the first strip is still in position ready to be advanced but ineffective to control said transmitting means, and means to return the control to the first strip.

17. In a transmitter, transmitting means, a control strip, means to advance the control strip through the transmitter, means to control the transmitting means according to coded areas on the strip, a second control strip, means to insert the second control strip in the transmitter, manual means to precondition the transmitter for automatically advancing the second strip, and signal control means to transfer the control of said transmitting means from the coded areas on the first strip to the coded areas on the second strip only after the manual means has been operated.

18. In a tape transmitter operating from a pair of tapes, a common tape sensing mechanism, tape feed means individual to each of the tapes, only one of the tapes being fed at any one time, and means responsive to predetermined code signals in the tape currently being advanced as sensed by said common tape sensing mechanism to disable said tape feed means associated with that tape and to initiate operation of the said tape feed means associated with the other of the tapes.

19. In a tape transmitter operating from a pair of tapes, a common tape sensing mechanism, tape feed means individual to each of the tapes, only one of the tapes being fed at any one time, means responsive to predetermined code signals in the tape currently being advanced as sensed by said common tape sensing mechanism to disable the

tape feed means associated with that tape and to initiate operation of said tape feed means associated with the other of the tapes, and means operating after said tape feed means associated with the other of the tapes has caused the tape to be advanced a predetermined distance to disable that tape feed means and initiate operation of said tape feed means associated with the tape initially advanced.

20. In a telegraph transmitter, a common sensing means having a sensing locus, feed means to advance a control form through the sensing locus, a second feed means to advance a second control form through the sensing locus, and means responsive to coded areas in said control form to determine which of the said feed means is to be operated.

21. In a telegraph transmitter, means to transmit code signals, a common sensing mechanism having a sensing locus, feed means to advance a control form through the sensing locus, a second feed means to advance a second control form through the sensing locus, and a common means for operating both said feed means, said common means operating under the control of said forms in such a manner that only one of said feed means will be operated at any one time to advance its associated control form through the sensing locus.

22. In a telegraph transmitter, means to transmit code signals, a common sensing mechanism having a sensing locus, feed means to advance a control form through the sensing locus, a second feed means to advance a second control form through the sensing locus, a common means for operating both said feed means, said common means operating in such a manner that only one of said feed means will be operated at any one time to advance its associated control form through the sensing locus, and means responsive to predetermined signals in the tapes to control the operation of said common means for operating both said feed means.

23. In a transmitting apparatus, a plurality of form feeding mechanisms, a separate control form having coded areas engaging each form feeding mechanism, a single form sensing means to generate signals under the control of any one of the forms, and means controlled by predetermined ones of the coded areas to transfer the control from one form to another.

24. In a telegraph transmitter, a first form feeding mechanism, a second form feeding mechanism, a sensing mechanism common to said first and said second form feeding mechanisms for sensing a control strip passing therethrough, and means to control the effectiveness of one or the other of said form feeding mechanisms.

25. In a telegraph transmitter, a first tape feeding mechanism for feeding a tape therethrough, a second tape feeding mechanism for feeding a second tape therethrough, a sensing mechanism common to said first and said second tape feeding mechanisms for sensing either of said tapes passing therethrough, and means to control the effectiveness of one or the other of said tape feeding mechanisms.

LOUIS M. POTTS.

#### REFERENCES CITED

The following references are of record in the file of this patent:

(References on following page)

2,451,045

19

UNITED STATES PATENTS

| Number    | Name           | Date           |
|-----------|----------------|----------------|
| 1,870,352 | Watson -----   | Aug. 9, 1932   |
| 2,106,805 | Lang -----     | Feb. 1, 1938   |
| 2,116,506 | Carr -----     | May 10, 1938   |
| 2,129,741 | Levy -----     | Sept. 13, 1938 |
| 2,154,547 | Walker -----   | Apr. 18, 1939  |
| 2,172,920 | Anderson ----- | Sept. 12, 1939 |

| Number    |
|-----------|
| 2,193,809 |
| 2,193,967 |
| 2,297,789 |
| 2,318,168 |
| 2,304,775 |
| 2,336,373 |
| 2,344,792 |

20

| Name               | Date          |
|--------------------|---------------|
| Dirkes -----       | Mar. 19, 1940 |
| Kleinschmidt ----- | Mar. 19, 1940 |
| Mills -----        | Oct. 6, 1942  |
| Lang -----         | May 4, 1943   |
| Blanton -----      | Dec. 15, 1942 |
| Starr -----        | Dec. 7, 1943  |
| Swezey -----       | Mar. 21, 1944 |

**Certificate of Correction**

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October 12, 1948.

LOUIS M. POTTS

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 16, line 1, claim 6, before the word "one" insert *said*; line 63, claim 11, after "area" strike out "condition";

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of May, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,  
*Assistant Commissioner of Patents.*