

Dec. 26, 1961

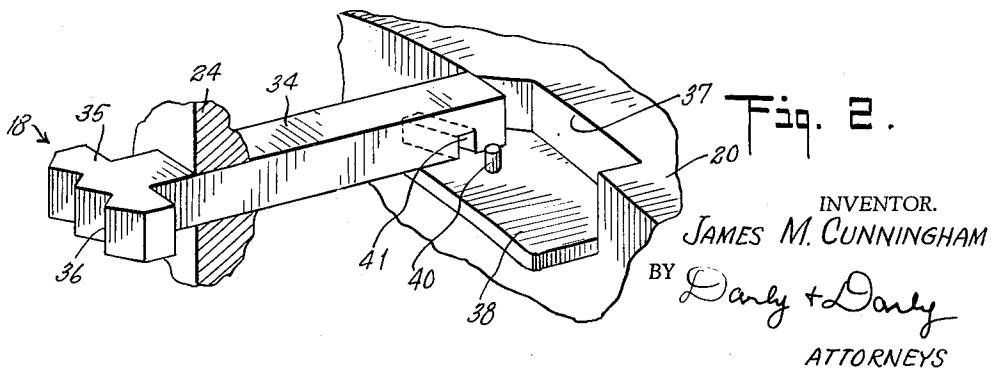
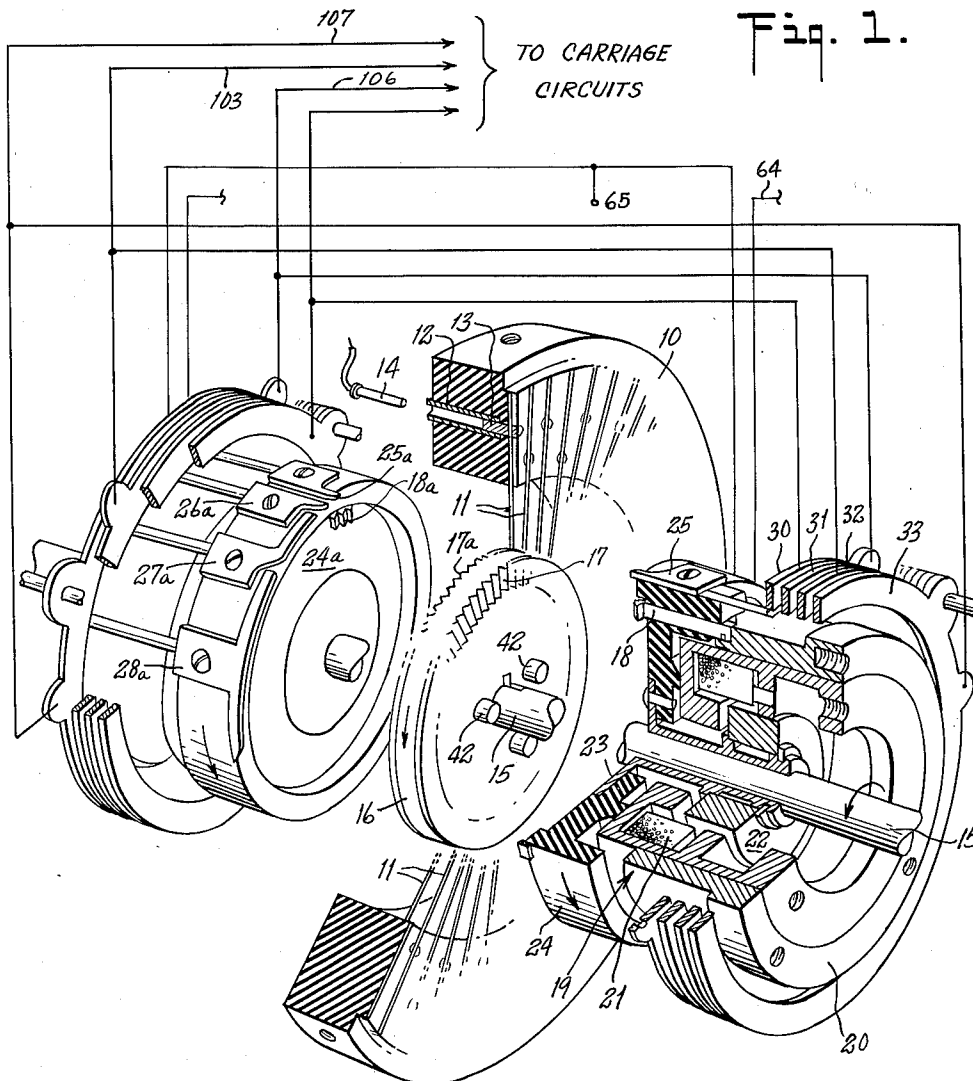
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3,014,570

CARRIAGE CONTROL UNIT FOR PRINTING MECHANISMS

Filed June 18, 1959

2 Sheets-Sheet 1



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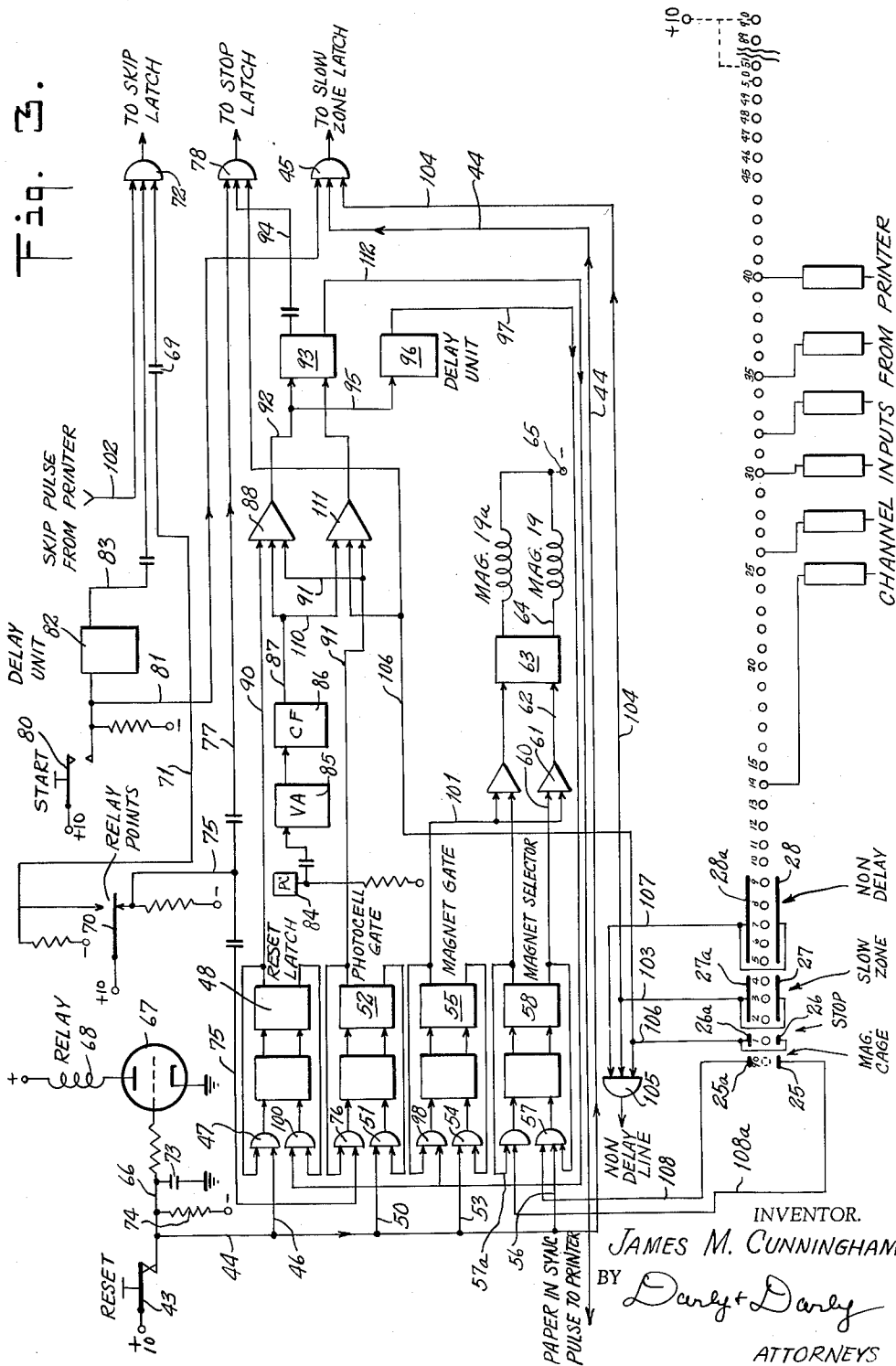
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2 Sheets-Sheet 2

Fig. 3.



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CARRIAGE CONTROL UNIT FOR PRINTING MECHANISMS

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The present invention relates to the control of line feeding movements of a platen on which data is printed by a printing mechanism. Examples of said printing mechanisms and platens are tabulating machines, read-out mechanisms for computers and the like.

More particularly the carriage control unit of this invention relates to the printing of data by a printer on forms which require spacing between data units greater than normal line feeding movements would impart and further requires non-uniform spacing.

An example of the type of machine to which a carriage control unit of this invention may be applied is the tabulating mechanism disclosed in Mills Patent No. 2,531,885, issued November 28, 1950, and assigned to the assignee of this application. As is discussed in the patent referred to, it is frequently desirable to utilize a tabulating mechanism for preparing forms such, for example, as invoices in which the data respecting a purchase will be given in spaced lines on the form starting at a given position. In order to accomplish the desired spacing the platen must be rotated rapidly between certain printing lines in accordance with designation changes, total and subtotal cycles, etc.

The above is a broad outline of the problem involved and may, of course, have many variations with respect to the number and length of the skip operations.

In general, the proper coordination of paper feed control with printing mechanisms may be accomplished in two manners. According to one mode, the paper feeding operations may be initiated at a time in the printing cycle when it can be predicted that the paper feeding operation will have been completed prior to the instant of firing the print hammers.

In a second manner the mechanisms may be so arranged that printing can be started only upon termination of platen movement and platen movement can be initiated only upon completion of printing. The second method is inefficient but is often the only possible choice because of the impracticability of predicting the time required for relatively long skips or advance of the paper forms.

The Mills machine mentioned above is an example of the first approach and utilizes a prepared endless paper tape to control the starting and, more importantly, the stopping of the platen at the desired location. The paper tape of the Mills patent is one mode of predicting the time required for each advance of the paper in order that the printer may continue to operate concurrently with paper feeding in order to avoid loss of time.

The control unit of this invention comprises a commutator mechanism and an electrical circuit arrangement and devices which are used in combination to eliminate counters, storage and memory devices commonly required in the more complex paper feed control systems, in order to compare paper position at one instant with that required at a later instant to assure that the operations conform with the requirements of the printing mechanism.

The control device of the present invention is so arranged that control channels energized by printer operations (including classification indications present in the data fed to the printer) may be connected by

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plugging or switching to selected contacts each representative of a particular line on the form to be printed. The control device is capable of determining at any instant when paper feeding is initiated whether high speed or low speed carriage advance is required; whether the paper has already been advanced past the speed change-over point; and whether or not the printer must be required to be idle for one or more cycles in order to permit sufficient time for the paper to advance to the next predetermined printing line.

The device comprises a ring of stationary brushes, each representing a line on the form, and cooperating with these brushes are commutator segments of varying length, the lengths being determined in accordance with the time characteristics of the particular unit controlled.

As is well known in the art and as is set forth in the Mills patent above referred to, it is desirable that the carriage rotate at a relatively high linear velocity when a long skip is necessary. On the other hand, when a short skip (which may be defined as one not exceeding 3" in length) is required, the carriage is not accelerated to so high a speed. Moreover, since during a long skip the paper acquires a relatively high linear speed, it is desirable, if not essential, that the energy stored in the paper drive mechanism, due to this high speed, be dissipated before the carriage is brought to a stop. This is normally accomplished by following each long skip or high speed operation by a low speed operation prior to the stop, thereby assuring that there will be no damage caused to the mechanism and that there will be no overthrow of the carriage causing it to stop at an undesired line.

The present invention operates at the instant when paper feeding is initiated to indicate the required stopping line, that is, where the next printed entry is to be made, and may thus immediately call for: low speed advance without delay of the printer; high speed and subsequent low speed advance without stopping the printer; high speed and subsequent low speed advance with stopping of the printer; and for other conditions which will be brought out subsequently. The net effect of the control is thus to provide maximum efficiency of use of the printing mechanism without employing counters and memory devices.

As indicated above, although the Mills patent shows one form of control applied to a particular tabulating mechanism, and although the control unit of this invention would be applicable to that tabulator in substitution for the tape control device there described, the present invention is useful in many types of paper feed devices especially those used with high speed data processing and computing mechanisms.

It is an object of the present invention to provide a carriage control unit for a printing mechanism by means of which the paper can be advanced in desired steps and in which the paper advance can be readily determined by plugging certain connections into the carriage control unit.

It is another object of the invention to provide such a carriage control unit which consists primarily of a commutator mechanism together with electrical circuit devices which cooperate to control the paper advance and to also control the cyclic operations of the printer when this is necessitated by the time requirement for advance of the paper.

It is another object of the invention to provide such a carriage control mechanism which is capable of determining at the instant when paper advance is initiated, whether high speed or low speed platen operation is required, whether the paper has already been advanced beyond the speed changeover point and whether or not

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one or more lost or idle cycles of the printer will be required to enable the paper to be advanced to the next selected printing line.

It is a further object of the invention to provide such a control unit wherein the commutator segments are of varying length, the length depending upon and corresponding to the time characteristics of the particular printing mechanism which is controlled by the unit as well as by the rate of speed of the platen in its paper feeding action.

It is a still further object of the invention to provide such a control unit wherein a photocell and associated circuits are arranged to cooperate with a mark on the paper form to position the first one of a continuous series of forms in its printing position and to thereafter check the registration of the mark on the form with the printer condition and stop the printer if the carriage is not in the proper position.

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:

FIGURE 1 is a perspective view of the carriage control unit of my invention showing particularly the commutator having wires or brushes which engage with rotating segments and which wires or brushes may be connected to the control circuits by means of plugs;

FIG. 2 is an enlarged fragmentary perspective view showing the mounting of a clutch dog and the mode of returning this clutch dog to an initial position after each complete revolution of the commutator driven thereby; and

FIGURE 3 is a schematic circuit diagram of the control circuits utilized with the commutator of FIGURE 1 to effect control of the paper carriage and of the printing mechanism.

Referring now to the drawings and particularly to FIGURE 1, the commutator of that figure comprises a stationary ring 10 in which a plurality of commutator wires or brushes 11 are fixed, these wires extending radially inward from the ring 10. Extending transversely through ring 10 are apertures in which sleeves 12 are positioned. Each sleeve 12 is provided with a metallic rod 13 which extends from the end of the sleeve and is electrically connected to one of the wires 11. The parts 12 and 13 thus form jacks adapted to receive plugs such as those indicated at 14. It will be obvious that in this construction the ring 10 is formed of insulating material and equally obvious that other forms of jacks might be utilized wherein the ring might be of conductive material, the jack members and the wires 11 being insulatingly mounted therein.

In the present example there are 90 wires 11 and the device is intended to control platen line feeding movement in connection with a form having a maximum of 90 printed lines thereon. However, other numbers of wires might be utilized if forms having different maximum numbers of printing lines were to be utilized.

The ring 10 is mounted concentrically with respect to a shaft 15 which shaft is suitably connected to the carriage or platen shaft of the controlled machine to rotate in unison with that shaft. It may, for example, be an extension of the shaft or may be connected thereto through gearing or otherwise so that for each step of line feeding movement the shaft 15 rotates through an angular distance equal to the angular distance between adjacent wires 11.

Mounted on the shaft 15 for rotation therewith is a toothed wheel 16 having teeth 17 and 17a on the opposite faces thereof which teeth cooperate with a toothed dog 18 or 18a to drive the commutators in a manner shortly to be described.

Since the commutator structure is provided in duplicate, one commutator being the mirror image of the other, but one of these commutators will be described, and since in

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FIGURE 1 the right hand commutator structure has been broken away to show the interior construction, that commutator will be described in detail. The left hand commutator will be understood to be identical and has been provided with the same reference characters as the right hand one with the suffix "a."

Fixedly mounted concentrically with the shaft 15 is an electromagnet 19 which has a cylindrical core 20 and is provided in the usual manner with a winding 21. The electromagnet also includes an armature portion 22 which, in the usual manner, cooperates with the pole piece to cause movement of the armature in a direction axially of the shaft 15, the armature being mounted on a sleeve 23 slidable on the shaft. Mounted on a flange at the inner end of sleeve 23 is a ring 24 of insulating material on which commutator segments 25, 26, 27 and 28 are mounted.

Axial extensions of the commutator segments extend beneath the commutator rings 30, 31, 32 and 33. Rings 30 through 33 are suitably mounted in a fixed position so that as the segments 25, 26, 27, 28 rotate, the extensions thereof are always in contact with the inner surface of rings 30, 31, 32, 33 respectively, it being understood that the commutator rings are sufficiently wide in the axial direction and sufficiently spaced with respect to the movement of the commutators so that each commutator segment extension contacts only a single ring at all times.

Provision is made to assure that once a magnet has been operated and the dog 18 or 18a caused to engage with the respective teeth 17 or 17a, that commutator will continue to rotate through a complete revolution although the commutator segments may disengage from the wires 11 prior to the completion of the revolution.

The construction which renders this possible is shown in FIGURES 1 and 2. The dog 18 comprises the generally rectangular shank 34 and the enlarged head 35, the head bearing the teeth 36 which, as indicated, engage with the teeth 17 of the wheel 16. The shank 34 is mounted in an aperture in the ring 24, the ring being slightly enlarged to make this possible. The right hand end of shank 34 lies against the end surface of the cylindrical core 20 of magnet 19 which core is notched at one point in its periphery as indicated at 37, FIGURE 2. When the magnet is energized the armature 22 moves to the left carrying the ring 24 with it and likewise carrying the dog 18 to the left so that its teeth engage those of wheel 16. If the shaft now turns through one line space the right hand end of shank 34 will lie against the left hand surface of the cylinder 20 and will be retained in its engaging position irrespective of the position of the magnet armature and ring 24 until the notch 37 is again presented to the rear surface of the shank 34. When a complete revolution has been made the dog is retracted into its starting position.

As shown in FIGURE 2, the cylindrical core 20 of magnet 19 is, in the area of the notch 37, extended to the left forming a shelf or ledge 38 on which is mounted a cam member 40 which may, for example, be a pin. Formed in the lower surface of the shank 34 of dog 18 is a groove 41 which extends across the surface at an angle to the longitudinal axis such that the dog will be retracted into its starting position as the wheel 16 moves through the last increment of movement corresponding to the space between the 90th printing line and the adjacent first printing line.

As indicated hereinabove, the commutators 25, 26, 27, 28 will, when magnet 19 is operated, engage certain of the wires 11. As a commutator rotates it will engage successive wires and this engagement will, as hereinafter described, control movements of the carriage and also operations of the printing mechanism. At a predetermined time during the rotation magnet 19 will be de-energized and magnet 19a energized. As a result commutator segments 25a through 28a will move into engagement with the wires 11 and additionally the inner or right hand surface of the ring 24 will strike the pins

42 which are placed in holes in wheel 16. These pins will then be extended and will urge the armature 22 of the now deenergized magnet into its retracted position, but as explained above, the dog 18 will remain in engagement. Consequently, the commutator will continue to rotate until it has completed a revolution at which time the dog will be returned to starting position. In the same manner energization of magnet 19 is effective to disengage commutator segments 25a-28a from wires 11.

FIGURE 3 illustrates circuits which may be utilized with the commutator device described above to effect control of carriage movement and of cyclic operation of the printer. The controls are, as has been indicated, flexible, and the stopping points of the carriage, that is, the printing lines at which the carriage will stop, are determined in accordance with plugging of the plugs 14 into the jacks 12.

The operation of the circuits is best described by means of illustrative example and in the following the operation of the device and the circuits in connection with a particular tabulating operation will be described, the operation being similar to that indicated by FIGURE 5 of the Mills patent above referred to.

In discussing an illustrative example of the operation of the device of this invention to control printing, the invoice of FIGURE 5 of the Mills patent will be utilized.

The Mills invoice form considered has a length of 51 lines of printing, heading material appearing thereon as follows:

Line #6 (shipped from) Washington, D.C.
Line #10 (shipped via) Horton Motor Lines
Line #12 (date) 12/5/39
Lines #15, 16, 17 (sold to) Intl. Business Mach. Corp.,
1244 Sumpter Avenue, Columbia, South Carolina
Lines #20, 21, 22 (shipped to) Intl. Business Mach.
Corp., 1244 Sumpter Avenue, Columbia, South Carolina
Lines #31, 32, etc. Listing of items purchased
Line #45. Total of item prices

Before proceeding with the description of operation of the mechanism to control carriage or platen position for filling in forms of the type mentioned immediately above, the circuits will be briefly described.

These circuits, shown in FIGURE 3, include certain electronic latches designated the reset latch, the photocell gate, the magnet gate and the magnet selector. These latches are of the type known as the Hughes double latch and are shown in detail in Hughes Patent No. 2,628,309, issued February 10, 1953, and assigned to the assignee of the instant invention. The circuits also include logical "and" and "or" circuits, amplifiers, cathode followers, inverters, relays, etc. all well known in the art.

Returning now to the circuit operation, the first operation to be performed is to reset the circuits and condition them for operation. This is done with no forms i.e., no paper in the printer.

The operator first depresses the reset key 43, FIGURE 3. As a result of this operation a pulse along conductor 44 and through "or" circuit 45 causes the slow zone latch in the carriage unit to operate. The operation of the reset key also sends a pulse over conductor 46 and through "or" circuit 47 to cause reset latch 48 to turn on. At the same time the same pulse over conductor 50 and "or" circuit 51 causes the photocell gate 52 to turn off; the pulse over conductor 53 and "or" circuit 54 causes the magnet gate 55 to be turned off and the pulse over conductor 56 and "or" circuit 57 causes the magnet selector 58 to select magnet 19 although magnet 19 does not operate since the magnet latch or gate is turned off. (It is to be noted that the showing of the commutator is repeated in schematic form in FIGURE 3 in order to simplify the consideration of the circuits.)

Closure of the reset key 43 also causes a voltage of

+10 volts to be applied over conductor 66 to the grid of vacuum tube triode 67. Current flow through the tube 67 energizes the winding 68 of a relay, the armature and contact points of which are indicated at 70. Operation of relay 70 causes a change in voltage level on conductor 71 which level change is differentiated by capacitor 69 and, through "or" circuit 72, causes the skip latch to operate, this latch controlling the connection of the carriage shaft and shaft 15 to the power source. The platen now commences to rotate and, because of the prior energization of the slow zone latch, to rotate at its low speed.

Upon the release of the reset key 43, condenser 73 discharges through resistor 74 thus assuring that the relay 68 will remain operated for a fixed time period. This time period is so selected that the control unit of FIGURE 1 operates through a complete revolution, and, at the end thereof, both clutch dogs 18 are returned to their initial position out of contact with the toothed wheel 16, in the manner explained hereinabove. When the relay 68 deenergizes and the armature rests upon the lower contact, as shown in FIGURE 3 a pulse is supplied over line 75 which is effective through "or" circuit 76 to turn the photocell gate on. The same pulse over conductor 77 is applied to "or" circuit 78 to operate the stop latch which will disengage the drive clutch and cause the carriage to come to rest in a particular position.

The machine now having been set for proper operation, the operator places the beginning of a continuous sheet of forms in the feeding tractors of the carriage mechanism and depresses the start key 80.

Upon closure of the start key 80 a pulse is generated and applied over conductor 81 and through "or" circuit 45 to operate the slow zone latch. This same pulse through delay unit 82 is applied over conductor 83 to "or" circuit 72 to cause operation of the skip latch.

As a result of energization of the skip and slow zone latches the paper is caused to move at slow speed. As the paper advances, the photocell 84 will scan an indicating mark on its surface which mark is printed on each form when the forms are prepared. This mark may be in the form of a vertical stripe extending from the top of the form downwardly to the line preceding the desired location of the information to be printed on the form by the tabulating or computing mechanism in the home position of the carriage or may be a spot on the line preceding the printing line regarded as the home position.

The pulse generated in photocell 84 is amplified and shaped by the voltage amplifier 85 and cathode follower 86 and applied over conductor 87 to "and" circuit 88. This pulse thus establishes coincidence with the "on" position of the reset latch and the "on" position of the photocell gate, the voltages from these two units being applied over conductors 90 and 91 respectively. The output from "and" circuit 88 applied over conductor 92 and cathode follower 93, conductor 94 and through "or" circuit 78 operates the stop latch and causes the paper to stop one printing line from the mark on the paper.

In our assumed example the platen is always to stop at the 31st printing line which is regarded as the "home" position of the commutator unit and the mark will terminate, or occur, on the 30th printing line.

The output pulse through "and" circuit 88 is also applied over conductor 95 to delay unit 96 and the delayed pulse output from this unit is applied over conductor 97 and through "or" circuit 98 to the magnet gate 55. The delayed pulse is also applied over conductor 97 and through "or" circuit 100 to cause the reset latch to turn to its "off" position.

Turning the magnet gate on as described above applies a voltage over conductor 101 to "and" circuit 61. Since the magnet selector gate is turned to magnet 19 the coincidence of level changes to "and" gate 61 will cause energization of this magnet and thus cause the

right hand commutator of FIGURE 1 to move to the left (lower commutator FIGURE 3 to move upwardly) at which time commutator segment 26 will engage wire #2; commutator segment 27 will engage wires #3, #4 and #5 and commutator segment 28 will engage wires #6, #7, #8, #9 and #10.

Line #31 of the first form corresponds to wire #1 of the 90 wires 11 and the plugging is arranged to treat the lines from line #31 of a form to line #31 of the succeeding form as though they constituted a single form.

Since line #31 is regarded as the home position and since the form considered requires skipping to lines #45, #60, #10, #12, #15, #20 and #31, in that order, printer channel #1 is plugged to wire #14 (i.e. to the wire corresponding to line #44 of the form), printer channel #2 to wire #26 (i.e. line #5 of the printed form), printer channel #3 to wire #30 (i.e. line #9), printer channel #4 to wire #32 (i.e. line #11), printer channel #5 to wire #35, (i.e. line #14), and printer channel #6 to wire #40 (i.e. line #19). It is to be noted that the carriage always comes to rest one step beyond the plugged commutator wire and thus the carriage will stop at lines #45, #6, #10, #12, #15 and #20 successively. As will be described the stop at line #31 is differently controlled.

At the time considered there will be a heading card rather than an item card in the card sensing mechanism and this will result in a level change on printer channel #2 and on commutator wire #26. At this time also a skip pulse is generated in the printer and applied over conductor 102, FIG. 3, to "or" circuit 72 causing energization of the skip latch.

Energization of the skip latch is effective to clutch the carriage to its drive motor, and the platen now operates at its high speed and the absence of a pulse from "or" circuit 105 causes the printer to delay.

After the platen has rotated through 17 steps of movement the non-delay commutator segment 28 comes into contact with wire #26 and the level change on printer channel #2 is applied to this segment and over conductor 107 to "or" circuit 105. Due to the operation of this circuit a non-delay pulse is sent to the printer which resumes operation.

The carriage now advances five steps at which time the level change is applied over commutator segment 27 to conductors 103 and 104. The level change on conductor 104 is effective to operate "or" circuit 105 to continue the printer in operation and also to operate "or" circuit 45 and thus energize the slow zone latch.

The carriage now advances through three spaces at which time the change in level is applied over commutator segment 26 and conductor 106 to "or" circuit 78 to operate the stop latch, the signal level being maintained on the non-delay line due to the connection of conductor 106 to "or" circuit 105.

Operation of the stop latch causes the platen to be positioned for printing on line #6 of the second form (the first form being ejected and discarded), the stop segment 26 of the commutator now rests on wire #27, and the level on channel #2 restores to normal.

The first heading item, namely, Washington, D.C. will now be printed on line #6. During the accompanying card feeding operation a printer operation of the type described in the Mills patent causes a change in voltage level of printer channel #3, which, as indicated above, is plugged to commutator wire #30.

At this time also a skip pulse is generated in the printer and applied over conductor 102, FIG. 3, to "or" circuit 72 causing energization of the skip latch.

Energization of the skip latch is effective to clutch the carriage to its drive motor. At the same time the level change on wire #30 produces a level change on conductor 103, FIGURE 3, which is applied over conductor 104 to "or" circuit 105 and also over conductor 104 to "or" circuit 45 and to the slow zone latch. Because of the operation of both the skip and slow zone latches the

platen operates at its slow speed. The pulse from "or" circuit 105 is fed back to the printer to indicate that it need not delay its operation.

The carriage thus advances through three spaces, that is, until commutator segment 26 engages wire #30. At this time the change in voltage level appears on conductor 106 and is applied to "or" circuit 105, the output of which then continues to send a non-delay signal to the printer. Also the change in level on conductor 106 is applied through "or" circuit 78 to cause energization of the stop latch and the carriage stops, after one step of movement, in position for printing on line #10 of the printed form. At this time commutator segment 26 rests on wire #31. (Note again that energization of the stop latch is effective to send a signal to the printing mechanism which causes the signal level on the channel concerned to return to normal.)

The name of the carrier, Horton Motor Lines, will now be printed on line #10 of the form which, as has been explained, corresponds in the present example to wire #31 of the commutator.

A change of level will now occur on printer channel #4 which is patched to commutator wire 32 and at the same time a skip pulse is generated by the printer which, in the manner described before, is effective to operate the skip latch and also, since commutator segment 27 now engages wire #32, to send a non-delay signal to the printer and to operate the slow zone latch. After one step of movement of the carriage commutator segment 26 engages wire #32 thus causing operation of the stop latch and the commutator then stops with commutator segment 26 in engagement with wire #33. As a result of this operation the form is positioned for printing on line #12 and, as before, energization of the stop latch restores the level of printer channel #4 to normal.

The printer now prints the date, 12/5/39, and the printer mechanism, in a manner similar to that mentioned above, causes a level change on printer channel #5. Since in the present example printer channel #5 is connected by a patch cord to commutator wire #35, this level change will appear on that wire.

At the same time a skip pulse will be applied from the printer to conductor 102 to energize the skip latch in the manner described above. The change in level on wire #35 will be effective through commutator segment 27 which is now in contact therewith to produce a non-delay pulse to the printer and to operate the slow zone latch. Consequently the carriage will move until commutator segment 26 engages wire #35 at which time the stop latch will be energized, the commutator coming to rest with segment #26 in engagement with wire #36. As a result the paper will be positioned for printing on line #15 of the form and as before the level on printer channel #5 will be restored to normal.

The printing mechanism now operates to print the name and address of the purchaser, namely, Intl. Business Mach. Corp., 1244 Sumpter Ave., Columbia, South Carolina, in three lines, respectively lines #15, #16 and #17. This operation involves only the normal line feeding operation of the printing mechanism without skipping.

At the completion of the printing a level change is produced on printer channel #6 which channel is connected by a patch cord to commutator wire #40. At the same time a skip pulse is produced to energize the skip latch. Since at this moment commutator segment 27 is in contact with wire #40, a pulse is produced which is effective to operate the slow zone latch and to energize the non-delay line. Thus, the platen moves at its lower rate of speed until after two steps of movement commutator segment 26 makes contact with wire #40. This causes energization of the stop latch and results in stopping the platen and commutator with commutator segment 26 in engagement with wire #41, now at its normal voltage level. At this time the paper is positioned for printing on line #20 of the form.

The printing mechanism now proceeds to print the destination of the shipment which is Intl. Business Mach. Corp., 1244 Sumpter Ave., Columbia, South Carolina, in three lines, the commutator of course meanwhile advancing step-by-step with the normal line feeding movement of the carriage. Thus at the end of these steps commutator segment 28 is in contact with wires #47, #48, #49, #50 and #51; commutator segment 27 is in contact with wires #44, #45 and #46 and commutator segment 26 is in contact with wire #43. At this time a skip pulse originates in the printer and is sent over line 102, FIGURE 3, and through "or" circuit 72 to operate the skip latch in the manner described above. Also a level change is present on wire #51 due to its being patched to wire #90 on which a +10 voltage is always present. The change in level on wire #51 is extended over conductor 107 and "or" circuit 105 to produce a non-delay pulse to the printer. However, no operation of the slow zone latch is initiated at this time and consequently the carriage advances at its high speed through five steps of movement. After advance through five steps of movement commutator segment 28 comes into contact with wire #51 thus transferring the level change of conductor 107 to conductor 103. As described hereinabove, this change in level on conductor 103 both maintains the printer non-delay line energized and, through "or" circuit 45, operates the slow zone latch.

The carriage now operates at its low speed through three steps of movement at which time commutator segment 26 makes contact with wire #51 which causes energization of the stop latch in the manner heretofore described. However, the normal level is not restored to wire #51, and the commutator stops with commutator segment 25 in engagement with wire #51 and with the carriage in position so that printing may be effected on line #31.

The voltage on wire #51 and over conductor 108a (FIG. 3) results in energization of "or" circuit 57a and operation of the magnet selector latch 58. This in turn results in energization of winding 19a and deenergization of winding 19. Commutator segments 25, 26, 27 and 28 disengage from wires 11 and segments 25a, 26a, 27a and 28a engage these wires, segment 25a making contact with wire #1, segment 26a with wire #2, segment 27a with wires #3, #4 and #5 and segment 28a with wires #6, #7, #8 and #9.

As explained hereinabove, the teeth of dog 18 remain in contact with teeth 17 of wheel 16 and consequently the right hand commutator unit will continue to rotate until it has completed its revolution, that is to say, the right hand commutator will advance through 39 additional steps of movement. When this has occurred the notch 37 is presented to the right hand end of dog 18 and the pin 40 causes the dog to restore to its right hand position, disengaged from teeth 17.

Of course, as this occurs the left hand commutator will advance through the same 39 steps of movement as will be described.

Line #31 is the first of a number on which articles sold are to be described the description indicating, for example, the quantity thereof, the price per unit, and the amount. As will be obvious, the number of different articles comprising the single invoice will vary. The tabulating mechanism is arranged to take a total when all the item cards associated with a particular group have been fed. Thus after completion of the item listing a total is automatically taken. The mechanism is so arranged that upon completion of the listing a level change is produced on printer channel #1. If it be assumed that two items comprise the entire purchase, then the level change on printer channel #1 will occur when items have been listed on lines #31 and #32 of the printed form.

At this time, commutator segment 26a will be in contact with wire #4, commutator segment 27a will be in contact with wires #5, #6 and #7 and commutator seg-

ment 28a will be in contact with wires #8, #9, #10 #11 and #12. At the time that the level changes on printer channel #1 a skip pulse also originates from the printer and in the manner heretofore described energizes the skip latch. Since none of the commutator segments 26a, 27a or 28a is in contact with wire #14 (to which printer channel #1 is connected by a patch cord), no pulse is applied to "or" circuit 105 and no non-delay pulse is sent to the printer. Consequently at this time the printer stops operating. Also, due to energization of the skip latch and non-energization of the slow zone latch the platen starts to move at its higher speed.

When the leading edge of commutator 28a strikes wire #14 the level change on that wire is applied over conductor 107 to "or" circuit 105 and thus produces a pulse on the non-delay line which causes the printer to resume operation. After five additional steps of movement of the platen at its high speed, commutator segment 27a comes into contact with wire #14 and in the manner heretofore described causes the slow zone latch to operate. The platen then advances through three additional steps at low speed at which time commutator segment 26a engages wire #14 and the stop latch is energized, the commutator coming to rest with segment 26 on wire #15. The form then presents line #45 at the printing point and immediately thereafter the total will be printed in the amount column on this line.

The printer is arranged so that following the printing of a total on the predetermined total line or, in fact, following any printing on this line a skip pulse is applied over conductor 102 to the skip latch in the manner heretofore described. Also, if a heading card has been sensed the printer will produce a level change on printer channel #2 whereas if additional item cards have been sensed a change in level will not occur. If a level change occurs the platen will come to rest at the first heading line under control of the commutator 24a; if however additional item cards are present the printer will skip to line #31 of form #3 and the listing will continue on that form.

As the third form passed printing line #30 a pulse was generated by the photocell 84 which, through the voltage amplifier 85, cathode follower 86, conductors 87 and 110, was applied to "and" circuit 111 and thence through cathode follower 93 and conductor 112 to the printer to indicate that the paper is in the proper position. If this pulse were not generated or if it were generated on an incorrect line, the printer would stop and the paper would have to be realigned before operations could proceed.

It should be observed that if any cards are missing from a sequence the level change on the associated printer channel will not occur and consequently the platen will advance to the next predetermined stopping point. This feature makes it possible, in the event that cards are missing, to partially fill out the form and to insert the remainder of the information at a later time. For example, item cards might be missing for one form and heading cards for another. If this should occur the headings would be properly printed on the first of the two forms, the carriage would then skip to the first item line on the second of the two forms (in the manner in which the ejection of the first form was described hereinabove) and would then print the items, take the total and properly align itself for printing on the first heading line of a third form.

It will be seen from the above that the commutators are energized alternately and always start from an initial position and it will be clear that the total number of printing lines of the form must be at least half of the number of control wires present in order that during an operation under control of one commutator the second commutator may have time to restore to its initial position. In the embodiment described, the form must be at least 45 printing lines in length since the

commutator is provided with 90 wires each associated with one printing line.

However, if forms of less than 45 line length are desired, two forms may be treated as one and the operation will be essentially the same as described hereinabove. This latter mode of operation has advantages in some instances in that two successive forms may be of different rather than the same character.

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 the following claims.

What is claimed is:

1. In a device for controlling the line feeding movements of a paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms, in combination, a commutator, said commutator having a plurality of contact segments each associated with a particular carriage and printer operation and having a plurality of contact brushes each associated with a selectable line on a form, means for rotating said commutator segments in synchronism with the paper carriage, circuit connections from the printing mechanism to said contact brushes to indicate the extent of a carriage feeding operation and means including said commutator segments and associated circuit elements for determining the rate of operation of the carriage and status of the printing mechanism during the indicated carriage feeding operation.

2. In a device for controlling the line feeding movements of a printer paper carriage of the type adapted for normal line feeding movements and skip movements at at least two rates of speed, to operate on a paper strip divided into forms having predetermined printing lines, in combination, a commutator device having two identical sets of contact segments, respective segments being associated with particular carriage and printer operations, and having a common plurality of contact brushes each associated with a selectable printing line on a form, means for advancing said commutator segments with respect to said contact brushes in synchronism with the movement of the paper carriage, circuit connections from the printing mechanism to said contact brushes to indicate the extent of a carriage feeding operation, circuits associated with said contact segments and means including said contact segments and associated circuits for determining the rate of operation of the carriage and status of the printer during the indicated carriage feeding operation.

3. In a device for controlling the line feeding movements of a printer paper carriage of the type adapted for normal line feeding movements and skip movements at at least two rates of speed, to operate on a paper strip divided into forms having predetermined printing lines, in combination, a commutator device having two identical sets of contact segments, respective ones of which are associated with a particular carriage and printer operation, and having a common plurality of contact brushes each associated with a selectable printing line on a form, means for advancing said commutator segments with respect to said contact brushes in synchronism with the movement of the paper carriage, circuit connections from the printing mechanism to said contact brushes to indicate the extent of a carriage feeding operation, circuits associated with said contact segments, means including said contact segments and associated circuits for determining the rate of operation of the carriage and status of the printer during the indicated carriage feeding operation and means for disengaging one set of said commutator segments from said

contact brushes and engaging the other set therewith at the completion of printing of a complete form.

4. In a device for controlling the line feeding movements of a printer paper carriage of the type adapted for normal line feeding movements and skip movements at at least two rates of speed, to operate on a paper strip divided into forms having predetermined printing lines, in combination, a commutator device having two identical sets of contact segments, respective ones of which are associated with a particular carriage and printer operation, and having a common plurality of contact brushes each associated with a selectable printing line on a form, means for advancing said commutator segments with respect to said contact brushes in synchronism with the movement of the paper carriage, circuit connections from the printing mechanism to said contact brushes to indicate the extent of a carriage feeding operation, circuits associated with said contact segments, means including said contact segments and associated circuits for determining the rate of operation of the carriage and status of the printer during the indicated carriage feeding operation, means for disengaging one set of said commutator segments from said contact brushes and engaging the other set therewith at the completion of printing of a complete form, and means for maintaining the drive of said one set of commutator segments while out of contact with said contact brushes until said segments have advanced through a number of steps equal to a complete revolution.

5. In a device for controlling the line feeding movements of a printer paper carriage of the type adapted for normal line feeding movements and skip movements at at least two rates of speed, to operate on a paper strip divided into forms having predetermined printing lines, in combination, a commutator device having two identical sets of contact segments, respective ones of which are associated with a particular carriage and printer operation, and having a common plurality of contact brushes each associated with a selectable printing line on a form, means for advancing said commutator segments with respect to said contact brushes in synchronism with the movement of the paper carriage, circuit connections from the printing mechanism to said contact brushes to indicate the extent of a carriage feeding operation, circuits associated with said contact segments, means including said contact segments and associated circuits for determining the rate of operation of the carriage and status of the printer during the indicated carriage feeding operation, means for engaging one of said sets of commutator segments with said contact brushes when a predetermined printing line of the form is presented to the printing mechanism and means for disengaging said one set of commutator segments from said contact brushes and engaging the other set therewith when the corresponding printing line of a succeeding form is presented to the printing mechanism.

6. A device according to claim 5 wherein said circuits associated with said contact segments comprise electronically operated latch mechanisms for causing the paper carriage to be driven at either rate of speed and to be stopped, and means for delaying operation of the printer during movements of the paper carriage of greater than a predetermined extent.

7. A device according to claim 5 wherein said circuit connections from the printing mechanism to the contact brushes comprises plugs and jacks whereby a printer output channel may be connected to a desired contact brush.

8. A device according to claim 5 wherein said commutator segments are of varying lengths, said lengths being determined by the operating time characteristics of the paper carriage and the printing mechanism.

9. In a carriage control unit for printing mechanism and the like, in combination, a shaft driven by the carriage in synchronism therewith, two commutators each

comprising a plurality of commutator segments arranged concentrically of said shaft and spaced apart therealong, drive means for said commutators fixed to said shaft in the space between said commutators, a plurality of contact wires angularly spaced about said commutator shaft and terminating in a concentric circular formation about said shaft, and means to selectively engage said commutators with said drive means to cause said segments to wipe over said wires.

10. In a carriage control unit for printing mechanism and the like, in combination, a shaft driven in synchronism with the carriage, a pair of commutators each comprising a plurality of contact segments arranged concentrically of said shaft and spaced apart therealong, a ring mounting the segments of each commutator on said shaft, drive means for said commutators fixed to said shaft in the space between said rings, a dog carried by each said ring and movable therewith to engage said drive means and cause said corresponding commutator to be driven by said drive means, a plurality of contact wires, angularly spaced about said commutator shaft and terminating in a concentric circular formation about said shaft, and electromagnetic means for selectively moving said commutators axially along said shaft into position with the dog engaging the drive means.

11. The device of claim 10 wherein said drive means comprises a wheel having toothed opposite faces and wherein said dogs are toothed in correspondence to said wheel.

12. The device of claim 10 wherein said contact wires are mounted in an annular member and wherein each contact wire is electrically connected to a jack insulatingly mounted in said annular member, said wires being regularly spaced annularly of the complete periphery of said annular member.

13. The device according to claim 10 wherein said dogs are provided with shanks and said commutator structure includes fixed annular members each having a notch therein against which one of said shanks bears whereby upon operation of the associated electromagnetic means the associated dog is retained in driving engagement with said drive means during a complete rotation thereof less a single step represented by said notch.

14. The device according to claim 13 wherein said dog and said fixed annular member carry interengaging cam means which restore the dog to disengaged position with respect to said drive means as the associated ring and commutator complete the last step of a complete revolution.

15. The device of claim 10 wherein means are provided for disengaging the commutator segments of one commutator from said contact wires upon energization of the electromagnetic means of the other commutator and engagement of its commutator segments with said contact wires.

16. The device of claim 15 wherein said disengaging means comprises a series of members mounted in said drive means for axial movement and bearing against said commutator segment mounting rings, said members being of such axial length as to move the commutator segments of one commutator out of engagement with said contact wires as the segments of the other commutator move into engagement therewith.

17. In a carriage control device for the paper carriage of a printing mechanism, a commutator device comprising in combination a shaft, a driving clutch element fixed on said shaft, a pair of sleeves rotatably mounted on said shaft on either side of said driving clutch element, a disk fixed to each sleeve at the end adjacent said clutch element, each said disk having an axially extending flange thereon, a plurality of commutator segments insulatingly mounted on each flange, said segments forming two identical sets, a cylindrical magnet armature fixed to each sleeve, a cylindrical electromagnet mounted in fixed position adjacent each said armature, a driven clutch mem-

ber mounted in each said disk and movable into engagement with said driving clutch element upon energization of the corresponding magnet, an annular ring fixedly mounted concentric to said shaft in the plane of said driving clutch element, a plurality of contact wires insulatingly mounted in said ring and extending radially inward to a position in which the ends thereof are adapted to be engaged by said commutator segments when the corresponding driven clutch element engages said driving clutch element, and means for connecting selected circuits to said contact wires, said means comprising jacks insulatingly mounted in said annular wire mounting ring and electrically connected to individual ones of said contact wires.

18. In a device for controlling the line feeding movements of the paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms and wherein the printing mechanism energizes circuits to operate a skip latch to cause the carriage to operate and a stop latch to cause cessation of said operation, in combination, a commutator, said commutator having a plurality of contact segments each associated with a particular carriage and printer operation and having a plurality of contact brushes each associated with a selectable line on a form, means for rotating said commutator segments in synchronism with the paper carriage, and a slow zone latch to cause the carriage to operate at its lower speed, said commutator segments being interposed between said printing mechanism control circuits and said slow zone and stop latches to cause the carriage to move from an initial to a final position at high speed followed by low speed or at low speed only, depending upon the number of lines between said initial and final position and the lengths of said commutator segments.

19. The device according to claim 18 wherein a circuit is provided which normally causes the printing mechanism to delay its functions and wherein the first of said segments to reach an energized circuit and contact brush causes said printing mechanism delay to cease, the second of said commutator segments to reach said energized contact brush extends said circuit to cause said slow zone latch to operate and the third of said commutator segments to reach said energized contact brush extends a circuit to cause said stop latch to operate, the intervals of printing mechanism delay, high speed operation and low speed operation depending respectively upon the number of line spaces between the leading edge of said first commutator segment and the energized circuit at the operation of the skip latch, the number of line spaces between said leading edge of said first commutator segment and said energized circuit at the time of operation of said skip latch and the length of said first commutator segment, and the length of said second commutator segment.

20. Device according to claim 19 wherein as the printer carriage stops under control of the stop latch the printing mechanism causes the selected energized circuit to be deenergized.

21. In a device for controlling the line feeding movements of the paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms and wherein the printing mechanism energizes circuits to operate a skip latch to cause the carriage to operate and a stop latch to cause cessation of said operation, in combination, a commutator device having two identical sets of contact segments, respective segments being associated with particular carriage and printer operations, and having a common plurality of contact brushes each associated with a selectable printing line on a form, means for advancing said commutator segments with respect to said contact brushes in synchronism with the movement of the paper carriage, and a slow zone latch to cause the carriage to operate at its lower speed, said commutator segments being interposed between said printing mecha-

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nism control circuits and said slow zone and stop latches to cause the carriage to move from an initial to a final position at high speed followed by low speed or at low speed only, depending upon the number of lines between said initial and final position and the lengths of said commutator segments.

22. Device according to claim 21 wherein a circuit is provided which normally causes the printing mechanism to delay its functions and wherein the first of said segments to reach an energized circuit and contact brush causes said printing mechanism delay to cease, the second of said commutator segments to reach said energized contact brush extends said circuit to cause said slow zone latch to operate and the third of said commutator segments to reach said energized contact brush extends a circuit to cause said stop latch to operate, the intervals of printing mechanism delay, high speed operation and low speed operation depending respectively upon the number of line spaces between the leading edge of said first commutator segment and the energized circuit at the operation of the skip latch; the number of line spaces between the trailing edge of said first commutator segment and said energized circuit at the time of operation of said skip latch; and the length of said second commutator segment.

23. Device according to claim 21 wherein a circuit is provided which normally causes the printing mechanism to delay its functions and wherein the first of said segments to reach an energized circuit and contact brush causes said printing mechanism delay to cease, the second of said commutator segments to reach said energized contact brush extends said circuit to cause said slow zone latch to operate and the third of said commutator segments to reach said energized contact brush extends a circuit to cause said stop latch to operate, the intervals of printing mechanism delay, high speed operation and low speed operation depending respectively upon the number of line spaces between the leading edge of said first commutator segment and the energized circuit at the operation of the skip latch; the number of line spaces between the trailing edge of said first commutator segment and said energized circuit at the time of operation of said skip latch; and the length of said second commutator segment, means for selectively engaging the contact segments of one of said sets with said brushes and disengaging the segments of the other set therefrom, an additional commutator segment following said three commutator segments, an energized lead connected to that brush of the series of brushes corresponding to the last line of a form, and circuit means connected to said additional commutator segments of said sets individually to energize the engaging means of the deenergized contact set.

24. In a device for controlling the line feeding movements of the paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms and wherein the printing mechanism energizes circuits to operate a skip latch to cause the carriage to operate in combination, a stop latch to cause cessation of said operation, a commutator device having two identical sets of contact segments, said sets being rotatable about a common axis, respective segments being associated with particular carriage and printer operations, said contact sets having a common plurality of contact brushes each associated with a selectable printing line on a form, a drive shaft, clutch means for connecting said commutator contact segment sets individually for drive by said shaft, individual actuating means for said clutch means, means for disengaging said clutch means individually after a single rotation of the associated contact segment, and reset means comprising a manually operable key, said reset means causing said skip latch and said stop latch to be operated sequentially to cause said drive shaft to rotate said commutator segment sets through a complete revolution while maintaining said actuating means inoperative

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to assure disconnection of said clutch means for both said sets of commutator contact segments.

25. Device according to claim 24 wherein said reset means includes delay means to cause the time interval between operation of said skip and stop latches to be at least equal to the time required for a revolution of said shaft.

26. Device according to claim 24 wherein said reset means comprises a reset latch and wherein a photocell for scanning the paper strip is provided, said photocell being under control of a photocell gate, said actuating means comprising magnet means for operating said clutch means individually for engaging one of said commutator contact segment sets with said contact brushes, a gate for said magnet means, and a selector for said magnet means, said reset means causing said reset latch to be turned on, said photocell gate and magnet gate to be turned off and said selector to select a predetermined one of said magnet means.

27. In a device for controlling the line feeding movements of the paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms having a mark for cooperating with a photocell for positioning said forms and wherein the printing mechanism energizes circuits to operate a skip latch to cause the carriage to operate, in combination, a stop latch to cause cessation of said operation, a commutator device having two identical sets of contact segments, respective segments being associated with particular carriage and printer operations and having a common plurality of contact brushes each associated with a selectable printing line on a form, a drive shaft, clutch means for individually connecting said commutator segment sets to said shaft for drive thereby, magnetic means for selectively energizing said clutch means upon a complete rotation of the corresponding commutator contact set, a photocell operable by the mark on the paper forms, a photocell gate, a gate for energizing said magnetic means, a selector for said magnetic means, reset means comprising a manually operable key, said reset means causing said skip latch and said stop latch to be operated sequentially to cause said drive shaft to rotate through at least a complete revolution while maintaining said magnetic means inoperative to assure operation of said clutch disengaging means for both said commutator contact segment sets, said reset means causing said reset latch to be turned on and said photocell gate and magnet gate to be turned off during said complete revolution, start means for causing the carriage to rotate at slow speed and means operable by said photocell coincidentally with said reset latch and photocell gate to stop the carriage in position depending on the mark on the paper form, said means also turning said reset latch off and said magnet gate on, said operation of said magnet gate causing energization of the magnet selected by said magnet selector.

28. In a device for controlling the line feeding movements of the paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms having a mark for cooperating with a photocell for positioning said forms and wherein the printing mechanism energizes circuits to operate a skip latch to cause the carriage to operate, in combination, a stop latch to cause cessation of said operation, a commutator device having two identical sets of contact segments, respective segments being associated with particular carriage and printer operations and having a common plurality of contact brushes each associated with a selectable printing line on a form, a drive shaft, clutch means for individually connecting said commutator contact sets to said shaft for drive thereby, magnetic means for selectively energizing said clutch means, means automatically disengaging said clutch means upon a complete rotation of the corresponding commutator

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contact set, a photocell operable by the mark on the paper forms, a photocell gate, a gate for energizing said magnetic means, a selector for said magnetic means, reset means comprising a manually operable key, said reset means causing said skip latch and said stop latch to be operated sequentially to cause said drive shaft to rotate through at least a complete revolution while maintaining said magnetic means inoperative to assure operation of said clutch disengaging means for both said commutator contact sets, said reset means causing said reset latch to be turned on and said photocell gate and magnet gate to be turned off during said complete revolution, start means for causing the carriage to rotate at slow speed and means operable by said photocell coincidentally with said reset latch and photocell gate to stop the carriage in position depending on the mark on the paper form, said means also turning said reset latch off and said magnet gate on, said operation of said magnet gate causing energization of the magnet selected by said magnet selector, and circuit means operable by said commutator segments at the completion of each form for causing energization of the other magnet to energize said clutch means to connect the corresponding commutator contact set for rotation by said shaft.

29. In a device for controlling the line feeding movements of the paper carriage of a printing mechanism which carriage is adapted to be driven at two rates to operate on a paper strip divided into forms having a mark for cooperating with a photocell for positioning said forms and wherein the printing mechanism energizes circuits to operate a skip latch to cause the carriage to operate, in combination, a stop latch to cause cessation of said operation, a commutator device having two identical sets of contact segments, respective segments being associated with particular carriage and printer operations and having a common plurality of contact brushes each associated with a selectable printing line on a form, a

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drive shaft, clutch means for individually connecting said commutator segment sets to said shaft for drive thereby, magnetic means for selectively energizing said clutch means, means automatically disengaging said clutch means upon a complete rotation of the corresponding commutator contact segment set, a photocell operable by the mark on the paper forms, a photocell gate, a gate for energizing said magnetic means, a selector for said magnetic means, reset means comprising a manually operable key, said reset means causing said skip latch and said stop latch to be operated sequentially to cause said drive shaft to rotate through at least a complete revolution while maintaining said magnetic means inoperative to assure operation of said clutch disengaging means for both said commutator contact segment sets, said reset means causing said reset latch to be turned on and said photocell gate and magnet gate to be turned off during said complete revolution, start means for causing the carriage to rotate at slow speed and means operable by said photocell coincidentally with said reset latch and photocell gate to stop the carriage in position depending on the mark on the paper form, said means also turning said reset latch off and said magnet gate on, said operation of said magnet gate causing energization of the magnet selected by said magnet selector, circuit means operable by said commutator segments at the completion of each form for causing energization of the other magnet to engage the corresponding commutator contact segment set for rotation, and a coincidence circuit operable by said photocell at each successive passage of a mark on a form to signal the printing mechanism that the paper is in proper position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,014,570

December 26, 1962

James M. Cunningham

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 15, line 70, after "segment" insert -- set --.

Signed and sealed this 24th day of April 1962.

(SEAL)

Attest:

ESTON G. JOHNSON

Attesting Officer

DAVID L. LADD

Commissioner of Patents