July 26, 1949. J. A. SKINNER 2,477,011

RECORD CONTROLLED PRINTING APPARATUS

Filed March 26, 1945 6 Sheets-Sheet 1

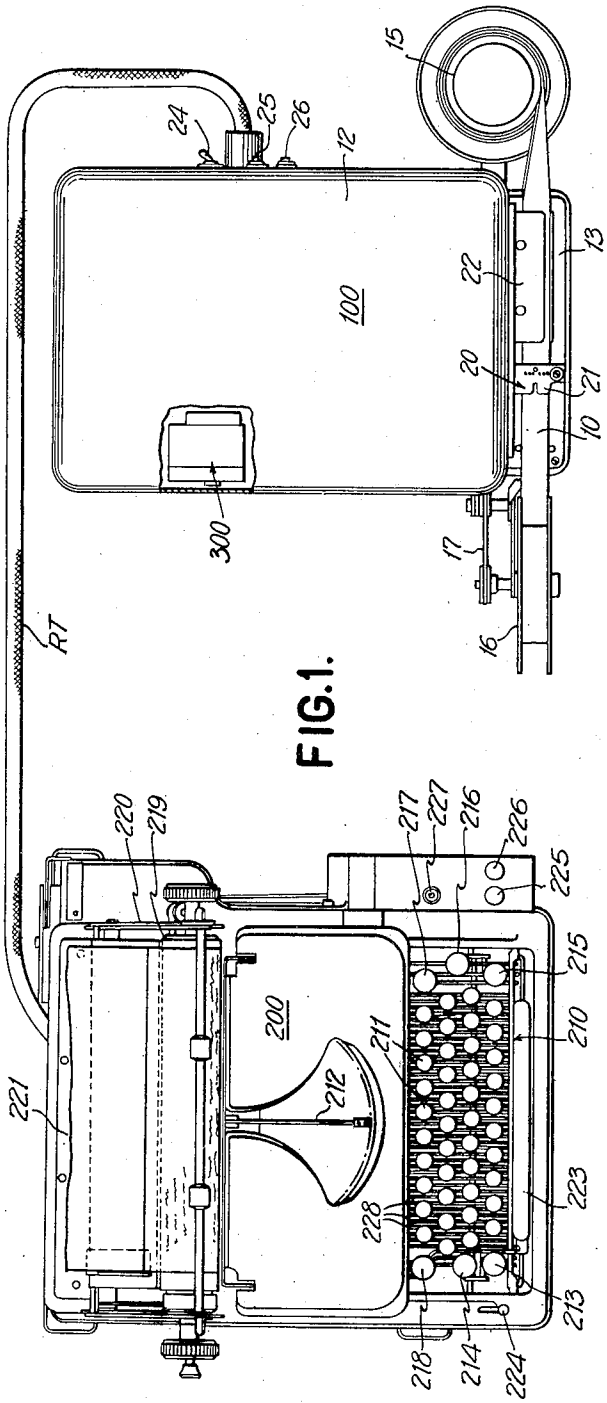


FIG.1.

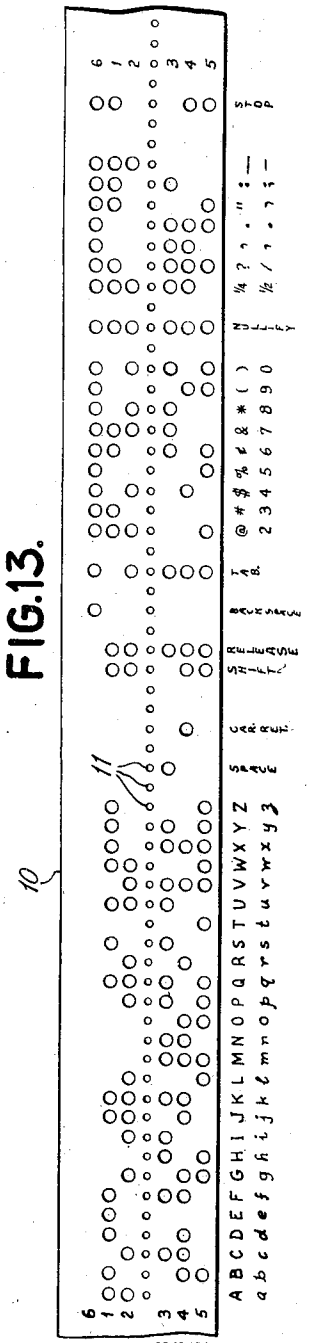


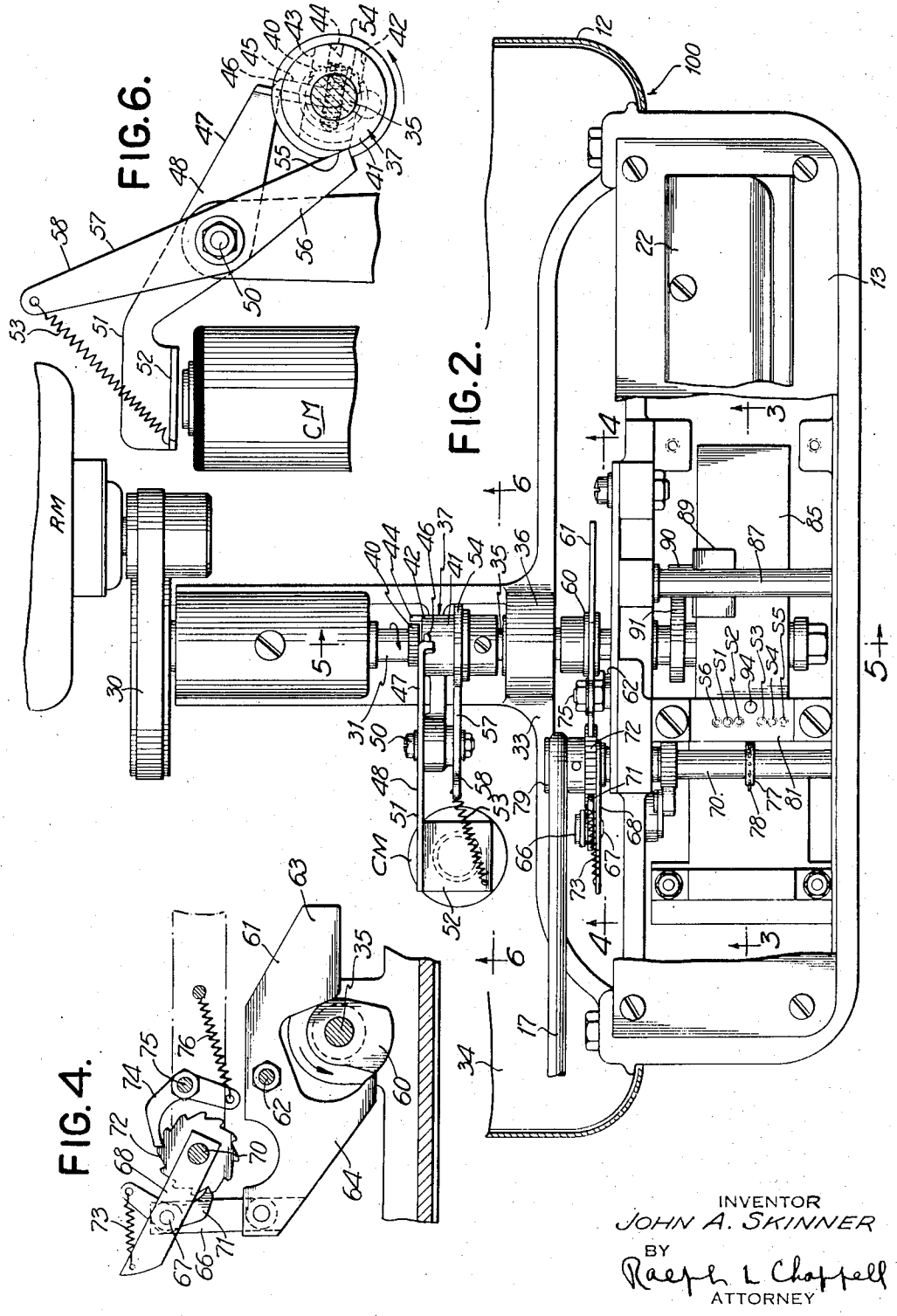
FIG.13.

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RECORD CONTROLLED PRINTING APPARATUS

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RECORD CONTROLLED PRINTING APPARATUS

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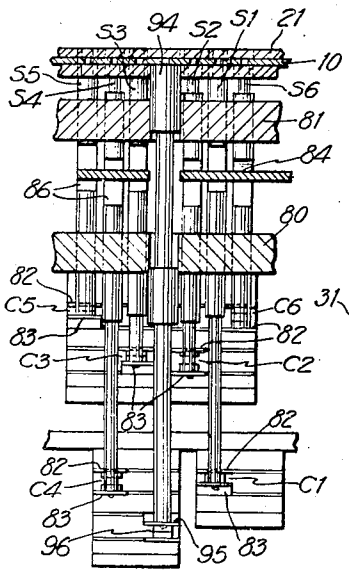


FIG. 7.

FIG. 5.

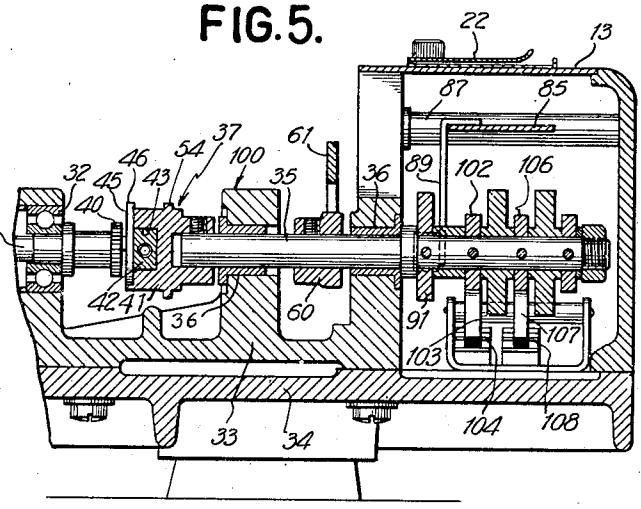
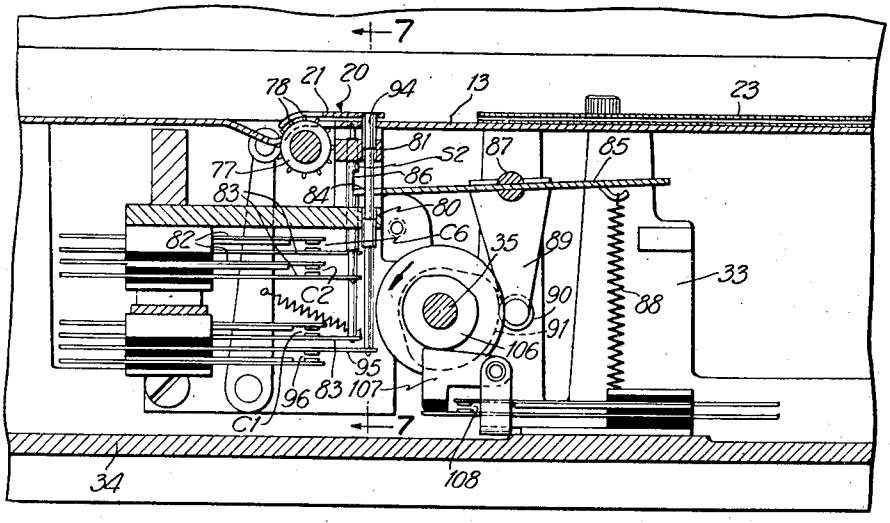


FIG. 3.



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FIG.8.

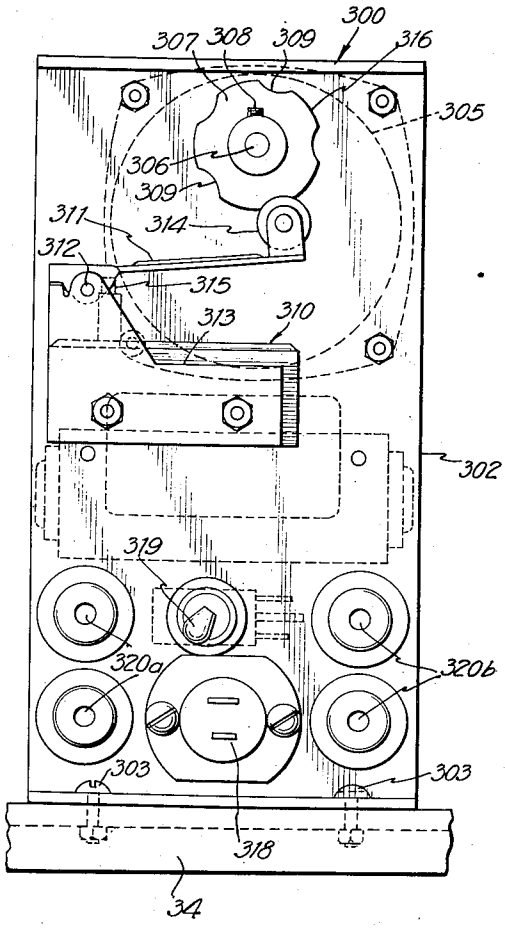


FIG.9.

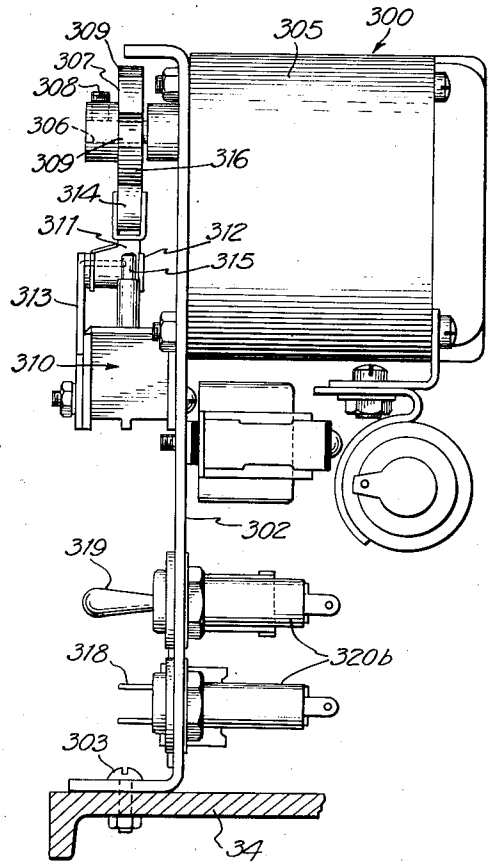


FIG.10.

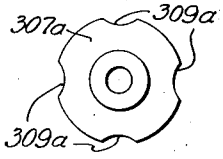
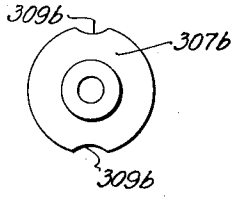


FIG.11.



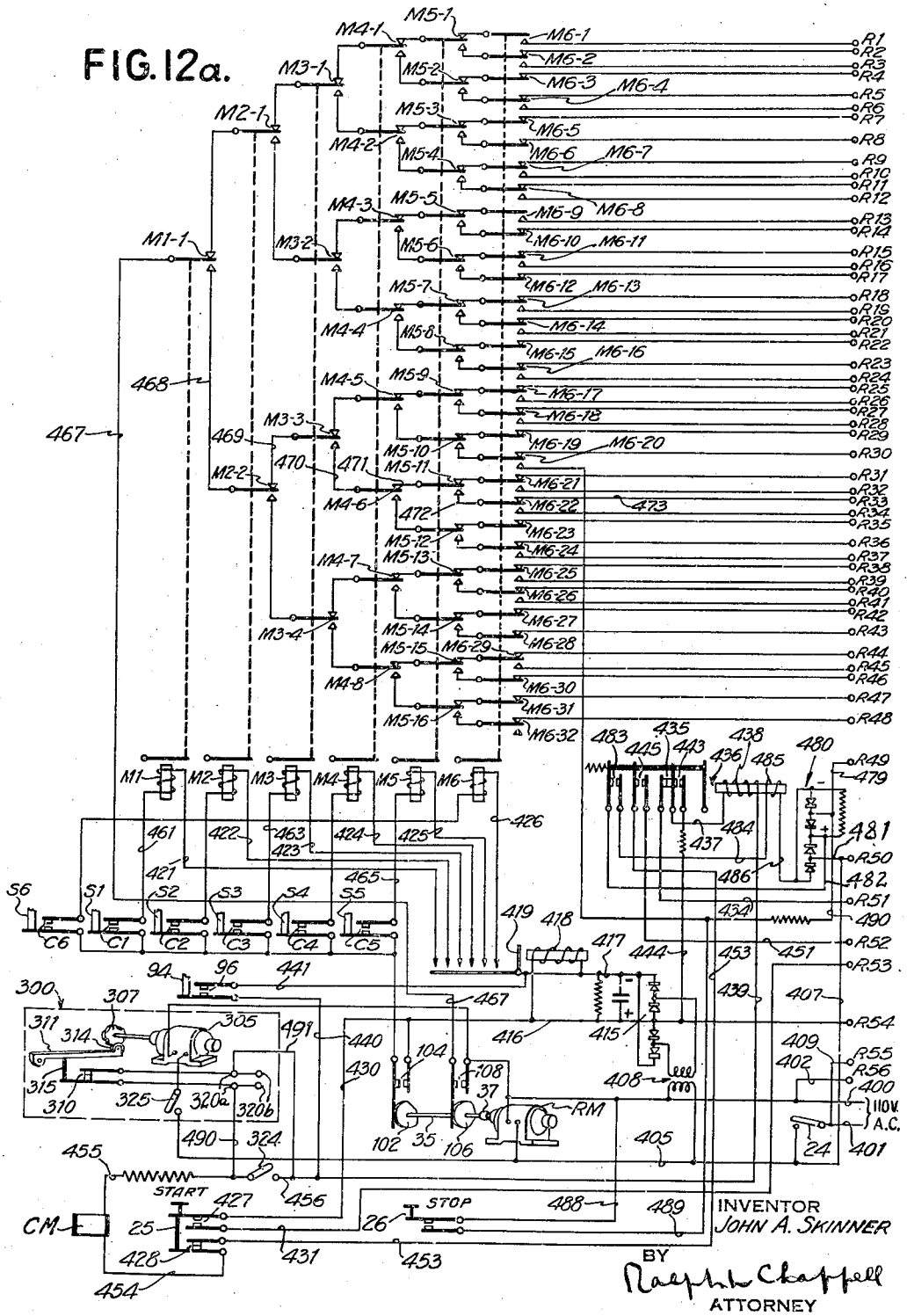
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FIG. 12a.

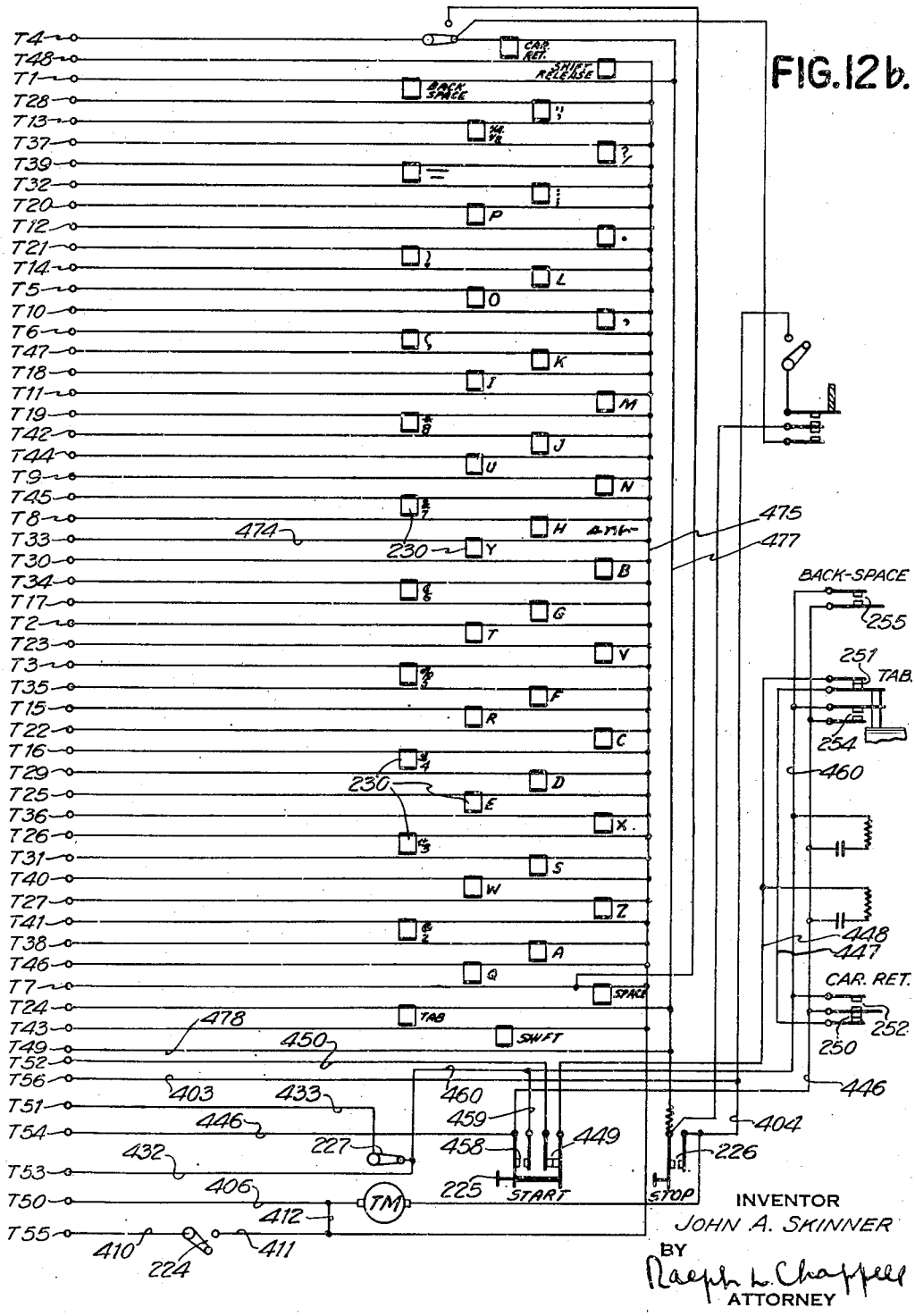


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FIG. 12b.



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Patented July 26, 1949

2,477,011

UNITED STATES PATENT OFFICE

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RECORD CONTROLLED PRINTING APPARATUS

John A. Skinner, United States Navy

Application March 26, 1945, Serial No. 584,991

10 Claims. (Cl. 197—20)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to cyclically operable apparatus and more particularly to record-controlled printing apparatus and it has for a general object to provide apparatus of this type which is of improved construction and arrangement of parts and one which operates in an effective and dependable manner.

According to one of its aspects, the present invention may be considered as being in the nature of an improvement over the apparatus disclosed in the copending application of Henry L. Tholstrup, Serial No. 492,896, filed June 30, 1943, which has matured into Patent No. 2,378,371, dated June 12, 1945. As will appear more fully hereinafter, the illustrative embodiment of the present invention includes as a part thereof the same apparatus as is disclosed in said patent.

A record-controlled printing apparatus of the type referred to above usually comprises a reader, a typewriter, and control instrumentalities which function to effect automatic operation of the typewriter in accordance with data recorded as code designations on a record strip and analyzed or sensed by the reader. In recording the code designations on the record strip of the data to be printed, code designations representing the required functional operations of the typewriter, such as space, back space, carriage return, tabulating, etc., are also recorded. Normally, the reader operates at its designed maximum speed in successive cycles and during each such cycle the record strip is spaced to bring a recording field in the strip into sensing position, a code designation occupying such field is sensed, and, in response to the latter, the key lever of the typewriter corresponding to the character or functional operation represented by the sensed code designation, is actuated to effect the printing of such character or to effect such functional operation.

In said copending application, provision is made for stopping the operation of the reader when a code designation is sensed that represents a typewriter functional operation requiring a longer time to be effected than is normally required to effect a simple typing operation, and provision is made for resuming the reading operation at maximum speed when such functional operation is completed. The reader includes an operating shaft, usually referred to as the reader shaft, and which is connectable by a suitable clutch to a suitable power shaft, the latter operating continuously at a designed maximum speed, and when it is desired to stop the reader operation momentarily, as in the case just mentioned,

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the clutch is operated to disconnect the reader shaft from the power shaft. For conventional letter writing operations, the apparatus just described operates effectively to transcribe recorded data on a copy sheet at a high rate of speed. Apparatus of this type, however, is sometimes used to control, or in coordination with, additional apparatus wherein functions are performed during each cycle which are in addition to those performed during a simple letter writing operation, and these additional functions require a longer time for their completion than is normally provided between successive reading cycles when character data is typed. One example of an application of the latter type is where the apparatus, in addition to transcribing on a copy sheet the data which is recorded as code designations on a first tape, controls at the same time the operation of a recording apparatus to reproduce the data recorded in the first tape, on a second record tape and in the same or in a different code. Other applications requiring a longer time between successive reading and printing cycles than is necessary for a simple letter writing application, will be apparent to those skilled in this art.

It is a more specific object of the present invention to provide an improved form of record-controlled printing apparatus which may be operated at the maximum designed speed for normal printing operations and which, at the will of the operator, may be readily adjusted in a simple and effective manner to operate at a predetermined slower time rate.

A still further object is to provide an improved cyclically operable record-controlled printing apparatus which includes, as a part thereof, a time controlled means for timing the successive operations of such apparatus.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a plan view showing generally the units composing one preferred embodiment of the present invention;

Fig. 2 is an enlarged fragmentary plan sectional view showing in detail the mechanical working parts of the reader, which form a component part of the preferred embodiment shown in Fig. 1; certain of the parts being broken away

to illustrate the details of construction more completely;

Fig. 3 is a fragmentary vertical sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary vertical sectional view taken on the line 4—4 of Fig. 2, and illustrating the tape feeding mechanism;

Fig. 5 is a fragmentary vertical section through the reader, the section being taken at right angles to Figs. 3 and 4 and being indicated by the line 5—5 on Fig. 2;

Fig. 6 is a fragmentary vertical sectional view taken on the line 6—6 of Fig. 2, and illustrating the clutch mechanism and its controlling magnet which function to connect the reader operating shaft with a source of power;

Fig. 7 is a fragmentary vertical section taken on the line 7—7 of Fig. 3 and showing the code sensing pins of the reader and the manner in which each pin controls its related sensing contacts;

Fig. 8 is a vertical front elevation showing a unitary timing mechanism which is mounted within the reader housing;

Fig. 9 is a vertical side elevation of the construction shown in Fig. 8;

Figs. 10 and 11 are detail views showing, respectively, in elevation, two different timing cams which may be used alternatively in the mechanism shown in Figs. 8 and 9;

Figs. 12*a* and 12*b* are two parts of an electrical wiring diagram illustrating diagrammatically the various control instrumentalities of the apparatus and the circuit wires connecting them; and

Fig. 13 is a view showing a portion of a record tape bearing all of the code hole designations of a preselected combinational hole code system.

Before considering in detail the construction and operation of the illustrated embodiment of the invention, it will be helpful to consider first one practical example of a preselected combinational code by means of which the intelligence, such for example, as a letter which it is desired to transcribe, can be recorded on a record strip or tape. In Fig. 13, a portion of a record tape 10 is shown, and punched in the tape are all of the code hole designations of a combinational six-hole code. The six code positions are indicated at both ends of the tape 10 by the reference numerals 1 to 6, inclusive, and each code designation is arranged in a vertical column or recording field, and opposite each field bearing a code designation and at the lower edge of the tape, is placed the particular character or typewriter function corresponding to the code designation in that field. The smaller holes 11 at the center of the tape 10 and within each of the several recording fields are for the purpose of feeding the tape lengthwise during the reading or sensing operation. The code hole designations and the feed holes 11 may be punched in the tape by any suitable form of code perforator (not shown herein).

As shown in plan in Fig. 1, the record controlled printing apparatus forming the illustrative embodiment of the present invention comprises generally a tape reader 100 enclosed within a suitable housing 12, and a power operated typewriter 200. As will appear more fully hereinafter, the apparatus also includes certain mechanisms, devices, circuits, and other control instrumentalities which provide for the automatic operation of the typewriter under the control of the code designations in the record tape 10 sensed by the reader. The housing 12 is shown in Fig. 1 as broken away so as to disclose in plan a unitary timing mechanism 300 which, as will later appear, forms an important part of the present invention. The timing mechanism 300 is shown in detail in Figs. 8, 9, 10, and 11 and diagrammatically in Fig. 12*a* and will be described fully hereinafter. The other control devices, instrumentalities, etc., and their connecting circuit wires are also shown diagrammatically in Figs. 12*a* and 12*b*. As will appear more fully hereinafter, these control instrumentalities are suitably mounted within the reader housing 12 and on and under the typewriter 200. The circuit wires connecting the control instrumentalities mounted in the reader 100 with those mounted on the typewriter 200 are suitably enclosed within a cable RT shown in Fig. 1.

As viewed in Fig. 1 the reader is provided across its lower side with a platform or tape table 13 across which the record tape 10 bearing the recorded intelligence is fed step-by-step during the operation of the apparatus. A tape supply spool 15 is suitably mounted at the right-hand side of the table 13 and serves to support the record tape 10 to be read and transcribed. A second or tape storage spool 16 is provided at the left of the table 13; and, as will later appear, is rotated by a flexible belt 17 during operation of the apparatus, for the purpose of winding the tape 10 thereon after it leaves the sensing station of the reader. The sensing station is indicated at 20 and, as will appear more fully hereinafter, the recording fields of the tape are successively sensed during successive operating cycles, by sensing elements located at the station 20. A removable gate 21 is provided at the sensing station for properly positioning and holding the tape with respect to the sensing elements. The tape 10 is guided in its movement toward the sensing station by a suitable guide member 22 fixed to the top of the tape table 13.

At the right-hand side of the reader 100 as viewed in Fig. 1, are provided three electrical switches indicated, respectively, at 24, 25, and 26. As will appear more fully hereinafter, the switch 24 is the power switch and when closed, connects a convenient source of alternating current with a motor for driving the reader unit and with a motor for operating the typewriter. The reader motor is indicated by the character RM in Figs. 2 and 12*a*, and the typewriter motor by TM in Fig. 12*b*. The switch 25 is the start switch and when closed, starts the sensing and feeding of the tape and the automatically controlled operation of the typewriter key members. The switch 26 is the stop switch and when closed instantly stops the feeding and sensing of the tape and the controlled operation of the typewriter.

The typewriter 200 which is shown in plan in Fig. 1 will be recognized as being a well known commercial form of power-driven typewriter. The typewriter 200 comprises a standard keyboard indicated generally by the reference character 210 and including the required complement of character keys 211 which operate corresponding type bars 212 and functional keys which include the shift key 213, shift lock key 214, shift release key 215, carriage return key 216, back space key 217, and tabulating key 218. The space bar is indicated at 223. The typewriter 200 also includes a rotatable platen 219 mounted on a carriage 220 which supports, in the usual manner, a copy sheet, indicated at 221, on which the data recorded in the tape 10 is automatically typed.

It is noted at this point that a complete showing of the details of construction of the typewriter **200** and a detailed description of the operation of the typewriter have not been included herein as they are not considered as being essential to a complete understanding of the present invention. The typewriter **200** is fully shown and described in a number of U. S. Letters Patent, and it is also disclosed in the said copending application of Henry L. Tholstrup and reference may be had thereto for a complete understanding of the details of construction.

The typewriter **200** may be operated manually in the usual manner by depressing the character and functional keys. Each key is mounted upon a corresponding key lever **228** which is moved downward when its key is depressed to effect the typing of the corresponding character, or to effect the corresponding functional operation of the typewriter, if the key be a functional key. As is well known, in the particular form of typewriter shown, the power for effecting the typing and functional operations is supplied by a power roller (not shown) which is continuously operated by the typewriter motor TM. The motor TM is not shown structurally herein as it is of a well known construction; but, as stated above, it appears diagrammatically in Fig. 12*b*. Those skilled in this art will readily understand that the depressing of each typewriter key effects a driving connection between the power roller and mechanism for effecting the operation of the corresponding character type bar, or for effecting the corresponding functional operation of the typewriter if a functional key is depressed.

In order that the typewriter may be operated automatically under the control of the code designations in the record tape being sensed by the reader, a key actuating solenoid **230** (see Fig. 12*b*) is operatively connected to each of the typewriter key levers **228**. When each solenoid becomes energized in a manner which will be described more fully hereinafter, such solenoid will pull down its corresponding key lever **228** to effect the corresponding operation of the typewriter in the same manner as when the key is manually depressed. The solenoids **230** have not been shown in Fig. 1 because to do so would only confuse the showing of other structure therein. The solenoids **230** are indicated diagrammatically in Fig. 12*b*, and adjacent each solenoid **230** is a legend indicating the character or functional operation controlled by such solenoid. The solenoids are arranged in the same order as their corresponding keys on the keyboard **210** in Fig. 1.

At the lower and left-hand side of the typewriter **200** as viewed in Fig. 1, is provided a power switch **224** which, when closed, like the power switch **24**, connects a source of alternating current with both the typewriter and reader motors. At the lower and right-hand side of the typewriter is mounted a start switch **225** and a stop switch **226** which function, respectively, the same as the switches **25** and **26** on the reader **100**. Thus, the operation of the apparatus may be controlled from either the typewriter or from the reader. An insert switch **227** is also provided on the typewriter which, when open, prevents starting of the tape feeding and sensing mechanisms in the reader **100** and thereby eliminates control by the latter of the typewriter, so that the typewriter keyboard **210** can be operated manually without interference from the reader. The insert switch **227** will normally be closed, and will be opened when it is desired to type manually an insert in

the data being transcribed; for example, when it is desired to type manually the name and address of the person to whom the transcribed copy is to be sent or any other data which will be of interest only to the recipient of the copy.

The detail construction of the reader **100** is shown in Figs. 2 to 7, inclusive. The reader comprises the reader motor RM which is suitably mounted within the housing **12** and which operates continuously as long as either the power switch **24** or power switch **224** is closed. The motor RM is at all times operatively connected by a suitable flexible drive belt **30** with a power shaft **31**, the latter being mounted for rotation within suitable bearings **32** mounted within a frame **33** which is bolted to the base **34** of the reader.

The reader **100** also comprises an operating shaft **35** which is aligned with the power shaft **31** and is supported for rotation within suitable bearings **36** carried by the reader frame **33**. The shaft **35** is the "reader" shaft which was mentioned hereinabove before the brief description of the several views. A clutch **37**, under the control of a clutch magnet CM, is operable to connect and disconnect the reader shaft **35** and the power shaft **31**. The reader shaft **35** effects the operation of the tape feeding and sensing means. A cycle of operation of the apparatus is effected during each revolution of the shaft **35**; viz., the tape **10** is fed or spaced a distance sufficient to bring the next recording field of the tape into sensing position, such next field is sensed to determine the code designations therein, if any, and the typewriter is operated in response to the sensing of the code designation. As long as the shafts **31** and **35** are clutched together the cycles of operation are repeated and the typewriter continues to transcribe the data recorded in the tape being read.

In so far as the present invention is concerned, any suitable form of clutch may be used to connect the reader shaft **35** to the continuously operated power shaft **31**. The clutch **37** which is shown, is well known to those skilled in this art, it being substantially the same as that disclosed in the U. S. Patent No. 2,206,646, granted July 2, 1940. If desired, reference may be had to this patent for a complete showing of the structural details thereof. For the purposes of the present disclosure, it is believed sufficient to say that the clutch comprises a driving element in the form of a toothed wheel **40** fixed to the end of the power shaft **31**, and a driven element in the form of a barrel **41** fixed to the reader shaft **35** and carrying a radially slidable clutch pawl **42**. The barrel **41** is formed with a diametrically disposed slot **43** within which the pawl **42** is slidably mounted. To the outer end of the pawl **42** is fixed a tooth element **44** which, when the pawl **42** is moved radially inward, engages the toothed wheel **40** to provide the driving connection between the shafts **31** and **35**. The pawl **42** is biased in a clutch engaging direction by a suitable spring mounted within the clutch barrel **41**. A clutch releasing lever **45** also extends diametrically across the clutch barrel and at right angles to the slot **43** and is mounted for limited angular movement therein. The lever is provided with an outer extension **46** which, when intercepted and engaged by the outer end of one arm **47** of a rocking lever **48**, is moved to move the clutch pawl **42** radially outward against the force of the aforementioned spring in the barrel **41** to disengage the clutch.

The clutch parts are shown in Figs. 2 and 6 in their declutched position which is the home or

starting position of the reader. The rocking lever 48 is mounted on a stud 50 carried by a part of the frame 33 and includes a second arm 51 which carries at its outer end the armature 52 of the clutch magnet CM. When the clutch magnet CM is energized, the lever 48 is rocked counterclockwise, as viewed in Fig. 6, which moves the outer end of the arm 47 upward and thereby releases the outer extension 46 of the releasing lever 45, and the clutch spring within the clutch barrel 41 then moves the pawl 42 radially inward to engage the toothed wheel 40 in the manner explained above. When the clutch magnet CM is deenergized, a tension spring 53 rocks the lever 48 clockwise and moves the outer end of the arm 47 into the path of the outer extension 46 of the lever so that the latter is engaged and moved to move the pawl outward to disengage the clutch.

In order to prevent rebound of the parts when the clutch is disengaged and in order to hold the operating shaft 35 in the home position, the clutch barrel 41 is also provided with an annular extension or collar 54 having a notch 55 formed therein which, when the clutch is disengaged, receives the outer end of an arm 56 of a detent lever 57. The detent lever 57 is also pivoted on the stud 50 and includes another arm 58 which is connected to the armature 52 by means of the tension spring 53 previously mentioned. Thus, the spring 53 serves the dual purpose of urging the arm 56 into engagement with the periphery of the collar 54 so that it will fit within the notch 55 in home position, and to urge the arm 47 into position to intercept the extension 46 of the pawl releasing lever 45 and thereby declutch the parts.

As stated above, during the first part of each revolution of the operating shaft 35, the tape is fed or spaced lengthwise to bring a new recording field into sensing position. The tape feeding mechanism is shown more clearly in Figs. 2 and 4, and comprises a cam 60 mounted on the reader shaft 35 and cooperating with a rocking lever 61 pivoted on a fixed stud 62 carried by the frame 33 and comprising a pair of arms 63 and 64. The cam 60 and lever 61 are shown in Fig. 4 in the starting or home position and are so constructed that when the cam 60 begins to rotate in a counterclockwise direction, it first engages the arm 63 to rock the lever 61 counterclockwise and then engages the other arm 64 to rock the lever 61 clockwise and return the same to the position shown. A link 66 is pivoted at its lower end to the outer end of arm 64 and extends upwardly therefrom and is pivoted at its upper end by a stud 67 with a second link 68. The link 68 is also pivoted to a shaft 70 and serves to hold the link 66 in its upright position shown.

Also pivotally connected on the stud 67 is a feed pawl 71 which is held in operative engagement with a ratchet wheel 72 fixed to the shaft 70, by means of a tension spring 73 connecting outer extending arms of the pawl 71 and the link 68. A detent 74 is pivotally supported by a fixed stud 75 and is held in engagement with the teeth of the ratchet wheel 72 by means of a tension spring 76 and thereby serves to prevent reverse movement of the ratchet wheel 72 and shaft 70. From the above, it is apparent that when the clutch 37 is engaged to rotate the reader shaft 35 and when the lever 61 is first rocked counterclockwise by the cam 60, the pawl 71 will be moved downwardly thereby and will rotate the ratchet 72 and shaft 70 counterclockwise; and, when the cam 60 rocks the lever 61 clockwise, the pawl 71 will be moved upward to engage the next tooth of the ratchet 72.

The shaft 70 is the tape feed shaft and is provided with a feed wheel 77 having radially extending pins 78 which are adapted to engage the feed holes 11 in the tape 10. Thus, when the feed shaft is partially rotated in the manner just described, the tape is fed to the left as viewed in Figs. 2 and 3, a distance equal to the width of a recording field. The belt 17 which rotates the spool 16 shown in Fig. 1, is driven from a pulley 79 fixed to the tape feed shaft 70.

The mechanism for successively sensing the recording fields of the tape comprises six sensing pins indicated, respectively, by the characters S1 to S6, inclusive. There is one pin for each of the code hole positions and the pins are arranged in a single plane extending at righ angles to the direction of movement of the tape, and so that when the tape comes to rest at the end of a feeding operation, the upper end of each pin will be directly beneath its corresponding code hole position in the field of the tape then in position to be sensed. The pins are guided for vertical movement within aligned openings in spaced guide blocks 80 and 81, respectively, which are suitably fixed to the frame 33. Aligned pairs of guide openings are also provided in the table 13 and in the gate 21 and they are aligned with corresponding openings in the guide blocks so that during a sensing operation each pin can be moved upward and through the tape when there is a hole in the code position in the tape corresponding to such pin.

The six sensing pins are supported and operatively connected, respectively, at their lower ends to six pairs of spring blade contacts indicated, respectively, by the characters C1 to C6, inclusive. Each pair of the contacts comprises an upper fixed blade 82 and a lower movable spring blade 83 which extends outwardly beyond the end of its related fixed blade and is connected at its outer end to the lower end of its related sensing pin. The construction is such that the spring blades 83 constantly urge their respective contacts upward into closed position and their related sensing pins upward as viewed in Figs. 3 and 7. Between sensing operations, the six sensing pins are held in home position, the position shown in Fig. 3, by the outer lateral edge 84 of a vane 85, which edge extends across all of the pins and within transversely aligned notches 86 provided, respectively, in the sides of the pins. The vane 85 is, in effect, a rocker arm pivotally supported on a rod 87 carried by the frame 33 and constantly urged to move in a clockwise direction, as viewed in Fig. 3, by a tension spring 88. The vane 85 is provided at its center with a depending arm 89 which carries at its lower end a roller 90 held by the spring 88 in contact with the face of a cam 91 mounted on the reader shaft 35. When the roller 90 is in engagement with the high point of the cam 91, the vane 85 is held in the position shown in Fig. 3 where the several sensing pins are held in their respective lower positions and the pairs of contacts controlled thereby are held open.

After the tape has been spaced by the feeding mechanism in the manner previously described and has come to rest with the new recordling field above the sensing pins, the cam 91 will have rotated counterclockwise from the position shown in Fig. 3, 94° of a revolution. When the shaft 35 has rotated 114°, the roller 90 will begin to move inwardly from the high point of the cam

91, and the vane 85 will move in a clockwise direction due to the force of the spring 88. The sensing pins S1 to S8, inclusive, will also follow the end 84 of the vane 85 upward due to the spring force in their respective movable blades 83. If there be a hole in the code position of the tape immediately above a sensing pin, its movable spring blade 83 will continue to move the pin upward and through such code hole and to a point where the pair of contacts controlled thereby will close. If there be no code hole in the position above a sensing pin, the upper end of such pin will strike the tape and will be held thereby against further upward movement, and in the latter position its related pair of contacts are held open.

By way of example, Fig. 7 shows the relative position of the parts during the sensing of a record field bearing the code designation for the letter "Y." Sensing pins S1, S3, and S5 have passed through code holes in the corresponding code positions in the tape, which as shown in Fig. 20 is the code designation for "Y," and their related contacts C1, C3, and C5 are closed. The sensing pins S6, S2, and S4 have been stopped in their upward movement by the tape and their related contacts C6, C2, and C4 are thereby held open.

From the foregoing, it is apparent that during a sensing operation the contacts C1 to C6, inclusive, are closed by their related sensing pins singly or in combination, depending upon the code hole designation in the record field of the tape being sensed. The sensing operation is terminated by the high point of the cam 91 engaging the roller 90 on the arm 89 and moving the vane 85 counterclockwise, as viewed in Fig. 3, so that the end 84 thereof engages again the lower ends of the notches 86 in the several sensing pins S1 to S6 inclusive, and thereby moves the latter downward to the position shown in Fig. 3, where the related contacts are held in open position. The sensing operation is completed and the vane 85 is restored to home position at approximately 346° of each revolution.

In order to provide for automatically stopping the reading and sensing operation when there is no tape at the sensing station, a seventh pin 94 is mounted for vertical sliding movement within aligned openings in the spaced guide blocks 80 and 81 and in the table 13 and gate 21 and is positioned so that it will engage the central portions of the tape. The lower end of the pin 94 is supported and operatively connected to the movable spring blade 95 carrying one of a pair of contacts 96. The blade 95 is normally urged upward by the spring force inherent therein, to open the contacts 96 and move the pin 94 upward. If there is tape at the sensing station, the upper end of the pin 94 engages the underside of the tape and the contacts 96 are held closed. This is the position of the parts shown in Fig. 7. When the tape runs out, the pin 94 moves upward and opens the contacts 96 which, as will later appear, opens the energizing circuit for the clutch magnet CM and thereby stops the feeding and sensing operation of the reader. In Fig. 3, no tape is at the sensing station and the pin 94 is shown in the upper position where the contacts 96 are open. The pin 94 is made sufficiently large in diameter so that the feed holes 11 in the tape will not affect its operation.

The sensing contacts C1 to C6, inclusive, control, respectively, the flow of direct current to six translator relays M1 to M6, inclusive, of a relay type of translator mechanism which is diagrammatically shown in Fig. 12*a*, and which will be described more fully hereinafter, in connection with the description of the complete wiring diagram shown in both Figs. 12*a* and 12*b*. At this point it is sufficient to say that by energizing translator relays M1 to M6, inclusive, singly and in combination, due to the selective closing of their related contacts C1 to C6, inclusive, during the reading operation described above, a number of controlling circuit paths through the translator are selectively conditioned. With one exception, each of these circuit paths, when closed, energizes a corresponding solenoid 230 and thereby actuates its related key lever 228 of the typewriter to effect the printing of its corresponding character, or to effect the corresponding functional operation of the typerwriter if the key lever actuated is a functional key lever. The circuit path just noted as being the exception, is conditioned by the sensing of a predetermined stop code designation and functions, when closed, to stop the sensing and tape feeding operation of the reader in a manner which will also be presently described.

A cam 102 is also fixed to the reader shaft 35 and controls through a pivoted follower 103 the operation of a pair of spring blade contacts 104. As will appear more fully hereinafter the contacts 104 control the flow of current from a source of D. C. current and through the contacts C1 to C6 inclusive, in parallel, to their related translator magnets M1 to M6, inclusive. The contacts 104 can be termed the D. C. common contacts and are normally held open by their movable spring blade. The cam 102 is so shaped and positioned on the operating shaft 35 that the contacts 104 are closed at 142° of a revolution which is after the time for closing the sensing contacts C1 to C6, inclusive, and are opened at 311° which is before the sensing contacts are opened by the vane 85. The purpose of the D. C. common contacts is to provide for simultaneously energizing and deenergizing the translator relays M1 to M6, inclusive.

A cam 106 is also fixed to the reader shaft 35 and controls through a pivoted follower 107 the operation of a pair of normally open spring blade contacts 108 which are herein termed the A. C. common contacts. As will appear more fully hereinafter, the current which flows through the controlling circuit paths of the translator previously mentioned as being conditioned by the selective energization of the translator relays M1 to M6, inclusive, is A. C. current, and the cam 106 is so shaped that it connects the source of A. C. current with these circuit paths at a predetermined point in each cycle of operation. In the structure shown, the cam 106 effects the closing of the A. C. common contacts 108 at approximately 170° of each revolution and opens the contacts at 294°.

Referring now to the wiring diagram shown in Figs. 12*a* and 12*b*, it is noted that all of the control instrumentalities and circuit wires located within the reader 100 are shown diagrammatically in Fig. 12*a*, and this includes the relay translator mechanism previously referred to herein and also the unitary timing mechanism 300; and all of the control instrumentalities and circuit wires mounted on the typewriter are shown in Fig. 12*b*. For the purposes of simplicity, the circuit wires of the reader which are connected, respectively, by the individual wires within the cable RT (Fig. 1) with corresponding circuit wires in

the typewriter are shown as terminating at the right-hand margin of Fig. 12*a* in plug socket connections, designated, respectively as R1 to R56, inclusive. The corresponding circuit wires in the typewriter terminate at the left-hand margin of Fig. 12*b* in plug socket connections T1 to T56, inclusive. It is to be assumed that the plug sockets R1 to R56 are connected, respectively, to the plug sockets T1 to T56, inclusive, by the individual cable wires.

As stated above, the relay translator mechanism comprises the series of relays M1 to M6, inclusive, which, during each cycle of operation of the reader, are energized singly or in combination, as a result of the sensing of code hole designations in the record tape. The relay translator shown is a well known mechanism which, in response to the selective energization of its relay magnets in the manner just stated, sets up a number of controlling circuit paths corresponding, respectively, to the code designations sensed. The relays M1 to M6, inclusive, control, respectively, the operation of one or more related transfer contacts which during each sensing cycle will be transferred, or left at normal position, so that the contacts may be connected in combinational series to condition the just mentioned controlling circuit paths. As shown, the armature of relay M1 operates a pair of contacts M1—1; the armature of relay M2 operates two pairs of contacts M2—1 and M2—2; the armature of relay M3 operates four pairs of contacts M3—1 to M3—4, inclusive; the armature of relay M4 operates eight contacts M4—1 to M4—8, inclusive; the armature of relay M5 operates sixteen contacts M5—1 to M5—16, inclusive; and the armature of relay M6 operates thirty-two contacts M6—1 to M6—32, inclusive. In Fig. 12*a*, these various relay controlled transfer contacts are shown in their upper or normal position, which is the position they occupy when their related operating relays are deenergized. When any translator relay is energized, all of its related contacts transfer to the lower position.

In Fig. 12*b* the plug socket connections T1 to T48, inclusive, are shown as connected, respectively, by individual circuit wires with the solenoids 230 which operate the character and functional key levers of the typewriter previously described. As stated previously, a legend appears adjacent each solenoid indicating the typewriter character or function corresponding thereto.

In Figs. 12*a* and 12*b*, all switches, solenoids, relays, contacts and associated parts are shown in the positions they normally occupy with no tape under the sensing gate 21 (Fig. 1) and with both power switches 24 and 224 in open position. It is also noted that a switch 324 and a switch 325 are shown in Fig. 12*a* as being in open position. As will presently appear these switches 324 and 325 are provided for the purpose of selectively including and eliminating control of the reader operation by the unitary timing mechanism 300. A source of alternating current is indicated in Fig. 12*a* by the lead wires 400 and 401.

As stated previously, both the reader motor RM and the typewriter motor TM are operated when either the power 24 or the power switch 224 is in closed position. One side of the motor RM is permanently connected to the lead 400, and also one side of the motor TM is permanently connected to the lead 400 by a wire 402, plug socket connections R56 and T56, wire 403, and wire 404. Upon closing of switch 24, the other side of the motor RM is connected thereby to the other AC supply lead 401 by a wire 405, and the other side of the motor TM is connected to the supply lead 401 by a wire 406, plug socket connections T50 and R50 and wire 407. The closure of the switch 24 also energizes a rectifier transformer 408, one side of the primary being permanently connected to the supply lead 400, and the other side being connected to the wire 405, and through the latter and switch 24 with the other supply wire 401.

With one side of the motors RM and TM and transformer 408 being permanently connected to the lead 400 in the manner just explained, the closing of switch 224 also energizes the motors RM and TM and the transformer 408 as follows: from wire 401, wire 409, plug socket connections R55 and T55, wire 410, the switch 224, a wire 411, wire 412, and wire 406, to the other side of the motor TM; and through wire 406, plug socket connections T50 and R50, the wires 407 and 405, to the other side of the motor RM and the other side of the primary of transformer 408.

With the transformer 408 energized in the manner just explained, alternating current is supplied to the input terminals of the rectifier 415. The positive and negative D. C. output terminals of rectifier 415 are connected, respectively, to the plus bus 416 and to the minus bus 417. The opposite sides of the coil of a reader relay 418 are permanently connected with the plus bus 416 and the minus bus 417, so that as long as the rectifier is supplied with alternating current, the relay 418 remains energized. When the relay 418 is thus energized, the armature 419 thereof connects the minus bus 417 to each of wires 421, 422, 423, 424, 425, and 426, which are respectively connected to the return sides of the six translator relays M1 to M6, inclusive.

The operation of the apparatus will first be described with the control by the unitary timing mechanism 300 selectively eliminated. In order to operate the apparatus without control by the mechanism 300, the switch 324 is closed and the switch 325 is open. It will be assumed first that the switches 324 and 325 are in these positions.

With a record tape properly positioned under the gate 21 in the reader 100, the contacts 96 are closed by the pin 94 and the apparatus is ready for successively reading and transcribing the code designations in the tape onto the record sheet 221 in the typewriter. The tape sensing and feeding operation is started by depressing either the reader start switch 25 or the typewriter start switch 225. The reader start switch 25 is provided with two pairs of spring blade contacts 427 and 428, respectively, the contacts 427 being normally open and being closed upon depressing the start switch 25, and the contacts 428 being normally closed, and being opened when the start switch 25 is depressed. The movable one of the normally open contacts 427 is connected by a wire 430, with the plus bus 416. Thus, when contacts 427 are closed by depressing switch 25, direct current will then flow from the plus bus 416 through the wire 430, contacts 427, a wire 431, plug socket connections R53 and T53, a wire 432, the normally closed insert switch 227, a wire 433, plug socket connections T51 and R51, a wire 434, normally closed pick-up contacts 435 of a master control relay 436, a wire 437 to one side of a main coil 438 of such relay 436; and, from the coil 438, through wire 439, a wire 440, the now closed contacts 96, and a wire 441 to the minus bus 417. When the master control 436 relay is thus energized, the armature thereof moves to

the right and thereby opens the pick-up contacts 435 and closes a pair of holding contacts 443, the latter being connected directly to the plus bus 417 by a wire 444. The contacts 435 and 443 are of the overlapping type, that is, the holding contacts 443 make before the pick-up contacts 435 break. With the holding contacts 443 closed, direct current will flow through the holding circuit for the main coil 438 which is traced as follows: from the plus bus 416, through the wire 444, contacts 443, wire 437, to the coil 438; and, from the latter, through wire 439, wire 440, contacts 96, and wire 441, to the minus bus 417.

Contacts 445 also close when master control relay 436 is energized and they thereby condition an energizing circuit for the clutch magnet CM. This conditioned clutch magnet control circuit is established when the start switch contacts 428 are again closed when the operator releases the start switch 25. The clutch magnet circuit is traced as follows: from the D. C. positive bus 416 through the plug socket connections R54 and T54, a wire 446, normally closed contacts 250 which are under the control of elements of the typewriter, a wire 447, normally closed contacts 251 which are also under the control of elements of the typewriter and will be explained hereinafter, a wire 448, normally closed contacts 449 of the typewriter start switch 225, wire 450, plug socket connections T52 and R52, wire 451, the now closed contacts 445 of the master control relay 436, a wire 453, the now closed contacts 428 of the start switch 25, wire 454, the clutch magnet CM, and from the latter through a wire 455, the control switch 324 now closed so as to eliminate control by the timing mechanism 300, a wire 456, the wire 440, the now closed contacts 96, and wire 441 to the minus bus 417. The clutch magnet circuit just traced directly controls the operation of the reader in the manner previously explained; i. e. when the clutch magnet CM is energized by the closing of this circuit, the operating shaft 35 of the reader is connected by the clutch 37 to the power shaft 31 and the successive cyclic tape feeding and sensing operations will begin and will continue at a rate determined by the designed speed of the power shaft until the clutch magnet is deenergized by the opening of any of the now closed contacts in its control circuit.

The typewriter start switch 225 is connected in parallel with the start switch 25, so that the operation of the apparatus may be started by depressing and releasing the switch 225 in the same manner as just described in connection with the switch 25. As shown, the switch 225 is provided with two pairs of spring blade contacts which are the normally closed contacts 449 mentioned above, and a normally open pair of contacts 458. One contact of the pair of contacts 458 is permanently connected to the D. C. plus bus 416 through the wire 446 and plug socket connections T54 and R54. The other contact of the pair of contacts 458 is connected by a wire 459 and a wire 460 with the normally closed insert switch 227 which, as explained previously in connection with switch 25, is connected to the D. C. minus bus 417 through the wire 433, plug socket connections T51 and R51, wire 434, pick-up contacts 435 of the master control relay 436, wire 437, coil 438, wire 439, wire 440, contacts 96, and wire 441. Thus, with the apparatus at rest, by depressing the switch 225 to close its contacts 458, and open the contacts 449, a flow path for direct current is established through the pick-up contacts 435 and coil 438 of the master control relay 436, and the latter, when energized, will close its holding contacts 443 and remain energized by the holding circuit established thereby which was previously traced. As explained above, the contacts 445 are closed by the energizing of relay 436 and the clutch magnet circuit is conditioned thereby. When the start switch 225 is released, its contacts 449 close and the conditioned energizing circuit for the clutch magnet CM is thereby established.

As described previously herein, when the reader shaft 35 commences to rotate, due to the energizing of the clutch magnet CM and the resulting engagement of clutch 37, the tape 10 is first spaced to move a record field into sensing position which is directly above the sensing pins S1 to S6, inclusive, and the field is sensed by the pins to determine the code hole designation therein. As an example let it be assumed that the record field being sensed bears the code hole designation for the letter character "Y," which, as shown in Fig. 13, comprises code holes in positions 1, 3, and 5. As shown in Fig. 7, and as previously explained, the sensing of the code hole designation for the letter "Y" will result in the sensing pins S1, S3, and S5 moving upward through the code holes in the tape to close contacts C1, C3, and C5, respectively. The contacts C1, C3, and C5 will close at approximately 130° of the revolution of shaft 35 and will remain closed until 325°, and the D. C. common contacts 104 are closed by the cam 102 at 142° and are opened at 311°. With the contacts C1, C3, and C5 closed, and with the D. C. common contacts 104 closed, direct current will flow from the D. C. positive bus 416 through contacts 104, the contacts C1, C3, and C5 in parallel, and through wires 461, 463, and 465 to translator relay magnets M1, M3, and M5, respectively, and from the latter through wires 421, 423, and 425, respectively, to the D. C. minus bus 417. With the relay magnets M1, M3, and M5 thus energized, their related contacts are transferred to their respective lower positions. As the relays M2, M4, and M6 remain deenergized, their related transfer contacts will remain in their normal upper positions.

With the transfer contacts of the translator in the position just stated, and when the cam 106 on the reader shaft 35 closes the A. C. common contacts 108 at 170° of the revolution of shaft 35, alternating current will flow through the circuit path established by the translator contacts to the solenoid 230 controlling the key lever 226 for the letter "Y" on the typewriter, and, thereby, effect the operation of the related type bar in the manner previously explained. The established circuit path is traceable as follows: from the A. C. supply lead 400, contacts 108 now closed, a wire 467, contacts M1—1 in the lower position, a wire 468, contacts M2—2 in the position shown, a wire 469, contacts M3—3 in the lower position, a wire 470, contacts M4—6 in the position shown, a wire 471, contacts M5—11 in the lower position, a wire 472, contacts M6—22 in the position shown, a wire 473, the plug socket connections R33 and T33, a wire 474, solenoid 230 for actuating the key lever corresponding to the letter character "Y," a wire 475, and if the power switch 24 is closed, through the wires 412 and 406, plug socket connections T50 and R50, the wire 407, switch 24 to the A. C. supply wire 401. If instead, the switch 224 is closed, the circuit will include the

wire 411, switch 224, wire 410, plug sockets T55 and R55, and wire 409.

From the foregoing it will be understood that if the clutch magnet CM remains energized, and the contacts 96 are closed by the tape 10 at the reading station 20, the cycles of operation of the apparatus will be repeated at the designed speed of the shaft 31. During each such cycle of operation, the tape will first be spaced to bring the new record field into sensing position, and such record field will then be sensed to determine the code designation therein in the manner previously described. If the field sensed bears a character code designation, a space code designation, a shift code designation or a shift release code designation, the translator relays will be operated to provide an A. C. controlling circuit path through the related solenoids to actuate the related key lever in the same manner as just explained in connection with the sensing of the code designation for the letter character "Y."

As is disclosed fully in the aforementioned copending application of Tholstrup, when the code designation is sensed which represents a functional operation of the typewriter requiring a longer-than-normal time for its completion, provision is made for stopping the cyclic sensing operation of the reader when such functional operations are being effected by the typewriter and for resuming the sensing operations upon a completion of such functional operation. Examples of such functional operations requiring a longer-than-normal time for their completion are carriage - return, tabulating, and back-space. From an examination of Fig. 12*b*, it will be noted that each of the key lever actuating solenoids 230 for effecting these three last-mentioned functional operations is connected to a circuit wire 477, and that the latter is in turn connected through a wire 478, plug socket connections T49 and R49 and the wire 479 with one input terminal of a rectifier 480. The other input terminal of the rectifier 480 is connected by a wire 481, the wire 407 and switch 24 with the A. C. supply wire 401. If the switch 224 is closed instead of switch 24 such other input terminal of rectifier 480 is connected to supply wire 401 through plug sockets R50 and T50, wire 406, wire 412, wire 411, switch 224, wire 410, plug sockets T55 and R55, and wire 409.

Thus, when the code designation corresponding to either the carriage return, tabulating or back space operation is sensed, and the translator is adjusted thereby to condition a controlling circuit through the solenoid 230 corresponding to the sensed code designation, the closing of the A. C. common contacts 108 will energize such corresponding solenoid 230 and will connect the input terminals of rectifier 480 across the A. C. supply line. One D. C. output terminal of the rectifier 480 is connected by a wire 482, relay contacts 483 and wire 484 with one side of a bucking coil 485 of relay 436, and the other side of the coil 485 is connected by a wire 486 with the other D. C. output terminal of the rectifier. With the relay 436 energized, the contacts 483 are closed. Consequently, the just described closing of A. C. common contacts 108 will result in the energizing of bucking coil 485. The coils 485 and 436 are oppositely wound, and the coil 485 is of sufficient strength to overcome the coil 438 and cause relay 436 to drop out and thereby open its holding contacts 443. The contacts 483 also drop out and break the circuit through the bucking coil 485. The contacts 445 in the clutch magnet circuit also open to deenergize the clutch magnet CM and thereby stop further sensing operations. The pick-up contacts 435 close, but the main coil 438 cannot be energized again until other normally open contacts in the pick-up circuit are closed.

As explained in said Tholstrup application, the typewriter includes an element which operates when a carriage return operation is begun, to open contacts 250 and close contacts 252, and operates to reclose contacts 250 and open contacts 252 when the carriage return operation is completed. As the contacts 250 are in the clutch magnet circuit, the latter circuit will now be open at two points, viz., the contacts 445 and 250. When the contacts 252 close, they establish a pick-up circuit for the main coil 438 of relay 436 through the now closed pick-up contacts 435. This pick-up circuit is as follows: from the plus bar 416, plug sockets R54 and T54, wire 446, contacts 252, wire 460, insert switch 227, wire 433, sockets T51 and R51, wire 434, pick-up contacts 435, wire 437, main coil 438, wire 439, wire 440, contacts 96, and wire 441 to the minus bus 417. The relay 438 is thereby again picked up and is held by its hold contacts 443 as before and its contacts 445 in the clutch magnet circuit close, but the latter circuit is not closed as typewriter contacts 250 are still open. When the carriage return operation is completed and the contacts 250 again close the clutch magnet CM is energized and the cyclic sensing operations of the reader continue as before.

When the typewriter begins a tabulating operation the contacts 251 in the clutch magnet circuit are opened by an element of the typewriter and contacts 254 are closed. Thus, when the code designation representing a tabulating operation is sensed, the typewriter carriage is tabulated and the master control relay 436 is dropped out by the energizing of the bucking coil 480, and the clutch magnet circuit is opened both by contacts 445 and 251. The closing of contacts 254 connects the wires 446 and 460, the same as contacts 252, and they thereby establish the pick-up circuit which was traced above for master control relay 436. The relay 436 is held energized by its contacts 443, and when the tabulating operation is completed and the contacts 251 again closed, the clutch magnet circuit is again established and cyclic reading operations are resumed.

When a back-space code designation is sensed, the typewriter is caused to back space and the master relay 436 is dropped out due to the energizing of the bucking coil 480, and the clutch magnet circuit opened by contacts 445, as before. However, as a back space operation only requires a relatively short period of time to be completed, the relay 436 is immediately picked up again and held and the clutch magnet circuit restored by its contacts 445. The latter is effected by contacts 255 connecting wires 446 and 460 and which are closed by a typewriter element which moves as a result of a back-space operation.

The operation of the reader 100 may also be manually stopped by depressing either stop switch 26 or 226. One side of switch 26 is connected by a wire 488 with the A. C. supply wire 400 and the other side of switch 26 is connected to the other A. C. supply wire 401 through a wire 489, wire 490, the rectifier 480 and wires 481 and 407. One side of stop switch 226 is connected to the A. C. supply wire 400 through the wires 404, 403, plug sockets T56 and R56, and wire 402, and the other side of switch 226 is connected to the other supply wire 401 through the wires 477 and

478, plug sockets T49 and R49, the wire 479, the rectifier 480 and the wires 481 and 407. Thus, when either switch 26 or switch 226 is depressed the rectifier is connected across the A. C. supply line and the bucking coil is thereby energized to drop out the master control relay 436 and thereby open the clutch magnet circuit and stop the reader. Reading operations can then be resumed only by depressing the start switch 25 or 225 to pick up the master relay again, as previously described.

As explained at the outset, letter writing apparatus, such as described hereinabove, is sometimes used in connection with, or to control, auxiliary apparatus which often requires a longer period of time to complete one operation than is provided during a cycle of operation of the reader shaft when the latter is driven continuously at the designed speed of the power shaft 31. As stated, one example of such an auxiliary apparatus would be a tape punch which operates, when each code designation in tape 10 is sensed by the reader 100 and the typewriter 200 operated as a result thereof, to record in a second tape a code designation which corresponds to the sensed code designation. The code designation recorded in the second tape may be in either the same code or in a different code from the code of the sensed designation. In accordance with the present invention, a record controlled printing apparatus is provided which for simple letter writing operations may operate in the usual manner and at its designed maximum speed and which may be readily adjusted by the operator when desired, to operate at some predetermined reduced speed which is slow enough to permit the controlled synchronous operation of auxiliary apparatus such as a tape punch. This advantageous result is accomplished in the illustrative embodiment by the unitary timing mechanism 300 which may be included or eliminated, at the selection of the operator, as a part of the means for controlling the operation of the reader 100.

The timing mechanism 300 is shown structurally in Figs. 1, 8, 9, 10, and 11, and is shown diagrammatically in Fig. 12*a*. As shown in Figs. 8 and 9 the mechanism 300 is suitably mounted upon a bracket plate 302 which is secured by screws 303 to the base plate 34 of the reader 100, and the mechanism comprises a synchronous motor unit 305, a shaft 306 driven by the motor at a predetermined time rate, a cam 307 fixed by a set screw 308 on to the shaft 306 and having formed in its periphery a predetermined number of switch operating recesses 309, and a switch 310 having an operating arm 311 pivotally supported at one end by a pin 312 carried by a fixed bracket plate 313, and the arm 311 carrying a roller 314 at its other end which roller is spring urged into contact with the periphery of the cam 307. The switch 310 may be of any suitable construction and is operated by the arm 311 engaging a pin 315 and in such a manner that when the roller 314 occupies a depression 309 of the cam 307 the switch 310 is closed and when the roller engages the high cylindrical surface 316 of the cam the switch 310 is held open. While the switch 310 may be of any suitable construction so long as it operates in the manner indicated and while it is diagrammatically represented in Fig. 12*a* as a pair of simple spring blade contacts, the actual switch structure disclosed in Figs. 8 and 9 will be readily recognized by those skilled in this art as being one which is known commercially as a "micro-switch."

As a typical example it is assumed that the motor unit 305 shown, is an A. C. synchronous motor operating at 1800 R. P. M. and that it has a built-in reduction gear unit (not shown) which drives the cam shaft 306 at the reduced speed of 60 R. P. M. or 1 R. P. S. The cam 307 is shown in Fig. 8 as being formed with five equally spaced depressions 309. Thus, for each revolution of the cam 307, the switch 310 is closed five times, or once each one fifth of a second. In Fig. 10 is shown a cam 307*a* having four equally spaced recesses 309*a* and Fig. 11 shows a cam 307*b* having two diametrically arranged recesses 309*b*. When desired, the cam 307 of Figs. 8 and 9 can be readily removed by loosening the set screw 308 and either the cam 307*a* or 307*b* substituted in lieu thereof. With the cam 307*a* on the shaft 306 the switch 310 will be operated four times for each revolution of the shaft 306 which is four times each second, or once each one fourth of a second. With the cam 307*b* on the shaft 306 the switch 310 will be operated twice each second or once each one half of a second.

By way of example, it is also assumed that in the illustrative embodiment, the motor RM and the belt drive connection between the motor RM and the shaft 31 is designed to provide a speed of shaft 31 which is on the order of eight and one third revolutions per second (8⅓ R. P. S.). Thus, when clutch 37 is continually engaged, the reader shaft 35 will rotate at 8⅓ R. P. S. to provide 8⅓ reading cycles per second or one reading cycle each twelve hundredths (.12) of a second.

Referring again to Figs. 8 and 9 it is noted that an outlet 318 is mounted on the bracket plate 302 and serves to connect the A. C. supply wires to the timing motor unit 305. A suitable power switch 325 is also mounted on the plate 302 and controls the flow of A. C. to the motor unit 305. Two pairs of plug sockets 320*a* and 320*b* are also mounted on the plate 302 and serve as a means for connecting the "micro-switch" into the reader control circuits. The timing motor unit 305, switch 310, switch 325, and the two pairs of plug sockets 320*a* and 320*b* are shown diagrammatically in Fig. 12*a*.

The coactive operating relationship between the timing mechanism 300 and the other elements of the illustrative embodiment of record-controlled printing apparatus forming the subject matter of the present invention, will be apparent from an examination of Figs. 12*a* and 12*b*. One socket of the pair of plug sockets 320*a* is shown as connected by a wire 490 with the wire 455 and the other socket of the pair 320*a* is connected by a wire 491 with the wire 456. The A. C. supply wire 400 is shown as connected directly to one side of timing motor unit 305, and the other side of the timing motor is shown as connected to the other A. C. supply wire 401 through the switch 325, the wire 405, and then either through power switch 24 or 224 in the manner previously explained. With this explanation it will be apparent that with the switch 324 open, the contacts of the cam controlled switch 310 will be connected in the energizing circuit for the clutch magnet CM, and with the switch 325 closed the timing motor 305 will operate to open the clutch magnet circuit when the roller 314 engages the high cylindrical portions 316 of the cam 307 and will close the clutch magnet circuit each time the roller 314 enters a depression 309 of the cam. With the cam 307 having five recesses, mounted on shaft 306, the

switch **310** will be closed once each one fifth (1/5) of a second and be opened immediately thereafter. The switch **310** will be closed long enough to energize the clutch magnet **37** and start a cycle of operation of the reader. As the clutch magnet circuit is opened immediately thereafter, the clutch magnet CM becomes deenergized and the reader shaft **35** stops at the end of such cycle of operation. Thus, with the cam **307** of Figs. 8 and 9 on the shaft **306** a cycle of operation of the reader is effected each one fifth of a second. The cam **307***a* will provide a cycle of reader operation each one fourth of a second and the cam **307***b* an operation cycle each one half of a second.

From the foregoing it will be readily appreciated that I have provided a new and improved record controlled printing apparatus which with the switch **324** closed operates at a maximum designed speed for ordinary letter writing operation and which with switch **324** open and switch **325** closed operates at a predetermined slower speed. The synchronous motor driven timing mechanism **300** is simple and inexpensive in construction, highly dependable in operation, and can be installed with a minimum of labor and cost.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a cyclically operable machine, the combination of a one-revolution clutch operable when engaged to effect an operating cycle of said machine; an electrically responsive device operable when energized to effect operative engagement of said clutch; means providing an energizing circuit for said device and including a source of electricity and a selective control switch operable when closed to maintain a flow of energizing current through said device; a timing means operable at a predetermined time rate; a timing switch operated by said timing means so that it is closed momentarily at predetermined time intervals; and circuit connections for connecting said timing switch into said energizing circuit and in parallel with said selective control switch whereby when the latter is open said energizing circuit is momentarily closed by said timing switch at the predetermined time intervals determined by said timing means.

2. Apparatus according to claim 1 wherein said timing means comprises an A. C. motor operable at a time rate determined by the frequency of the current, a shaft driven by said motor, and a cam fixed on said shaft and having a predetermined number of switch actuating portions thereon adapted to operatively engage said timing switch.

3. In a cyclically operable machine, the combination of an operating shaft effective to provide an operating cycle of said machine for each revolution thereof; a power shaft operating continuously at a predetermined time rate; a connecting device effective to provide a driving connection between said operating and power shafts so that as long as said device remains effective the operating cycles are repeated at the speed determined by said power shaft; a first control means operable to render said connecting device continuously effective over an extended period of time; timing means; a second control means controlled by said timing means and operable at each of predetermined time intervals for rendering said connecting device effective to connect said operating and power shafts for one revolution and then disconnect said shafts; and selectively operable means having first and second positions of adjustment and effective when in said first position of adjustment to render said first control means operable and said second control means inoperable and effective when in said second condition of adjustment to render said second control means operable and said first control means inoperable.

4. In apparatus for printing, on a copy sheet, data which has been recorded as code designations on a record sheet, the combination of cyclically operable mechanism for successively sensing said code designations, there being one sensing operation for each operating cycle; printing means for printing the data on a copy sheet; means acting in response to the sensing of each code designation for effecting an operation of said printing means in accordance with said sensed designation; a control device effective each time it is operated, to effect one cycle of operation of said mechanism; means operating at a predetermined time rate independently of said cyclically operable mechanism; and means responsive to said last named means for operating said control device at predetermined intervals of time.

5. Apparatus for printing, on a copy sheet, data which has been recorded as code designations on a record sheet, and comprising cyclically operable mechanism effective during each operating cycle to space the record sheet to bring a code designation into a position to be sensed and to sense a code designation in sensing position; mechanism for printing data on a copy sheet; means responsive to the sensing of each code designation for operating said printing mechanism in accordance with such sensed code designation; electrical control means operable when energized to effect a cycle of operation of said cyclically operable mechanism; mechanism operable at a predetermined time rate independently of said cyclically operable mechanism; and means responsive to said last-named mechanism for successively energizing and deenergizing said electrical control means at said predetermined time rate.

6. In apparatus for printing, on a copy sheet, data which has been recorded as code designations on a record sheet, the combination of cyclically operable mechanism for successively sensing said code designations, there being one sensing operation for each operating cycle; printing means for printing the data on a copy sheet; means acting in response to the sensing of each code designation for effecting an operation of said printing means in accordance with said sensed designation; an electro mechanical device operable when energized to effect one cycle of operation of said mechanism; means including an electrical circuit and a device for closing said circuit and operable each time said circuit is closed to energize said electro mechanical de-

vice; and means operable at a predetermined time rate independently of said cyclically operable mechanism to effect operation of said circuit closing device to close and then open said circuit at predetermined intervals of time.

7. In apparatus for printing, on a copy sheet, data which has been recorded as code designations on a record sheet, the combination of cyclically operable mechanism for successively sensing said code designations, there being one sensing operation for each operating cycle; printing means for printing the data on a copy sheet; means acting in response to the sensing of each code designation for effecting an operation of said printing means in accordance with said sensed designation; an electro mechanical device operable when energized to effect one cycle of operation of said mechanism; timing means including an A. C. motor operating continuously at a time rate determined by the frequency of the current supply, a cam shaft driven by said motor, and a cam on said shaft formed with switch actuating portions; and means for energizing said electro mechanical device comprising an electrical circuit and a switch engageable by said portions on said cam for closing said circuit.

8. In apparatus for printing on a copy sheet data which has been recorded as code designations on a record sheet, the combination of cyclically operable reader mechanism including a rotatable reader shaft, each revolution thereof corresponding to an operating cycle, means operated by said reader shaft during each revolution for spacing said record sheet to bring a code designation into a sensing position, and means operated by said reader shaft during each revolution for sensing a code designation in said sensing position; printing means for printing the data on a copy sheet; means acting in response to the sensing of a code designation and controlled by said reader shaft for operating said printing mechanism in accordance with the sensed code designation; a continuously rotating power shaft; a one-revolution clutch operable when engaged to connect said power and reader shafts for one revolution and then become disengaged; timing means operable at a predetermined time rate independently of said cyclically operable reader mechanism; and means responsive to said timing means for effecting engagement of said clutch at predetermined time intervals.

9. In apparatus for printing on a copy sheet data which has been recorded as code designations on a record sheet, the combination of cyclically operable reader mechanism including a rotatable reader shaft, each revolution thereof corresponding to an operating cycle, means operated by said reader shaft during each revolution for spacing said record sheet to bring a code designation into a sensing position, and means operated by said reader shaft during each revolution for sensing a code designation in said sensing position; printing means for printing the data on a copy sheet; means acting in response to the sensing of a code designation and controlled by said reader shaft for operating said printing mechanism in accordance with the sensed code designation; a continuously rotating power shaft; a one-revolution clutch operable when engaged to connect said power and reader shafts for one revolution and then become disengaged; an electro magnetic device operable when energized to effect engagement of said clutch; an energizing circuit for said device including a source of electricity and a switch for closing said circuit; timing means operable at a predetermined time rate independently of said cyclically operable reader mechanism; and means responsive to said timing means for momentarily closing said switch at predetermined time intervals.

10. In apparatus for printing on a copy sheet data which has been recorded as code designations on a record sheet, the combination of cyclically operable reader mechanism including a rotatable reader shaft, each revolution thereof corresponding to an operating cycle, means operated by said reader shaft during each revolution for spacing said record sheet to bring a code designation into a sensing position, and means operated by said reader shaft during each revolution for sensing a code designation in said sensing position; printing means for printing the data on a copy sheet; means acting in response to the sensing of a code designation and controlled by said reader shaft for operating said printing mechanism in accordance with the sensed code designation; a continuously rotating power shaft; a one-revolution clutch operable when engaged to connect said power and reader shafts for one revolution and then become disengaged; an electro magnetic device operable when energized to effect engagement of said clutch; an energizing circuit for said device including a source of electricity and a switch for closing said circuit; and timing means for operating said switch comprising an A. C. motor operating continuously at a time rate determined by the frequency of the current supply, a shaft driven by said motor, and a cam fixed to said shaft and having switch actuating portions thereon operable to effect momentary closing of said switch.

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