Nov. 25, 1952 T. I. RESS 2,619,533

PERMUTATION CODE PRINTING RECEIVER

Filed July 3, 1950 5 Sheets-Sheet 1

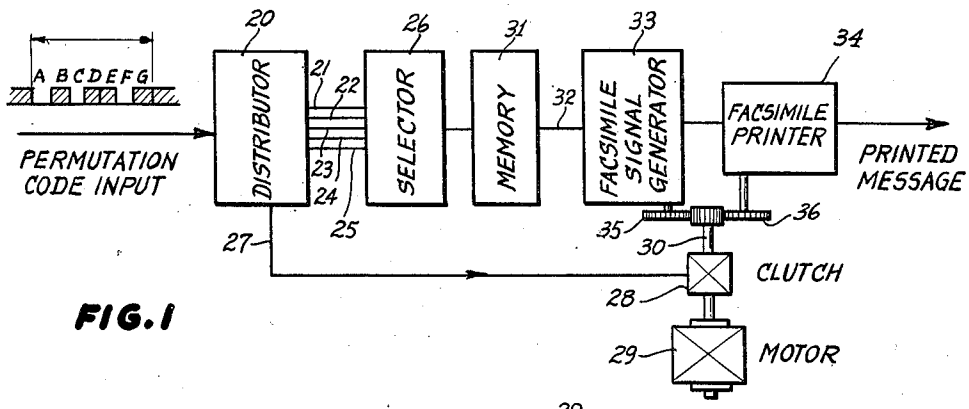


FIG. 1

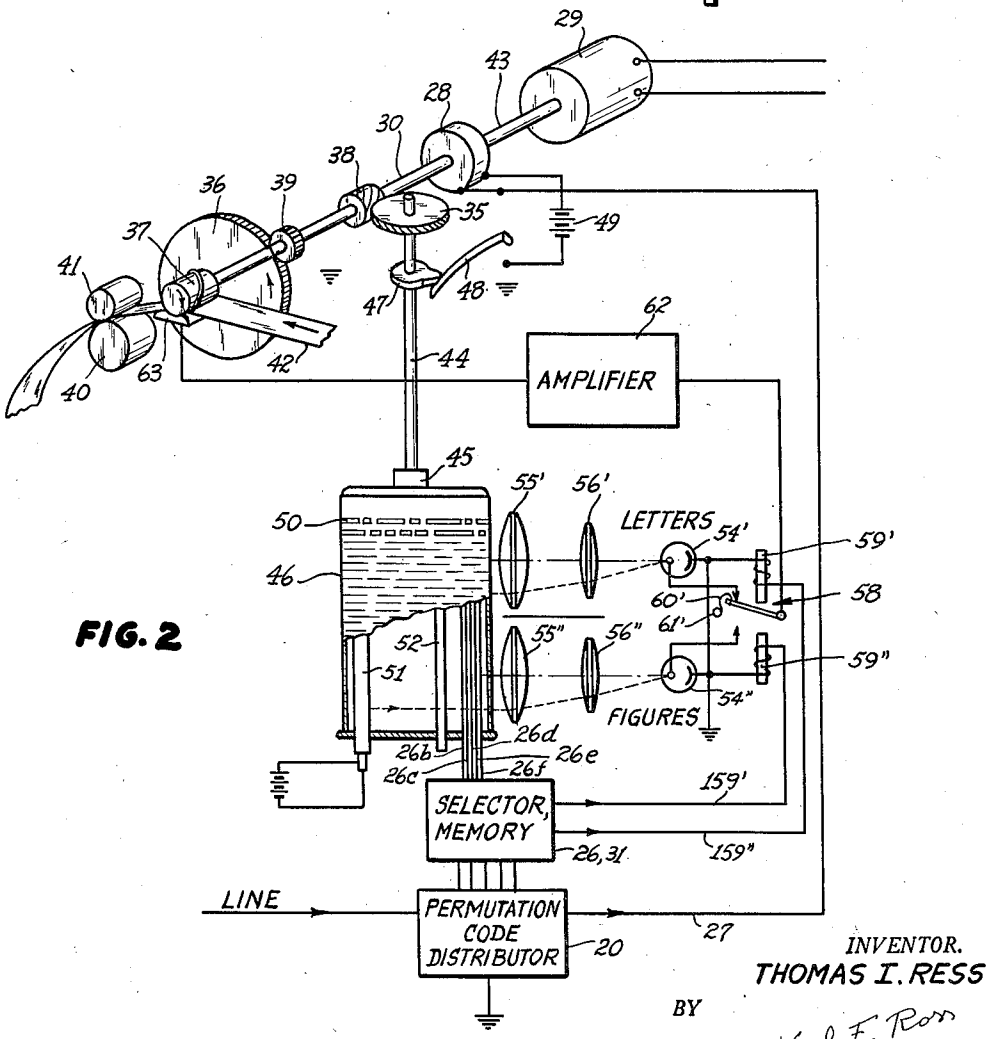


FIG. 2

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PERMUTATION CODE PRINTING RECEIVER

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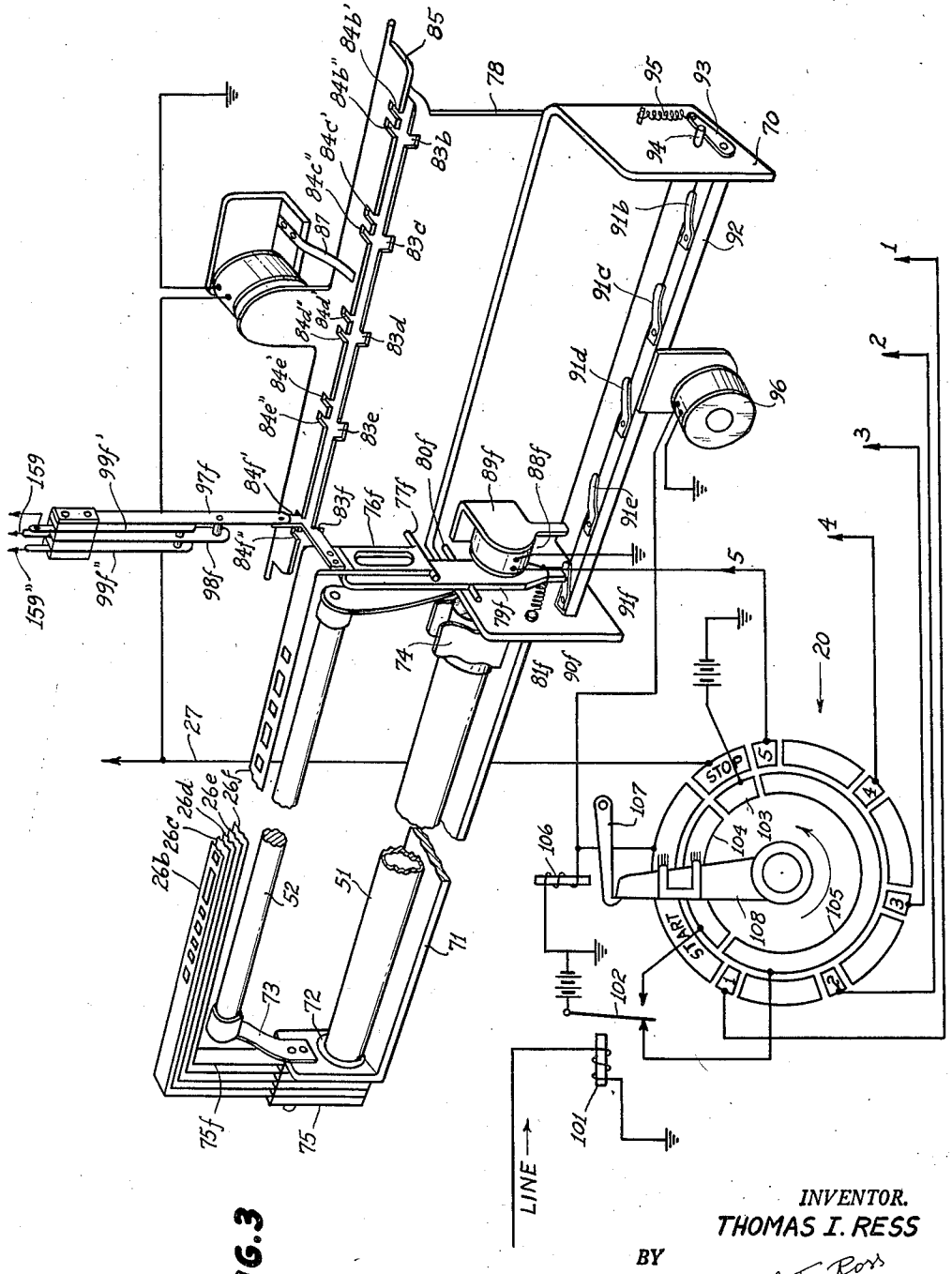


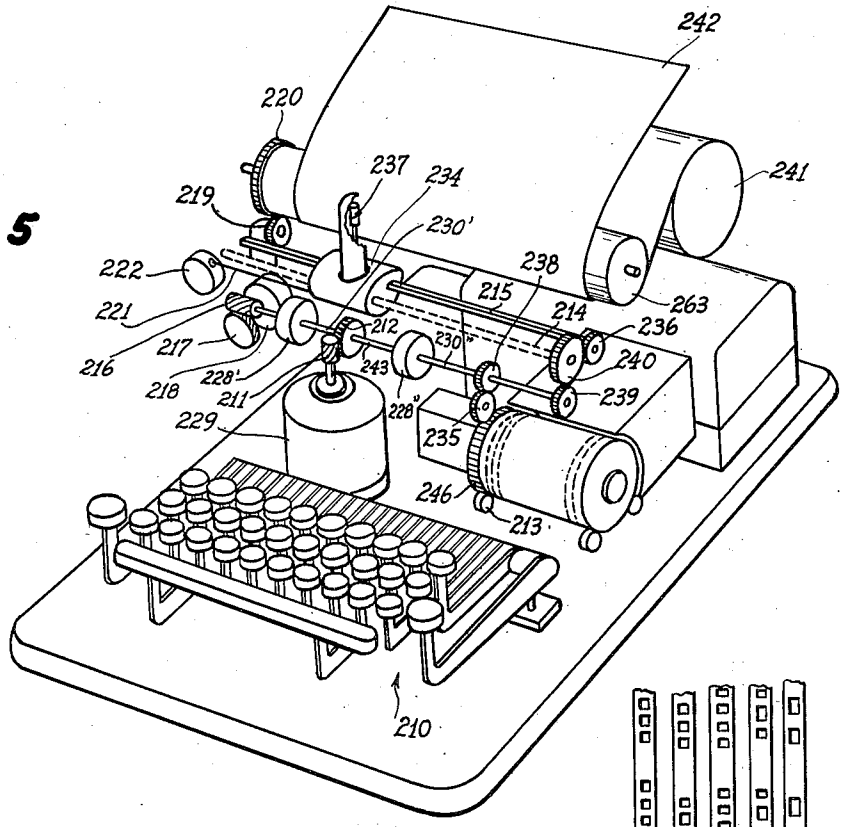
FIG. 3

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PERMUTATION CODE PRINTING RECEIVER

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FIG. 5



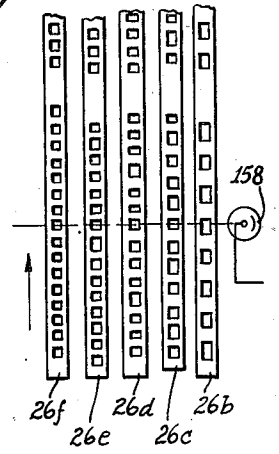


FIG. 4

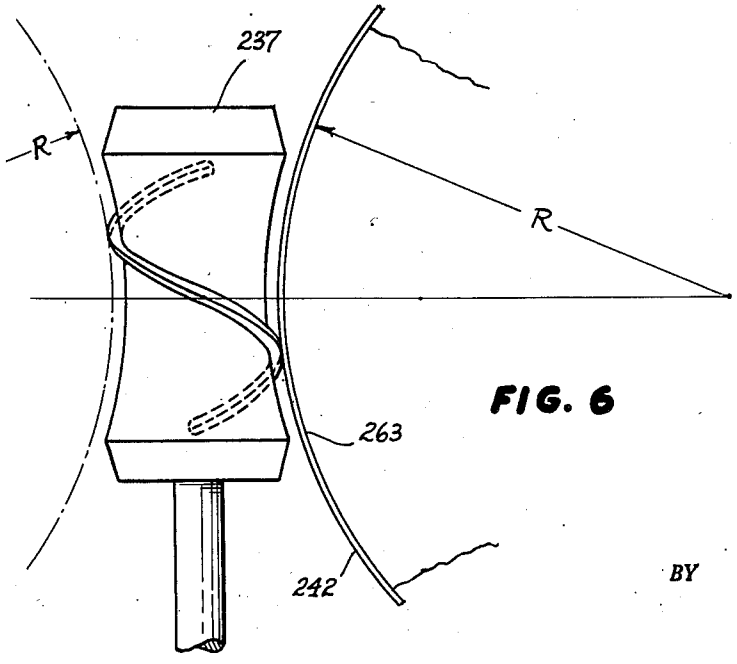


FIG. 6

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Nov. 25, 1952 T. I. RESS 2,619,533

PERMUTATION CODE PRINTING RECEIVER

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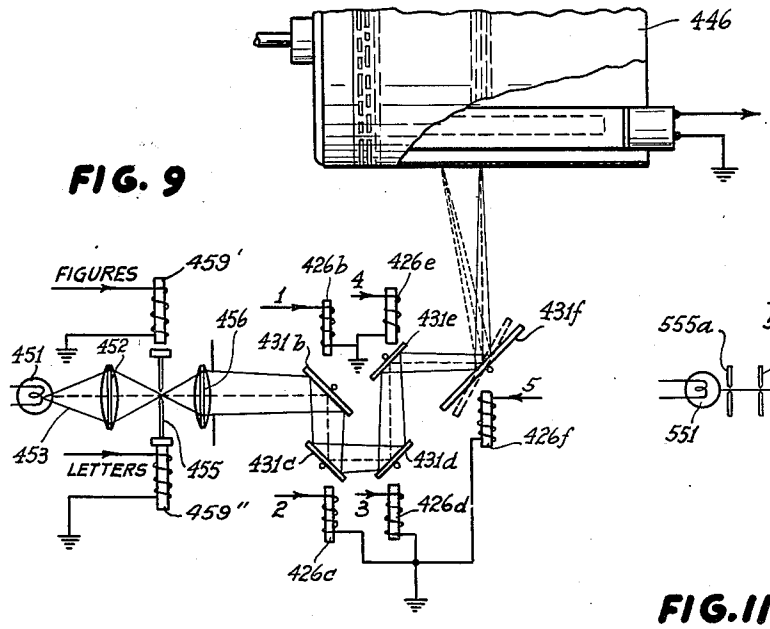


FIG. 9

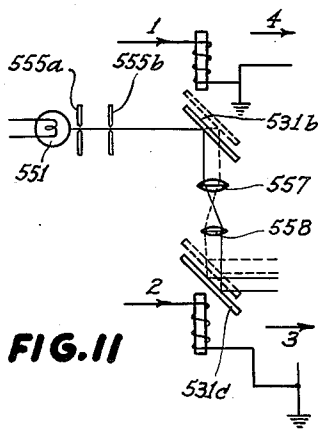


FIG. 11

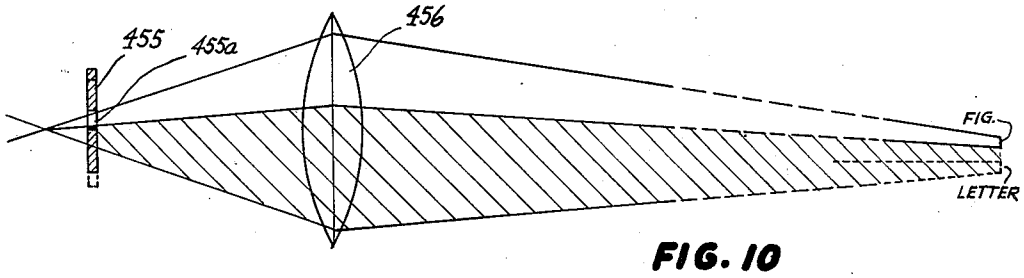


FIG. 10

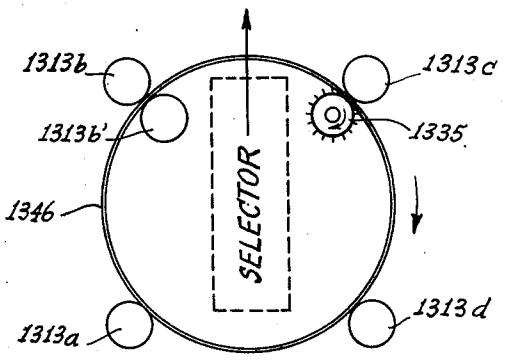


FIG. 7

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PERMUTATION CODE PRINTING RECEIVER

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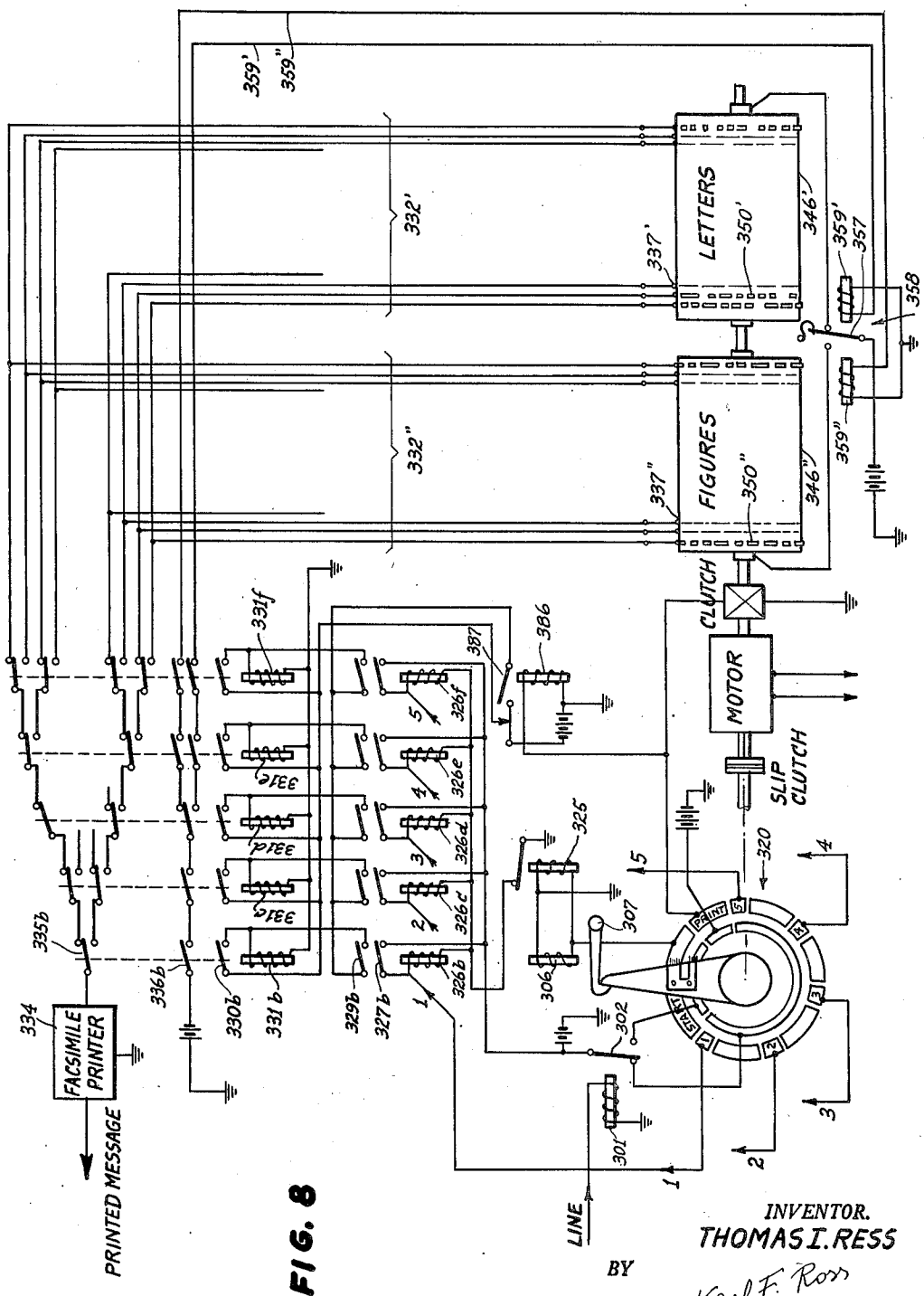


FIG. 8

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Patented Nov. 25, 1952

2,619,533

UNITED STATES PATENT OFFICE

2,619,533

PERMUTATION CODE PRINTING RECEIVER

Thomas I. Ress, Evanston, Ill.

Application July 3, 1950, Serial No. 171,875

5 Claims. (Cl. 178—26)

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My invention relates to printing receivers and, more particularly, to printers responsive to start-stop signals, e. g. to conventional seven- or eight-unit code combinations based on a five- or six-element permutation (Baudot) code.

The advantages of facsimile reproduction of characters in response to suitable signals, e. g. by means of a printing helix co-operating with a recording surface, over conventional printing receivers (using a typewheel or type bars) have long been recognized. They reside, essentially, in a considerable simplification of the receiving apparatus, by virtue of a substantial reduction in the number of separately movable parts, thus in turn resulting in lower maintenance cost and decreased likelihood of mechanical failure.

It has already been proposed to increase the speed of transmission in such systems by providing at the transmitter selectable elements, one for each character to be transmitted, representing permanent records of the various characters to be transmitted, these records having been made beforehand by what is termed a "prescanning" operation for the purpose of producing, upon subsequent selective scanning, a train of pulses adapted to control the operation of the printing helix after transmission to the receiving station. A disadvantage of such a system, as well as of any system using direct scanning, is the need for transmitting a large number of pulses for each character, thus materially slowing down the rate of transmission, as compared with characters transmitted in the form of a seven- or eight-element code, or necessitating the use of a greatly enlarged band of signaling frequencies for comparable speeds.

Furthermore, precise synchronization between the source of the pulse trains and the printing elements is necessary to obtain an exact duplication of the original signal; such synchronization over appreciable distances is difficult and costly to obtain, wherefore it has heretofore been customary to use double helixes for the purpose of minimizing the effects of out-of-step scanning by reproducing each character twice, so as to insure the appearance of at least one complete character. An arrangement of this description is, however, entirely impractical for a page printer since the lines of each page thus printed would be interspersed with fragments of characters greatly detracting from the intelligibility of the message.

It is, therefore, an important object of my invention to provide an improved teleprinting receiver adapted to respond to permutation code

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signals but reproducing the characters corresponding to such code signals by facsimile printing.

More particularly, it is an object of this invention to provide, in a teleprinting receiver, highly efficient means for translating permutation code signals into pulse trains adapted to actuate a printing helix or similar facsimile reproducer.

Another object of the invention is to provide an improved teleprinter according to the foregoing adaptable for use as a page printer.

A further object of the present invention is to provide means for so controlling the operation of the receiver that permutation code signals representing a character may be received before the facsimile reproduction of the immediately preceding character has been completed.

It is also an object of this invention to provide, in a receiver of the character set forth, means responsive to "shift" signals (usually referred to as "letter shift" and "figure shift" signals) in lieu of an additional permutation code element, so as to enable substantially the number of characters transmittable with a six-element code to be reproduced with a five-element code, with the attendant increased speed of transmission and material reduction of receiving equipment as compared with systems utilizing the longer code.

With the above objects in view, and others that will subsequently appear, the invention according to one of its aspects provides, in a teleprinting receiver, a distributor responsive to a combination code signal including a start element, a plurality of permutation code elements and a stop element, a set of selector members equal in number to the permutation code elements of the combination signal and selectively positionable, under the control of the distributor, in accordance with the nature of respective permutation code elements, and a set of track members each corresponding to a respective character to be reproduced, these track members being individually selectable by the positioning of the selector members to produce trains of characteristic pulses adapted to control the operation of a facsimile reproducing device.

According to another, more specific aspect of the invention, the selection of a track member is effected by optical means causing the illumination of a selected track member by a beam of light which is modulated by the track member on its way to a photosensitive device, thereby giving rise to a train of characteristic pulses adapted to reproduce the character identified with such track member. The selective illumi-

nation of a track member may be effected by means of masks integral or operatively connected with respective selector members.

A desirable feature of the invention consists in the provision of a locking device arranged to maintain the selection of any track member effective until the arrival of the stop signal following the next permutation code combination and to cause a new selection to be made in response to such stop signal, the same signal initiating the scanning movement which produces the characteristic pulses under the control of the selected track member; such a locking device may be termed a "memory" unit, inasmuch as it preserves each code combination for utilization at a time subsequent to its actual transmittal.

According to another feature of the invention the set of track members is divided into two subgroups, each containing a number of track members equal to the number of selector members and respectively controlled thereby, the arrival of a "shift" or "unshift" signal causing one or the other group of track members to become effective to control the facsimile reproducing device.

The invention will be more fully described with reference to the accompanying drawing in which:

Fig. 1 is a diagrammatic view, partly in block form, of the general organization of a teleprinting receiver according to the invention;

Fig. 2 is a more detailed view of the track selector system and the reproducing device controlled thereby;

Fig. 3 is a perspective view, on an enlarged scale, of the selector members, locking device and track system, together with the associated distributor;

Fig. 4 shows a set of selector members in the form of light masks, forming part of the system of Fig. 3;

Fig. 5 is a perspective view of a teleprinter similar to those shown in the preceding figures but adapted for use as a page printer;

Fig. 6 is a side view of the printing helix used on the printer of Fig. 5;

Fig. 7 is a side view of a modified track cylinder;

Fig. 8 is a circuit arrangement of a modified form of printing receiver according to the invention;

Fig. 9 shows schematically a further embodiment, utilizing another form of optical track selection;

Fig. 10 is an enlarged schematic representation of the letter shift arrangement of Fig. 9; and

Fig. 11 shows a modification of the system shown in Fig. 9.

Referring first to the schematic arrangement of Fig. 1, a line signal consisting of seven elements A . . . G is fed to a distributor **20** of a type known per se; this signal consists, in the usual manner, of an invariable "space" impulse representing the start element, five code pulses B, C, D, E and F (here given as the combination mark-space-mark-mark-space) and an invariable "mark" impulse representing the stop element. The distributor, which responds to the start element A, applies the code pulses B . . . E over signal paths **21–25** to a selector unit **26** and the stop pulse G over a path **27** to a magnetic clutch **28** coupling the motor **29** to the transmission shaft **30**. Pulses B . . . F prepare the selector **26** for operation under the control of a memory unit **31** which responds to the stop signal G, thereby causing a path **32** for the transmission of pulses to be completed through a facsimile signal generator **33**. The generator in turn will produce a train of characteristic pulses which may be pulses of current or radiant energy adapted to be converted into pulses suitable to actuate the facsimile printer **34** and yield the desired printed message. The facsimile signal generator **33** and the facsimile printer **34** are mechanically coupled to transmission shaft **30** through gears **35, 36**, respectively, and consequently operate in precise synchronism.

Reference is now made to Fig. 2 for a more detailed description of certain of the units shown in Fig. 1. The facsimile printer **34** is here shown to comprise a printing helix **37** mounted on the transmission shaft **30**, on which shaft is also mounted a worm **38**, meshing with a worm gear **35**, and a pinion **39**, meshing with a large gear **36** Gear **36** drives the roller **40** of a pair of feed rollers **40, 41** between which passes the tape **42**, the rollers and tape moving in synchronous relation to the movement of printing helix **37**. Shaft **30** is coupled to the continuously rotating shaft **43** of the motor **29** by means of a magnetic clutch **28**.

The worm gear **35** is mounted on a shaft **44** to one end of which is fixed the hub **45** of a hollow drum **46** which comprises a major component of the facsimile signal generator **33**. Mounted on the shaft **44** adjacent the gear **35** is a cam **47** which, near the end of each complete rotation cycle, bears upon a spring contact **48**, thereby opening the energizing circuit for magnetic clutch **28**, leading from battery **49** to ground.

On the periphery of the drum **46** are tracks **50**, provided in the form of angularly spaced slots extending in circumferential direction. The slots are characterized by their transparency as contrasted with the body of the drum, hence they may constitute either physical apertures or merely transparent portions bounded by relatively opaque ones. Although only a relatively small number of tracks have been illustrated, for clarity's sake, the number of tracks actually provided in the system illustrated, using a five-element Baudot code, will be of the order of sixty.

The tracks **50** are divided into two groups, each containing approximately half their number, to be referred to in the following as the "letters" and the "figures" group. Associated with both groups of tracks are an elongated source of light **51**, extending inside the drum **46** across the whole length thereof, and a cylindrical lens **52** positioned between the source and the selector members **26*b*, 26*c*, 26*d*, 26*e*** and **26*f***, these members forming part of the selector unit **26**. As will be more fully apparent from the subsequent discussion in connection with Figs. 3 and 4, the members **26*b*** . . . **26*f*** are characteristically apertured light masks whose apertures are staggered in such manner that in each relative position thereof the light from the source **51** will fall upon only one of the tracks **50** in each of the two groups of tracks, the two tracks so selected varying upon displacement of any one or more of these members from a "normal" into a "selected" position or vice versa. A single pair of light rays, indicated at **53'** and **53''**, respectively, will thereby be directed upon two photocells **54', 54''**, which form electrical translating units for the "letters" and "figures" tracks, respectively; the rays pass through two parallel lens systems **55', 56'** and **55'', 56''**, each associated with a respec-

tive one of the two groups of tracks. Either photocell may be conditioned for energization over the contacts of a mechanically locking relay 58, comprising in addition to armature 57 two windings 59', 59'', energizable by way of leads 159', 159'', respectively, and an ogee spring 60 which cooperates with a pin 61 to lock the armature in either of two positions, depending on which winding is energized. Armature energization is selectively controlled by the system 26, 31 in a manner shortly to be described. The cathodes of the photocells are grounded, the plate circuits being selectively connected over the armature 57 through an amplifier 62 to a counter-electrode 63 opposite the printing helix 37, sufficient space between the latter elements being provided to accommodate the moving tape 42.

From the foregoing it will be apparent that certain signals, known as "function" signals, have no tracks associated therewith; where the system is employed with a page printer in lieu of a tape recorder, these signals may include, in addition to "letters" and "figures," such well-known function signals as line feed, carriage return, back spacing and so forth. Another signal for which no track need be provided is the "spacing" signal which may be either a function signal, operating a contact switching system such as will be described in connection with Fig. 3 for the purpose of causing advance of tape 42 without printing, or a signal causing the beam of light to fall upon a wholly opaque portion of the drum 46. As a result, the number of tracks actually provided in each group will generally be somewhat less than thirty-two.

The tripping of clutch 28 is effected at the end of each incoming signal by means of the "stop" pulse G (Fig. 1) applied by the permutation code distributor 20 to the lead 27. This connects ground to one side of the clutch, bypassing open contacts 48. Engagement of the clutch will effect rotation of the cam 47, allowing the spring contacts 48 to close and thereby establishing a connection to ground for substantially the remainder of the rotation cycle. At the close of the cycle, the contacts will again be opened, disengaging the clutch and conditioning the circuit for subsequent closure by the next "stop" pulse.

Assuming the relay 58 to be in the position illustrated, indicating the last shift signal received from the control system 26, 31 to have been of the "letter shift" type, the beam 53', modulated by a selected one of the tracks 50, will give rise to current pulses in the photocell 54' which will be applied in the form of voltage pulses, by way of the amplifier 62, to the counter-electrode 63 associated with the printing helix 37. Since rotation of the helix is synchronized with the movements of the tape 42 by way of roller 40, and also with the rotation of the track-carrying drum 46, markings together constituting a printed character will be impressed upon the sensitive tape 42.

Fig. 3 shows details of the light mask actuating and locking unit, or memory device, and the distributor 20. The light source 51 and the cylindrical lens 52 occupy, in relation to the drum 46 (not shown in Fig. 3), the positions shown in Fig. 2. The energizing elements of the light mask actuating mechanism are fastened to a U-shaped frame 70 which is located outside the drum 46. A bracket 71 is secured to the end of the frame 70 and extends into the drum 46. Bracket 71 contains sockets 72 (only one visible) at each end for light source 51, above which

sockets are secured clamps 73 retaining the cylindrical lens 52. A clip 74 fastened to the bracket 71 holds the light source 51 in place. The light masks 26*b* . . . 26*f* form a group of nested, inverted U's, the apertured sections extending along the bight of the respective U's and being yieldably supported by their vertical arms. One group of supporting arms are a set of leaf springs 75*b* . . . 75*f* clamped in a block 75 to the bracket 71 at the end farthest from the frame 70, the arms being sufficiently spaced to allow a small amount of free horizontal movement. The other group of vertical arms form leaf springs, such as 76*f*, pivotally secured by a pin 77*f* to a plate 78 mounted on the back of the frame 70. A lever arm 79*f*, pivoted about a pin 80*f* projecting from the frame 70, is urged in a clockwise direction by a spring 81*f* fastened to the frame 70 and engages the leaf spring 76*f* at a point near its junction with the horizontal section of the light mask 26*f*. An L-shaped dog 82*f* is also fastened to the leaf spring 76*f*, the horizontal portion thereof bearing on an edge of a notch 83*f* which is one of five notches 83*b* . . . 83*f* cut in the top edge of the plate 78. The vertical portion of the dog 82*f* fits into either of a pair of adjacent notches 84*f*' and 84*f*'', cut in an edge of a plate 85 hingedly connected to the plate 78 and extending at right angles thereto; notches 84*b*' . . . 84*f*' correspond to the "normal" and notches 84*b*'' . . . 84*f*'' to the "selected" portion of the associated selector members 26*b* . . . 26*f*. As shown, the member 26*f* is normal, its dog 82*f* being engaged by the notch 84*f*'' corresponding thereto. A solenoid 86, spaced a short distance from the plate 85, acts to pivot the plate about its hinge, thus freeing the dog 82*f* from the notch 84*f*' and allowing the spring 76*f* to follow counterclockwise rotation of the lever arm 79*f*. A leaf spring 87, fixed to the solenoid support, returns the plate 85 to its original position upon de-energization of the solenoid. A movable arm 97*f* of a spring contact assembly is fixed to the end of the dog 82*f*, this arm causing a tongue 98*f* selectively to engage either of the contacts 99*f*', 99*f*'' depending upon the position of dog 82*f*.

A second solenoid 88*f* is mounted on an angle bracket 89*f*, secured in turn to the frame 70, the solenoid facing the lever arm 79*f* below its pivot and acting to urge it into counterclockwise motion upon energization. The lever arm 79*f* terminates in a finger 90*f* which bears upon a spring 91*f*, the latter being one of five springs 91*b* . . . 91*f* mounted on a bar 92 extending along the length of the frame and pivoted thereto. A dog 93, fixed to the axle of the bar 92 and to a biasing spring 95, cooperates with a stop 94 to limit the angle through which the bar 92 may turn. Energization of the solenoid 88*f* causes the finger 90*f* of the lever arm 79*f* to swing past the spring 91*f* which thereupon latches it in "selected" position; the lever arm may be released by the energization of a third solenoid 96 which acts to pivot the bar 92 against the action of spring 95, causing the spring 91*f* to swing free of the finger 90*f*.

Energization of the aforementioned solenoids is controlled by a conventional Baudot distributor 20 responsive to signal pulses from an incoming line which selectively energize a relay 101 whose armature 102 connects battery to either of two segments 104, 105 of the distributor. The solenoid circuits are as follows: first solenoid 86 is connected to the "Stop" segment of the distributor, second solenoid 88*f* is connected to seg-

ment 5 of the distributor (segments 1 through 4 of the distributor will in like manner be connected to associated solenoids not shown), third solenoid 96 is connected to the "Start" segment of the distributor; each of the solenoids is grounded at one end. Battery is permanently connected to segment 103 of the distributor, which is associated with the "Stop" segment, while segments 104 and 105, associated respectively with the "Start" segment and with segments 1 through 5, are selectively connected to battery over armature 102. A solenoid 106, grounded at one end, is connected to the "Start" segment and acts to attract a latch 107 to permit movement of the distributor arm 108 upon receipt of a "spacing" pulse, representing the start element of a code signal, over the line.

The condition illustrated in Fig. 3 indicates a period during which no signal is being transmitted. The relay 101 is continuously energized by a steady closed-line (or "marking") condition. The system is prepared for the receipt of a message by the starting element thereof which de-energizes the relay 102, connecting battery to the "Start" segment, thus energizing the solenoid 106 and displacing the latch 107 to release the distributor arm 108 for a single revolution. At the same time the solenoid 96 is energized, causing the bar 92 to turn and freeing lever arms such as 79*f* from associated locking springs 91*b* . . . 91*f* if previously engaged thereby. The distributor arm continues to rotate, passing the "Start" segment, thus de-energizing solenoids 106 and 96 and thereby allowing latch 107 and bar 92 to resume their former positions. Subsequent marking signals will energize the relay 101 and, through synchronization with the distributor arm in a manner well-known in the art, produce voltages at the terminals of selected ones of segments 1 . . . 5. These voltages will serve to energize solenoids such as 88*f* which will rotate the lever arm 79*f* counterclockwise. Although any substantial displacement of the associated selector member 26*f* is temporarily prevented by the engagement with notch 84'' of the dog 82, the lever arm 79 is free to rotate about its pivot 80*f* until the finger 90 thereof has cleared the locking spring 91*a*. Continued rotation of the distributor arm 108 brings it to bear upon the "Stop" segment, energizing solenoid 86 which in turn causes plate 85 to pivot, momentarily freeing the dogs such as 82*f* from the associated notches, such as 84*f*'. The leaf springs 75*f*, 76*f* are so biased as to force the associated light mask 26*f* to the left. The positions of the remaining light masks will similarly be determined at this instant by the position previously occupied by the associated lever arms. Simultaneously, the clutch 28 (Fig. 2) will be energized over lead 27, effecting entrainment of the drum 46 and printing helix 37 as already described. As the distributor arm leaves the "Stop" segment the solenoid 86 will be de-energized and the notched plate 85 will fall back into position, locking the light masks in place. The distributor arm continues to the "Start" segment, again energizing the solenoid 96 and thus freeing the lever arms such as 79*f* from their associated locking springs such as 91*f*. Further movement of the distributor arm is prevented by stop arm 107 until a new code signal is received, at which time the foregoing procedure is repeated.

It will thus be seen that printing of a character corresponding to any code combination received will take place during a period following the completed reception of such combination; since the resetting of the selector members (light masks) is virtually instantaneous, there is thus made available for character reproduction a time interval equal to almost a full signaling cycle, so that a subsequent code combination may already be received and registered (by means of the lower arms such as 79*f*) while the printing of the preceding character is still in progress.

Fig. 4 illustrates the light masks 26*b* . . . 26*f* and shows the relative positioning of their apertures. It will be noted that each mask is provided with two identical series of apertures, so that two rays (for selection of a character from the "letters" and "figures" group, respectively) may pass in each of the 32 different relative positions of the masks.

Shifting and other functions are controlled by the set of contacts 98*f*, 99*f*', 99*f*'' conjointly with similar contacts associated with the other selector members, these contacts effecting the selective closure of several control circuits in certain relative positions of the selector member. Thus it will be seen that leads 159', 159'', leading to the windings of the shift relay 58 (Fig. 2), have been shown connected to contacts 99*f*' and 99*f*'', respectively. It may be mentioned that some or all of these functions may also be carried out with the aid of special photocells, as indicated at 158 (Fig. 4), positioned to receive light only in certain relative positions of the light masks.

Figs. 5, 6 and 7 show a page printing apparatus utilizing the principles underlying the foregoing embodiment. Fig. 5 shows a perspective view of the apparatus, including a transmitting keyboard which operates in cooperation with a conventional seven element code distributing system; the transmitting section may be coupled to the receiver, presently to be described, so that the operator may have a record of the page as it is printed.

As shown in Fig. 5, the page printer presents a picture somewhat similar to a conventional typewriter, having a keyboard 210, a movable platen 263 and a printing element, the printing helix 237, adjacent the carriage. The actuating mechanisms are powered by a motor 229, to the shaft of which is secured a worm 211. The worm mates with a worm gear 212 mounted on a shaft 243, this shaft terminating in magnetic clutches 228', 228'', one on each end thereof. Shafts 230', 230'' are coupled to the clutches 228', 228'', respectively, for entrainment by the shaft 243 upon energization of the respective clutch. Shaft 230'' carries a gear 238 which mates with another gear 235 and through the latter is coupled to a cylindrical drum 246. The drum is seated on two pairs of rollers 213 rotatably secured to the base of the printer housing. Mounted at the end of the shaft 230'' is a pinion 239 which mates with a gear 240, the latter driving a helically threaded spindle 214 which engages a mating nut (not shown) inside housing 234 of the printing helix. The housing rides on a grooved shaft 215, extending parallel to shaft 214, which terminates in a gear 236 coupled to the gear 240. The shaft 215 controls the turning of the printing helix 237; thus the printing helix and the drum are again synchronized. In order to conform to the cylindrical shape of the platen 263, the printing helix 237, as best seen in Fig. 6, will be of an hour-glass shape so as to maintain a fixed spatial relationship with the surface of the paper 243 over the full height of each line of print.

This unique features assures unform marking intensity over the entire printing area.

The other magnetic clutch 228' carries a shaft 230' on which is mounted a worm 216 which mates with a worm gear 217 and is coupled by way of transmission means 218 to a pinion 219 which mates with a gear 220 secured to the platen; the mechanism just described performs a line feeding operation in response to a suitable function signal which energizes the clutch 228'. Carriage feed is effected by means of the cord 221, wound upon a spring-biased reel inside a box 222, the return of the carriage in response to a corresponding signal being accomplished by suitable mechanism not further illustrated because well-known per se.

A modified form of track-carrying drum is illustrated in Fig. 7. Bearing upon the outer surface of the drum 1346 are four rollers 1313*a* . . . 1313*d*, tangent to the drum at points 90° apart. A roller 1313*b*' bears on the inner surface of the drum opposite the roller 1313*b*. The drum is driven by a sprocket wheel 1335, mounted on the inside of the drum opposite roller 1313*c*. With this arrangement, wobbling of the drum is prevented, the drum moving evenly between the rollers.

The drum 1346 is preferably made of lightweight material, such as a celluloid film to which the several tracks are applied by photographic means. Such a drum has a very low moment of inertia, thus enabling rapid starting and stopping of the reproducing mechanism.

Fig. 8 shows another embodiment of the invention in which a system of relays is used in lieu of the light masks of the previous figures. The conventional Baudot distributor arrangement previously described in connection with Fig. 2 is here reproduced for better understanding of the figure. Elements 101, 102, 106, 107, and 120 of Fig. 3 are labeled 301, 302, etc. in the present figure and need not be further described. In Fig. 8, however, there is connected in parallel with solenoid 306 a relay 325 connecting ground, in its de-energized position, to the windings of five preselecting relays 326*b* . . . 326*f*. The other sides of the aforementioned windings are connected to the segments of the Baudot distributor respectively numbered 1 through 5, and are also connected to respective holding armatures such as 327*b*. A locking circuit to battery and ground is provided over the front contacts associated with the aforementioned armatures. A second set of armatures such as 329*b* are connected to the armature 387 of a switch-over relay 386, the front contacts of armatures 329*b* etc. being connected to the grounded windings of respective selector relays 331*b* . . . 331*f*. The selector relays 331*b* . . . 331*f* are each provided with a holding armature such as 330*b*, one or more character selecting armatures such as 335*b* and one or more function selecting armatures such as 336*b*. Holding armatures 330*b* etc. are normally connected to battery via the back contacts associated with armature 387 of relay 386. Relay 386 is connected to the "Stop" segment of the Baudot distributor, thus being energized only during the time the distributor arm thereof sweeps over this segment. The character selection armatures 335*b* etc. of relays 331*b* . . . 331*f*, which are in series with the printer 334, increase in number according to a binary law, relay 331*b* having one selection armature, relay 331*c* having two and relay 331*f* having sixteen. The function selection armatures 336*b* etc. of these relays also increase in number, but to a less extent depending upon the number of functions to be performed; among the circuits selectively closed by the latter are those of shift relay 358, including leads 359' and 359''.

Two sets of conductors 332', 332'', connected in parallel to the front and back contacts associated with the character selection armatures of relay 331*f*, lead to brushes 337', 337'' which bear against the tracks 350', 350'' on drums 346', 346''. The tracks consist of insulated strips which cover the conductive drums, thus the brushes will bear against the conductive surface at spaced intervals. The armature 357 of shift relay 358 selectively connects battery to drum 350', the "Letters" drum, or drum 350'', the "Figures" drum.

The operation of the relay system is analogous to that of the light mask system. Again the Baudot arm is released by latch 307 upon reception of a spacing pulse over the line. Subsequent marking pulses will connect battery to certain of the segments 1 through 5 over line relay contact arm 302; the voltage will be transmitted to the associated preselecting relays such as relay 326*b* which will lock over armature 327*b* to ground on the armature of normally de-energized relay 325. When the distributor arm reaches the "Stop" segment, relay 386 will operate and, over its make-before-break contact, will connect battery to the winding of any selector relay associated with a locked preselecting relay before removing battery from the holding circuits of all the selector relays previously operated. As soon as the arm leaves the "Stop" segment, relay 386 will be de-energized, yet the holding circuit for relays 331*b* . . . 331*f* will be closed before battery is removed from their operating circuits extending through armature 329*b* etc. Thus the selector relays will remain selectively operated, in accordance with the combination previously received, while the preselecting relays are being reset by the subsequently arriving code pulses, their own circuits having been broken upon arrival of the start impulse preceding the next code combination.

Assuming the relay 358 to be in the position shown, the "Letters" drum 350' will be connected to battery and a voltage between the facsimile printer 334 and the drum will be generated. Current will flow through the facsimile printer whenever the brush 337' bears against the conductive drum; this current may be used to produce a voltage which may be applied to a printing helix and counter-electrode assembly as shown in the preceding figures.

In Figs. 9 and 10 another modification of the invention is shown whereby selective rotation of five mirrors serves to deflect a beam of incident light into any of 32 positions. Five solenoids 426*b* . . . 426*f* serve as the actuating mechanism for five associated mirrors 431*b* . . . 431*f*, respectively, the energizing voltage being supplied by a Baudot distributor (not shown) operating in the same fashion as previously described. A beam of light 453 is produced by a light source 451 and is brought to a focus by a converging lens 452. A portion of the resultant beam is permitted to pass through a mask 455 having a pinhole 455*a* placed a little beyond the focus, as best seen in Fig. 10. Two solenoids 459', 459'', operating under the control of systems analogous to those shown in connection with shift relay windings 59', 59'', selectively displace the screen allowing either the top or the bottom portions of

the beam of light to pass through the opening. A second converging lens **456** now directs toward a remote focal point the resultant beam, the focal length of the lens **456** somewhat exceeding the overall length of the light path on its way to the surface of drum **446**. As shown in Fig. 10, movement of the pinhole will have the effect of cutting off different, slightly overlapping portions of the beam, so that the locus of impingement of the light rays will appear somewhat displaced. This apparent displacement should correspond to about half the unit of displacement obtainable through movement of the mirrors (i. e. the displacement obtainable by moving the last mirror **431** through energization of the associated solenoid **426***f*); by alternating "Letters" and "Figures" tracks on the surface of drum **446**, the desired shifting operation may be performed in simple manner by an almost infinitesimal displacement of the mask **455**.

It should be understood that, for the purpose of obtaining the proper increments of displacement with the mirrors shown, their distances from the surfaces of the drum (measured along the path of light) should increase according to a binary law or else their angles of displacement should be suitably staggered. Furthermore, the spacing between the drum and the last mirror **431***f* should be so large that the beam need only to swing through a very small angle in sweeping from one end of the drum to the other, unless other precautions (as by curving the outer surface of the drum) are taken to insure that the length of its path remains essentially the same for all positions of the beam.

Fig. 11 shows part of an optical selector system similar to that of Fig. 9, except that the mirrors **531***b*, **531***c* (only two shown) are now displaced parallel to themselves rather than about a pivot. In order to dispense with the need for staggering the extent of displacement of successive mirrors, converging lenses **557**, **558** have been inserted therebetween, the focal length of the first lens **557** being half that of the second lens **558**. As a result of this arrangement, a displacement of the beam due to movement of the mirror **531***b* will manifest itself at the mirror **531***c* in a displacement of twice the original magnitude, this magnitude being further doubled at each successive mirror. Selective movement of the five mirrors of the system will, therefore, again result in **32** different end positions of the beam. It will also be noted that with this arrangement the overall length of the light path remains substantially the same for all positions of the beam.

The various embodiments of the invention herein disclosed lend themselves to the control of a large variety of reproducing devices utilizing voltage, heat, ink, light, pressure or other forms of energy for marking a sensitive blank. The reproducing device need not be a helix but may, for example, take the form of a disk having projections on its face spaced along a portion of a spiral, similar to the apertures of a Nipkov disk, which projections successively scan different portions of the area to be printed. Moreover, the conventional platen shown in Fig. 5 may be replaced by a vertical cylinder, having its axis parallel to that of the printing helix, in which case the latter need not have hourglass shape but may be of cylindrical configuration; also, such a vertical platen might be used in combination with a disk having a spiral ridge on its face, this ridge scanning the printing area along vertical lines in essentially the same manner as does the helical ridge of the scanning element **237** (Figs. 5 and 6).

Finally it may be mentioned that the invention is not limited to the reproduction of characters from elongated tracks having alternating light and dark areas in linear succession. Thus it will be possible to employ, instead, track members of, say, square or rectangular configuration, each carrying a respective letter or figure, which may be traversed or impinged upon by a beam executing an area scanning movement so as to produce a pulsating output adapted to be applied to the reproducing device at the printer. Various other modifications and adaptations will be readily apparent to persons skilled in the art and are intended to be embraced in the scope of the invention as defined in the objects and in the appended claims.

I claim:

1. In a printing receiver, in combination, a source of light, first focusing means forming said light into a converging beam, second focusing means positioned back of the focal point of said first focusing means and causing said beam to converge at a remote point, a receiving surface adjacent said remote point, masking means adjacent said focal point displaceable to cut off different portions of said beam, thereby obliterating different portions of the image projected by said beam upon said receiving surface, signal-responsive shift means controlling the position of said masking means, and signal-responsive deflecting means in the path of said beam for selectively displacing the image projected upon said receiving surface.

2. In a printing receiver, the combination according to claim 1 wherein said deflecting means include a set of mirrors positioned back of said second focusing means, said mirrors directing said beam upon said receiving surface over a circuitous path, and signal-responsive control means for selectively displacing said mirrors.

3. In a printing receiver, in combination, a permutation code distributor, a plurality of track members of varying optical permeability, said track members being divided into groups, a source of light producing a beam of light, optical deflecting means between said source and said track members adapted to change the direction of said beam of light for selectively aligning said beam with different ones of said track members, selector means connected to said permutation code distributor and operatively linked with said optical deflecting means for controlling the position of said beam in response to code signals received by said distributor, switch-over means controlled by said selector means for limiting the positions of said beam to alignment with track members of a selected group only, said selector means actuating said switch-over means in response to predetermined code signals for changing the group thus selected, scanning means for relatively displacing the selected track member and said source of light, thereby modulating said beam, and output means in the path of the modulated beam and responsive to the modulation thereof.

4. In a printing receiver, the combination according to claim 3 wherein track members of different groups alternate, the minimum displacement of said beam due to said control means corresponding to the minimum distance between elements of the same group, said switch-over means displacing said beam by a fraction of said distance.

5. In a printing receiver, in combination, a permutation code distributor, light source means at a first location, photosensitive means at a second location, a pair of photoelectric translators each including part of said light source means, part of said photosensitive means and a respective group of track members of varying optical permeability between said light source means and said photosensitive means, switch means at one of said locations controllable by said permutation code distributor for selectively inactivating either of said photoelectric translators in response to a shift signal received by said distributor, selector means intermediate said locations common to both of said photoelectric translators and controllable by said permutation code distributor for directing light from said light source means onto a selected track member of either group in response to a code signal received by said distributor, scanning means for relatively displacing said selected track member and said light source means, thereby producing a modulated light beam impinging upon said photosensitive means, and electric signal generator means connected to said photosensitive means for producing an output varying with the modulation of said beam.

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