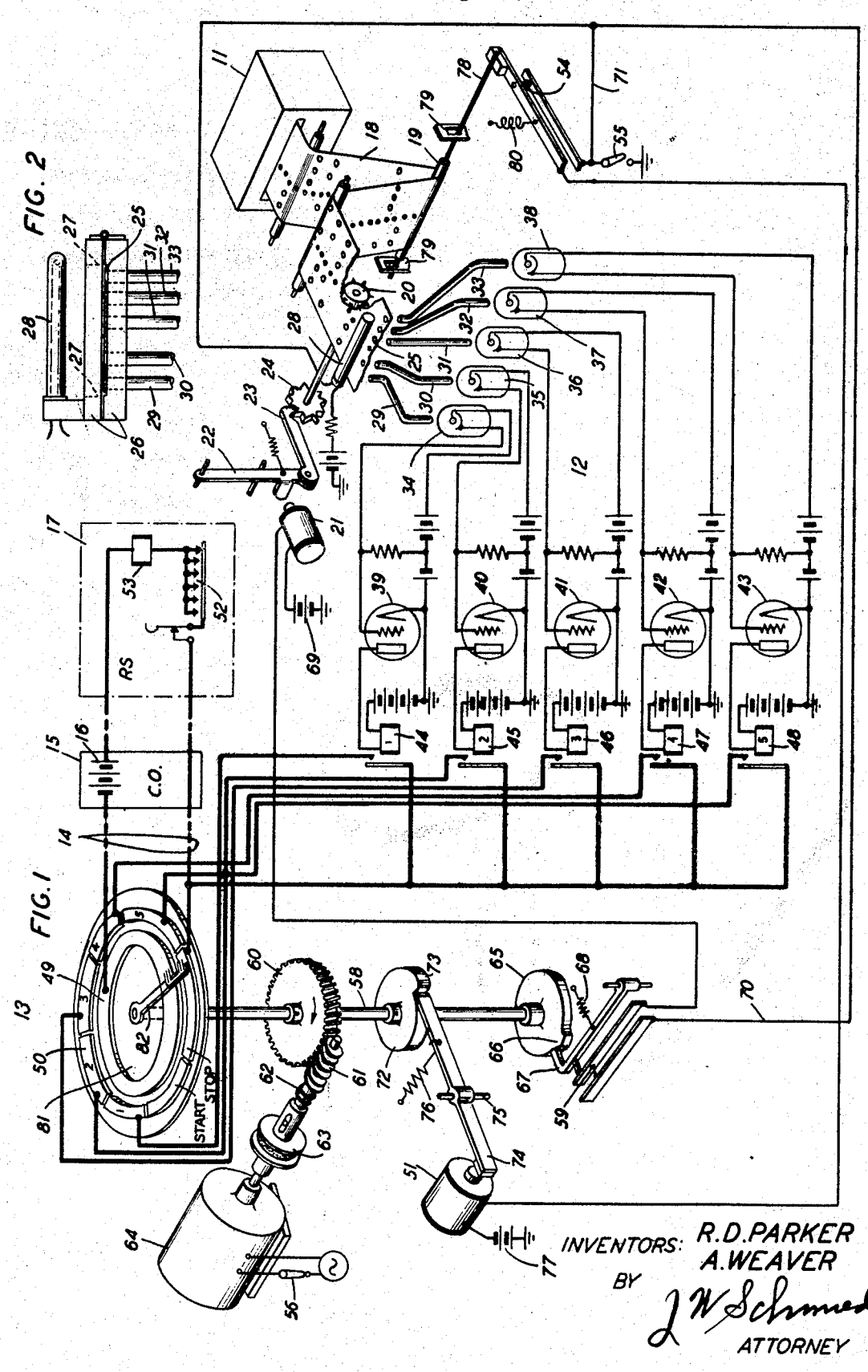
Aug. 14, 1945. R. D. PARKER ET AL 2,382,251

TELEGRAPH PERFORATOR-TRANSMITTER

Filed Aug. 25, 1943 2 Sheets-Sheet 1



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Filed Aug. 25, 1943 2 Sheets-Sheet 2

FIG. 3

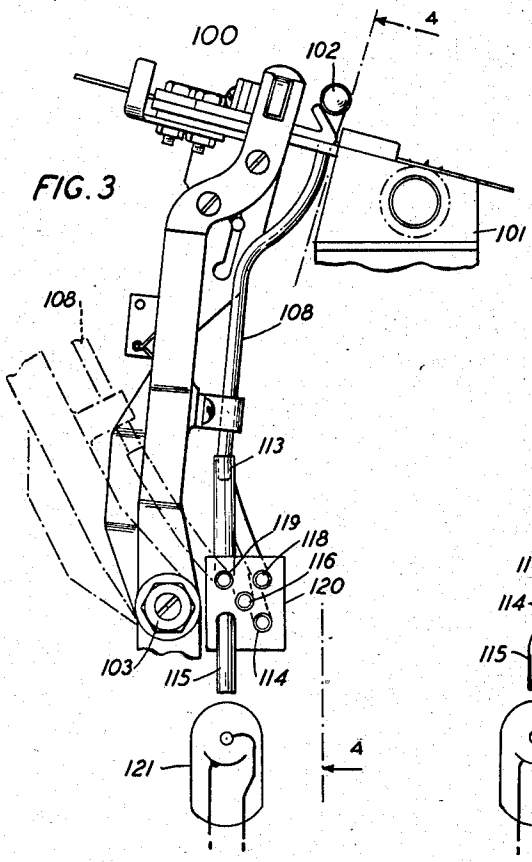


FIG. 4

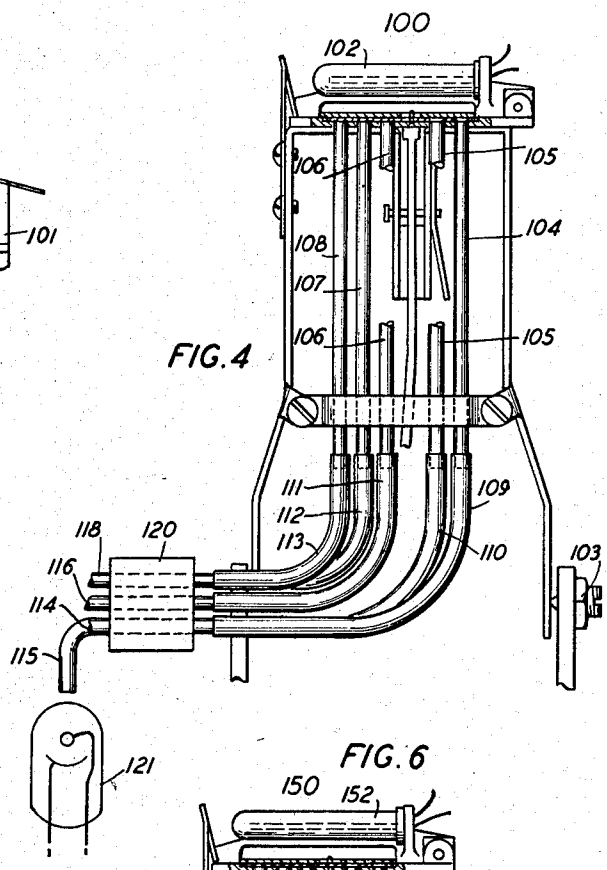


FIG. 5

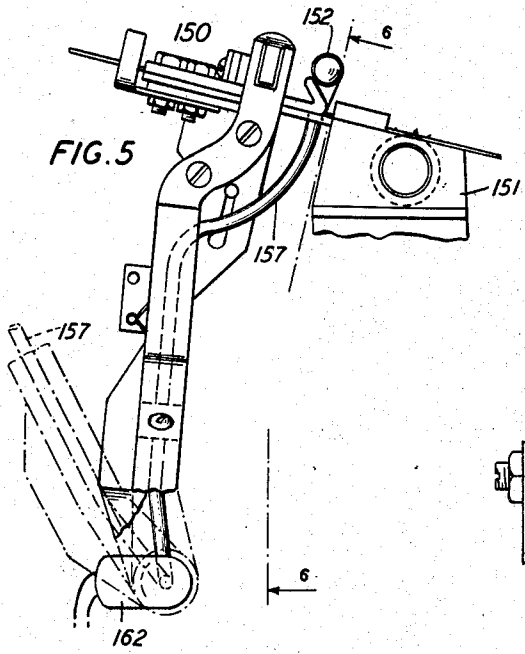
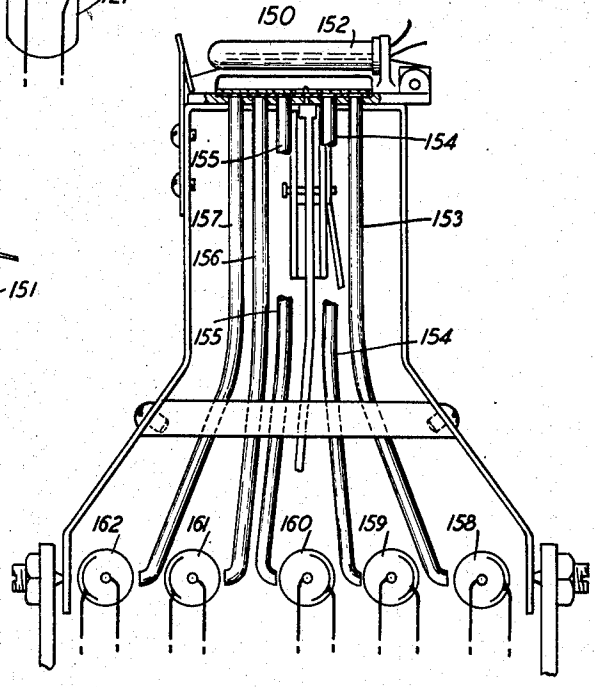


FIG. 6



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TELEGRAPH PERFORATOR-TRANSMITTER

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5 Claims. (Cl. 178—17)

This invention relates to printing telegraph apparatus and more particularly to telegraph transmitters for the transmission of character identifying signals.

Transmission of character identifying signals in telegraph systems is frequently achieved in accordance with a paper tape including control indicia formed in varying combinations. Specifically the control indicia may be in the form of transverse rows of perforations formed in the tape either by a keyboard perforator or by a signal controlled perforator which is commonly referred to as a reperforator. The tape thus prepared passes through a transmitter or sensing mechanism to control the transmission, in succession, of signals respectively identified with the transverse rows of perforations.

The prime object of the invention is to control photoelectrically the transmission of permutation code signals, each of which may be identified as a single transverse row of perforations in the tape.

Another object is to successively translate the transverse rows of perforations in the tape into corresponding combinations of beams of light and to transmit these beams of light through light conducting rods, these beams of light after passing through the rods activating photoelectric cells for producing the signal impulses in combination respectively corresponding to the transverse rows of perforations.

Another object is to successively sense, or scan, by means of a light source, signals corresponding to each transverse row of perforations in the tape and to photoelectrically transmit the current impulses of each signal so sensed, to a storing circuit for transmission over a start-stop distributor to an outgoing line.

Another object is to reduce the number of mechanically operated parts heretofore required in the perforated tape transmitter wherein operable metallic pins were employed for sensing.

The permutation signal code generally employed to transmit characters uses five selecting impulses in various combinations of "current" and "no current" intervals (or other current or voltage differentiated intervals) and each combination appears on the ordinary telegraph tape as a row or group of perforations, each perforation representing in a common case a "current" impulse of a combination, and each space provided for a possible perforation but not perforated, representing a "no current" impulse. In a transverse row the possible perforations appear on a basis of about 0.1 inch center to center and the over-all width of the tape is ⅝ inch approximately.

According to the present invention a common light source is used in place of operable metallic pins for sensing signals in a perforated telegraph tape which is operated in the usual manner for transmission over an outgoing line. The signals appear in transverse rows in the tape, each row comprising a distinctive arrangement of perforations to correspond to the current impulses of the signal, in permutation code, which it represents. Immediately below the transverse row, that is being sensed, are five narrow rods of light conducting material to correspond to the five selecting impulses of a signal combination and these rods may be molded to conduct light in any desired direction or directions. The light passes through each of the perforations in the transverse row being sensed and then through the corresponding rods of light conducting material substantially without spreading laterally, even though the rod may be bent to a considerable extent, to a photoelectric cell which becomes activated to operate a relay in a signal storing circuit. A start-stop rotary distributor transmits to the line each signal in turn as it is prepared by the operated and unoperated relays of the signal storing circuit.

A feature of the invention is the use of photoelectric cells for transmitting telegraph signals perforated in a narrow telegraph tape.

Another feature is the elimination of metallic pins for sensing and the numerous operable mechanical parts required with metallic pin sensing.

Another feature is that the perforated telegraph tape is not subjected to tearing as in tape transmitters wherein metallic pins are employed for sensing.

In a mechanism using sensing pins or sensing levers the controlled contacts are physically related to the sensing elements; in the arrangement of the present invention there is great latitude in locating the controlled photoelectric cells with respect to the sensing or scanning point of the tape.

Although the word "scan" may be preferably descriptive of a function involved in the present invention, the word "sense" is used interchangeably with it herein in referring to the same function.

A better understanding of the invention may be had from the following description taken in conjunction with the accompanying drawings wherein like reference characters designate simi-

lar parts throughout the several views, and in which:

Fig. 1 shows a typewriter sending and receiving station in diagrammatic form wherein one station is shown schematically and includes provisions for transmission by (1) sensing a perforated telegraph tape with light from a common source and (2) impinging the light from such source in the form of individual beams on photoelectric cells through narrow rods of light conducting material. The rods are shown in a simple fanned-out arrangement and the means of stopping the transmission, while perforation of signals is continued, is that of the well-known taut-tape type;

Fig. 2 shows a fragmentary view of the front elevation of the tape sensing head with the source of light for sensing the perforated tape;

Fig. 3 shows a side elevation view of an alternative sensing device for a perforated tape transmitter wherein the rods of light conducting material are mounted in a carrier capable of oscillation about a fixed pivot away from and toward the exit tape channel of a tape perforator. Each of the rods of light conducting material is shown in two sections interconnected by a tube coated internally with reflecting material and arranged to extend in directions at right angles to each other, the five selecting rods of a group forming a square having a cross-section with one rod in each corner and one in the center. The position of the carrier displaced from the perforator is shown in dot and dash lines;

Fig. 4 is an elevation view taken along line 4—4 of Fig. 3;

Fig. 5 is a side elevation view of another alternative of the sensing device wherein the rods of light conducting material are bent to form a different arrangement from that shown in Figs. 3 and 4. Similar to that shown in Fig. 3, the position of the carrier displaced from the perforator is shown in dot and dash lines;

Fig. 6 is an elevation view taken along lines 6—6 of Fig. 5; Figs. 4, 5 and 6 being somewhat schematic.

The system shown in Fig. 1 may be considered as including three principal units, namely, a tape perforator 11, a tape sensing unit 12, and a transmitting unit 13, these units are at one station which is connected by the conductors of outgoing line 14 to central office 15 where the transmission signaling current of source 16 is furnished for a connection extended to a remote subscriber station 17.

Referring to Fig. 1 perforator 11 which may be of the type disclosed in United States Patent 2,262,012 granted to R. A. Lake on November 11, 1941, prepares the controlling perforated paper tape which is advanced in steps by a tape feed mechanism (not shown) in the perforator. Tape 18 passes taut-tape operated bar 19, to the tape feed wheel 20 of the automatic tape transmitter. Tape feed wheel 20 is operated in steps by stepping magnet 21, each operation of the stepping magnet being effective to attract armature 22 which in its movement causes pawl 23 to rotate ratchet wheel 24 one step.

Transmitting tape 18 in being advanced step-by-step passes through tape channel 25 in a hinged blockhead 26, the upper member of which has a cut-out portion indicated by dotted lines 27 for permitting radiant energy or light from an exciter element, say lamp 28, to sense the "current" impulses of a signal in each transverse row of perforations in tape 18. Each transverse row in tape 18 may be said to be an area of different light controlling abilities, or a combination of transparent and/or opaque portions, the transparent portion represents "current" impulses and the opaque, "no current" impulses. Immediately below the tape and in direct alignment with lamp 28 are five rods of light conducting material. These rods designated 29, 30, 31, 32 and 33 are positioned below the tape to correspond to the five selecting pulses of a signal combination and are of a sufficiently narrow width to be positioned on the basis of 0.1 inch center to center. Rods 29 to 33 are premolded to fan out sufficiently to conduct light to five photoelectric cells 34, 35, 36, 37 and 38 respectively. Except for the light conducting rods, the transmitter or scanning unit 12 may be of the type disclosed in United States Patent 2,262,012, supra.

When lamp 28 in its lighted condition illuminates or senses a perforation in tape 18, the corresponding rod conducts light to its associated photoelectric cell which is thereby activated to set up a current which is amplified by a corresponding amplifier of those designated 39, 40, 41, 42 and 43, sufficiently to operate the corresponding relay of storing relays 44, 45, 46, 47 and 48.

A distributor 13 comprises an inner solid commutator ring 49 and an outer commutator ring 50, both of which are suitably attached to the upper surface of an insulating disc 81. The outer commutator ring is divided into seven insulated segments which includes the five segments corresponding to the five selecting units of the "Baudot code," a "stop" segment and a "start" segment. A distributor brush 82 wiping on the stop segment closes a line circuit 14 connecting therewith a remote subscriber station 17 preferably through a central office 15. The remote subscriber's station is provided with the usual sending contacts 52 and receiving printer magnet 53. It will be understood that while central office 15 may be used for connecting the local distributor and the remote subscriber station, the system shown is not necessarily limited thereto and may be readily applied to include a private wire or direct wire system, wherein a central office is not employed.

The tape transmitter assembly 12 is arranged to operate with light sensitive devices, such as photoelectric cells 34 to 38, which correspond to the five segments of the outer commutator ring 50. Assume that the signal combination about to be transmitted is shown on the tape 18 immediately above rods 29, 30, 31, 32 and 33, and that the signal is made up of a blank space for impulse No. 1 and perforations for impulses Nos. 2 to 5 inclusive, as shown in the drawings. Light from source 28 is therefore conducted through rods 30, 31, 32 and 33 to activate photoelectric cells 35, 36, 37 and 38. The currents generated by photoelectric cells 35 to 38 are individually amplified by amplifier tubes 40, 41, 42 and 43 to operate relays 45, 46, 47 and 48 respectively.

During the next rotation of brush 52 over the segments of distributor ring 50, the five selecting impulses transmitted over line 14 will be "no current" for the first impulse and "current" for each of the next four impulses of the signal transmitted.

In connection with the perforated tape, each transverse row representing a signal combination contains five potential perforations. A row of perforations when sensed will permit light from lamp 28 to pass through the tape, but the

absence of perforations in the tape will obviously prevent light from passing through. The light passing through perforations in a transverse row is conducted through rods immediately below such perforations and thereby impinged on photoelectric cells. The cells that receive light are momentarily activated to cause a "mark" or "current" impulse to be transmitted over the line and the cells that received no light, because of no perforation, over the corresponding rods remain inactive and thereby cause to be transmitted to the line a space or "no current" impulse condition.

In connection with the start-stop rotary distributor, brush 82 comprising metallic portions for wiping over the commutator rings 49 and 50, is mounted on one end of a main drive shaft 58 having a gear wheel 60 fixed thereon in mesh with a worm 61 carried on a shaft 62 which is connected through a friction clutch 63 to a motor 64 employed to drive the main shaft 58. On the lowermost portion of the shaft 58 is fastened a tape feed operating cam 65 provided with a raised cam portion 66 which engages pivoted member 67 normally controlled by a coil spring 68. The raised cam portion is predeterminedly fixed on the main drive shaft with respect to the distributor brush in a manner so that when the brush commences to wipe over the stop segment of the outer commutator ring 50 after each revolution, pivoted member 67 which heretofore was riding on the low portion of cam 65, begins now to engage the raised cam portion 66 with the result that the contacts 59 become closed and thereby complete a circuit traceable from grounded positive battery 69, through the winding of stepping magnet 21, closed contacts 59, conductors 70 and 71, to ground at switch 55 in its operated position. Stepping magnet 21 operates and causes pawl 23 to rotate ratchet wheel 24 an angular distance to an amount equivalent to the distance between contiguous teeth of the ratchet. Accordingly, the tape is advanced to set up the code unit combination for the next character to be transmitted.

In the normal operation of the transmitter-distributor, it occurs frequently that there is a difference between the rate at which the character units are transmitted and that at which the tape is fed from the perforator 11. Since the tape is fed directly from the perforator to the transmitter, it will be evident that if for any reason the perforator operation is interrupted the transmitter will use up all of the slack in the tape and thereafter proceed to damage the feed holes used with the feed wheel 20 for advancing the tape, unless a provision is made to stop the transmitter-distributor 13 automatically. For the purpose, therefore, of taking care of the difference between the rates of operation of the transmitter-distributor and the perforator there is fixedly mounted on the main drive shaft intermediate the gear wheel 60 and the tape feed operating cam 65 a stop cam 72 formed with a peripheral shoulder 73. Associated with the stop cam is a stop arm 74 pivoted at 75 and normally having one end held in engagement with the periphery of the stop cam by coil spring 76. The opposite end of stop arm 74 is operatively associated with magnet 51 which is employed to rotate the stop arm about its pivot to thereby move the former out of engagement with the stop cam periphery. Grounded negative battery 77 is connected through the winding of magnet 51 to electric contact 54 which is opened and closed under control of an automatic stop lever 78 projecting between the transmitter and perforator. Stop lever 78 is so arranged that the tape passes thereunder. It is supported in vertical slots provided in upright members 79, 79. The contacts 54 are also connected through a manually operated switch 55 in its operated position to ground.

After the motor has been started by closing the switch 56 the manually operated switch 55 is closed to complete an obvious lighting circuit for lamp 28 and an energization circuit for magnet 51 which was hereinbefore traced. Lamp 28 lights for the purpose of effecting the sensing of each signal combination perforated in the tape. Magnet 51 operates to disengage stop arm 74 from stop cam 73 to thereby permit the rotation of the main drive shaft 58. So long as the perforator continues to operate, the tape being fed therefrom will have sufficient slack to allow the stop lever 78 to rest on the upper member of contacts 54 thereby retaining contacts 54 in the closed condition. In the event that the perforator operation is interrupted the tape will be pulled taut to raise the stop lever 78 out of engagement with the upper member of contacts 54 thereby enabling the upper member of contact 54 under the influence of coil spring 80 to disengage from the lower member, to interrupt the circuit extending through magnet 51. The upper and lower members of contact 54 are, preferentially, made of spring material so that coil spring 80 is is not necessary in commercial installations. Stop arm 74 actuated by coil spring 76 when magnet 51 becomes deenergized moves into contact with the stop cam periphery and eventually engages shoulder 73 to stop the distributor brush by holding the main drive shaft from rotation. In this event it will be evident that the transmitter is also stopped since it is also driven from the main shaft. It will be understood that the distributor brush will only be stopped on the "stop" segment of the commutator ring 50 due to the fact that the shoulder 73 of stop cam 72 is predeterminedly positioned with respect to the distributor brush to effect this result.

Figs. 3, 4, 5 and 6 show two alternative scanning devices or mechanisms, namely, Figs. 3 and 4, as 100 and Figs. 5 and 6 as 150 wherein the rods of light conducting material are mounted in a carrier capable of oscillation about a fixed pivot away from and toward the exit tape channel of the keyboard perforator. Normally, the tape entrance channel of the scanning, or sensing, unit is immediately adjacent the exit channel of the perforator, say perforator 101 in Fig. 3 and perforator 151 in Fig. 5, and the tape passes directly from the perforator to the sensing unit without exposing any portion of the tape. When the perforator is operated the tape feed mechanism thereof advances the tape and moves the sensing unit about its pivot a distance equal to the distance between the transverse rows of perforations, to start a transmitting distributor which includes means to move the sensing unit toward the perforator to sense the new row of perforations. The sensing unit through the light from lamp, say lamp 102 of Figs. 3 and 4, and lamp 152 of Figs. 5 and 6, then senses the transverse row of perforations and thereby controls the operative condition of storing relays 44 to 48 (Fig. 1) for the transmission of impulses corresponding to the combination of perforations in the transverse row that is being sensed.

The sensing unit operates at a definite predetermined speed whereas the perforator may

be operated at a speed dependent upon its inherent limitations and the speed of the operator. If the perforator is operated at a higher speed than the speed of rotation of the transmitting distributor shaft 58 (Fig. 1), the tape will be fed at a rate higher than the rate at which it is consumed by the sensing unit, in which case the sensing unit will be pushed in a counter-clockwise direction about its pivot bearing 101 (Fig. 3) until it reaches a predetermined position when, if the perforator is continued to be operated at a speed higher than the speed of operation of the shaft 58, the tape will be formed in a loop extending between the sensing unit and the perforator.

When a cessation in the operation of the perforator occurs the tape will continue to be advanced through the sensing unit by the tape advancing mechanism thereof. When the loop of the tape has been exhausted and the tape becomes taut between the sensing unit and the perforator and provided operation of the perforator is not resumed, the sensing unit due to the cyclic operation of the tape advancing mechanism and its cooperation with the feed holes in the tape, will be moved in a clockwise direction toward the perforator and in such movement, which is step by step, the transverse rows of perforations will be sensed successively until the sensing head is brought in abutting relation to the perforator. When the sensing unit abuts the perforator, mechanism is operated for discontinuing the operation of the tape advancing mechanism through arresting the rotation of the transmitting distributor shaft 58.

The tape advancing mechanism, as shown in United States Patent 2,262,012, supra, includes elements operated practically in accordance with cyclic rotation of transmitter-distributor shaft 58. Included in the sensing unit and constituting a part of the tape feeding mechanism is a slidably mounted member (not shown) carrying at its upper extremity pins spaced corresponding to the spacing of the feed perforation and operated cyclically by the transmitter-distributor shaft 58 to cause its pin to engage and disengage the feed perforations in the tape. The feeding movement of the noted element is achieved through the provision of a cam operated lever (not shown) carrying at its extremity a pin which cooperates with a cam slot in the element carrying the pins which engage the feed perforations in the tape to cause the rectilinear movement thereof; that is, a movement whereby the pins thereof engage the next succeeding feed perforations in the tape to effect a relative movement between the sensing unit and the perforated tape. If the tape is taut, movement of the element carrying the pins will cause the sensing unit to move about its pivot bearing 103 toward the exit channel of the perforator. However, if the tape between the perforator and the sensing unit is not taut the action of the recited element will be such as to cause the tape to be advanced step by step through the sensing unit until the tape becomes taut when the condition previously described will be repeated; that is, the sensing unit will be moved in a direction whereby its tape entrance channel will approach and abut the tape exit channel of the perforator.

If the sensing unit through the operations previously described abuts the perforator and if operation of the perforator is resumed, the sensing unit will be moved about its pivot bearing, say 103, in a counter-clockwise direction to repeat the operations previously described. For a more detailed description of a sensing mechanism carrier capable of oscillation about a fixed pivot away from and toward the exit tape channel of a keyboard perforator, reference may be had to United States Patent 2,262,012 supra.

The light conducting rods, according to the present invention, are shown in Fig. 4 respectively extending through apertures in a plate over which the perforated tape advances. In accordance with the provision of five selecting impulses to a signal combination there are five light conducting rods 104 to 108 arranged to fit into the five apertures respectively, in the tape bearing plate. As the tape advances each transverse row of perforations in the tape appear immediately about the five light conducting rods, there being a light conducting rod for each of the possible perforations appearing in a transverse row of perforations. The light conducting rods 104 to 108 are shown in Fig. 3 extending downwardly through an offset to points where they are respectively connected to tubes 109 to 113 (Fig. 4) which are internally coated with a light reflecting material. These tubes are bent to form approximately 90-degree elbows and positioned in the direction of the plane of rods 104 to 108 to extend to a formation wherein the five light conducting rods form a square in cross-section having one tube in each corner and one in the center. At this point other rods of light conducting material such as those designated 114 to 119 are respectively connected to tubes 109 to 113 respectively, and extended through block support 120 and then turned through any angle to impinge light upon any desirable arrangement of photoelectric cells in a manner such as shown in Figs. 3 and 4, for example, rod 115 impinges light on photoelectric cell 121.

Figs. 5 and 6 show another alternative arrangement of light conducting rods wherein rods 153 to 157 are brought down through an offset somewhat similar to that shown for rods 104 to 108 in Fig. 3, but instead of being connected to tubes coated internally with light reflecting material, they are fanned out in a manner shown in Fig. 6 to respectively impinge light on photoelectric cells 158 to 162.

For the purpose of this specification "light" and "radiant energy" include all radiations in the general region of ultra-violet, visible light, and infra-red which may be useful for sensing purposes; perforations in a transmitting tape shall constitute any portions of such tape which are sufficiently transparent, translucent or reflective to pass or control the passage of enough light to control a light sensitive element, actual perforations are preferred.

What is claimed is:

1. An impulse transmitter controlled by a strip having areas thereon opaque to light and other areas transparent or translucent thereto comprising a light source progressively movable over a given range with said strip and also movable with respect thereto, fixed position light sensitive elements, and light conveying means for causing light passing said transparent or translucent areas to impinge upon said elements in all positions of said light source.

2. In a transmitter, a medium bearing representations of coded signals in physical form, a plurality of light sensitive means, a source of light, a pivotally mounted sensing head for scanning the representations of said medium in succession, means having a pivoted portion for conducting light, interrupted in accordance with said

representations, substantially without spreading laterally, to said light sensitive means, and means for advancing said medium with respect to said head past a point where each of said signals may be sensed separately and in turn.

3. In a transmitter of permutated conditions representing characters, a plurality of photoelectric cells, a source of radiation, a tape having transverse rows of conditions, one row for each character, means for advancing said tape, step by step, through the range of said source whereby each of said rows is sensed by said source to produce permutated beams of radiation, and radiation conveying tubes individual to said photoelectric cells and respectively arranged to transmit said beams of radiation to activate said photoelectric cells, said tubes being jointed to allow for relative movement between the respective ends thereof.

4. A telegraph tape transmission device comprising two units, one of said units being stationary and the other having a pivot point about which it may move from and toward said one unit, a tape, a perforator in said one unit for applying transverse rows of code conditions and a longitudinal row of feed perforations in said tape, means on said one unit cooperating with said feed perforations for longitudinally moving said tape, step by step, a sensing point on said other unit over which said tape is moved, a source of radiant energy on said other unit immediately above said sensing point, an element provided for each of the possible conditions in any one of said transverse rows for conducting radiant energy, photoelectric cells each fixedly located at the termination of one of said elements, a flexible radiant energy conducting pivot point in each of said elements, and means included in each of said cells respectively responsive to the radiant energy conducted through one of said elements whereby said cells control the transmission of impulses corresponding to said code conditions as presented successively in said transverse rows at said sensing point.

5. Pulse control transmission means comprising a relatively narrow strip designed to be impressed with pulse controlling indicia, a sensing head, means for causing said strip to progress relatively to said sensing head, means for supplying radiant energy to said sensing head in a manner to cause a plurality of beams thereof to be modified in accordance with the indicia upon various portions of said strip, radiant energy sensitive means, light conducting cylinders having one end adjacent said head and positioned to pick up and convey said modified beams to said radiant energy sensitive means respectively, said cylinders being fanned out at their ends adjacent said light sensitive means to positions widely separated as compared with the separations of their ends at said sensing head, said cylinders being provided with flexible joints between their ends.

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