Aug. 14, 1945. M. T. GOETZ 2,382,558

PRINTING TELEGRAPH APPARATUS

Filed Sept. 20, 1941 3 Sheets-Sheet 1

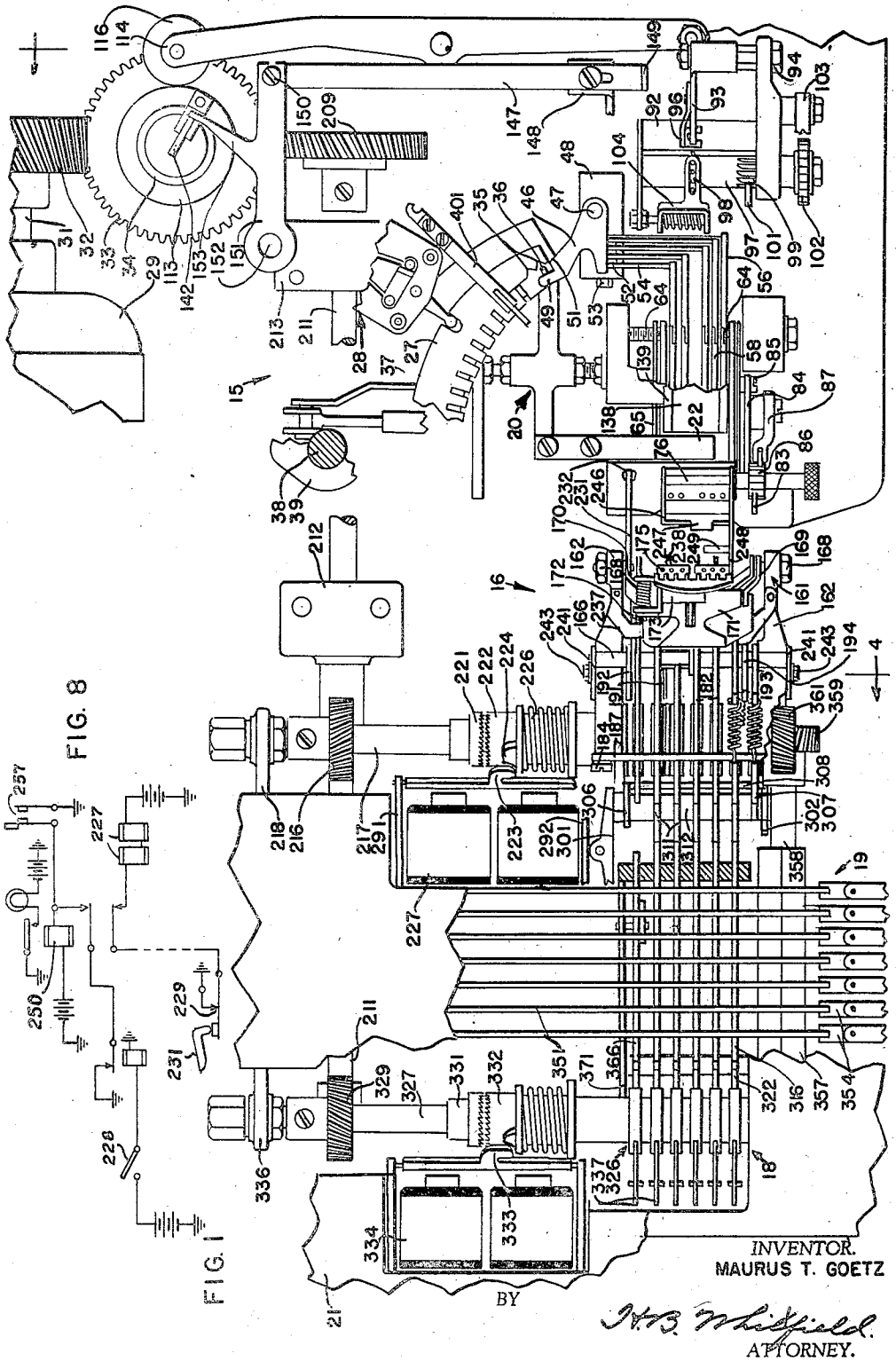


FIG. 8

FIG. 1

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Filed Sept. 20, 1941 3 Sheets-Sheet 2

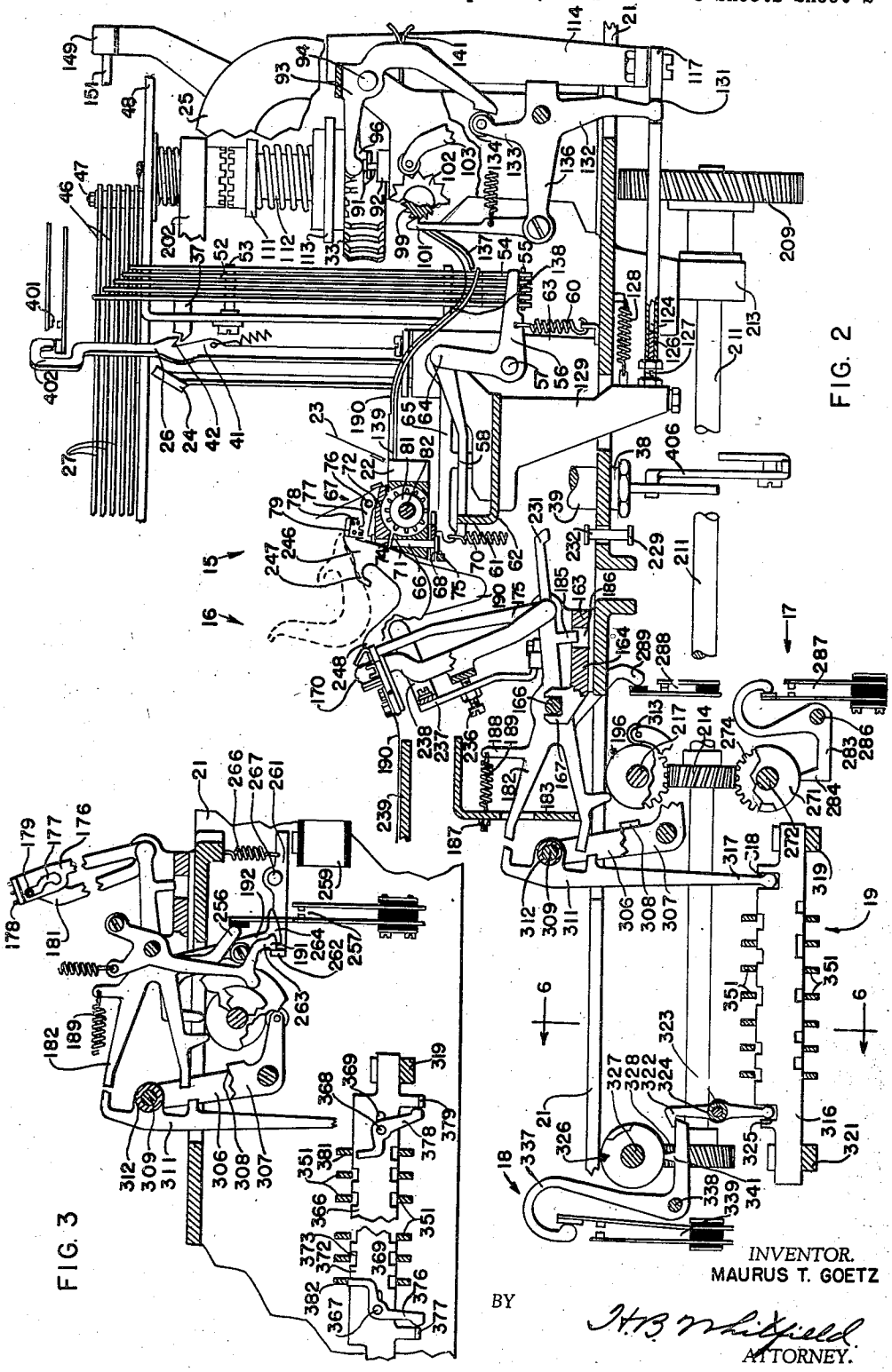


FIG. 2

FIG. 3

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Filed Sept. 20, 1941 3 Sheets-Sheet 3

FIG. 6

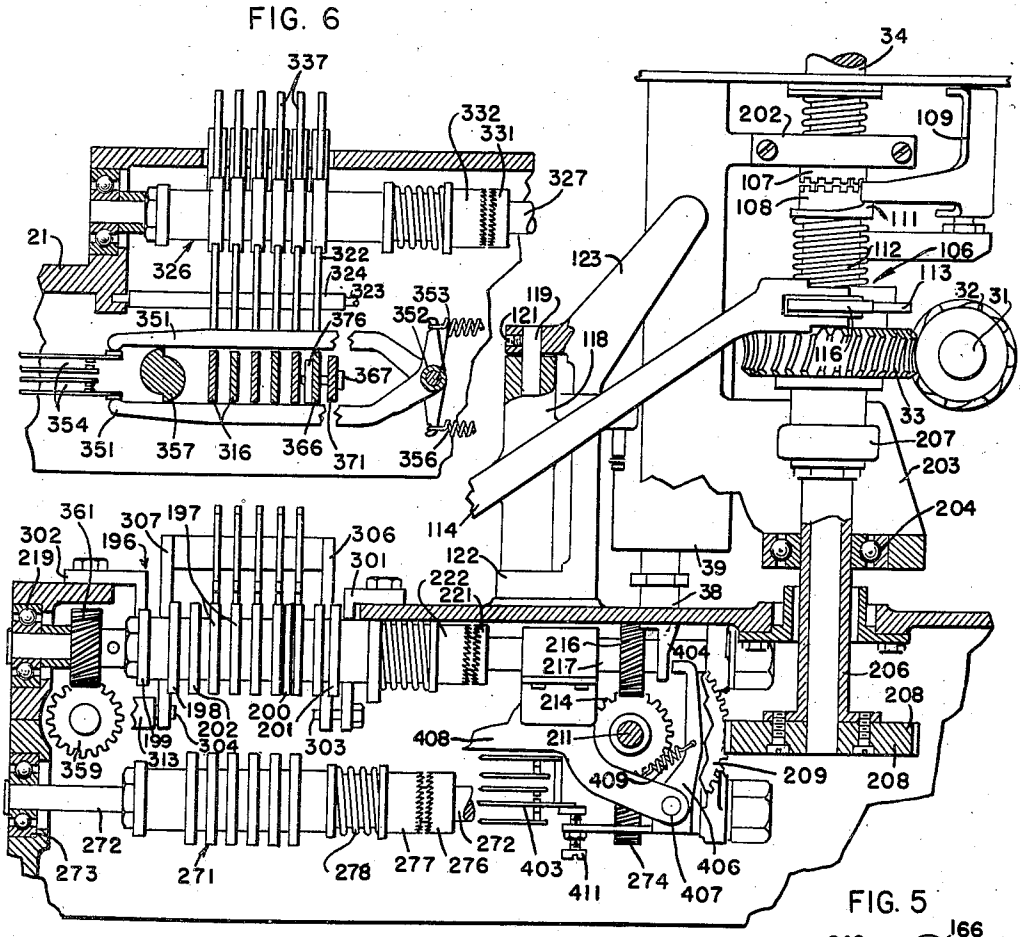


FIG. 4

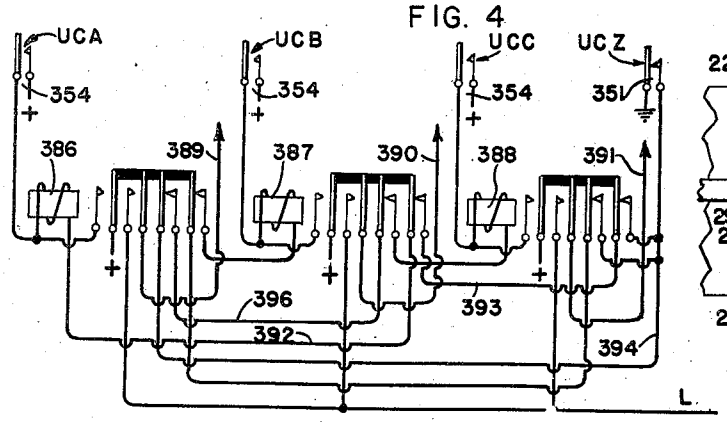
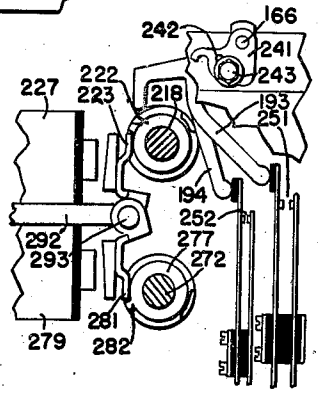


FIG. 7

FIG. 5



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UNITED STATES PATENT OFFICE

2,382,558

PRINTING TELEGRAPH APPARATUS

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Application September 20, 1941, Serial No. 411,665

14 Claims. (Cl. 178—4)

This invention relates to printing telegraph apparatus and more particularly to signal recording and repeating apparatus and switching mechanism controlled thereby.

An object of this invention is to provide a telegraph apparatus that will receive and store telegraph signal combinations, record the characters represented thereby, and redistribute the signal combinations to other locations.

Another object of this invention is to provide a transmitting mechanism controlled mechanically by a control strip and having a complete signal overlap.

Another object of this invention is to provide a switching mechanism selectively responsive to switching signals in a control strip.

A further object of this invention is to provide a strip controlled circuit selecting mechanism responsive to switching signals preceding a message to determine the communication channel over which the message signals are routed.

A still further object of this invention is to provide in a telegraph apparatus a plurality of transmitting devices controlled simultaneously by a common control strip and flexibly arranged to be associated with one or more communication channels whereby a signal message may be distributed over one or more channels.

In communication systems, particularly those in which messages may originate in any of a number of substations to be transmitted to certain of the remaining substations, it is frequently the practice to transmit the message to a central office for rerouting or retransmission to the desired substation. In such a system, the message is customarily stored as it is received, preferably in a record tape, until the necessary retransmission channels are selected and conditioned. The retransmission channels are generally conditioned manually through plugs and jacks or semi-automatically through relay circuits. After the message channels have been established, the stored message is applied thereto and transmitted directly to the desired substation, if a through connection is available, or to a further central office for relaying to the desired substation. At each message relaying point or central office, there is provided a message receiving and storing mechanism, such as a printing reperforator, manually or relay operated switching mechanism for establishing message channels, and a message redistributor, such as a tape transmitter, adapted to be associated with the determined channels.

This invention features a telegraph apparatus which may be utilized in communication systems to facilitate and expedite message transmission between substations and which includes within one compact unit a printing reperforator, a plurality of transmitters and entirely automatic switching mechanism. Telegraph signal combinations received by this apparatus are recorded in a control tape and a sensing device senses the tape and conditions the retransmitting distributors in accordance with the received signal combinations to retransmit the message. The switching mechanism of this apparatus operates under the control of the same tape and sensing device in response to switching signal combinations received from the originating substatian preceding the message signal combinations to establish the necessary communication channel to direct the message to the desired substation.

As a further feature there is provided in accordance with this invention a plurality of transmitting devices associated with a common sensing mechanism, affording a flexible arrangement for signal redistribution. One transmitting device is associated with the automatic switching mechanism to be selectively connected thereby into one of several communication channels and another transmitting device, disassociated from the switching mechanism, may be connected to another channel. Either or both of the transmitters may be employed to redistribute the received message over one or more channels.

This invention also features a device included in the telegraph apparatus to render the switching mechanism selectively operable; that is, to enable the switching mechanism when switching signal combinations are being sensed by the sensing device, and to disable the switching mechanism when message signal combinations are being sensed. The switching mechanism includes a holding device operable to maintain a communication channel determined by the operation of the switching mechanism in response to received switching signals and to preclude further switching functions until the determined channel has been released by a predetermined operation of the switching mechanism.

Communication systems employing apparatus which embody the features of this invention may operate rapidly and automatically to relay a message from an originating substatian to the desired substation. For such automatic operation a series of switching signal combinations is transmitted from the originating substation to establish the necessary communication channel to the desired substation through the operation of the automatic switching mechanism. Thereafter, message signal combinations from the originating

substation are directed over the established channel to the desired substation.

The apparatus for accomplishing the above-enumerated objects of this invention includes a printing reperforator, a sensing or transmitting device, transmitting distributors and an automatic switching device. Code signal combinations received by this apparatus condition the printing reperforator to store the received signal combinations and print the character represented thereby on a control strip. The printing reperforator includes a pre-punch unit to prepare feed holes in the strip operated concomitantly with the code perforating unit with each cycle of rotation of a selecting cam drum of the printing unit. The cam drum is adapted to be manually released for continuous rotation to feed a desired length of the tape or control strip through the operation of the feeding devices of the perforating units. From the reperforator, the control strip passes into the sensing or transmitting device to control that device in accordance with received signal combinations stored in the tape.

The sensing or transmitting device, being of the pivoted type, is movable with respect to the reperforator and may, therefore, probe each signal combination including the last stored in the tape by the code punching unit. When the sensing device has been conditioned in accordance with a complete signal combination in the control strip, a transfer device operates to transfer the setting of the sensing device to a plurality of code bars and to restore the sensing device to its initial condition preparatory to another sensing operation. Each code bar is associated with a locking latch of a cam type transmitting distributor and the code bars when they have received a setting of the sensing device, establish the setting on the contacts of the distributor so that the signal is retransmitted by the distributor while the sensing device is performing the next succeeding sensing operation and through this arrangement complete signal overlap is provided. The code bars condition automatic switching mechanism as well as the transmitting distributor to perform switching functions to determine the channel into which the distributor transmits in response to received switching signal combinations.

The automatic switching mechanism includes a plurality of switching function levers which in response to the permutable setting of the code bars permit selective operation of the switching mechanism. In order to restrict the operation of the switching mechanism to only those settings of the code bars that represent switching signal combinations, a device including a plurality of control bars serves to hold the switching function levers normally nonresponsive to the settings of the code bars. When a switching operation is to be performed, a predetermined signal combination is set up in the code bars by the control strip and this conditioning of the code bars is effective to operate the blocking device and render the switching function levers responsive to subsequent settings of the code bars. After the desired switching functions have been accomplished, the control tape establishes another predetermined condition in the code bars that restores the device into blocking relation with respect to the switching function levers rendering them nonresponsive to the subsequent settings of the code bars that relay the message signals over the determined communication channel through the agency of the transmitting distributor.

Upon the operation of a switching function lever under the control of a switching signal, the retransmitting distributor is associated with a determined communication channel for transmission thereover. As the channel is selected and associated with the distributor, a holding circuit is conditioned which maintains this association and precludes the establishment of other channels until the holding circuit is dumped preparatory to accomplishing another switching function. Accordingly, if signal combinations included within the repeated message condition the switching mechanism to respond to the operation of the code bars, switching functions will not be accomplished and the determined channel will not be disturbed.

A second retransmitting distributor which is free from the control of the automatic switching device is provided and may transmit into any channel, as for example one leading to a supervisory position, with which it may be electrically associated. The sensing device also controls this distributor, the control being effected through the agency of contact operating fingers integrally formed with each sensing element. The contacts operated are connected serially with the corresponding cam operated contacts of the cam type distributor and determine the transmitted signal combination in accordance with the sensing device as it is conditioned by a signal combination stored in the control strip.

The sensing or transmitting device has a tape out pin that is operated cyclically with the code sensing pins to interrupt the operation of the transmitter at a predetermined point in message signaling, as determined by a special perforation in the tape, or when the tape supply is broken or exhausted. The transmitter is also equipped with a tape feed suppression device operable to arrest the tape feed through the transmitter so that a given signal combination may be transmitted several times in succession.

The pivoted transmitter is movable with the tape and when there is a predetermined length of tape intermediate the transmitter and reperforator a locking device, which serves to form this length of tape into a depending loop, locks the transmitter rendering it immovable with respect to the reperforator. Under the continuous operation of the transmitter, this length of tape will eventually be shortened and finally the tape will engage the locking device and move it out of engagement with the transmitter permitting the transmitter to approach the reperforator to sense every code combination in the tape.

Many features included in the disclosure of the present application are also disclosed in copending application Serial No. 411,660 filed September 20, 1941 by R. A. Lake and Serial No. 412,829 filed September 29, 1941 by E. A. Gubisch.

For a more complete understanding of the foregoing objects and 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, partly in section, of a portion of a telegraph apparatus embodying the features of this invention;

Fig. 2 is a front elevational view, partly in section, of the apparatus of Fig. 1;

Fig. 3 is a detailed view, in section, of the tape feed suppression device and control bar of the automatic switching mechanism;

Fig. 4 is a view, partly in section, taken approximately along lines 4—4 of Fig. 1 to show the transmitting cam assembly;

Fig. 5 is a detailed view illustrating the release magnet assembly including the transmitter release magnet and a distributor release magnet;

Fig. 6 is a sectional view taken on the lines 6—6 of Fig. 2;

Fig. 7 is a schematic representation of the electrical circuit associated with the automatic switching mechanism; and

Fig. 8 is a schematic of the electrical circuit of the transmitter release magnet.

The apparatus disclosed in the drawings embodies the several features of this invention and may be considered as including the following principal units and associated driving mechanisms; a printing reperforator unit **15**, a tape sensing unit **16**, a retransmitting distributor **17**, a retransmitting distributor **18**, and an automatic switching device **19**. The several units are supported by a base casting **21**.

Printing reperforator

The printing reperforator **15** included in the apparatus under consideration is substantially the same as that printing reperforator which is the subject of a copending application filed in the name of Ross A. Lake, Serial No. 274,796 filed May 20, 1939 and for a more complete understanding of the structure and mode of operation of this unit, reference may be had to the aforementioned copending application which is incorporated herein by reference. Since the unit under consideration is substantially the same as that disclosed in the above-identified copending application, the description of that mechanism to be set out hereinafter will be of a general nature and will be detailed only in the description of those features of the present unit which are different from features in the above-identified copending application.

A printing platen **22** is located in the front and central portion of the reperforator and is associated with an improved platen shift mechanism **20** which is the subject of a copending application Serial No. 420,802, filed in the name of R. A. Lake on November 28, 1941, which matured into U. S. Patent No. 2,339,785, dated January 25, 1944. An inking ribbon **23**, Fig. 2, is directed thereover in well-known manner from ribbon supply reels **25** (only one of which is shown). A plurality of type bars **24** (only one of which is illustrated), is positioned in an arcuate path about and to the rear of the printing platen **22** and are articulated to their supports in a manner to permit their striking forwardly and downwardly into cooperation with the platen to effect printing. A plurality of pull bars **26** (only one of which is shown) is assembled to the rear of the type bars **24** and is adapted to operate the type bars through a gear and rack connection (not shown). The pull bars are normally urged against a series of notched code bars **27** which are semi-circular in shape and which may be conditioned in various permutable settings by means of a selector mechanism **28**, (Fig. 1, of the sword and T-lever type, shown in U. S. Patent No. 1,745,633) to bring into alignment the notches on the code surfaces so that the pull bars may be individually selected for operation. A continuously operating driving motor **29** carries on its shaft **31** a gear **32** which meshes with a gear **33** carried on the main shaft **34** of the reperforator to drive the reperforating mechanism; a selecting cam sleeve (not shown) is rotatably supported upon continuously rotating shaft **34** and is adapted to be driven therefrom through a suitable friction or slip clutch.

A receiving magnet (not shown) is adapted to be conditioned in response to received line signals to release the friction clutch and cause the rotation of the selecting cam sleeve from driving shaft **34** in a manner set out in detail in the aforementioned patent. The cam sleeve is thereupon rotated at a speed substantially synchronous with the speed of the code impulsing so that the energization of the receiving magnet in response to marking and spacing code signals may be effective through the selector **28** to condition the individual code bars **27** in a clockwise or counterclockwise direction in accordance with a received code signal combination. The permutable setting of the code bars **27** results in the selection of one particular pull bar **26**, depending upon the alignment of the code notches in code bars **27**, and with the selection thus determined the code bars are locked during the printing operation by means of a locking bar **36**, Fig. 1, through its engagement with locking notches **35** provided in each of the code bars. The locking bar **36**, which has the same general contour as pull bars **26**, is moved into and out of locking engagement with code bars **27** by means of the printing bail **37**, Figs. 1 and 2, as it is raised and lowered. The printing bail **37** is suitably articulated to a bail operating plunger **38**, Fig. 1, slidably mounted within a guide sleeve **39**, and plunger **38** is controlled by means of a cam (not shown) on the main shaft **34**. The precise operation of the printing mechanism including bail **37** from the main shaft **34** is set out in detail in said aforementioned patent.

When the bail **37** is in its lowermost position under the control of plunger **38**, it cooperates with beveled surfaces **41**, Fig. 2, on the plurality of pull bars **26** to hold the pull bars out of engagement with code bars **27** so that the code bars may be readily shifted in accordance with the operation of the selector mechanism **28** under the control of received code signal impulses. When the printing bail **37** is operated upwardly to perform the printing operation, the bars **26** and **36** due to their cam surfaces **41** are permitted to be actuated gradually toward the code bars **27** by their individual springs. Pull bars **26** are provided with a hook projection **42** which cooperates with the printing bail **37** when a pull bar is permitted by the alignment of notches in the code bars **27** to be operated by its biasing spring into the path of bail **37** which in its upward movement engages hook projection **42** to lift the pull bar, and through the rack and pinion engagement with the type bar causes the type bar to rotate about its pivot and bring the type face downwardly to impinge upon platen **22**. The locking bar **36** is not provided with a hook portion since its function is merely to rock on its pivot into and out of locking engagement with code bars **27** under the control of bail **37** to retain the permutable setting of the code bars during the printing operation. For a more comprehensive and detailed description of the printing operation performed by the printing reperforator, reference may be had to the aforesaid Patent No. 1,745,633 which is specifically directed to a printing mechanism of the type incorporated in the printing reperforator unit.

For the purpose of controlling code punches in the reperforating operation to record the code combination in a tape as well as print the corresponding character on the tape, there is provided a plurality of bell cranks **46**, Figs. 1 and 2, one associated with each code bar and pivotally supported upon a stud **47** which is mounted in a

supporting plate 48 secured to the frame of the reperforating unit. Each of the bell cranks 46 is provided with a projecting finger 49 adapted to overlap the locking bar 36 and be operated thereby to position the bell cranks 46 in a counterclockwise direction as the bar 36 under the influence of bail 37 is cammed out of locking engagement with code bars 27 preparatory to conditioning the code bars in accordance with a received code signal combination. The bell cranks are biased in a clockwise direction and each is provided with a shoulder portion 51 which performs a sensing operation on the associated code bars 27 when locking bar 36 under the control of bail 37 is moved into the locking notch 35 releasing the bell cranks to respond to their clockwise bias. If a code bar is in its counterclockwise position, as indicated in Fig. 1, the shoulder portion 51 of the associated bell crank 46 will be clear of the code bar and when locking bar 36 responds to the bail 37 and enters locking notch 35 as shown, the bell crank 46 will be permitted to assume its clockwise position. However, in the event that a code bar is in its extreme clockwise position, locking bar 36 would engage the alternate locking notch on the particular code bar and that bar would be positioned in the path of its associated bell crank 46 so that when locking bar 36 has moved into engagement with the alternate locking notch 35 releasing the particular bell crank 46 for rotation, that rotation will be restrained. Accordingly, through the cooperation of the individual code bars 27 and the blocking shoulders 51 of the bell cranks associated with the particular code bars, the permutable setting of the code bars is transferred to the plurality of bell cranks 46 when those bell cranks are permitted to sense the positionment of the code bars as locking bar 36 is moved into a locking notch 35.

The frontward portion of supporting plate 48 as viewed in Fig 1, is slotted to provide a comb-like structure which guides a plurality of vertically disposed pivoted levers 52 which are pivotally supported upon a stud 53, Fig. 2, carried in support member 48. The levers 52 which are guided by the comb portion of member 48 project into the path of operation of bell cranks 46 and each lever 52 is controlled by one of the bell cranks 46. The lower ends of levers 52 cooperate with and control a series of bell cranks 54 pivoted on a pivot shaft 55, Fig. 2, secured to the casting 63. Bell cranks 54, in turn, extend beneath the horizontal portion of a second set of bell cranks 56 pivoted on shaft 57 supported in the perforator casting 63. The bell cranks 56 are normally urged in a clockwise direction by means of individual springs 60 which springs also serve through the engagement of bell cranks 56, bell cranks 54, pivoted levers 52, and bell cranks 46 to impart a clockwise bias on each of the bell cranks 46. Pivotally articulated to the vertical arms of bell cranks 56 are a plurality of punch interponents 58. Interponents 58 are guided by a comb cut in a flanged portion 61 of a cradle member 62 pivotally supported by the casting 63 of the printing reperforator and serving as the punch operator as will appear hereinafter. The pivot for cradle member 62 is in substantial alignment with the pivotal connection between the interponent members 58 and the vertical arms of bell cranks 56. This pivot point is indicated 64. Through the mechanical linkage above described, each permutable setting of the code bars 27 is transferred when locking bar 36 assumes its locking relation with respect to the code bars, to the interponents 58 to permutably condition the interponents with respect to code punches 66, Fig. 2.

Locking bar 36, in being retracted from a locking notch 35 preparatory to setting up a signal combination in code bars 27, rocks bell cranks 46 in a counterclockwise direction and through the mechanical linkage described, similarly rocks bell cranks 56 and advances all interponents 58 leftwardly. After the code bars have been set, locking bar 36 releases bell cranks 46 permitting the interponents 58 to be selectively moved from their normal, leftward position. If any of the bell crank levers 46 is held in its counterclockwise position by the engagement of its locking shoulder 51 with its associated code bar 27, the corresponding interponent 58 through the mechanical linkage above described is retained in its leftward position in alignment with its code punch 66. However, if a bell crank 46 is permitted to assume its clockwise position by its associated code bar 27, its spring 60 is effective to shift its associated interponent 58 to its rightward position, as illustrated in Fig. 2, out of alignment with punches 66. The connection between the selector mechanism 28 and code bars 27 is such that when a marking impulse is received a code bar is moved to its clockwise position, the associated interponent 58 is retained in alignment with its code punch 66 and conversely, when a code bar is positioned in its counterclockwise position in response to the reception of a spacing impulse, its associated interponent is shifted from its normal position and moved out of alignment with its associated code punch.

A punch block 67, Fig. 2, secured to the reperforator casting is suitably apertured to receive in a slidable manner the code punches 66 which project through the punch block and a guide comb 68 formed in the leftward extremity of a punch stripper bail 65 that is pivoted on the same pivot studs as cradle 62. A spring 70 is secured to a depending projection of bail 65 and a spring post (not shown) located on the perforator casting and serves to urge the bail in a counterclockwise direction to withdraw the code punches from their operated positions. The code punches have a limited downward travel, being limited by a yoke member 75, Fig. 2, that depends from the code punch 67 and which is overlapped by the leftward extremity of comb 68. The punches 66 are flattened or hammered out at their lower extremities to provide suitable shoulders beneath comb 68 so that as cradle 62 is rocked in a counterclockwise direction, comb 68 may under the influence of spring 70 withdraw punches 66 to their lowermost positions. The front surface of the punch block is at an angle inclined to the vertical for a purpose which will be hereinafter described, and the top surface 71 is at an acute angle with respect to the axes of the punches to provide an inclined path for a tape through the punch block. The front surface of the punch block is chamfered back to the apertures which accommodate the code punches to prevent the accumulation of tape chips over the code punches. The punch elements 66 may be associated with the punch block 67 in much the same manner as disclosed in detail in the first mentioned copending application and that detail will not be repeated here.

Disposed above the punch block 67 is a die plate 72 and there is provided in the die plate a die sector for each code punch located in punch block 67. The die sectors are similar to the die

openings described in detail in the first mentioned copending application and illustrated in particular in Fig. 6 thereof at 107, the construction being such that the cooperation of a die punch with such a die opening will produce a lidded aperture in the tape. The bottom surface of die plate 72 is cut at such an angle that, when the die plate is assembled into a punching unit with punch block 67, the lower surface thereof will define with the upper surface 71 of the punch block, a tape guideway for directing a tape to be perforated at an angle to the top surface of the code punches 66. With this construction, the lidded aperture is provided in the tape through a shearing rather than a blanking operation; that is, with the tape lying at an angle across the top surface of a code punch, as the punch is elevated in the perforating stroke into cooperating engagement with the die plate 72, the punch, due to the incline of the die plate, initially blanks a small sector in the tape and, as the punch is further advanced into the die plate, the punch and die plate engage along an inclined shearing plate to produce a perforation.

A lidded aperture is produced in the tape with each perforating operation and because of the angular relationship of the tape and code punches, the lagging edge of the lid is forced well above the tape web and into the die plate while the neck of the lid is not raised appreciably. A plurality of stripper pins 74 is provided to remove the lids from the die plate at the end of each perforating cycle. Secured to the die plate 72 is a pivot pin 76 upon which is pivotally supported a plurality of spring operated levers 77 operated by compression springs 78 to depress the stripper or ejector pins 74 at the end of each perforating cycle and eject the lids from the die plate. The compression springs 78 are held between a frame member 79 secured to die plate 72 and a projecting lug extending from each of the levers 77. In each perforating cycle, the operated code punches 66 project into the sector openings provided in die plate 72 and force the stripper pins 74 upwardly and at the completion of the perforating cycle, the code punches 66 are retracted from the die plate by comb 68 rendering the levers 77 operative under the influence of springs 73 to depress the ejector pins 74 and eject the lids from the die plate. The code perforating punch block described above forms no part of the present invention but is the subject of U. S. Patent No. 2,255,794, filed in the name of R. A. Lake and reference may be had thereto for a more complete disclosure of the punch assembly.

A feed wheel 81, Fig. 2, provided with sprocket teeth to engage feed perforations in the tape and feed the tape through the code perforating mechanism, is rotatably supported within the punch block on a shaft 82, Fig. 2, and is stepped intermittently by means of a feed pawl 83, Fig. 1, pivotally supported on a lever 84 which is secured by screws 85 to cradle member 62 and engages a feed ratchet 86 with each operation of the cradle 62 in a well-known manner. See copending application filed by Erwin A. Gubisch, Serial No. 412,829, filed on September 29, 1941, and directed in part to the feed wheel located within the punch block. A spring pressed detent 87 is provided to bear against the ratchet and hold the feed wheel immovable between feeding strokes of the pawl 83.

A pre-punch unit is provided to perforate a feed hole in the tape prior to the code perforating operation and comprises a feed punch 91. Figs. 1 and 2, which is adapted to be reciprocated vertically in a feed hole punch block 92 by means of a bell crank 93 pivoted on stud shaft 94 and provided with a fork shaped extension member 96, the tines of which engage beneath the flared upper end of the punch 91 and confine the head of the punch between the fork member and the bell crank so that the punch is reciprocated as the bell crank is oscillated about pivot 94. Feed pins 98, Fig. 1, are secured to a shaft 97 rotatably supported in the pre-punch unit and provided at one end with milled ratchet teeth 99 to be engaged by a feed pawl 101 to intermittently advance the pins 98 and cause the feed of the tape by the engagement of pins 98 with the feed perforations invariably provided in the tape by the pre-punch 91. A star wheel 102 and detent 103 are provided for holding the feed shaft intermediate the feeding strokes of pawl 101. A spring pressed guide 104, Fig. 1, of the general contour of shaft 97 presses the tape against the feed pins to assure positive tape feed from the pre-punch in the direction of the printing platen and code perforating point.

By providing a pre-punch for perforating feed holes in the tape and independent feeding mechanisms at both the pre-punch and code punching units, it is possible to vary the position of the code holes with respect to the feed holes in the tape. That is, with the feed holes already prepared in the tape, the detent 87 associated with feed wheel 81 may be adjusted so that each operation of feed pawl 83 positions a feed hole in or out of alignment with code punches 66. Thus the code perforations and feed hole perforations may or may not be aligned transversely of the tape.

The code perforating punches and the pre-punch are operated cyclically from a common operating means which is controlled by a perforating cam located on main shaft 34. Main operating shaft 34, as described in the first mentioned copending application, supports a selector cam drum (not shown) which is released for rotation in response to the reception of a code signal combination and a second cam drum 106, Fig. 4, that is released for rotation with each operation of the selector cam drum. Cam drum 106 is driven through a grab clutch comprising driving member 107 and driven member 108 which has a clutch throwout cam 111 formed on its periphery to control the engagement of the clutch. A pivotally supported clutch throwout lever 109 is spring urged about its pivot into engagement with cam 111 to hold the clutch elements normally disengaged. When, however, the selector cam drum rotates, a cam therein actuates clutch throwout lever 109 and pivots it away from cam 111 permitting spring 112 to slide driven element 108 into engagement with driving element 107 to drive cam drum 106 through one cycle. At the completion of that cycle, lever 109 again cooperates with cam 111 to slide driven member 108 from driving member 107 and arrest the rotation of the cam drum. When the selector receives a continuous succession of code signals, it will be effective to release cam drum 106 for a corresponding succession of cycles of operation.

A perforating cam 113 is included in the cam drum 106 and actuates a pivoted, punch operating lever 114 through a cam following roller 116 rotatably supported upon a stud which extends transversely of a bifurcation provided in the rightward extremity of lever 114. Lever 114 extends obliquely from main operation shaft 34 at the rear of apparatus casting 21 downwardly and forwardly and is pivotally articulated at its lower extremity to a horizontally disposed link 117,

Fig. 2, located near the front of the casting. Lever 114 has a vertical projection 118 bored so as to be assembled in the perforator by means of a pivot shaft 119 secured in bearing blocks 121 and 122 formed integrally with an upstanding supporting structure 123 to be described more fully hereinafter.

At its leftward extremity, Fig. 2, link 117 is provided with an aperture 124 which receives a projection 126 adjustably carried by cradle 62. Cradle 62, which serves as the code punch hammer, is urged by means of a spring 128 secured thereto and to a spring post depending from base casting 21 into abutting relation with the leftward extremity of link 117, adjustable stop 127 secured to depending portion 129 of cradle 62 serving to limit this counterclockwise movement of the cradle. Cradle 62 is guided in its movement by the engagement of stud 126 with the guiding aperture 124 of link 117.

Link 117 is slidably articulated through a slot 131 to pivoted three-arm lever 132 which carries an eccentric 134 on arm 133, and the eccentric provides an adjustable engagement between lever 132 and the bell crank 93 of the pre-punch. Feed pawl 101 for the pre-punch is adjustably secured to arm 136 of the lever 132 by means of an eccentric so that the feed stroke may be adjusted. Through the engagement of abutment 129 with link 117 and the articulation of link 117 to lever 132, the code punches and the pre-punch are operated with each oscillation of lever 114 under the control of cam 113.

As has already been pointed out, the selector mechanism 28 which controls the code bars 27 conditions in this one operation both the printing mechanism through the alignment of the code notches in the code bars 27 and the code punches through the conditioning of punch interponents 58. Cam assembly 106, however, responds to the operation of selector mechanism 28 so that upon the receipt of a code signal combination by the selector mechanism, there is accomplished a printing operation which records on the tape a character corresponding to the received code signal combination, and, simultaneously, there is accomplished one perforating operation that stores the received code signal combination in the tape and another perforating operation that prepares a feed hole in the tape.

A tape guide, Fig. 2, extends from the feed pins 98 at the pre-punch unit to the printing platen 22 to serve as a guide for the tape and prevent the tape from becoming engaged with the perforating unit mechanism. This guide for the sake of a better understanding of the perforating mechanism has been disclosed only partially in Fig. 1. The tape guide consists of two sections, one section 137 extending leftwardly and downwardly from the feeding pins 98 of the pre-punch, and another section 138 extending rightwardly and downwardly from platen 22 and being overlapped by the leftward extremity of section 137. The guide sections are supported by the castings of the pre-punch unit and code punch unit, respectively. In order to guide the tape to the platen accurately, section 138 is provided with bent over flange portions 139 leading to platen 22. A similar guide 141 directs the tape from a supply into the pre-punch unit. By providing individual tape feeding mechanisms at both the pre-punch unit and the code punch unit, a tape loop may be maintained between the units and supported by the tape guide. This tape loop removes the drag of the tape supply reel from the feeding mechanism at the code perforating unit and consequently greatly reduces the tape load at this point. Further, since the feed pawl at the code punch unit may be secured to the cradle member 62 in an adjustable manner similar to the articulation of the feed pawl at the pre-punch unit to its operator, there is given a flexibility to the printing reperforator not otherwise attainable through the use of a single tape feding device.

Tape feed out mechanism

Although it is contemplated that the perforating unit operate as an incident to printing in response to received code signal combinations, it may sometimes be desirable to initiate the operation of the perforating mechanism independently of received code signal combinations; that is, independently of the selector receiving magnet which usually initiates the operation of the perforating mechanism. For this purpose, a manual release of the selector cam assembly has been provided enabling an operator to cause the perforating unit to operate a number of times so that through the resultant actuation of the feeding devices, any required length of tape may be fed through the printing reperforator.

As has been set forth above, the printing reperforator includes a selector mechanism which is the subject of U. S. Patent 1,745,633. This selector mechanism, however, has been modified by including therein an improved stop gate which is the subject of U. S. Patent 1,884,743, Figs. 5 and 9 of which illustrate the improved stop gate. The improved stop gate mechanism includes a pivotally mounted bell crank 142, Fig. 1, corresponding to bell crank 219 of Patent 1,884,743, which when rotated in a counterclockwise direction releases the selector cam assembly for rotation.

In the idle condition of the printing reperforator, that is, when no code signal combinations are being received by the selector magnet, the stop gate controlling mechanism holds the selector cam assembly arrested. When the start impulse of a code signal combination is received, the armature (not shown) of the selector magnet is released and causes bell crank 142 to be rotated in a counterclockwise direction to release the stop gate and permit the selector cam assembly to rotate. The normal operation of the stop gate mechanism is fully described in U. S. Patent 1,884,743 and resort may be had to that patent, which is incorporated herein by reference, for the details of structure and operation not here disclosed.

Manual release of the stop gate may be effected by operating a release rod 147, Fig. 1, which is slidably supported upon a bracket 148. Bracket 148 may be carried by any suitable portion of the printer frame structure, preferably finding its support at the support for ribbon reel 25. Release rod 147 extends from the front to the rear of the apparatus and its foremost extremity is bent upwardly forming a thumb piece 149 while its rearmost extremity carries a pin 150 which projects through a crank 151 pivoted to the supporting plate of the selector mechanism at 152. Arm 153 of crank 151 is disposed rightwardly of bell crank 142 of the stop gate release mechanism so that when release rod 147 is shifted toward the rear of the apparatus, rotating crank 151 in a counterclockwise direction, arm 153 releases the stop gate in a manner similar to the release of the selector magnet armature in response to the reception of a start impulse. Release rod 147 is biased forwardly and it is, therefore, necessary to hold the rod in its rear-

ward position to cause a plurality of cycles of operations of the perforating units and their feeding mechanisms whereby a desired length of tape may be fed through the apparatus.

Sensing unit

Associated with the hereinbefore described printing reperforator, is a sensing unit 16 provided to sense the perforated tape as it leaves the printing reperforator to control functions to be hereinafter indicated and described. In order to take full advantage of line time, the sensing or transmitting unit employed with the printing reperforator is of the pivoted or traveling type which is adapted to sense every code perforation recorded in a tape by the printing reperforator, without the necessity of stepping the perforated tape a plurality of feeding distances from the perforating unit into the transmitting or sensing unit. This pivoted transmitter, is described in detail in copending application Serial No. 219,770 filed July 18, 1938 by Ross A. Lake and reference may be had to that copending application for the details both in structure and mode of operation of the pivoted transmitter. The transmitter comprises essentially a plurality of sensing elements to sense the perforations in a tape, a member for feeding the tape through the transmitter having imparted to it rectilinear motion, and a cam drum for controlling the operation of the sensing elements and the tape feeding member.

Unit 16 has a base casting 161, Fig. 1, which is removably mounted upon the base casting 21 of the apparatus. The casting 161 consists of a pair of parallel vertical wall sections 162 interconnected by a relatively flat web portion 163, Fig. 2. The leftward extremity of portion 163 is formed into a vertical portion 164 which is channeled to serve as a journal for a shaft 166 and slotted to provide a comb 167 which serves to guide the vertical oscillations of the members which support and operate the sensing elements. The rightward portion of wall sections 162, as viewed in Fig. 1, support pivot studs 168 upon which the movable or pivoted portion of the sensing unit is secured. Specifically, the frame members 169 and 170 are secured to the pivots 168. A plate 171 is carried by the pivoted frame members and carries a hinge post 172, Fig. 2, upon which is hingedly supported a tape gate 173 which in conjunction with the plate 171 defines the passage way for the perforated tape through the transmitter. A spring latch holds the tape gate in cooperating relation with the plate 171. This structure of the transmitter is substantially identical with that disclosed in the above-identified copending application, and reference may be had to that application and particularly to Fig. 1 thereof, for a more detailed disclosure of the mechanical details of the transmitter frame. Both plate 171 and the tape gate 173 are provided with a plurality of apertures which are in alignment when the tape gate is in cooperative relation with plate 171.

Apertures in plate 171 receive the reduced portions of sensing pins 175, Fig. 2. There is provided a sensing pin or finger for each of the possible perforations appearing in a transverse row of perforations in the tape, plus an additional pin to be employed as a tape-out indicator in a manner to be hereinafter described. In the particular apparatus under consideration there are provided six sensing fingers, inasmuch as it is contemplated to utilize a five-unit code.

A slidably movable feed member 176, Fig. 3, which is formed with a cam groove 177 is provided to feed the tape through the transmitter in accordance with a rectilinear feeding movement precisely as has been described in great detail in the above-identified copending application Serial No. 219,770 and illustrated in Figs. 9 to 12 thereof. In view of the detailed description of this tape feeding mechanism, in the latter copending application, the apparatus description and the mode of operation will be set out herein only briefly, and reference should be had to the aforementioned application for a more complete understanding of both the structural details and the precise mode of operation of this rectilinearly operable feed mechanism. Member 176 carries on its upper extremity pins 178 which enter and normally engage the feed perforations in a tape to advance the tape or advance the transmitter, depending on which of the two is held immovable and cooperating with cam groove 177 in lever 176 is a pin 179 secured to the free end of a cam operated lever 181.

As will be described hereinafter, members 176 and 181 are operated in timed relation, and as lever 181 is drawn downwardly in slot 177, the pin 179 due to the particular shape of cam groove 177 will oscillate member 176 in a counterclockwise direction to effect relative movement between the pivoted frame of sensing unit 16 and the tape. Following this operation, lever 176 is moved downwardly to withdraw pins 178 from engagement with the feed perforations in the tape after which arm 181 is moved upwardly and under the influence of the cam groove, member 176 is moved in a clockwise direction as viewed in Fig. 3, and the member 176 is thereafter elevated to cause the pins 178 to engage other feed perforations in the tape to achieve on a subsequent cycle, a relative movement between the sensing unit 16 and the perforated tape.

On the shaft 166 which is supported by the channel 164, Fig. 2, formed in the base casting of the sensing unit are pivotally supported a plurality of Y-levers 182 as well as other levers including those required to control the operation of the members 176 and 181 of the tape feeding mechanism. The Y-levers are individual to the sensing fingers 175 and those fingers are pivotally secured to one arm of the Y-levers on a centerline substantially coincident with the pivots 168. The leftward portions of the Y-levers are supported in a member 183 secured by screws 184, Fig. 1, to the vertical wall sections of the base casting of the sensing unit, and member 183 is suitably slotted to provide a comb guide structure to guide the vertical oscillation of the Y-levers about the shaft 166. Depending from the rightward extremities of the Y-levers, as viewed in Fig. 2, are guide fingers 185 which when the Y-levers are rotated in a clockwise direction about shaft 166 are received in horizontal slots 186 of the casting of the sensing unit, which in this manner guide the oscillating movements of the Y-levers. Each Y-lever is provided leftwardly of the shaft 166 as viewed in Fig. 2, with an upstanding projection 188 to which is secured a spring 189 the other end of which is anchored to a spring post 187 carried by member 183, and springs 189 tend normally to rotate the Y-levers 182 in a counterclockwise direction about shaft 166, and elevate the sensing fingers 175 vertically to sense the perforations in a tape 190 presented to the transmitter.

It is preferred that the sensing fingers 175 be secured to the Y-levers in the same manner in which the sensing elements 125 of the above-identified copending application Serial No. 219,770 are secured to their operating bell cranks 146—152; that is, each sensing finger is provided near its lower extremity with an aperture arranged to be engaged by a pin secured near the end of the horizontally extending arm of the Y-levers. A reed spring riveted to the horizontal arm of the Y-lever serves to retain the lower end of the sensing finger and prevents accidental displacements. This described preferred association of the sensing fingers and Y-levers is not illustrated in the drawings but is adequately illustrated in Fig. 2 of the latter copending application.

Also pivotally supported by shaft 166 is a lever 191, Fig. 1, which is cam controlled to effect the vertical reciprocation of feed member 176, a lever 192 which controls the operation of lever 181, and the resulting oscillation of member 176 about its pivot, a lever 193 which operates a pair of contacts 251, see Fig. 5, and a lever 194 which operates an associated pair of contacts 252 for purposes to be hereinafter described.

A cam drum 196, Figs. 2 and 4, carries a plurality of cams which operate, as followers, the several levers pivotally supported by shaft 166, and located on this cam drum, are a plurality of cams 197, six in number to control the operation of the Y-levers, and the operation of the sixth sensing pin which may be carried by a Y-lever or a bell crank lever, a cam 198 to control the operation of contacts 251, a transfer cam 199 for a purpose to be hereinafter described, a cam 200 for controlling the operation of feed lever 176 through lever 191, cam 201 for controlling the operation of feed lever 181 through lever 192, and cam 202 to control the operation of contacts 252. In Fig. 4, the cam drum has been illustrated and the elements of the structure which would obscure the view of the cam drum have been omitted for the purpose of giving a clear showing of the drum.

The power for driving cam drum 196 is derived from motor 29 through continuously rotating shaft 34. Main shaft 34, Fig. 4, is rotatably supported by the vertical supporting structure 123 which also provides the support for punch operator 114. Formed integrally with structure 123 are horizontally extending members 202 and 203 in which are securely fixed the bearings 204, preferably ball bearings, for shaft 34. An extension 206 is secured to main shaft 34 through a suitable coupling 207 and carries a gear 208 in mesh with a gear 209, Fig. 2, affixed to a power transmission shaft 211 extending across the rear of the printing reperforator. Shaft 211 is rotatably supported by bearings 212 and 213 depending from the principal apparatus casting 21 and carries a second power transmitting gear 214. Gear 214, Fig. 2, which is continuously rotated by shaft 211 meshes with a gear 216 secured to shaft 217 which is journaled in suitable bearings preferably ball bearings 218 and 219 depending from the horizontal portion of base casting 21. Grab clutch driving element 221 is driven continuously from shaft 217. The driven element 222 of the clutch is loosely supported on shaft 217, and normally held out of engagement with driving element 221, by means of a clutch throwout lever 223 which normally is spring urged into engagement with a clutch throwout cam 224 formed on the periphery of driven element 222. A compression spring 226 normally urges the clutch elements into engagement with one another and by means of a splined connection driven element 222 of the clutch imparts rotation to the cam drum 196 when the clutch elements have been engaged. An electromagnet 227, when energized, retracts the clutch throwout lever 223 from engagement with the throwout cam on the driven element of the clutch and permits engagement of the driving and driven elements, to rotate the cam drum 196. So long as electromagnet 227 remains energized the cam drum will rotate continuously and upon de-energization of the electromagnet the clutch is disengaged after cam drum 196 completes its instant cycle of revolution.

The energization of electromagnet 227 is under the joint control of a manually operated switch 228, Fig. 8, and a transmitter operated switch 229 so that the operation of the transmitter may be initiated when desired and terminated automatically upon the operation of the transmitter as the transmitter senses the last code signal combination perforated in the tape by the printing reperforator. The manually operated switch 228 may be located within the apparatus or may be external to the apparatus as may be best suited for the installation, but the transmitter controlled switch 229 is located within and is part of the apparatus. Frame member 179 of the transmitter structure carries a rightwardly extending projection 231, Figs. 1 and 2, and when the transmitter in pivoting about pivots 168 has reached its limiting clockwise position, projection 231 will have been brought down into engagement with a plunger 232 which is reciprocally mounted within an aperture in the base casting 21 and normally rests upon a contact of switch 229 so that as the projection 231 bears against and depresses plunger 232, the plunger in turn depresses and operates the switch 229 to break the circuit to the electromagnet 227, and shut down the operation of cam sleeve 196.

Cams 197 are arranged on cam drum 196 with their respective cam recesses in axial alignment so that a cam recess is presented to each of the Y-levers 182 and to the operator of the sixth sensing finger simultaneously whereby the six sensing fingers are elevated to their probing positions simultaneously and, depending upon the presence or absence of a perforation in the tape over an individual finger, into its restrained or its extreme counterclockwise position. The recesses of cams 197 are of sufficient length circumferentially of the cam sleeve 196 to retain the fingers 175 in tape probing position until the operation of a transfer mechanism, to be hereinafter described, has been completed and thereafter the cams rotate the fingers simultaneously in a clockwise direction, retracting them from probing relation with the tape preparatory to advancing the tape through the transmitter. Cams 200 and 201 are orientated to operate, respectively, followers 191 and 192 in precisely the same manner in which cams 207 and 205 in the above-identified copending application Serial No. 219,770 cooperate, respectively, with their followers 167 and 170, to impart a rectilinear feeding movement to members 176 and 181 of the transmitting device. Furthermore, cams 200 and 201 are orientated on cam drum 196 with respect to the cams 197, which operate the sensing fingers, in the same relation as the feed cams are orientated on the cam drum of the latter above-identified copending application with respect to the cam therein

which operates the tape sensing fingers. This orientation, or a similar one, is important and necessary to assure the proper operation of the feeding mechanism for if the feeding mechanism were permitted to operate in other than the timed relation set forth in the above-mentioned copending application with respect to the operation of the sensing pins, there would result a tearing of the tape and incomplete transmission.

As has already been mentioned, the motion imparted to the transmitter, through the operation of the pin 179 carried on lever 181 which is in engagement with cam groove 177, imparts a feeding stroke to the tape to feed the tape through the transmitter, and so long as there is a tape loop or a tape surplus between the printing reperforator and the tape transmitter, the tape will be advanced in this manner, but when the tape is taut between the reperforator and the transmitter, the operating movement of the transmitter will be restrained in a counterclockwise direction because of the engagement of the pins 178 in the taut tape and will result in the clockwise movement of the transmitter frame about its pivots 168. This movement of the transmitter will continue so long as the tape remains taut between the transmitter and the reperforator, providing that not stop abutment has been reached and that sleeve 196 is maintained in operation. As may be clearly seen in Fig. 2, the sensing unit 16 is pivoted to oscillate about a vertical center; that is, to either side of a vertical center. This over-central travel of the transmitter requires the inclined feed of the tape through the perforating punch block, which has been defined above, in order that there may be a substantially straight line feed of the tape from the reperforator into the transmitter when the transmitter has assumed its most clockwise position; that is, in abutment with the punch block. The forward or leading surface of the punch block, Fig. 2, is cut back at an inclined angle, inclined to the vertical, to present a plane which is substantially parallel to the position of the transmitter frame when it has engaged the punch block so that there is in effect a plane of contact between the two units. With the transmitter in this extreme clockwise position, the tape guideway defined by plate 171 and the tape gate 173 above mentioned, will be in a plane inclined to the vertical necessitating the feed of the tape from the reperforator at a similar angle so that the tape may feed in one continuous line from the reperforator into the transmitter in this extreme position.

It is clear from the detailed description of the rectilinear movement of the feeding mechanism of the sensing unit, which has been pointed out above and which is defined in greater detail in the above-identified copending application Serial No. 219,770 that the pins 178 are normally in engagement with the tape, and it follows that if the printing reperforator operates at a greater rate than the operation of the sensing unit thereby accumulating tape therebetween, the tape will advance the transmitter in a counterclockwise direction about its pivot 168 until finally the transmitter has reached its extreme counterclockwise position; that is, in abutment with an adjustable limit stop 236, Fig. 2. This adjustable stop is suitably secured to a substantially U-shaped frame member 237 which spans the sensing unit and is secured thereto by means of screws engaging the vertical wall sections 162 thereof, Fig. 1.

Frame member 239 has a depending portion centrally thereof, which secures or supports the stop abutment 236, Fig. 2. A pair of tape supporting fingers 238, Figs. 1 and 2, are carried by the web portion of the frame 237 and extend forwardly of the transmitter unit toward the perforator unit, extending, when the transmitter is in its extreme counterclockwise position against the stop 236, between the spaces which intervene the first and second, and fifth and sixth tape sensing fingers. Fingers 238 may project between any desired sensing elements of unit 16. The tape supporting fingers by projecting through the tape sensing unit serve to support the tape and sustain the weight of the tape loop between the tape sensing unit and the tape reperforator preventing bending of the tape over plate 171 of the transmitter. Should the tape be supported by the sensing fingers and the edge of plate 171 and there be a substantially large tape loop intermediate the tape sensing unit and reperforator, it is possible for the weight of the tape to bend or substantially break the tape over the plate 171 and prevent the feed of the tape through the transmitter. The tape supporting fingers which are provided obviate this danger.

It is to be understood that the tape fingers which are shown in Fig. 2 as being mounted upon the frame 237 may, if desired, be supported by the frame members of the transmitter itself, so that the fingers would travel with the transmitter and support the tape in all positions of the transmitter. However, with such a construction it would be necessary to mount the fingers movably on the frame so that upon the frame's approaching the perforating punch block these fingers could be deflected downwardly or otherwise so as not to impede the movement of the transmitter to its extreme clockwise position against the code punch block which is necessary for the unit to sense the last code combination perforated in the tape.

The tape 190 as it leaves the sensing unit 16 is supported upon a tape guide 239, Fig. 2, and directed thereover out of the apparatus. The guide 239 supported by base casting 21, extends across the transfer mechanism and switching mechanism, to be described hereinafter, and has been omitted from the remaining figures of the drawings for the sake of disclosing elements of the apparatus which would be obscured by the guide.

There has been provided an adjustment in the transmitter whereby the tape sensing elements 175 may be adjusted vertically with respect to the transmitter plate 171 and tape gate 173. The adjustment comprises a plate 241, Fig. 5, rotatably secured to each extremity of shaft 166. The plate has an arcuate slot 242 through which projects a stud 243 which threads into the vertical wall section 162 of the transmitter casting. By adjusting plates 241 the position of shaft 166 within channel 164 may be varied, resulting in an adjustment of fingers 175 with respect to the transmitter tape gate.

A tape deflector 246 of substantially U-shape, Figs. 1 and 2, is provided intermediate the sensing unit and reperforator and is pivotally secured to the punch block of the perforator, Fig. 1, with the rightwardly extending arms of the deflector 246 pivotally supported upon shaft 76 of the reperforator which also supports the stripper elements 77. A downwardly directed projection 247 depends from the web section of the deflector into the path of the tape as it emerges from the code punch block. The deflector normally tends to

rotate in a counterclockwise direction under the influence of gravity and, if desired, a biasing spring. Due to the contour of the deflector, tape as it emerges from the reperforating punch block and abuts against the deflector is directed downwardly into a depending loop between the reperforator punch block and the sensing unit. A storage container may receive the tape as it accumulates between the units. The tape deflector is relatively narrow, Fig. 1, and exposes that portion of the tape on which is printed the code characters and, accordingly, the message printed on the tape intermediate the transmitter and reperforator may nevertheless be read even though the tape deflector is in its operative tape loop forming position. The deflector **246** may, if desired, be rotated over center in a clockwise direction to an inoperative position; that is, out of the path of the tape as it emerges from the perforating code punch block. The deflector may be rendered inoperative in this manner when it is necessary to thread the tape, initially through the transmitter.

Extending forwardly of the deflector is a latching finger **248** which serves to engage the plate **171** of the transmitter when the transmitter is in its extreme counterclockwise position, as illustrated in Fig. 2, and renders the transmitter immovable with respect to the perforating punch block, so long as there is a sufficiently large tape loop intermediate the transmitter and reperforator. If, because the reperforator unit operated at a greater speed than the transmitter, there is a sufficiently large tape loop formed between the two units, the deflector **246** will pivot about its shaft **76** and come into locking engagement with the transmitter **16** which would have been advanced to its extreme counterclockwise position by reason of the movement of the tape with respect to the transmitter caused by the operation of the reperforator at a greater rate than the operation of the transmitter. Sensing will then be carried out with the sensing unit held by the latching finger **248**, so long as there remains a sufficiently large tape loop intermediate the two units. However, assuming that the sensing unit should operate at a rate greater than the rate of operation of the reperforator, the tape loop will be shortened as it is fed through the transmitter at a greater rate than incoming tape is fed from the reperforator. If the transmitter continues to operate at the greater rate, the tape loop will become entirely taken up, and in so doing, the tape will engage a pin **249** extending horizontally from finger **248**, and as the tape becomes taut it will cam the deflector upwardly, and latching finger **248** will be lifted out of the path of the transmitter so that under the subsequent operations of the rectilinear feed mechanism of the transmitter, the pivoted transmitter will be permitted to advance toward the reperforating unit without having its movement in this direction impeded in any way by the latching projection **248** of the tape deflector. In Fig. 2 there is indicated in dotted construction, the position of the tape deflector when it has been cammed by the tape in a counterclockwise direction about shaft **76** due to a shortening of the tape loop.

Briefly the operation of the transmitting or sensing unit is as follows:

Assume switch **228** to be manually closed and that the transmitter **16** is in its extreme clockwise position against the perforator code punch block. In this condition projection **231** secured to frame member **170** of the transmitter, will have depressed plunger **232** and opened switch **229**, deenergizing the electromagnet **227** and disabling the power drive to the cam drum **196** by reason of the engagement of clutch throwout lever **223** and the throwout cam **224** on the periphery of the clutch driven element **222**. Toward the completion of a cycle of operation of the printing reperforator in response to a received code signal, a perforated code combination will be stored in the tape and advanced from the reperforator to the transmitter, and this advancing movement of the tape, because of the fact that the pins **178** of feed member **176** are in engagement with feed perforations in the tape, will rock the pivoted transmitter in a counterclockwise direction for a distance corresponding to the tape feed, and this movement is sufficient to withdraw projection **231** from engagement with plunger **232** and permit the spring element of the switch **229** to elevate the plunger and close the switch **229** completing the circuit to electro-magnet **227** which attracts its armature resulting in the removal of clutch throwout lever **223** from the path of the throwout cam on the clutch driven element **222**, permitting the engagement under the influence of spring **226** of the elements **221** and **222** of the clutch and connecting the power drive from motor **29** through to the cam drum **196**. As cam drum **196** rotates, cams **197** simultaneously present cam depressions to the plurality of Y-levers **182** to elevate the sensing fingers **175** into tape probing position under the influence of biasing springs **189** individual to each Y-lever. If a given Y-lever finds a perforation in the tape, its associated spring **189** will be permitted to rotate the Y-lever to its extreme counterclockwise position about shaft **166**, positioning the leftward extremity of the Y-lever in the lowermost position in its guide comb **183** but if a sensing finger **175** does not find a code perforation in the tape, the counterclockwise rotation of its associated Y-lever is restrained so that its spring **189** can rotate the Y-lever **182** to a very limited extent about shaft **166** resulting in a positionment of the Y-lever in an upper position in the guide comb **183**. The relative position of the Y-levers, that is, whether the Y-levers remain in a relatively high portion of the guide comb **183**, or are positioned in the lower portion of the guide comb, controlled in accordance with the code perforated in the tape, is utilized in a manner to be hereinafter described, to control transmitting redistributors to repeat the signals and function levers to perform switching operations in accordance with the permutable setting of the Y-levers. As cam drum **196** continues its cycle of rotation, cams **197** retract fingers **175** from probing engagement with the tape, cams **200** and **201**, controlling the operation of levers **176** and **181** in a manner above described, effect a rectilinear feed of member **176** and advance the transmitter again to its extreme clockwise position to cause projection **231** to open switch **229** and interrupt the operation of the transmitting cam shaft at the completion of the cycle of operation of the sensing unit.

If during the operation of the sensing unit, a second advancement is given to the tape and consequently to the sensing unit by the operation of feed wheel **81** in the printing reperforator, the movement of the transmitter frame at the completion of the instant cycle of operation of cam drum **196** will not cause the switch **229** to open and the sensing unit will continue to operate. If the printing reperforator continues to operate at a greater rate than the sensing unit, a tape

loop will form intermediate the units and the tape deflector 246 will be effective to latch the sensing unit against its counterclockwise stop 236 until the deflector is cammed out of engagement with the sensing unit by the tape resulting from a subsequent operation of the transmitter at a greater rate than that of the printing reperforator. With the deflector 246 cammed out of the path of the transmitter, the continued operation of the transmitter and its rectilinearly operated feed member 176 will advance the transmitter toward the printing reperforator and ultimately interrupt the operation of the transmitter by opening switch 229 as the transmitter is moved into a position to sense the last code perforation in the tape.

Tape-out indicator

In Fig. 1, it may be clearly seen that there are provided six sensing fingers 175 only five of which are employed to probe the code perforations in the tape as indicated above, the sixth finger being employed as a tape-out indicator to interrupt the operation of cam drum 196 when the tape in the transmitter has become exhausted or broken or in response to the probing of a special perforation in the tape. The sixth sensing finger may be carried by a Y-lever similar to the Y-levers which carry the code sensing fingers but provided with a depending projection 256, Fig. 3, which is effective to operate contacts 257 when the spring 189 associated with the lever carrying the sixth sensing pin, is permitted to rotate that lever in its extreme counterclockwise position about shaft 166, moving projection 256 into engagement with the contact 257. In view of the fact that contact 257 is closed cyclically upon each rotation of cam drum 196 and is immediately reopened, and since the electromagnet 227 should remain de-energized during the depletion of tape supply, the contacts 257 are connected to a control circuit shown in Fig. 8. This control circuit forms no part of the present invention but is illustrated only for the purpose of showing the relation between contacts 257 and clutch magnet 227. Briefly, however, the momentary closing of contact 257 effects the energization of magnet 250 over an obvious circuit, which is locked up over an obvious locking circuit. The circuit for a warning lamp is closed, and the circuit of the clutch magnet 227 is opened due to the operation of armatures of magnet 250. By the closing of manually operated contacts 228 the locking circuit of magnet 250 is broken and the reenergization of clutch magnet 227 is effected.

The sixth sensing pin or tape-out pin will be permitted to be rocked into its extreme counterclockwise position to operate contacts 257 when the tape is exhausted or broken. If it is desirable to arrest the operation of transmitter 16 at a predetermined point, a special perforation may be made in the tape in alignment with the sixth sensing pin so that as this special perforation is presented in the transmitter over the sixth pin, that pin in moving to tape probing position will sense the special perforation and interrupt the operation of the transmitter at this predetermined point.

Tape feed suppression

Under certain conditions of operation of communication systems in which the apparatus according to this invention may be employed, it may be desirable to sense and transmit the same perforated code combination a plurality of times and for that purpose, a tape feed suppression means is provided which, when operated, disables the operation of the tape feeding mechanism in the transmitter so that as the cam drum 196 effects a plurality of operations of the sensing unit, the unit will sense one code combination in the tape a plurality of times. In Fig. 3, the details of the tape suppression device are illustrated. The device comprises a tape suppression magnet 259 which may be energized by any local, manually closed circuit or relay operated circuit, not shown, a pivoted armature 261 provided with a laterally extending blocking projection 262 and projections 263 and 264 provided on follower levers 191 and 192, respectively, of the tape feeding mechanism. A spring 266 extending between the base casting 21 of the apparatus and armature 261 normally holds the armature in its counterclockwise position about its pivot 224 out of engagement with projections 263 and 264.

When it is desired to operate the tape suppression device, any suitable energizing circuit to magnet 259 is manually conditioned, energizing the magnet which attracts its armature, rocking the armature in a clockwise direction about pivot 267 introducing the blocking projection 262 of armature 261 into blocking relation with respect to projections 263 and 264 on feed levers 191 and 192, respectively, holding the members 191 and 192 of the feed mechanism from responding to the influence of their respective biasing springs when a depression in their cams 200 and 201, respectively, is presented to the cam followers secured to levers 191 and 192. Accordingly, as cam drum 196 continues this cycle of revolution, the cams 200 and 201 are ineffective upon the feed levers 176 and 181 since their operating levers 191 and 192, respectively, are held nonresponsive to the control of said cams. Therefore, as cam drum 196 is rotated through a plurality of revolutions it causes the sensing elements 175 under the control of cams 197 to sense the same code combination of the tape a plurality of times.

Retransmitting distributors and transfer mechanism

The sensing unit, in the manner described above senses the successive code perforations in the tape as the tape passes from the printing reperforator to the sensing unit, and in each sensing operation positions the Y-levers 182 in guide comb 183 in accordance with the code combination sensed; that is, the Y-levers are permutably positioned in the upper or lower portions of the guide slots in comb 183 in accordance with the extent of the counterclockwise rotation of the Y-levers under the influence of their biasing springs 189 as controlled by the perforations in the tape. The permutable setting of the Y-levers 182 controls the operation of cam type retransmitting distributors 17 and 18, Figs. 1 and 2, which redistribute or retransmit the received and recorded code signal combinations. A plurality of distributing devices, have been provided to afford a flexible retransmitting or redistributing system, as will hereinafter appear.

Each of the cam type retransmitting distributors is substantially the same as the distributor which is the subject of Patent No. 1,595,472 to Krum and includes a cam drum upon which are mounted the five code impulse controlling cams and a start-stop controlling cam described with particularity in the Krum patent. Distributor 17 has a cam

assembly 271 of this type rotatably supported upon a continuously rotating shaft 272 which is supported in suitable bearings preferably ball bearings, one of which, 273, is illustrated in Fig. 4. Shaft 272 carries at its rearward extremity or rightward extremity as viewed in Fig. 4, a gear 274 in mesh with power transmitting gear 214 secured to continuously rotating shaft 211. A clutch, including a driving portion 276 secured to shaft 272 and driven member 277 rotatably supported upon shaft 272, is provided to impart driving force to the cam assembly. A spring 278 is effective when a distributor release magnet 279, Fig. 5, is energized retracting a clutch throwout lever 281 from engagement with the clutch throwout cam 282 formed on the periphery of driven member 277 to engage the clutch elements and rotate the cam assembly.

A plurality of pivotally supported contact operating bell crank levers 283, Fig. 2, having cam following projections 284 is supported upon a pivot shaft 286 suitably secured to the apparatus frame structure and biasing springs (not shown) serve to urge the bell cranks in a clockwise direction to maintain the cam followers in engagement with their associated cams in cam assembly 271. A pair of transmitting contacts 287 is associated with each contact operating lever to be operated thereby. The individual cams comprising the assembly 271 are arranged in helical arrangement and present cam recesses to the contact operating levers successively so that the contact operating levers are invariably operated in succession with each rotation of the cam sleeve whereby a signal including start-stop phasing impulses may be transmitted.

The particular signal transmitted is determined by a series of contacts, in this case five in number, one of which is serially connected with the code impulse contacts of the distributor 17. These character determining contacts 288 are supported in the apparatus assembly in operative relation with respect to a depending projection 289 depending from each of the Y-levers corresponding to the code probing sensing elements to be conditioned thereby in accordance with a code combination sensed by sensing mechanism 16. Five code controlling contacts 288 have been provided because it is contemplated that the apparatus will be operated by a five unit code. It is to be understood that the number of such contacts employed will be determined by the particular code utilized.

As indicated above, the contact operating lever 194, Fig. 5, is pivotally supported on shaft 166 to operate under the control of a cam 202 a pair of contacts 252 which contacts, when operated, complete the energizing circuit (not shown) for the distributor release magnet 279 to initiate a cycle of operation of retransmitting distributor 17. Cam 202 is oriented within the cam drum 196 to operate lever 194 in proper timed relation to the operation of the sensing mechanism 16 under the operation of the plurality of cams 197 so that distributor 17 will be operated to repeat a signal combination that has been sensed.

The distributor release magnet 279 as well as the transmitter release magnet 227 is supported by a bracket that depends from the main casting, the magnets being secured thereto in superposed relation, Fig. 5. A pair of horizontally extending arms, 291 and 292, project from the bracket, Fig. 1, and a pivot shaft 293 upon which is mounted clutch throwout levers 223 and 281 is supported by the rightward extremities of the arms.

In the operation of the retransmitting apparatus thus far described, the transmitting distributor 17 repeats into the channel with which the distributor is electrically associated the signal combinations stored in the tape and sensed by the sensing device. The Y-levers 182 are permutably conditioned under the operation of the sensing fingers 175 about the shaft 166 and thereby operate the series of contacts 288 in a corresponding permutation. This permutation is determined as follows: When a Y-lever has assumed its extreme counterclockwise position as when its associated sensing finger has found a perforation in the tape, its projection 289 causes its associated contact pair 288 to be closed, and when the counterclockwise rotation of a Y-lever is impeded due to a spacing condition represented by the absence of a perforation in the tape over the particular sensing finger, its projection 289 retains contacts 288 open so that with each operation of the sensing device contacts 288 are opened and closed to determine a code signal permutation. In timed relation to the operation of the sensing device, cam 202 operates lever 194 to energize the distributor release magnet 279 which transmits a start impulse following which, through the invariable operation of its cam operating levers, it transmits the marking and spacing impulses comprising the particular code signal combination under the control of contacts 288 and finally it transmits a stop impulse whereupon the clutch throwout lever 282 arrests the cam sleeve pending another operation of the sensing device.

Transmitting drum 271 in its stopped condition maintains marking condition on the line, as is well understood in the art, and holds each of the code impulse contact pairs open whereas the sensing device in its arrested condition, retains the Y-levers in their extreme clockwise positions holding contacts 288 open preparatory to a sensing operation. Early in the cycle of cam drum 196 the sensing elements are operated simultaneously and establish a signal combination immediately upon contacts 288. At substantially the same time, distributor 17 is released and during the remaining portion of the sensing time, transmits over its associated line the signal combination established on contacts 288.

Y-levers 182 control the signals generated by a second retransmitting distributor 18 through a transfer mechanism that reads the setting of the Y-levers, determined by a sensing operation, and establishes that setting on the contact operating levers of the distributor. The particular association of the distributor with the sensing mechanism, being through the agency of a transfer mechanism, affords complete signal overlap in this portion of the apparatus which is similar to a tape transmitter.

The transfer mechanism is supported by a pair of depending structural brackets, depending from base casting 21. These elements 301 and 302, Fig. 1, are provided with horizontally extending flanges through which the brackets are bolted to base casting 21. Pivot studs 303 and 304, Fig. 4, are carried at the lower extremity of brackets 301 and 302, respectively, and support the frame of the transfer mechanism in a pivotal manner. The frame comprises a pair of vertical arms 306 and 307 interconnected by a horizontally disposed member 308, Fig. 1. A horizontally disposed pivot shaft 309, Fig. 2, extends between the upper portions of vertical frame members 306 and 307 of the transfer frame and there is mounted on the shaft a plurality of transfer levers 311 which are substantially T shaped and suitably spaced hori-

zontally along shaft 309 by means of spacing discs 312. The upper and lower extremities of the vertical sections of T-levers 311 face the fork elements of the Y-levers 182, Fig. 2, and when the Y-levers are positioned in the upper portion of the slide groove of comb 183, the upper tines of the Y-levers are in substantial alignment with the upper extremities of the T-levers and, conversely, when the Y-levers are positioned in the lower portion of the comb, as illustrated in Fig. 2, the lower tines are in substantial alignment with the lower extremities of the T-levers. Shaft 309 is preferably eccentric in cross section so that by rotating the shaft an accurate alignment of the T-levers and Y-levers may be obtained.

In order to transfer the permutable setting of the Y-levers to the transfer levers, the frame of the transfer mechanism is pivotally supported as described above, and cam 199, Fig. 4, which is included in cam drum 196, operates upon a cam follower 313, Figs. 2 and 4, formed as a projection on the member 307 of the frame of the transfer mechanism. A biasing spring (not shown) operates normally to hold the transfer frame in its counterclockwise position, but the operation of cam 199 on cam follower 313 is sufficient to overcome this spring bias and rotate the transfer frame and the T-levers 311 into a clockwise position in which the terminals of the T-levers come into abutting relation with the tines of the Y-levers in accordance with the permutable setting of the Y-levers, and this engagement of the T-levers with the Y-levers rocks the T-levers in a clockwise or counterclockwise direction about shaft 309 and transfers the setting of the Y-levers to the T-levers.

More particularly, if a Y-lever is assumed to be in its lower position in comb 183, in response to the projection of its associated sensing finger 175 through a code perforation in the tape under the influence of its biasing spring 189, when the cam 199 operates the transfer mechanism in timed relation to the probing of the tape under the control of cams 197, that is, after the tape has been sensed and the Y-levers permutably conditioned, it will bring the T-lever associated with the particular Y-lever toward the Y-lever, the lower tine of which will engage the lower extremity of the vertical section of the T-lever 311, and through this engagement will rock the T-lever 311 in a clockwise direction about shaft 309. Conversely, when the Y-lever is in its upper position in the comb 183 due to the failure of its finger 175 to enter a perforation in the tape, when the associated T-lever is brought into engagement with the Y-lever, the upper tine of the Y-lever will engage the upper extremity of the vertical section of the T-lever and in this engagement rock the T-lever in a counterclockwise direction about shaft 309. The transfer of the setting of the individual Y-levers to the associated individual T-levers takes place simultaneously and after it has taken place, the return spring on the transfer mechanism is effective under the control of cam 199 to rotate the transfer mechanism, and the T-levers in their permutable relation with respect to one another, to their normal or counterclockwise position and, in this manner, free the plurality of Y-levers which may then be returned to their normal position by cams 197 retracting the fingers 175 from engagement with the perforated tape, preparatory to the sensing of a subsequent code combination. When the transfer mechanism is returned to normal, it maintains control over a retransmitting distributor to transmit the signal combination transferred from the Y-levers and during this transmission, cam drum 196 initiates another cycle of the sensing unit, setting the Y-levers in accordance with the following code signal combination recorded in the tape, thereby providing complete signal overlap between the sensing unit and transfer mechanism.

There is associated with each T-lever a code bar 316, Figs. 1 and 2, and this association is through the shank portion 317 of T-lever 311 which is received in a recess 318 provided in the upper surface of the code bar. Each code bar 316 is slidably supported at each of its extremities within guide combs 319 and 321, Fig. 2, carried in depending fashion from the base casting 21 of the apparatus. There are as many code bars provided as there are T-levers, one bar being associated with one T-lever in the above-described manner. In this particular embodiment of the invention, wherein it is contemplated to employ a five-unit code, there are provided five Y-levers, five T-levers and five code bars mutually associated with one another. The code bars 316 extend leftwardly from the transfer T-levers and at its left ward extremity, Fig. 2, each code bar receives a latching lever 322 to control the transmitting contacts of cam type distributor 18.

Latching levers 322 are pivotally supported upon a pivot shaft 323, Fig. 6, secured to main casting 21 and properly positioned axially along the shaft by spacing discs 324. At its lowest extremity each latching lever enters a recess 325 provided in the upper surface of its associated code bar to provide a suitable, articulation therebetween so that the permutable setting of the code bars will be automatically established on the latching levers. The latching levers determine the signal transmitted by cam type distributor 18.

Cam type distributor 18, Figs. 1 and 2, comprises a cam drum 326 upon which are mounted the five code impulse controlling cams and the start-stop controlling cam, as is well known in the art, and described with particularity in Patent No. 1,595,472 to Krum. Cam drum 326 is loosely mounted on shaft 327 which receives its driving power from shaft 211, Figs. 1 and 2, which carries gear 328 meshing with a gear 329 secured to shaft 327. A grab or positive clutch comprising a driving element 331, Fig. 1, secured to shaft 327 and a driven portion 332 rotatably mounted upon shaft 327 and controlled by clutch throwout lever 333 is provided to connect the power from shaft 327, through the grab clutch, to cam drum 326 when magnet 334 is energized, retracting the clutch throwout lever 333 from engagement with the cam on the peripheral portion of clutch element 332 permitting engagement of the elements of the grab clutch in a manner referred to hereinbefore in connection with another similar grab clutch construction. Shaft 327 is suitably journaled on supports provided in the base casting 21, one of which is illustrated at 336.

Associated with the cam drum 326 are a plurality of levers 337, Fig. 2, pivoted on a shaft 338 and operated by cams on cam drum 326 when permitted to move by the latching levers 322 to control the operation of transmitting contacts 339 associated with a telegraph line (not shown).

In Fig. 2 the levers 337 and cam drum 326 are illustrated, and from that view it may be seen that the horizontally extending portion of each

lever 337 carries a cam following element 341. A spring (not shown) individual to each lever 337 tends normally to rotate each lever in a counterclockwise direction about pivot 338. When cam drum 326 is permitted to rotate due to the energization of magnet 334, the code impulse controlling cams, successively present cam depressions to the cam followers 341 and in response thereto, the biasing springs rotate the levers in a counterclockwise direction to close the associated contact 339 if the latching lever 322 associated with the particular lever 337 is in its clockwise position, as illustrated in Fig. 2, due to the leftward positionment of its respective code bar, under the control of the T-levers. If a code bar has been conditioned in its rightward position by its T-lever, the latching lever 322 operated by that code bar will be positioned in its counterclockwise position or into locking relation with the lever 337 associated therewith, and when the cam recess is presented to the cam follower 341 of that lever, the counterclockwise rotation of the lever is restrained through the engagement of the latching lever 322 with the lever 337, preventing the closure of the cam operated contacts 339 associated with that particular lever.

The energization of electromagnet 334 is under the control of cam 198 on cam sleeve 196 of the sensing unit which, through the orientation of cam 198 on the sleeve, releases the distributor shaft 327 to drive the cam sleeve 326 in timed relation to the sensing and transfer of the code combinations in the tape. Cam 198 operates a bell crank 193, Fig. 1, pivoted on shaft 166 to close contacts 251, Fig. 5, which complete a simple energizing circuit (not shown) to the electromagnet 334 in each cycle of revolution of the sensing unit cam drum 196 to cause the grab clutch 331—332 in the transmitting distributor unit to be engaged for a single cycle of revolution.

The operation of the transfer mechanism and the transmitting distributor briefly is as follows:

In timed relation to the setting of the Y-levers 182, cam 199 operates to move the transfer mechanism including the transfer T-levers 311 to their clockwise position and permutably set the T-levers in their clockwise or counterclockwise position about shaft 309 in accordance with the engagement of the T- and Y-levers; that is, by engagement with the lower extremities of the Y-levers, the T-levers are rotated in a clockwise direction in response to a marking impulse indicated in the perforated tape and, conversely, are rotated in a counterclockwise direction in response to the spacing impulse indicated in the tape. Through their association with the T-levers the code bars will be correspondingly conditioned in a permutable setting corresponding to that setting which has been transferred to the T-levers from the Y-levers and in this setting the T-levers which have been rotated in a clockwise direction, position their associated code bars leftwardly and, conversely, those T-levers which are positioned in a counterclockwise direction condition their code bars in a rightward position. Correspondingly, the latching levers 322 are moved respectively out of and into latching position with respect to the levers 337. Those code bars 316 which have been positioned in a leftward direction in response to a marking impulse rotate their latching levers out of engagement with their associated levers 337 permitting the contacts controlled by those levers to be closed under the control of the cam drum 326, to initiate a marking impulse. Conversely, the code bars 316 which have been moved in a rightward direction in response to spacing impulses, position the latching levers 322 into blocking relation with their levers 337, to prevent the closure of the contacts 339 associated with those levers and thus initiate a spacing impulse. In this manner, the code combination, sensed by the sensing unit and transferred to the code bars by the transfer mechanism, is set up in the retransmitting distributor and retransmitted.

Automatic switching mechanism

In order to effect automatic switching or any of the various functions which it may be desired to control from the perforated tape, there is provided an automatic switching mechanism 19 including a plurality of function levers 351, Figs. 1, 2, and 6, pivotally supported upon a shaft 352 which is suitably carried by the base casting to the rear of the apparatus. The function levers are bell cranks and are properly positioned along shaft 352 by means of spacers 353 interposed between successive bell cranks and to accommodate a large number of function levers, the levers are assembled on shaft 352 to define two rows, one on either side of code bars 316. For the purpose of effecting switching operations, contacts 354 associated with communication channels are suitably supported in a position to be operated by the horizontal arms of bell cranks 351, Fig. 6. Each function bell crank 351 is provided with a biasing spring 356 tending to rock the bell crank about its pivoted shaft 267 in a direction to operate the contact pair associated therewith.

Each code bar 316 is coded on both its upper and lower surfaces; that is, each bar carries a series of recesses or cutaway portions in its upper and lower surfaces, located in code manner so that for each permutational setting of the code bars there will be one, and only one, alignment of notches including a notch or recess located in each code bar. Function levers 351 are positioned transversely of the code bars to be selectively operated thereby. The positionment of the function levers with respect to the code notches is such that there is a predetermined permutational setting of the code bars for each function lever which will present an alignment of code notches to that function lever, and that lever alone, permitting the lever to be positioned into the alignment of code notches by its biasing spring to thereby actuate its associated contacts 354.

A selected function bell crank 351, selected in response to the setting of code bars 316, is restored to its unselected position against the tension of its biasing spring by a spreader cam at the completion of the instant cycle of operation which is ample time to accomplish the selected switching operation. For this purpose, cam 357, Fig. 1, is provided extending parallel to bars 316 and rotatably supported beneath the horizontal portion of main casting 21 on a shaft 358. The cam is disposed transversely of and between function bell cranks 351. Shaft 358 carries a gear 359 which meshes with gear 361 secured to cam assembly 196 and preferably the gear ratio is 2:1 since cam 357 includes a pair of cam surfaces to operate both rows of function levers 351. With this arrangement, shaft 358 rotates coextensively with but at half the speed of cam assembly 196 so that near the completion of each cycle of cam drum 196, cam 357 moves all function levers 351 to an extreme position out of engagement with code bars 316, freeing the bars for the next per-

mutational setting. In the following cycle of operation, after cam drum 196 has caused a succeeding permutational setting to be transferred to code bars 316, cam 357 frees the function levers and permits the restoring springs 356 to rock the function levers into probing relation with respect to the code bars resulting in a selected operation of the bell cranks and contacts 354.

A cognizance device, Fig. 3, is provided to hold the function levers 351 normally nonresponsive to the permutable settings of code bars 316 and to render the function levers selectively responsive to the operation of the code bars following a predetermined operation of the code bars which is effective to remove the cognizance device from disabling association with the function levers. The cognizance device comprises a selectively operable control bar which must be properly conditioned to render the function bell cranks 351 responsive to the permutable setting of the code bars 316. Referring more particularly to Figs. 1 and 3, the control bar 366 is supported by guide combs 319 and 321 and is spaced from but parallels code bars 316. The control bar 366 is also slidably supported upon pins 367 and 368 which are mounted in a frame member 371 and which project through slotted apertures 369 in the control bar. Frame member 371 is supported by combs 319 and 321. Control bar 366 extends transversely of and beneath the function bell cranks 351 and normally presents blocking projections 372 to each of the function bell cranks which prevent the rotation of the bell cranks under the control of their springs 356 in response to the permutable setting of the code bars 316. However, control bar 366 is provided with notches 373 which, when the control bar has been operated in a predetermined manner, will be positioned beneath the function bell cranks 351 rendering the bell cranks responsive to subsequent operations of the code bars 316.

Pivotally supported on pin 367 is a bell crank 376 one arm of which is directed downwardly into alignment with a forwardly extending, depending projection 377 secured to control bar 366. Similarly, a bell crank 378 is pivotally supported on pin 368 and one arm of the bell crank is in alignment with a second, forwardly extending projection 379 that depends from control bar 366. It may be observed that the bell cranks engage opposite sides of projections 376 and 379 so that the bell cranks, when rotated about their pivots in a manner to be presently described, will slide control bar 366 in opposite directions. A plurality of control function levers indicated 381 and 382 is provided for operating the bell cranks 376 and 378 to effect the responsiveness of the switching function levers 351 to the permutable setting of the code bars 316. Although any particular function levers of the group indicated 351 may be employed to condition the control bar, specific ones to be identified presently have been selected in this embodiment of the invention. Control function lever 381 is the "figure" function lever and control function lever 382 is the "letters" function lever.

When the function levers 351 are held from responding to the permutable setting of the code bars 316, control bar 366 is positioned in its leftward position as viewed in Fig. 3, presenting a blocking tooth 372 beneath each of the function levers exclusive of the figures function lever 381 and letters function lever 382. When it is desired to perform a switching or other function through the agency of the function bell cranks 351, the signal combination to select the figures function lever is set up from the perforated tape in the code bars 316 in response to which control function lever 381 is selected and operated about pivot 352 into its extreme counterclockwise position, as viewed in Fig. 6, since there is a notch in the control bar 366 beneath this particular bell crank. In assuming its most counterclockwise position, lever 381 depresses bell crank 378 rocking it in a counterclockwise direction, as viewed in Fig. 3 about pin 368, and accordingly, the bell crank through its engagement with projection 379 shifts the control bar 366 rightwardly. This positionment of control bar 366 presents a notch under all of the function levers 351 and in this condition the cognizance device permits selective operation of the control or switching function levers 351 in response to subsequent code signal combinations set up in the code bars by the perforated tape.

When the required switching or other functions have been accomplished through the code combinations set up in code bars 316 subsequent to the conditioning of the cognizance device, the letters selection combination is set up in the code bars which operates the control function lever 382. In operating, control function lever 382 rotates bell crank 376 in a clockwise direction, as viewed in Fig. 3, and through its engagement with projection 377 slides the control bar in a leftward direction disabling the function levers 351 from responsiveness to the subsequent permutable settings of the code bars, until the cognizance device has again been operated in the above-described predetermined manner.

In order to utilize the automatic switching mechanism, the substation at which a message is to be originated, transmits in sequence, the figures signal combination and the switching signal combinations. Following the switching signal combinations, the letters function signal combination is transmitted after which the message signal combinations may be transmitted. At the receiving station these signals are received, recorded, and stored in a tape, transferred to the transmitting distributor and automatic switching mechanism to first condition the switching mechanism for operation, selectively operate it, and disable it in sequence. The switching signals preceding the message signals may set up and desired switching combinations for signal distribution.

In Fig. 7 there is disclosed a circuit diagram demonstrating one switching function which may readily be performed under the control of code signal combinations stored in a tape and sensed by sensing mechanism 16. The description of the retransmitting distributors thus far has brought out the fact that a code signal combination sensed is transmitted or repeated twice; that is, by retransmitting distributor 17 and again by retransmitting distributor 18. Only one of these distributors, however, namely, 18, is associated with the switching mechanism and one practical utility for that switching mechanism is the determination of the communication channels with which the retransmitting distributor 18 is associated for the repetition of code signal combinations received by the printing reperforator. The circuit of Fig. 7 will accomplish this purpose.

In the circuit arrangement disclosed there are represented the contacts 354 operated by four of the function levers 351. It is, of course, to be understood that this is merely a representative circuit and may be expanded as desired. The

contacts have been designated UCA, UCB, UCC, and UCZ indicating that those contacts which are operated by the signal combinations A, B, C, and Z, respectively, when those signal combinations are received with the control bar **366** conditioned to render the function levers **351** responsive to the permutable settings of the code bars **316**. A plurality of relays **386**, **387**, and **388** is provided to connect the line L which represents the outgoing conductor from retransmitting distributor **18** selectively to outgoing communication channels **389**, **390**, and **391** over which the signals originating in the retransmitting distributor **18** may be repeated to receiving stations A, B, and C, respectively (not shown).

In describing the circuit operation it will be assumed that a figure signal combination has been conditioned in the switching mechanism **19** to render the switching levers **351** selectively responsive to the operation of code bars **316**. The signal combination of upper case A will cause the selection and operation of that function lever **351** associated with contacts **354** indicated UCA in Fig. 7. These contacts will be closed completing a circuit from battery through contacts UCA, relay **386**, line **392**, armature and closed contacts of relay **387**, line **393**, armature and closed contacts of relay **388**, line **394** and closed contacts UCZ to ground. In the above-defined circuit, contacts UCZ have been identified as normally closed whereas the remaining contacts associated with the function levers **351** are normally opened and are closed upon the selection of their associated function levers. This one contact pair, however, UCZ, is normally closed and is opened upon the selection of the upper case Z function lever. The above-defined circuit energizes relay **386** which draws up its armature and closes a locking or holding circuit including battery, inner left-hand armature and contact of relay **386**, winding of relay **386**, line **392**, closed armature contacts at relays **387** and **388** to line **394** and ground, as recited previously. The holding circuit which retains the relay **386** energized is effective thereby to retain a circuit connection from line L through operated relay contacts at relay **388** to line **389** which thereby associates the retransmitting distributor with sub-station A over communication channel **389**.

In the course of a message to be repeated over channel **389**, it frequently happens that the message will include signal combinations which represent the figures selection. This, of course, comes about when it is necessary to transmit any upper case characters which may be included in the message. Since the figure selection combination conditions the function levers **351** to be selectively responsive to subsequent code signal combinations established in code bars **316**, it is desirable to preclude the operation of any function levers from being effective to establish additional switching or communication circuits; that is, it is desirable to maintain the established connection between retransmitting distributor **18** and the selected channel. For this purpose a circuit disabling mechanism is provided and associated with each communication determining relay **386**, **387**, and **388** to maintain the connection from the retransmitting distributor **17** over a predetermined channel or a selected channel until that channel has been interrupted by the establishment of a dumping signal condition in the switching mechanism.

Continuing with the assumed selection of line **389** connecting the line L from the retransmitting distributor thereover to station A, the operation of this holding device is as follows: with relay **386** energized, the two left-hand armatures of the relay establish the locking circuit for the relay and the connection from the retransmitting distributor to the selected substation, respectively. The two right-hand armatures, however, which normally engage their associated contacts are moved from engagement therewith and disable the energizing circuits to relays **387** and **388** precluding the energization thereof should contacts USB or UCC be operated while the selected channel remains in electrical connection with the line L. Assume that contacts UCB are selected and operated, the circuit to relay **387** includes battery, contacts UCB, winding of relay **387**, and the extreme right-hand contact and armature of relay **386**. The circuit is interrupted at this last point, and accordingly relay **387** will not be energized.

Assume that contacts UCC are selected and operated. The energizing circuit to relay **388** would include battery, contacts UCC, winding of relay **388**, closed contacts of relay **387**, line **396**, and opened contact and armature of relay **386** so that relay **388** will not be energized. In a similar manner, it may be demonstrated that if the line L is associated with either of stations B or C, the energized line relay maintaining that association will preclude the operation of either of the remaining relays so long as that selected circuit association maintains.

After the communication over the selected channel, which in the illustration chosen is channel **389**, has been completed it is necessary to interrupt that channel and the relay which maintains it to prepare the switching mechanism to operate in response to the next group of switching signal combinations to establish the next communication channel with retransmitting distributor **18**. For this purpose, following completion of the message signal combination, the figures combination is established in the code bars **316** to assure that the function levers are permitted to respond to the switching signal combinations following which the Z signal combination, which, of course, is the upper case Z, is established in code bars **316** whereupon that function lever associated with contacts UCZ is selected and operated. The operation of this function lever opens contacts UCZ and interrupts the holding circuit to relay **386** de-energizing the relay and establishing the normal circuit condition illustrated in Fig. 7. Thereafter, switching may be accomplished through the selection of any of the upper case signal combinations which control the communication channels.

The described circuit illustrates one embodiment of the operation of the switching mechanism and its controlling circuits. The control circuit may be rearranged and modified to permit the selection of more than one communication channel at a time as by cascading the relays. These and other modifications will readily appear to those skilled in the art.

The apparatus described provides a flexible retransmitting arrangement which enables various services to be carried on through the employment of this apparatus by providing a plurality of retransmitting distributors. Message signals received in the printing reperforator may be repeated over a plurality of communication channels. One of those channels may be invariably connected to one of the retransmitting distributors, such as distributor **17**. A supervising or

master station may conveniently be connected to such a transmitter to supervise and study the operation of the apparatus. Any of a plurality of communication channels, however, may be associated with the remaining distributor, the selection of the particular channel or channels connected therewith being under the control of signal combinations established in the code bars 316 of the switching mechanism. In the event that the message is to be transmitted over only a signal channel, it, of course, is merely necessary to disable one of the retransmitting distributors and associate the desired communication channel with the remaining distributor. Similarly, if the features of the automatic switching mechanism are not to be taken advantage of, signal repetition may be carried on through retransmitting distributor 17 and need not be carried on through distributor 18.

Additional functions may be effected through the control of function circuits associated with pull bar operated contacts provided at the printing reperforator 15. The pull bar operated contacts 401 are actuated when predetermined pull bars 26 provided with contact operating projections 402 are selected upon a predetermined operation of the notched code bars 27. A preferred association of the pull bar and the pull bar operated contacts is the subject of copending application Serial No. 405,301, filed under the name of Walter J. Zenner.

The function circuits controlled by the pull bar operated contacts 401 are preferably completed through contact pile up 403, Fig. 4, controlled by the main operating plunger 38 of the printing reperforator which is provided with a cam surface 404 to operate a contact operating bell crank 406 pivoted on a stud 407 which is secured to a bracket 408 depending from the apparatus casting 21. A spring 409 extended between one arm of bell crank 406 and bracket 408 urges the bell crank in a counterclockwise direction to follow the cam surface 404 of the main operating plunger 38. Bell crank 406 at its opposite extremity carries an adjustable screw 411 which engages the movable elements of the contact pile up 403.

With this mechanical construction and electrical circuit arrangement when it is desired to accomplish a function through a circuit associated with a pair of pull bar operated contacts 401, the associated pull bar 26 is selected through a predetermined operation of the code bars 27 in response to the received code signal combination characteristic of the particular function. Upon the selection of the pull bar, the contact pair 401 is closed immediately as in a manner fully described in the above-identified application to Zenner. Subsequently, as the printing reperforator continues the instant cycle of operation, the main operating plunger 38 is elevated and bell crank 406 which is normally held in a clockwise position riding upon the high portion of cam surface 404 follows the cam surface and is rotated by its biasing spring in a counterclockwise direction to a position, illustrated in Fig. 4, in which the contact pile up 403 is operated completing the circuit through the selected pull bar operated contact 401. Near the completion of this cycle of operation of the printing reperforator plunger 38 is returned to its lowermost position rotating the bell crank 406 to its normal clockwise position which opens the contact pile up 403 and disables the function circuit closed through the pull bar operated contacts 401 and the contact pile up 403 and finally as the cycle is completed, the selected pull bar 26 is returned to its normal position which opens the contact pair 401 through which the function had been completed.

Although a specific embodiment of the invention has been disclosed in the drawings and described in the specification, it is to be understood that the invention is not limited to such specific embodiment but may be modified and rearranged without departing from the spirit and scope of the invention.

What is claimed is:

1. A telegraph apparatus including a plurality of switching function levers, a plurality of coded elements adapted to be conditioned to enable the selective operation of said function levers, and all mechanical means normally dissociated from said coded elements and effective under the control of signal indicia on a control form to control the conditioning of said coded elements and effectuate the operation of a selected function lever.

2. A telegraph switching mechanism including a plurality of switching function levers, a plurality of code bars to be permutably conditioned to enable the selective operation of said function levers, and all mechanical means normally dissociated from said code bars and effective under the control of signal indicia on a control form to control permutably the conditioning of said code bars and selectively effectuate the operation of said function levers.

3. In combination, a sensing mechanism to sense control indicia on a strip, a plurality of code bars, means operable independently of said sensing mechanism to transfer a setting of said sensing mechanism to said code bars to permutably condition said bars in accordance with the indicia sensed, a plurality of function levers selectively responsive to the setting of said bars, and means to enable the selection of said levers to accomplish a function represented by the sensed indicia.

4. A switching apparatus including a sensing device having a plurality of sensing elements to sense control indicia in a form, a corresponding plurality of selecting elements, means operable independently of said sensing device to condition said selecting elements in accordance with the operation of said sensing elements, a plurality of switching control levers selectively responsive to the operation of said selecting elements, and means to enable the selection of said levers to accomplish switching functions.

5. A signal controlled function operating mechanism comprising a sensing device to sense control indicia in a strip, a plurality of selecting elements, means operable independently of said sensing device to condition said elements in accordance with the operation of said sensing device, function controlling levers selectively operable under the control of said selecting elements to accomplish functions represented by sensed indicia, means to selectively render said function controlling levers responsive to said selecting elements, and means adapted to be selectively controlled whereby said function controlling levers are operated only in response to function controlling indicia in the strip.

6. A signal controlled function operating mechanism comprising a sensing device to sense indicia in a strip, a plurality of code bars, means operable independently of said sensing device to condition said bars in permutations in accord-

ance with the operation of said sensing device, function operating levers selectively operable under the control of the permutable setting of said code bars, means operable to render said function operating levers responsive to said code bars, and means adapted to be selectively controlled whereby said function levers are operated only by function controlling indicia in the strip.

7. A signal controlled function operating mechanism comprising a sensing device to sense control indicia in a control strip, a plurality of code elements, means operable independently of said sensing device to condition said code elements in accordance with the operation of said sensing device, a plurality of function controlling levers, a control mechanism maintaining said function controlling levers in an unoperated condition, means for causing said control mechanism to respond to a predetermined setting of said code elements to free said function controlling levers to be selectively operated by said code elements, and means to enable the selection of said levers to accomplish functions in accordance with sensed indicia.

8. A signal controlled function operating apparatus including a sensing device to sense control indicia in a strip, a plurality of code elements, means operable independently of said sensing device to condition said code elements in accordance with the operation of said sensing device, function levers to be selectively operated by said code elements, a control mechanism, means for operating said control mechanism in response to a predetermined operation of said code elements to render said function levers selectively responsive to the operation of said code elements, and means to enable the selection of said levers to accomplish functions under the control of function indicating signals.

9. A signal controlled switching apparatus including a sensing device to sense control indicia in a strip, a plurality of code elements, means operable independently of said sensing device to condition said code elements in accordance with the operation of said sensing device, switching control levers to condition switching contacts, a control mechanism, means for operating said control mechanism in response to a predetermined operation of said code elements to render said switching control levers selectively responsive to the operation of said code elements, and means to enable the selection of said levers to accomplish switching functions under the control of switching signals.

10. A signal controlled switching device including a sensing device to sense control indicia in a strip, a plurality of code elements, means operable independently of said sensing device to condition said code elements in accordance with the operation of said sensing device, a plurality of switching function levers, means to normally retain said switching function levers ineffective to effect switching functions, means responsive to a predetermined operation of said code elements to render said switching function levers responsive to the operation of said code elements, and means to effectuate said response of said levers.

11. A signal controlled switching apparatus including a sensing device to sense control indicia in a strip, a plurality of code elements, means operable independently of said sensing device to condition said elements in accordance with the operation of said sensing device, a plurality of circuit selecting devices, means to render said devices selectively responsive to the conditioning of said elements, a plurality of circuits conditioned in response to the operation of said selecting devices, means operable upon the selection of a selecting device to maintain the circuit conditioned thereby, and means operable in response to a predetermined operation of said code elements to disable the conditioned circuit.

12. A telegraph apparatus comprising a sensing mechanism for sensing control indicia on a strip, a plurality of code elements, a plurality of function levers selectively responsive to the setting of said code elements, a signal transmitter including a cam type distributor, means controlled by said code elements to determine signal transmission from said transmitter, and means operable independently of said sensing mechanism to transfer a setting of said sensing mechanism to said code elements to condition said code elements in accordance with the operation of said sensing mechanism to selectively control said function levers and said transmitter to accomplish a function and transmit the code signal representing the function.

13. A switching mechanism comprising a sensing device to sense control indicia on a strip, a plurality of permutably settable elements, means to set said elements in permutations in accordance with the operations of said sensing device, switching levers to be operated selectively under the control of said elements, means to initiate a predetermined switching operation in response to a predetermined operation of said elements, means effective thereafter to consummate said switching condition according to the predetermined selection of one of said switching levers, and means comprising a plurality of relays wherein a relay is operatively associated with each switching lever and with each other relay in a manner that the energizing circuit of each relay is completed through certain of the contacts of each of the other relays so that said operated relay prevents operation of said other relays as long as said operated relay remains operated, whereby said switching circuits are rendered effective only one at a time.

14. A switching mechanism comprising a sensing device to sense control indicia on a strip, a plurality of permutably settable elements, means operable independently of said sensing device to set said elements in permutations in accordance with the operation of said sensing device, switching levers to be operated selectively under the control of said elements, means to initiate a predetermined switching condition in response to a predetermined operation of said elements, means effective thereafter to consummate said switching condition according to the predetermined selection of one of said switching levers, and means comprising a plurality of relays wherein a relay is operatively associated with each switching lever and with each other relay in a manner that the energizing circuit of each relay is completed through certain of the contacts of each of the other relays so that said operated relay prevents operation of said other relays as long as said operated relay remains operated, whereby said switching circuits are rendered effective only one at a time.

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