

Sept. 1, 1942.

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2,294,385

SELECTIVELY OPERABLE MECHANISM FOR TYPOGRAPHICAL MACHINES AND THE LIKE

Filed Sept. 23, 1939

6 Sheets-Sheet 1

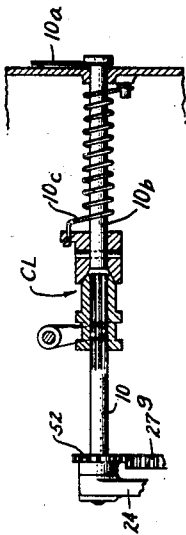


Fig. 1a.

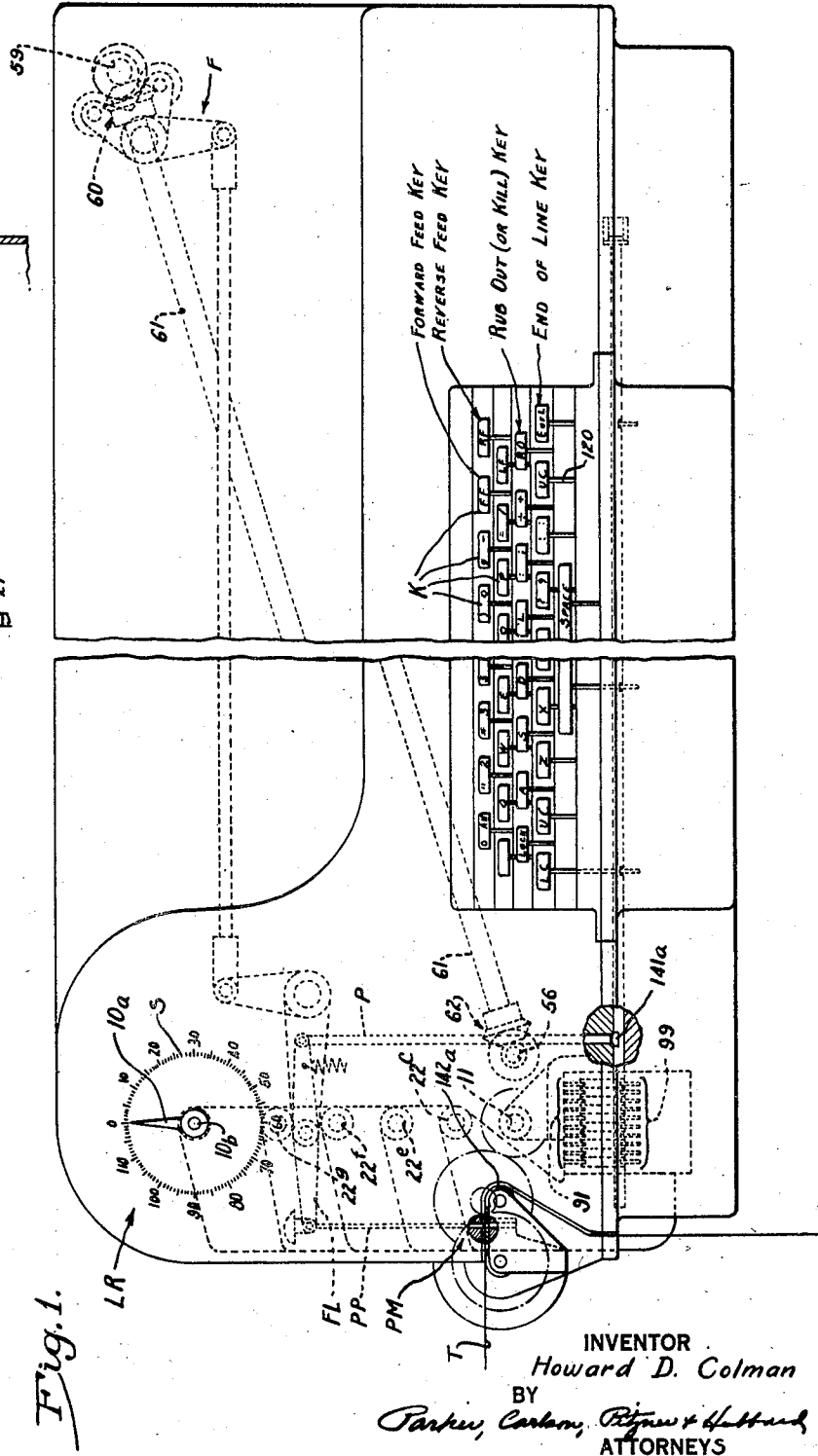


Fig. 1.

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6 Sheets-Sheet 2

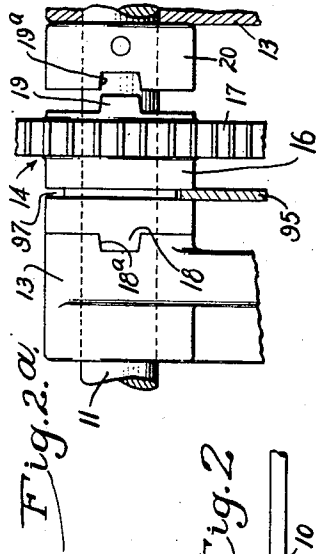
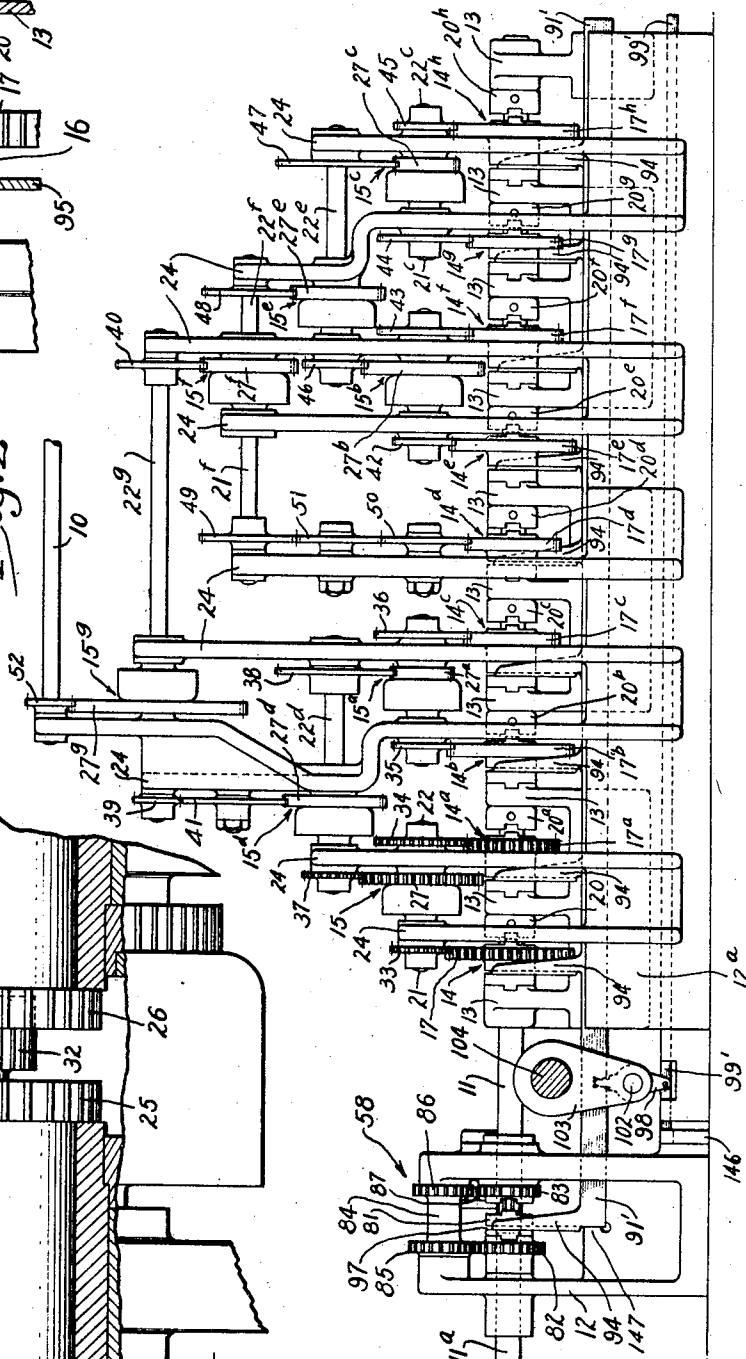
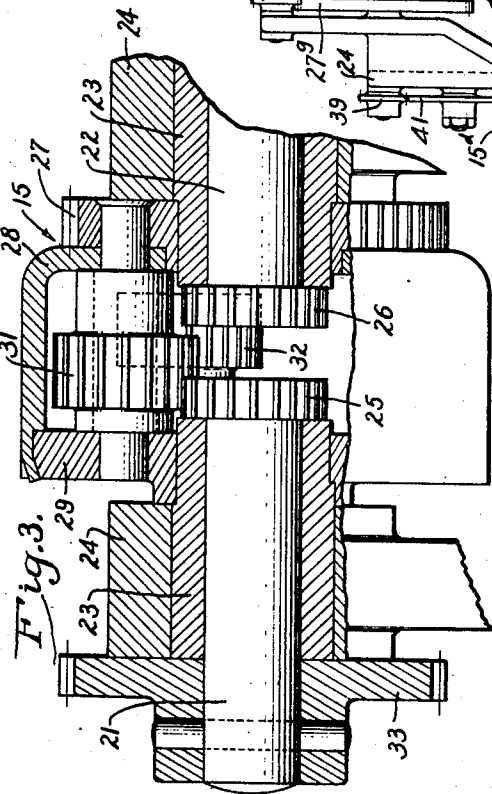


Fig. 2



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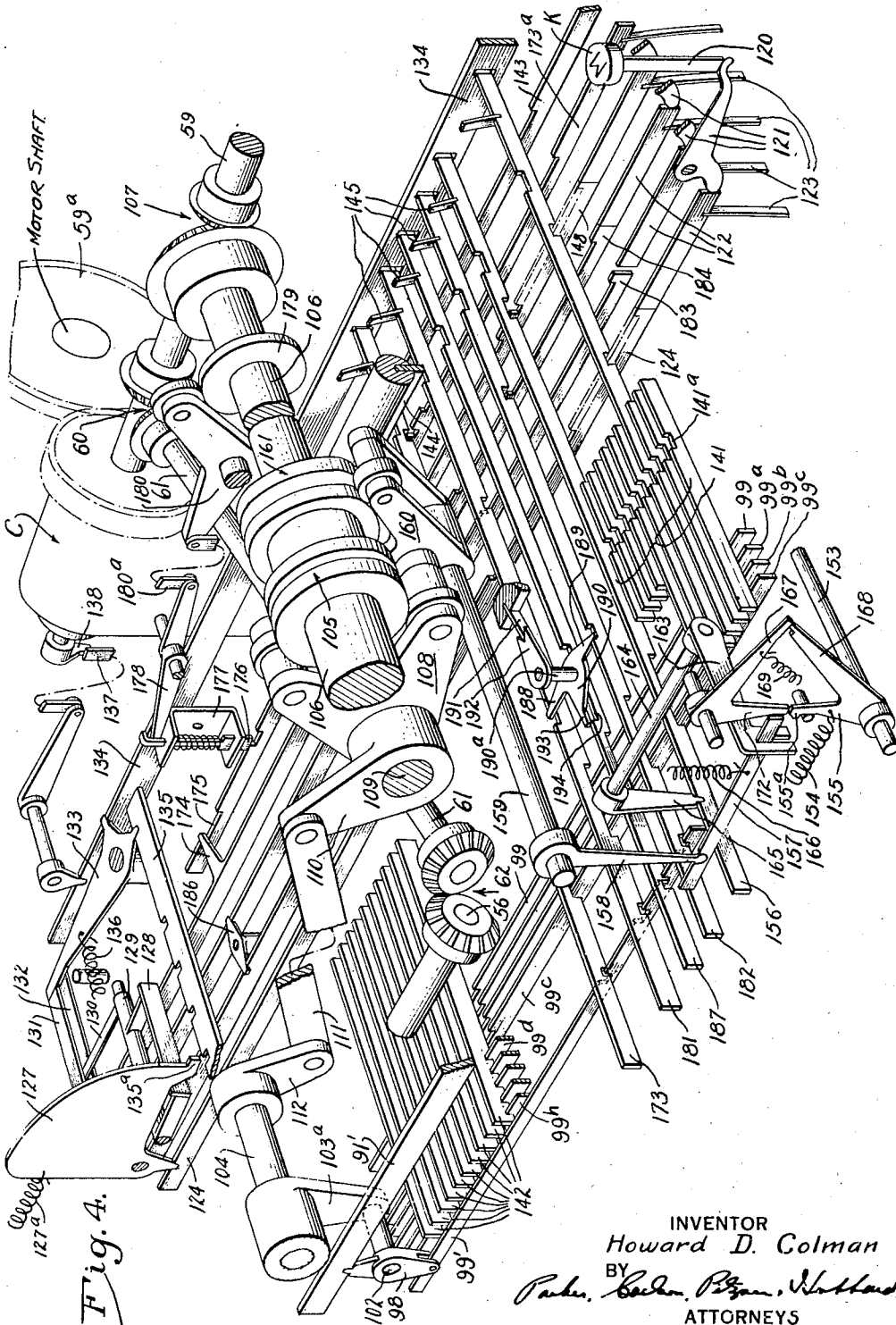
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6 Sheets-Sheet 3



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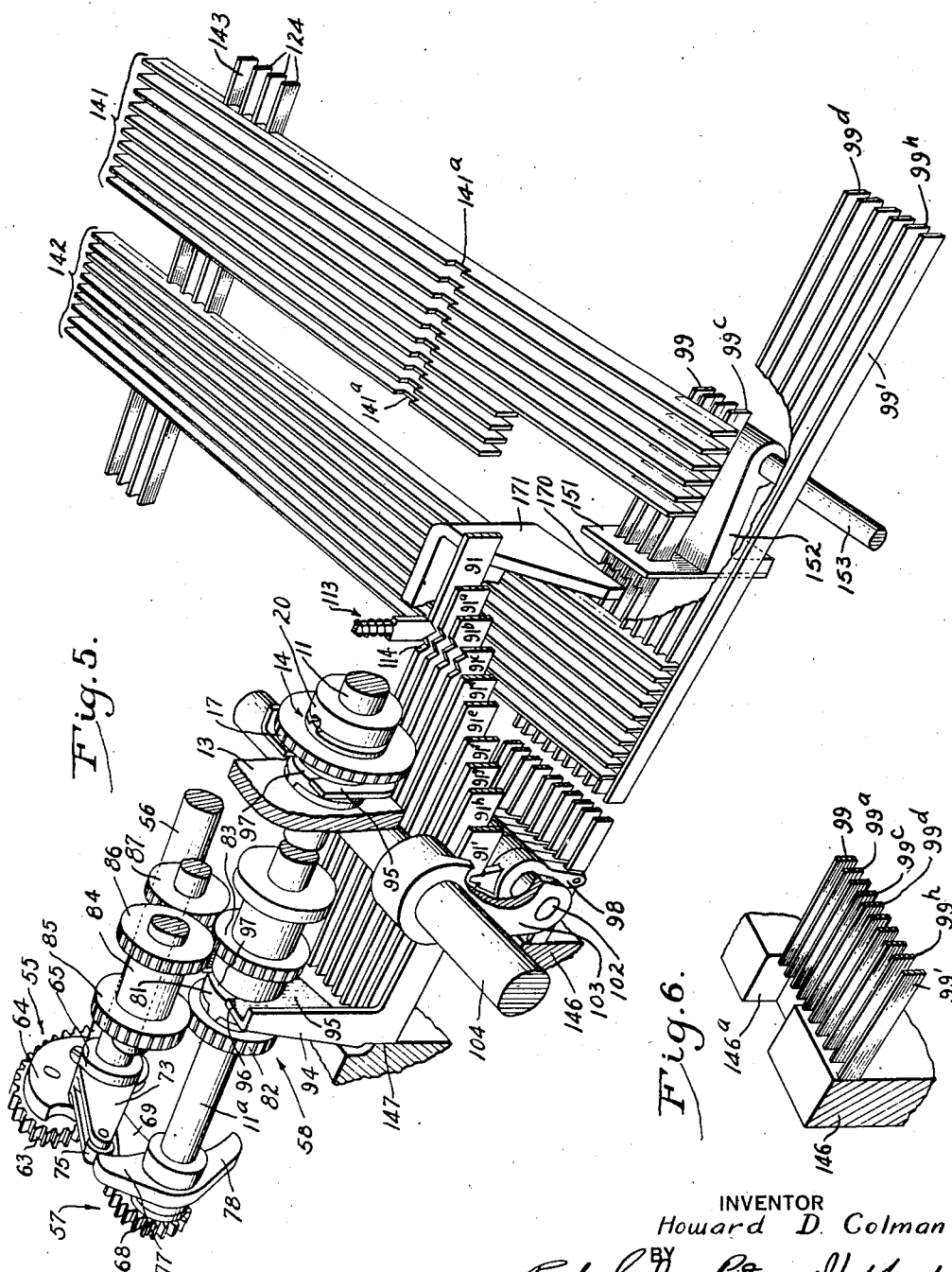
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SELECTIVELY OPERABLE MECHANISM FOR TYPOGRAPHICAL MACHINES AND THE LIKE

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6 Sheets-Sheet 4



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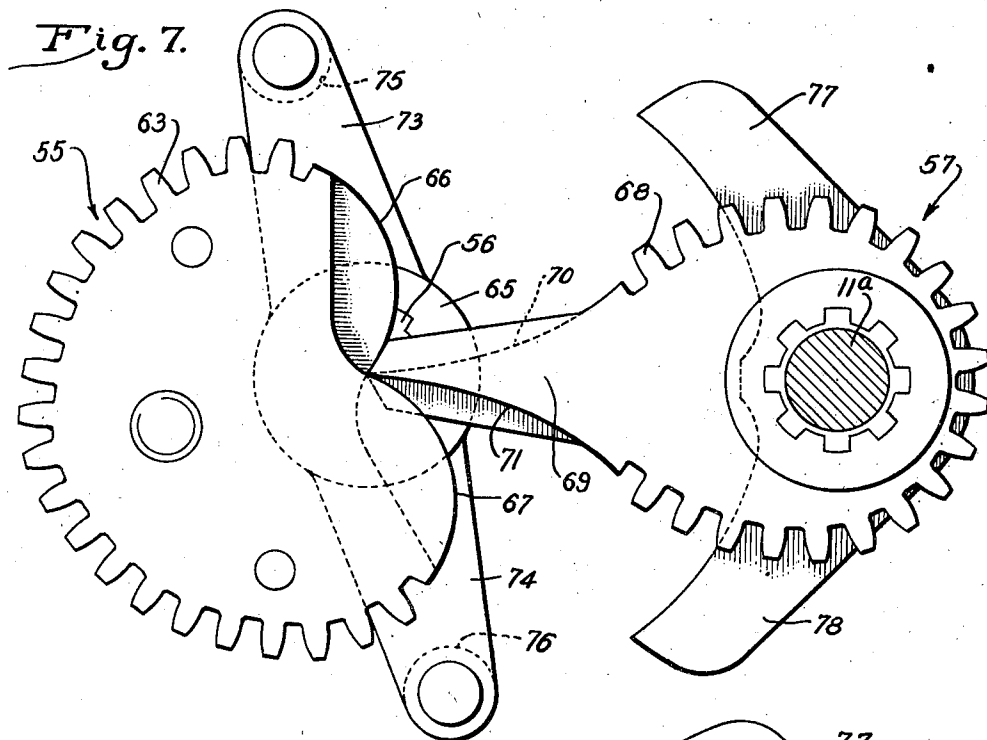
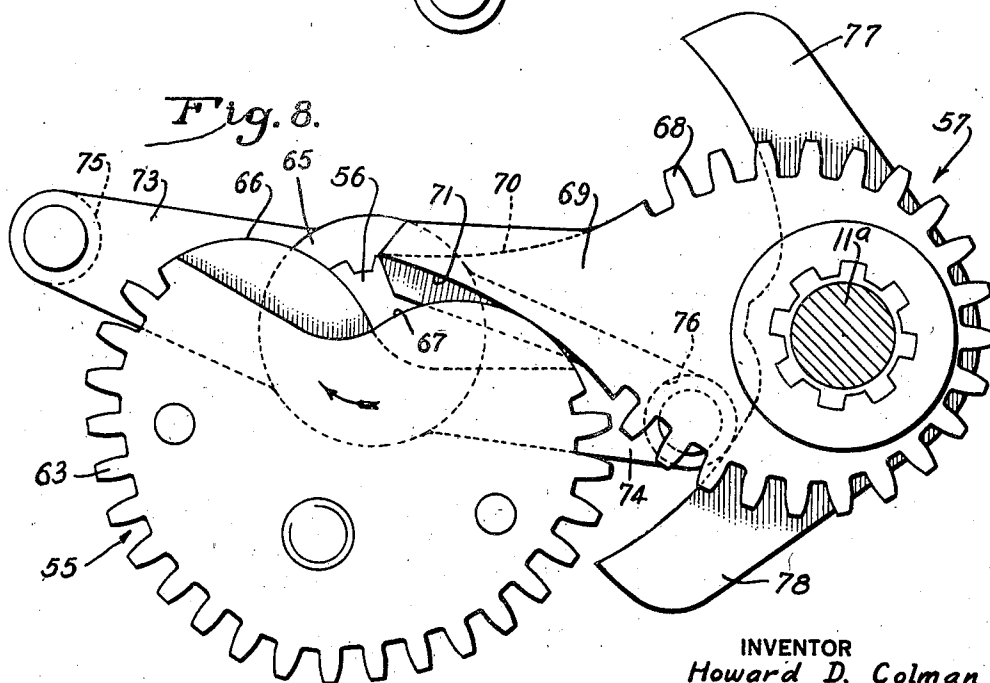
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SELECTIVELY OPERABLE MECHANISM FOR TYPOGRAPHICAL MACHINES AND THE LIKE

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6 Sheets-Sheet 5



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SELECTIVELY OPERABLE MECHANISM FOR TYPOGRAPHICAL MACHINES AND THE LIKE

Filed Sept. 23, 1939

6 Sheets-Sheet 6

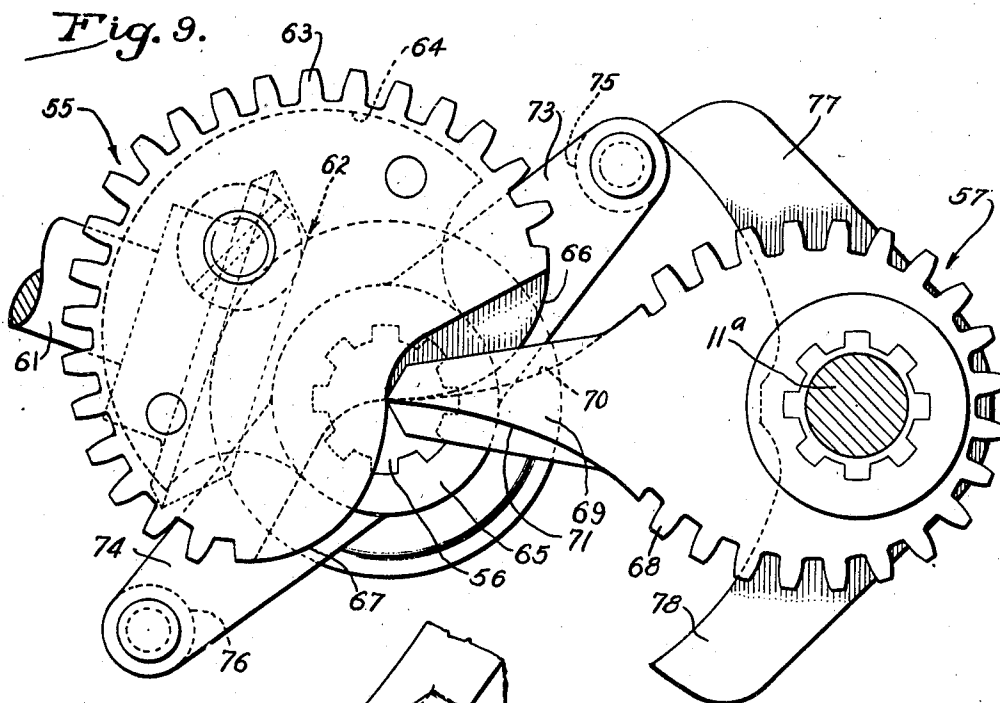
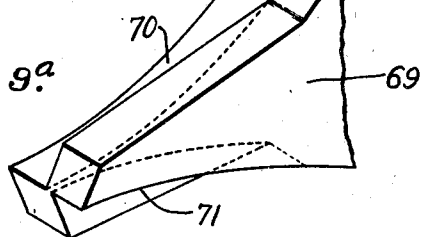
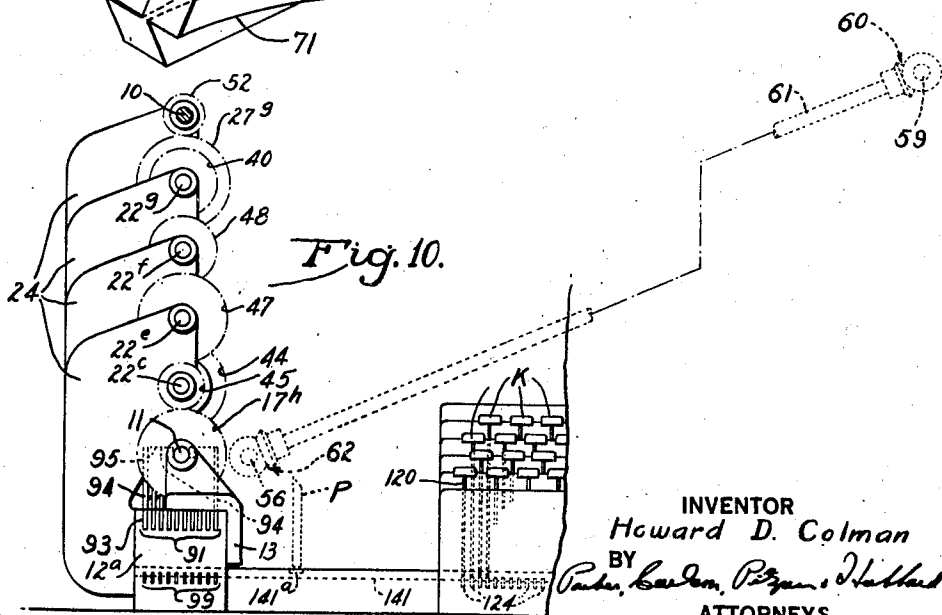


Fig. 9a



UNITED STATES PATENT OFFICE

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SELECTIVELY OPERABLE MECHANISM FOR
TYPOGRAPHICAL MACHINES AND THE
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Application September 23, 1939, Serial No. 296,201

77 Claims. (Cl. 164—112)

The invention relates to an improved selectively operable mechanism including a novel variable drive mechanism and associated operating and controlling instrumentalities particularly adapted for use in typographic composing machines.

In practically all machines of the above general character, there is some part which must be moved in relatively small steps on the order of a fraction of an inch, accurately proportioned to the set widths, that is, the dimensions measured longitudinally of a line, of characters being composed into justified lines. Thus perforators employed in the preparation of control tapes for line casting or type casting machines are ordinarily provided with a part such as an indicator or pointer adapted to be moved in successive incremental steps relative to a scale to totalize and indicate cumulative widths of characters as the corresponding signals are perforated in the tape, so that the operator may determine the point at which the line can be justified. Indicators of this character are employed for a similar purpose in type casting and line casting machines arranged for keyboard operation. Additionally, in type casting machines accurate movement of a part in extremely small steps is required for adjustment of the type mold to enable it to produce type slugs of the desired set width. In printing and typing machines also, a variable drive is essential for relatively shifting the paper carriage and character impressing mechanism in steps accurately proportioned to the set widths of the characters printed, so that each character will occupy its proper position in the line. Other examples of incrementally movable parts can be cited, but the foregoing are believed sufficient to indicate the environment in which the present invention is particularly useful.

One object of the present invention is to provide an improved selectively operable mechanism for variably moving the incrementally movable parts in machines of the above general character which to a maximum degree is certain and extremely accurate in its operation under all conditions and particularly under the condition of high speed operation.

Another object is to provide a selectively operable mechanism which, while of simple, compact construction, is capable of imparting to the movable part any selected one of a large number of steps of different amplitude.

Another object is to provide a variable drive mechanism embodying a relatively small number of primary driving elements adapted to be

conditioned for operation permutably to enable the mechanism to impart to a movable member any one of a large number of steps of different amplitude.

Another object is to provide a novel arrangement of permutably engageable clutches and differential gearing for variably operating a shaft or other driven element.

Still another object is to provide improved means for selectively engaging a group of clutches in different permutational combinations for variably operating a driven member.

It is also an object of the invention to provide an improved control strip perforating machine embodying novel key actuated means for controlling the concurrent operation of a strip perforating mechanism and a register mechanism.

A more specific object is to provide a novel variable drive mechanism particularly suitable for driving the line register of a keyboard operated composing machine and adapted to produce an extremely accurate measure of the normal set width of characters employed in a composition.

A further object is to provide a novel variable drive mechanism of the above general character adapted to register by appropriate movement of an indicator or the like the set widths of the characters of the composition and to add thereto fixed increments representing predetermined different spacings of the characters.

Another object is to provide a novel drive mechanism selectively controllable to rotate a shaft in either direction in steps of varying amplitude and operative to impart such rotative steps to the shaft with uniform acceleration and deceleration regardless of the direction of rotation of the shaft or the amplitude of the steps.

It is also an object of the invention to provide, in a keyboard operated composing machine or the like, improved means for selectively controlling the direction of rotation of a register drive shaft.

The objects of the invention above set forth together with other and ancillary advantages are obtained by the structure illustrated in the accompanying drawings and hereinafter more particularly described. It is to be understood, however, that various changes and modifications in the form, construction and arrangement of the parts may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims.

In the accompanying drawings:

Figure 1 is a front elevational view of a keyboard operated control strip perforating machine embodying the features of the machine.

Fig. 1^a is a detail view of the connecting mechanism interposed between the register drive shaft and the register pointer.

Figure 2 is a partly diagrammatic side elevational view of a variable drive mechanism embodying the features of the invention.

Fig. 2^a is a detail view of one of the clutches of the drive mechanism.

Fig. 3 is a sectional view of a spur gear differential employed in the drive mechanism.

Fig. 4 is a fragmentary perspective view somewhat schematic in character, showing characteristic elements of the keyboard selector mechanism with which the variable drive mechanism is associated and by which it is selectively controlled.

Fig. 5 is a perspective view showing the arrangement of the control bars and other elements utilized in the selective control and operation of the drive mechanism.

Fig. 6 is a fragmentary perspective view of the latch bars and cooperating abutment for positioning the same.

Fig. 7 is a detail view of the uniformly accelerated gears comprising a part of the drive mechanism showing the gears in normal rest position.

Figs. 8 and 9 are views similar to Fig. 7 showing the gears in different positions.

Fig. 9^a is a fragmentary view showing details of the uniformly accelerated gear drive.

Fig. 10 is a fragmentary front elevational view showing the relative arrangement of the variable drive mechanism and the manual keyboard.

By way of illustration, the improved variable drive mechanism and associated controlling and operating instrumentalities may be used in a keyboard operated control tape composing machine equipped with printing mechanism of the type disclosed in my prior application Serial No. 62,742, filed February 7, 1936, now Patent No. 2,196,354, granted April 9, 1940, and in my copending application Serial No. 313,851, filed January 15, 1940. In general, the keyboard mechanism illustrated is similar to that of the prior application with certain additions and modifications to better adapt it to function with the drive mechanism without materially changing its mode of operation insofar as the printing mechanism is concerned. The connections between the keyboard mechanism and the printing mechanism are fully shown in Fig. 16 of the patent referred to above.

In the present embodiment of the invention, the composing machine is designed and intended to perforate in a paper strip or the like permutably arranged groups of holes constituting permutational code signals for controlling the operation of a line casting, type casting, printing or other typographic machine. Generally speaking, there are two types of code signals, namely, character signals and function signals. The first mentioned signals determine the particular character to be produced in the typographic machine while the latter signals initiate various functions of the machine. Simultaneously with the perforating of a character signal on the control strip the corresponding character may, if desired, be printed on a separate visibility sheet for the guidance of the operator. Printing mechanism for accomplishing this result is disclosed

in the above mentioned patent and in copending application Serial No. 313,851 by same applicant.

In order to enable the operator of the perforator to determine the point at which a line should be terminated so that it can be justified, suitable means such as a line register is provided for totalizing and indicating the cumulative width of the characters and spaces as the signals representing them are perforated in the tape. The register of course must be driven variably in accordance with the characters used in the composition and with this in view it is desirable to incorporate in the machine a part adapted to be moved variably in steps of accurately predetermined amplitude under control of the various keys actuated to perforate the character signals in the control tape.

In the exemplary machine selected to illustrate the invention, the variably movable part utilized to drive the register comprises a rotatable shaft 10 (Fig. 2) hereinafter referred to as the register drive shaft. The present invention is concerned primarily with the driving of an element such as this shaft through any one of a large number of steps, each of which is of different amplitude, and in the present embodiment is applied to the rotation of the register drive shaft in steps accurately proportioned to the set widths of the characters represented by the signals perforated in the control tape and also the widths of the spaces to be interposed between the characters in the finished composition. These movements are imparted to the shaft by power driven means through a novel variable drive mechanism constituting a part of a selectively operable mechanism of the machine. The shaft 10, in turn, is suitably connected to drive a pointer 10^a (Figs. 1 and 1^a) relative to a scale S, these parts comprising the indicating portion of a line register LR. In the particular form illustrated, the pointer is carried on a shaft 10^b drivingly connected with the shaft 10 by a clutch device CL which is disengageable to permit restoration of the pointer to normal rest position by a suitable return spring 10^c.

Referring more particularly to Fig. 2, the variable drive mechanism in its preferred form comprises an actuating member having a fixed range of movement, herein shown as a cyclically operable shaft 11, conveniently called the primary drive shaft. This shaft is rotatably supported in a plurality of bearings one of which is carried on a rigid frame 12 and the other carried by brackets 13. The frame 12 may be integral with or suitably secured to the base of the machine in which the mechanism is installed. As herein shown, the brackets 13 are mounted on an auxiliary frame 12^a secured to the machine base, the brackets being appropriately spaced apart longitudinally of the shaft. Suitable means is provided for rotating the shaft cyclically through its fixed range of movement, in this instance a single revolution, and in either direction, as will appear presently.

The cyclic rotation of the shaft 11 through its fixed range is utilized to drive the register drive shaft 10 variably through the medium of a transmission or drive mechanism including a series of primary driving elements, 14, 14^a, 14^b, 14^c, 14^d, 14^e, 14^f, 14^g, 14^h, capable of being conditioned to be driven by the shaft 11 singly or in different permutational combinations. For conditioning these elements there is provided a series of positively acting clutches adapted to be engaged and disengaged by means of shiftable devices operat-

ing selectively. The rotational movements of the driving elements are combined by means of differential gearing preferably comprising a plurality of differential gear units 15, 15^a, 15^b, 15^c, 15^d, 15^e, 15^f, 15^g, arranged in pyramid formation. The terminal unit of the pyramid is suitably connected with the shaft 10, thus providing a geared driving connection between the actuating member or shaft 11 and the part to be variably moved, in this case the shaft 10.

The primary driving elements 14 to 14^h are all of similar construction, each comprising a central hub portion 16 (Fig. 2^a) and an integrally formed gear 17. The driving elements are loosely mounted on the shaft 11, one between each pair of brackets 13, and are adapted to be selectively locked either to the shaft or to a stationary part of the frame by movement of the element longitudinally of the shaft. For this purpose, locking and driving clutches 18 and 19 are provided. These clutches are herein shown as comprising suitable clutch teeth formed on opposite ends of the hub 16 and adapted to engage cooperating clutch elements such as grooves 18^a and 19^a formed respectively in the face of the adjacent bracket 13 and in the face of a collar 20 pinned or otherwise rigidly secured to the shaft 11. Accordingly when a driving element is shifted to the left, as viewed in Figs. 2 and 2^a, it is positively locked to the frame structure by the locking clutch 18 and therefore remains stationary when the shaft is rotated. When the driving element is shifted to the right, the teeth of the driving clutch 19 are engaged to connect the driving element to the collar 20 for rotation with the shaft.

The differential gear units 15 to 15^g, which operate to combine the movements of the primary elements 14 to 14^h, may be of any suitable construction. It is preferred, however, to employ spur gear differentials which, by reason of their compact construction, require a minimum of space and which can be manufactured with a high degree of accuracy and yet at relatively low cost. Gearing of this character is illustrated and described on page 221 of "Mechanism and Mechanical Movements," by Jones, The Industrial Press, 1920, first edition.

Referring now to Fig. 3, the spur gear differentials 15 to 15^g, as herein shown, each comprises a pair of terminal elements in the form of shafts 21 and 22 rotatably supported in axial alignment in bearing sleeves 23 carried on upright members 24 rigid with the machine base. The terminal shafts are formed on their adjacent inner ends with spur gears 25 and 26 respectively, while suitable terminal gears to be referred to hereinafter are pinned or otherwise rigidly secured to the outer ends of the shafts for driving purposes. Rotational movements imparted to the shafts 21 and 22 by the gears 17, 17^a, etc., are transmitted to an intermediate element in the form of a gear 27 in variable amounts according to the selective operation of the locking and driving clutches 18 and 19. For this purpose the following construction is provided.

The intermediate gear 27 is journaled on the right-hand bearing sleeve 23 (Fig. 3) and to it is suitably attached a cup-shaped member or shell 28 extending over the adjacent ends of the shafts 21 and 22 and enclosing the gears 25 and 26. A disk 29 staked or otherwise firmly secured in the open end of the shell 28 cooperates therewith to form a cylindrical gear casing and to

provide a bearing for the assembly on the left-hand sleeve 23.

Journalled in the opposite end walls of the gear casing, respectively, with their axes parallel to the axes of the shafts 21 and 22, are a pair of intermeshing spur pinions 31 and 32. The pinions are arranged in offset relation so that pinion 31 meshes with the gear 25 of the left-hand terminal shaft while pinion 32 meshes with the gear 26 of the right-hand shaft. Since these pinions also mesh with each other, rotative movement of either shaft individually or the combined rotative movements of both shafts are imparted to the intermediate gear 27. Thus when the shaft 21 is locked against movement and the shaft 22 is rotated, the gear 26 drives the pinions 32 and 31. As the latter is in mesh with the stationary gear 25, both pinions travel in an orbit around the stationary gear thus imparting rotation to the gear casing and the attached intermediate gear 27. Conversely, when the shaft 22 is locked against movement and the shaft 21 is rotated, gear 25 drives the pinions 31 and 32 which describe an orbit around the stationary gear 26 and thus impart rotation to the gear case and intermediate gear 27. If both shafts are rotated, the pinions are driven at a higher rate of speed in their orbit around the gears 25 and 26, the gear casing and intermediate gear 27 being turned through an angle proportioned to the combined angular movements of the two shafts. In this way, the intermediate gear is enabled to transmit the motion of either terminal shaft or the combined motions of the two terminal shafts to the succeeding element of the drive mechanism.

In the exemplary drive mechanism shown in Fig. 2, the nine primary elements 14 are divided into two groups with separate driving gear trains hereinafter referred to as the character registering train and the letter space registering train, respectively. The latter includes the four primary elements, 14, 14^a, 14^b, and 14^c, while the other five primary elements are included in the character registering train. The purpose of this grouping is to provide for the operation of the register drive shaft from two independent sources of control, in this instance, for registering on the one hand the set widths of characters, and on the other the width of spaces between characters. The control devices differ in mode of operation, as will be explained in detail hereinafter, but the two driving trains operate as a unit in so far as their action on the register drive shaft is concerned.

As herein shown, the four primary driving elements of the letter space registering train are coupled in pairs by the differentials 15 and 15^a, respectively. The latter two differentials in turn are coupled by a third differential 15^d. Thus the gear 17 of the primary driving element 14 is arranged to mesh with a terminal gear 33 on the left-hand terminal shaft of the differential 15, while the gear 17^a of element 14^a is arranged to mesh with gear 34 on the right-hand terminal shaft of that differential. The differential 15^a is similarly driven by the primary elements 14^b and 14^c, its left-hand terminal gear 35 meshing with the gear 17^b and its right-hand terminal gear 36 meshing with the gear 17^c.

The intermediate gears 27 and 27^a of the differentials 15 and 15^a in turn mesh respectively with left and right-hand terminal gears 37 and 38 of the differential 15^d. The intermediate gear 27^d of the last mentioned differential is arranged

to drive the left-hand terminal gear 39 of the differential 15^a, the right-hand terminal gear 40 of which is driven by the differential gearing of the character registering train to be described presently. An idler gear 41 is interposed between the gears 27^d and 39 to compensate for the fact that an additional differential gear unit is employed in the character registering train so that both terminal gears of the differential 15^a will rotate in the same direction.

Since there are five primary driving elements in the character registering train, a somewhat different arrangement of differential gearing is required than that provided for the letter space registering train. In this case, the gears 17^a and 17^c drive terminal gears 42 and 43 of differential 15^b and gears 17^a and 17^b drive terminal gears 44 and 45 of differential 15^c. Intermediate gears 27^b and 27^c of the two differentials drive the terminal gears 46 and 47 of the differential 15^e. Intermediate gear 27^e of this differential drives one terminal gear 48 of the differential 15^f, the other terminal gear 49 of this differential being driven directly by the primary gear 17^d through the medium of idler gears 50 and 51. As the differential 15^f is last in the train, its intermediate gear 27^f is arranged to drive the terminal gear 40 of differential 15^a while the other terminal of this differential is connected with the letter space registering train. Thus the differential 15^a couples the gear trains of the two groups of primary driving elements. The combined movement of the elements is accordingly transmitted to the register drive shaft 10 by the intermediate gear 27^f of the last mentioned differential which meshes with a pinion 52 fast on the shaft 10.

Each of the primary driving elements 14 to 14ⁿ and each permutational combination of such elements is effective to impart a rotative step of different length to the register drive shaft 10 in response to a single revolution of the shaft 11 by reason of the different driving ratios of the various intermeshing pairs of gears, as shown in Fig. 2. Preferably, the gearing is so arranged that the rotative steps of the shaft 10 vary uniformly so that each step may represent one or more whole units, such as are commonly used to measure the set width of type slugs or printed characters in the typographical art.

In the particular mechanism illustrated, the four driving elements of the letter space registering train are capable of being clutched selectively to the drive shaft 11 in fifteen different permutational combinations and are thus adapted to rotate the shaft 10 and with it the pointer 10^a to register the width of any one of fifteen spaces differing from each other in multiples of the type unit. The gearing of the primary driving elements of the character registering train is similarly arranged so that these five elements are enabled to register thirty-one different character widths since the elements can be selectively clutched to the shaft 11 in any one of thirty-one different permutational combinations. In the operation of a machine such as that illustrated, the clutches associated with the driving elements of the character registering trains are engaged selectively to effect the registering of a character width and are then disengaged in each operating cycle of the machine. The clutches associated with the letter space registering train, however, are set only when a change in letter spacing is required, this setting being retained until another change is neces-

sary. The letter space registering train is thus effective to add a predetermined increment to the movement imparted to the register shaft 10 by the character registering train.

As the improved drive mechanism is particularly designed for high speed operation, it is advantageous to drive the various parts with uniform acceleration and deceleration, thereby minimizing strain on the moving parts and substantially eliminating the shock and jar incident to quick starting and stopping of the same. To this end, the shaft 11 is arranged to be driven by suitable mechanism, herein shown as gearing arranged to translate the uniform rotation of a cyclically operable drive shaft into uniformly accelerated and decelerated rotation of an intermediate shaft 11^a which, in the present instance, is drivingly connected with the shaft 11 through a suitable coupling device 53 (Figs. 2 and 5) to be described hereinafter. The gearing for producing the uniformly accelerated motion above referred to includes a driving member 55 (Figs. 5 and 7 to 9) fast on a drive shaft 56 and a driven member 57 fast on the intermediate shaft 11^a.

The shaft 56 may be driven in any suitable manner, and as herein shown is arranged to be driven directly from a cyclically operating shaft 59 (Fig. 4), in this instance, the start-stop shaft of the machine which in turn is driven by a single revolution clutch C of well known construction deriving power from a constantly driven gear 59^a which may be mounted on the shaft of a suitable motor (not shown) as indicated by the legend in the drawings. The driving connection between the shafts 59 and 56, as herein shown, includes bevel gears 60, cross shaft 61 and bevel gears 62. The gears have a one-to-one ratio so that the shaft 56 executes a single revolution in synchronism with each revolution of the start-stop shaft 59. With this arrangement, the operation of the shaft 11 can be accurately coordinated with the operation of the other elements of the machine.

Referring now to Figs. 5 and 7 to 9, the driving member 55 in its preferred form comprises a generally elliptical gear segment 63 riveted or otherwise rigidly secured to a correspondingly shaped plate 64 carried at one end of a sleeve 65 splined to the shaft 56. The gear segment and plate are disposed eccentrically with respect to the axis of the shaft 56 and each is cut away at one side to form driving and locking surfaces 66 and 67, respectively, which intersect substantially on the axis of the shaft.

The driven member 57 includes an elliptical gear 68 especially shaped to cooperate with the gear segment 63 of the driving member. One side of the segment 63 is extended to form an enlarged gear tooth 69 having opposite side edges cut to provide oppositely facing pitch surfaces 70 and 71 (Fig. 8) for cooperation with the driving and locking surfaces 66 and 67, respectively, of the driving member 55.

Mounted on the hub 65 of the driving member are a pair of radially projecting arms 73 and 74 carrying rollers 75 and 76 adapted to coact respectively with specially formed surfaces on arms 77 and 78 rigid with the gear 68 for locking and driving the member 57. The surfaces of the arms 77 and 78 are also pitch surfaces and are generated from the pitch surfaces 70 and 71 to assist in imparting the uniformly accelerated and decelerated motion to the driven member as will appear presently.

The various elements of the mechanism including the gears 63 and 68 are so positioned on their respective shafts that they occupy the position shown in Fig. 7 at the beginning and end of each operating cycle. This may be called the initial position of the elements. As the shaft 56 moves through the first 60° of its cyclic rotation, the gear 68 remains stationary as the tip of the projecting tooth 69 is locked between the surfaces 66 and 67 of the gear 63. This dwell provides sufficient time for the performance of certain functions of the machine such as the setting of the clutches of the variable drive train as will be described hereinafter.

Upon further rotation of the drive shaft 56, driving surface 66 engages the pitch surface 70 of the enlarged gear tooth and rocks the driven member with uniform acceleration to a position in which the first tooth of the gear 63 engages the first tooth of the gear 68. During this part of the cycle, roller 75 engages the pitch surface of the arm 77 as shown in Fig. 9 to lock the gears together and thus avoid any possibility of the gear 68 running ahead of the driving gear.

The drive is now effected through engagement of the gear teeth while the shaft 56 rotates through the next 270° of its revolution, the shape of the gears causing the shaft 11^a to accelerate uniformly until it completes one half of its revolution and then to decelerate uniformly. As the last tooth of the gear 63 passes the last tooth of the gear 68, the drive is taken over by the arm 74 and roller 76 acting on the pitch surface of the arm 78 as shown in Fig. 8. This pitch surface is formed to continue the uniform deceleration until the shaft 11^a is brought to rest with the shaft 56 still 30° from its initial position. Overrunning of the driven gear is effectively prevented by the locking action of the locking surface 67 and the pitch surface 71 of the gear 63 and tooth 69, respectively. The locking surface 66 moves into the path of the tip of tooth 69 at the instant the roller 76 leaves the pitch surface of the arm 78 and with driving surface 67, acts to lock the driving and driven members together as above explained, while the driving member completes the last 30° of its movement to initial position.

It will be apparent from the foregoing that, by reason of the shape of the gears 63 and 68, the intermediate shaft 11^a is uniformly accelerated in the first half of its revolution and uniformly decelerated in the second half of the revolution. Moreover, the shaft 11^a does not begin to turn until the shaft 56 has rotated through an angle of 60° and it is brought to rest when the shaft 56 is still 30° from rest position. As a result, the first mentioned shaft dwells both at the beginning and the end of each cycle. These dwells provide time for engagement and disengagement of the clutches of the drive mechanism so that the drive mechanism can carry out its intended function in one operating cycle of the machine. It will be understood, of course, that the length of the dwells, as well as their timing with respect to the rotation of the driving member, can be varied as required by appropriately shaping the coacting parts, thereby enabling the drive mechanism to be readily coordinated with the operation of the other elements of the machine.

As stated hereinbefore, the primary drive shaft 11 is connected with the intermediate shaft 11^a by the coupling mechanism 58 (Figs. 2 and 5). This coupling mechanism, as herein shown, comprises

a clutch and suitable reversing gears arranged to impart either forward or reverse rotation to the register drive shaft, although it will be understood that the mechanism may, if desired, include speed change gearing capable of varying the extent of rotation of the shaft 10 in each operating cycle of the machine. In the present instance, the clutch which comprises a part of the coupling mechanism additionally serves as a means for interrupting the rotation of the drive shaft 11 and thus prevents operation of the register drive shaft while the machine executes certain functions to be described hereinafter.

In the normal operation of the machine the shaft 10 is rotated in a forward direction, reverse rotation occurring in the present instance only when it is necessary to cancel, that is to rub-out or kill previously recorded characters as when the corresponding perforated character signals or printed characters are to be blanked out or otherwise rendered ineffective. This is ordinarily done by back spacing (reverse feeding) the tape sufficiently to bring the first character to be blanked out under the punches. Thereafter, the character and succeeding characters are blanked out in known manner by successive operations of a "rub-out" or "kill" key. In back spacing the tape, the same keys are used as were operated to punch the original character signals, the keys being operated in reverse order. As each key is operated, the clutches of the primary driving elements are set in premutational combinations corresponding to the character represented by the key so that the step imparted to the register drive shaft is accurately proportioned to such character. As the step is in the reverse direction with reference to the normal movement of the same, pointer 10^a is thus turned back to subtract an appropriate amount from the total registered thereby.

The coupling mechanism 58, as shown in Figs. 2 and 5, comprises a shiftable clutch member 81 provided at each end with suitable clutch teeth and splined to the shaft 11 so as to rotate therewith, but free to slide longitudinally of the shaft. The clutch teeth on one end of the member are adapted to engage cooperating teeth formed on the adjacent face of a gear 82 keyed to the end of the intermediate shaft 11^a while the teeth on the other end of the member are adapted to engage cooperating clutch teeth formed on the face of a gear 83. The last mentioned gear is loosely mounted on the shaft 11 and is arranged to be driven by the gear 82 but in the reverse direction.

Reverse rotation of the gear 83 is effected in the present instance by driving mechanism including a jack shaft 84 journaled at opposite ends in bearings on the frame 12 and formed with rigid gears 85 and 86 the first of which meshes with the gear 82 and the latter meshes with an idler gear 87 (Fig. 5) which in turn meshes with the gear 83. When the clutch member 81 is shifted to the left, as viewed in Fig. 2, the shaft 11 is directly coupled with the shaft 11^a and driven in the same direction. When the clutch member is shifted to the right, the drive is taken through the gears 82, 85, 86, 87 and 83 and the rotation of the shaft is therefore reversed. Further, the driving members 82 and 83 are spaced apart so that the driven member 81 may be set in an intermediate or neutral position to interrupt the driving connection for the shaft 11.

It will be apparent from the foregoing that by reason of the novel arrangement of the clutches

and gearing, a variably movable part such as the shaft 10 may be moved either forwardly or backwardly in incrementally varying steps accurately proportioned to the set widths of characters and spaces composed in a line. Moreover, the part is uniformly accelerated and decelerated regardless of its direction of movement or of the length of the step imparted thereto, thereby adapting the mechanism for high speed operation.

Various means may be utilized for setting, that is for engaging and disengaging the clutches of the primary driving elements in different combinations selectively to govern the length of the step imparted to the shaft 10 and to determine the direction of movement of the same. The particular setting means to be employed will depend upon the type of machine in which the variable drive mechanism is incorporated.

Preferably, power actuated means operating under the control of a permutation selector mechanism is employed, and in the case of the tape perforating machine herein shown, the clutches are set in combinations corresponding to character and space signals perforated in the control tape, the number of different combinations possible being, in the present instance, thirty-one for the character registering train and fifteen for the letter space registering train.

Referring more particularly to Figs. 2 and 5, the means for setting the clutches in its preferred form comprises a plurality of clutch shifter bars 91 and 91^h, inclusive, operatively associated with the primary driving elements 14 to 14^h, inclusive, and a shifter bar 91' similar in all respects to the first mentioned shifter bars and operatively associated with the shiftable member 81 of the reversing clutch. The shifter bars are arranged in side-by-side relation below the shaft 11 and are supported and guided for endwise sliding movement generally parallel to the axis of the shaft by suitable supporting frames or guides 93 (Fig. 10) mounted on the framework of the machine.

Each of the shifter bars is formed adjacent its rear end with an upstanding arm 94 having a laterally projecting flange 95 which is slotted as at 96 to fit into a peripheral groove 97 in the associated clutch member. With this arrangement, the clutch members, while free to rotate, are adapted to be shifted longitudinally of the shaft 11 by endwise movement of the associated shifter bars. Thus, when any of the shifter bars 91 to 91^h are moved rearwardly, the clutch members of the primary driving elements 14 to 14^h are locked to the stationary brackets 13. Upon movement of the shifter bars forwardly, the associated clutch members engage the collars 20 to 20^h to effect a driving connection with the shaft 11.

The shifter bar 91' for the reversing clutch 58 functions in the same general manner as the other shifter bars except that, in this case, the bar has an intermediate or neutral position in which it is effective to disengage the driven member 81 from both of the associated driving members. When the bar 91' is moved rearwardly from neutral position, it shifts the member 81 into engagement with the driving member 92, thus establishing a direct driving connection between the shaft 11 and the shaft 11^a so that the shafts rotate in the same direction. Movement of the shifter bar forwardly from neutral position shifts the member 81 into engagement with the driving member 83 and the shaft 11 is thereupon rotated in the reverse direction.

In the exemplary machine shown, the shifter

bars 91 to 91^h and 91' are operated selectively in different permutational combinations by power actuated devices comprising a series of individual floating levers 98 under the control of a series of latch bars 99 forming a part of a permutation selector mechanism of the keyboard type to be described in detail hereinafter. For convenience of identification the latch bars associated with the floating levers of the shifter bars 91 to 91^h are designated by the reference characters 99 to 99^h while the latch bar associated with the floating lever for the shifter bar 91' is designated by the reference character 99'. As will be seen by reference to Figs. 4 and 5, the floating levers 98 are assembled in side-by-side relation and pivoted intermediate their ends on an oscillating support in the form of a horizontal rod 102 extending below and transversely of the shifter bars. As herein shown, the rod 102 is supported by radially projecting arms 103 and 103^a fast on a rock shaft 104.

The upper end of each floating lever 98 engages in a notch in its associated shifter bar, thus providing an operative connection between these parts. The lower end of each lever is pivoted to one of the latch bars 99 which, as herein shown, are disposed substantially parallel to the shifter bars 91 and are likewise slidably supported for endwise movement.

Means is provided for rocking the shaft 104 to move the floating lever assembly forwardly to an advanced position and then back to normal rest position in each operating cycle of the machine, and shifting movements are imparted to selected ones of the shifter bars under the control of their corresponding latch bars 99 to 99^h and 99'. As herein shown, the means for rocking the shaft 104 comprises a cam 105 fast on a shaft 106 (Fig. 4), in this instance, the main cam shaft of the machine which is arranged to be driven cyclically from the shaft 59 through the medium of bevel gears 107. Cooperating with the cam 105 is a double cam follower 108 fast on a rock shaft 109 which has a crank arm 110 connected by a rigid link 111 with a crank arm 112 fast on the shaft 104. The cam 105 is thus enabled to rock the shaft positively in both its forward and reverse movements.

When the shaft 104 and floating lever assembly is initially rocked away from normal rest position, each floating lever acts to advance either its associated shifter bar or its latch bar. As each shifter bar is yieldably restrained against movement by a spring-pressed detent 113 (Fig. 5) engaging in a notch 114 in one edge of the bar, it accordingly remains stationary and the latch bar moves forward unless it is blocked, in which case the shifter bar is advanced against the action of the detent 113.

The selective blocking of the latch bars is effected, in the present instance, by means of control bars which in the exemplary machine, constitute permutational elements of the keyboard mechanism. This mechanism may be of any suitable type and, as herein shown, comprises a plurality of character and function keys K (Figs. 1, 4 and 10) arranged in a series of parallel rows at the front of the machine frame. As shown in Fig. 4, each of the keys has a stem 120 engageable with one arm of a pivoted bell crank lever 121. The other arm of the lever is operative through an intermediate member or key-return bar 122 to shift a codal element in the form of a notched bar or flag. Individual leaf springs 123 acting on the return bars 122 tend to

hold the keys in their normal elevated position.

The flags for the character keys of which only one flag 124 is shown by way of illustration, are notched along their upper edges so as to control in well known manner the operation of the permutation elements or control bars. These flags as well as the flags of certain of the function keys are also utilized to initiate an operating cycle of the machine whenever the associated key is depressed. To this end, the flags are extended to the rear of the machine into operative relation with means for tripping the main clutch C which drives the start-stop shaft 59. The clutch tripping means is so arranged that the operation is invariably limited to a single cycle, in this instance consisting of a single revolution of the shaft 59.

The clutch tripping means in its preferred form comprises a series of pivoted members 127 each articulated to one of the flags 124 to be rocked about its pivot when the flag is shifted rearwardly upon the depression of its associated key. A spring 127^a normally tends to hold the member in a retracted position and the associated flag in its forward position. When the member 127 is rocked out of retracted position, it engages a bail 128 and rocks a shaft 129 which has a radially projecting finger 130 cooperating with a pair of spring latches 131 and 132. The latch 131 is normally positioned to block one arm of a pivoted three-arm lever 133 whose other arms are operatively connected to a release bar 134 and a locking bar 135 respectively. Upon withdrawal of the latch 131 incident to the depression of a key, the lever 133 is rocked about its pivot by a spring 136 to shift the release bar 134 rearwardly and to shift the locking bar 135 to the right as viewed in Fig. 4.

The locking bar 135 is disposed below forwardly projecting lugs 135^a of the several pivoted elements 127 and its rearward edge is notched to provide clearance for the lugs. When the latch bar is shifted by the lever 133 as above explained, the notches are withdrawn from the path of the lugs 135^a and the bar accordingly operates in well known manner to lock an operated member 127 and its associated flag in operated position and to prevent operation of a second flag.

Movement of the release bar 134 in response to the withdrawal of the latch 131 serves to trip the clutch C for an operating cycle by withdrawing a detent 137 from blocking relation to a finger 138 carried by the driven element of the clutch. Upon completion of the operating cycle the detent is again positioned to block the clutch finger and the members 127 are released by return of the release bar and locking bar to normal retracted position, such return being effected by suitable means such as a cam on the main cam shaft 106 as shown and described in the prior application Serial No. 62,742, above referred to.

If the key which initiates the operating cycle is released before the cycle is completed, the latch 131 again engages the lever 133 and holds the release and locking bars in retracted position. If this key should be held depressed, the auxiliary latch 132 occupies such a position as to block the member 133 and thus hold the bars retracted to prevent initiation of another operating cycle.

In the particular machine illustrated, two independent sets of control bars, namely, a set of punch control bars 141 (Fig. 5) and a set of register control bars 142, are arranged for control by the key flags 124. The punch control bars 141

operate through the medium of notches 141^a cooperating with punch feeler rods P (Figs. 1 and 10) to control the punches PP of a perforating mechanism PM for perforating combinations of holes in a strip of tape T. For this purpose, the punches and feeler rods are pivoted respectively on opposite ends of floating levers FL which are shifted toward and from the control bars in each operating cycle by suitable cam means on the main cam shaft 59 acting through a follower and linkage F as indicated in Fig. 1. The tape T is advanced relative to the mechanism step by step in timed relation to the other operations of the machine by a feed roller 142^a driven from the shaft 11 in any suitable manner.

Where printing mechanism is employed, the bars 141 control such mechanism in the manner disclosed in the prior patent hereinbefore referred to and in copending application Serial No. 313,851 (see Fig. 22). In the present instance, certain of the control bars 141 are additionally utilized to control the latch bars for setting the clutches of the letter space registering train, as will be described presently. The register control bars 142 control the latch bars for the clutches 14^d to 14^h for registering character widths.

The use of a separate and independent set of control bars for registering character widths is particularly advantageous in the case of machines intended for preparing control strips or tape for compositions in different fonts, since the characters of such fonts do not always vary in width in exactly the same ratios. Thus, in one font the letter "A" may have a width of twelve units and in another font a width of fourteen units, the unit being a predetermined fraction of the "EM" of the particular font involved, as is well known in the typographical art. The register of the composing machine must, however, be operated so as to register the exact width of the character so as to provide an accurate indication of the space available in the line.

A machine equipped with the auxiliary set of control bars for the character registering train can accordingly be conditioned for composing in any font by merely inserting a suitable set of register control bars 142 for the font to be composed. This may be done in a number of ways as by bodily replacing one set of bars with another or a plurality of sets may be permanently installed in the machine along with suitable means such as a font selector flag or flags for selecting one set of bars at a time for operation.

The set of register control bars 142, as herein shown, is divided into two groups of five bars each, one for upper case characters and one for lower case characters. The particular group to be operated is determined by a case shift flag 143 ((Fig. 4) operable to either of two positions by the usual case shift key or keys (not shown) and cooperating with the bars 142 in a well known manner so as to be effective in each operation to lock one group of bars in retracted position and release the other group of bars to the control of the character key flags 124.

The entire set of control bars is extended to cooperate with the latch bars 99^d to 99^h. The lower edges of the first mentioned bars are suitably notched so as to provide clearance for the latch bars when in normal retracted position but operative when advanced to block a particular one of the latch bars against movement. As explained above, blocking of the latch bar causes the associated shifter bar to advance and shift

clutch element 14 into engagement with its associated driving element 20.

The control bars 142 are normally held in retracted position by a bail 144 arranged to be withdrawn in any suitable manner in proper timed relation to the other operations of the machine. When a character key is depressed to perforate a character signal in the control tape, the bail is withdrawn immediately after its associated key flag is shifted to operated position. As the bail is withdrawn, the various control bars are advanced by their individual actuating springs 145. Depending upon the particular key flags operated, certain of the bars will be blocked while others will be free to move to fully advanced position, in which position they serve to exert their control on the latch bars 99^d to 99^h to set the clutches of the character registering train, that is, the clutches for the primary driving elements 14^d to 14^h in the combination corresponding to the character signal perforated in the control tape.

By reason of the timing of the cam 105 the floating lever assembly of the clutch shifting mechanism is swung forwardly following the selective positioning of the control bars. The latch bars which encounter operated control bars are blocked against forward movement, hence, their associated shifter bars 91 advance with the floating lever assembly and effect a corresponding setting of the clutches 14^d to 14^h. Thus the combination in which the clutches are set is determined by the particular character key operated and the clutches are accordingly conditioned to drive the register shaft 10 through a step proportioned to the character represented by the key.

The foregoing operations occur during the initial dwell in the rotation of the shaft 11. Following the setting of the clutches, the shaft is rotated through a single revolution with uniform acceleration and deceleration. The engaged clutches, accordingly act to rotate the register drive shaft 10 through a step proportioned to the width of the character. This rotation is executed with uniform acceleration and deceleration regardless of the length of the step.

During the final dwell in the rotation of the shaft 11, the floating lever assembly is rocked back to normal position, the control bars having been previously restored to retracted position by operation of the bail 144. As the floating lever assembly executes its return movement, the latch bars 99^d to 99^h are moved against a fixed stop 146 (Figs. 5 and 6) whereby the associated clutch shifter bars 91^d to 91^h are again shifted rearwardly to disengage all of the clutches 14^d to 14^h at the end of the cycle. The stop 146 is cut away, as at 146^a to provide a passageway for the latch bars 99 to 99^c so that the clutches of the letter space registering train are not disengaged in the normal operating cycle of the machine. The limit position of the shifter bars is determined by a fixed stop 147.

When letter spacing is to be introduced into the composition, two special signals, namely, a function signal hereinafter called the "letter space" signal followed by a "numeral" signal which is indicative of the width of the space to appear in the final composition are perforated in the control tape. The letter space signal serves to condition the typographic machine with which the tape is used for adjusting the printing, type-casting, or other operating mechanism under control of the numeral signal so that subsequent characters will be spaced apart as called for by

the latter signal. This condition is maintained until a new letter space signal and numeral signal appear in the control tape.

In the exemplary machine, perforation of both the letter space signal and the numeral signal is controlled by the main set of control bars 141 in successive operating cycles of the machine. The control bars are released in the proper combination to form the letter space signal under control of a letter space signal flag 148 (Fig. 4) adapted to be actuated by a letter space key (not shown) similar to the other keys of the keyboard. Since the letter space signal is a function signal, its flag 148 is arranged to block the register control bars 142 to prevent operation of the register shaft in this cycle.

The letter space numeral signal preferably is one of a group of character signals perforated in response to the depression of the appropriate character key. Its functional character is identified by the preceding letter space signal which conditions the typographical machine to respond by adjusting the spacing mechanism instead of printing or otherwise producing the character corresponding to the signal. In the perforating machine, the character signal designating the letter space numeral determines the setting of the clutches for the driving elements of the letter space registering train so that the widths of the letter spaces will be properly registered in subsequent cycles of the machine.

In order to enable the control bars to control the setting of the clutches 14 to 14^c of the letter space registering train only following an operation of the letter space key, the latch bars 99 to 99^c for the letter space registering train are normally held in an inactive position in which they are disassociated from the control bars 141. Means is provided for temporarily moving the latch bars out of inactive position and into operative relation to the control bars 141 only when such bars are operated to perforate the letter space numeral signal. To this end, the latch bars 99 to 99^c are supported for limited edgewise movement in a vertical plane by means of a guide plate 151 (Fig. 5) carried on an arm 152 fast on a rock shaft 153. The shaft is normally held in the position shown in Figs. 4 and 5 by a spring 154 acting on an arm 155 rigid with the shaft. With the shaft so positioned, the latch bars are held substantially below the control bars so that the latter exert no controlling action thereon. When the shaft is rocked to operated position, the latch bars are raised sufficiently to cooperate with the control bars in the usual manner.

Preferably, the shaft 153 is rocked to operated position in the machine cycle in which the letter space signal is perforated in the tape and is latched in this position during the succeeding cycle in which the letter space numeral signal is perforated. The mechanism for accomplishing this result, as herein shown, includes a letter space control bar 156 similar to the control bars hereinbefore described which is released for movement by its spring 145 in response to the operation of the letter space flag 148. The control bar on moving to the right, as viewed in Fig. 4, conditions a power actuated operator for rocking the shaft 153 to raise the latch bars 99 to 99^c to their upper position.

Referring again to Fig. 4, the actuator in its preferred form comprises a push rod 157 arranged to be moved forwardly and back in each operating cycle of the machine by means of an arm 158 fast on a rock shaft 159 to which is

secured a double cam follower 160 cooperating with a cam 161 on the main cam shaft 106. The forward end of the push rod 157 is held in vertical alignment with the projecting end of the arm 155 by a bifurcated guide finger formed on the free end of an arm 163 carried on a rock shaft 164 which has a depending finger 165 engaging in a notch in the control bar 156. A spring 166 acting on the push rod normally holds it in an elevated position above the end of the arm 155.

When the control bar 156 is moved to operated position upon the depression of the letter space key, shaft 164 is rocked in a counterclockwise direction and, through the arm 163, depresses the push rod into the path of the arm 155. Accordingly, when the push rod is moved forwardly by the cam 161, it acts through the arm 155 to rock the shaft 153 and raise the latch bar guide plate 151 and latch bars 99 to 99° to their upper position for control by the bars 141. The push rod is maintained in its lower position independently of the arm 163 by a rearwardly projecting shoulder 155^a on the arm 155 which engages the forward end of the push rod. Near the end of the cycle, the push rod is retracted and, as it moves out of engagement with the shoulder 155^a, the spring 166 restores it to the normal position shown in the drawings.

The latch bars, however, are held in raised position during the remainder of this operating cycle and through a portion of the succeeding operating cycle by means of a pivoted latch 167 adapted to engage in a notch in the end of an elongated latch lug 168 formed integrally with the arm 155. When the shaft 153 is rocked to operated position by engagement of the push rod with the arm 155 as above described, a spring 169 draws the latch 167 into the notch in the latch lug so that the shaft 153 and associated parts are held in their operated position and the latch, in turn, is held in latching position after the push rod is retracted.

The forward movement of the push rod 157 is so timed that the latch bars are moved to elevated position after the floating lever assembly has been rocked forwardly but before it has returned to normal position. Upon return movement of the floating levers, shoulders 170 (Fig. 5) on the upper edges of the now elevated latch bars engage a stop 171 which blocks the bars against rearward movement, thereby rendering the floating levers operative to cause the associated shifter bars 91 to 91° to move all of the primary driving elements 14 to 14° rearwardly and thus lock them in disengaged position. This prepares the driving elements for resetting (in accordance with the selected letter space numeral signal) in the next operating cycle of the machine.

In such succeeding cycle the letter space numeral signal is perforated in the control tape by actuation of an appropriate one of the character keys and the clutches of the primary driving elements 14 to 14° are set accordingly. This setting of the clutches is accomplished through the medium of the flag 124 of the depressed key, releasing one or a combination of four of the control bars 141 cooperating with the latch bars 99 to 99°. The latter act to transfer the setting of the control bars to the clutches of the elements 14 to 14° of the letter space registering train as hereinbefore explained. As soon as the clutches have been set and before the floating lever assembly begins its return movement, the

latch 167 is withdrawn to release the shaft 153 which immediately returns to normal position under the action of the spring 154, thus returning the latch bars 99 to 99° to inactive position in which they are removed from operative association with the control bars 141 and the stop 171. The withdrawal of the latch is effected in the present instance by the push rod 157 which, in its raised position, is adapted to engage a latch releasing finger 172 rigid with the latch 167. Accordingly, the push rod in moving forwardly in this cycle withdraws the latch so that the latch bars may be returned to inactive position in time to prevent disengagement of the set clutches by the stop 171. The clutches of the letter space registering train are thus left in set position so that in subsequent cycles of the machine, the letter space increment will be registered coincident with the registration of each character width by the character registering train.

In order to prevent false operation of the register drive shaft in the perforation of the letter space and letter space numeral signal, means is provided for shifting the clutch member 81 to neutral position in the operating cycles required for such signals. This means, as herein shown, comprises a neutral control bar 173 arranged to be released selectively by a flag 173^a (Fig. 4) hereinafter termed the "numeral" flag. This flag has no finger key associated with it but is adapted to be moved into operative position in the preceding machine cycle in response to the operation of the letter space key. To this end, the letter space flag 148 is formed with a lateral extension 174 engaging in a notch 175 in the upper edge of the numeral flag. The notch is of such length that the letter space flag may be restored to normal position while the numeral flag remains in operated position. A spring-pressed detent 176 supported and guided for vertical movement in a stationary bracket 177 engages in a notch in the edge of the flag 173^a to hold the flag in operated position independently of the letter space flag. As long as the flag 173^a is in operated position, the neutral bar 173 is permitted to advance. In this position, the neutral bar is in blocking relation to the latch bar 99', the latter being notched in a manner such as to enable it to execute only a partial movement, as for example, a half stroke under these conditions. As a result, the associated clutch shifter bar 91' is advanced to shift the clutch member 81 into neutral position, thereby disconnecting the driven shaft 11 from the drive shaft 56.

Near the end of the operating cycle, the latch 176 is automatically withdrawn to release the numeral flag and thus condition the machine for perforating ordinary character signals. Such withdrawal is effected by a pivoted detent withdrawing lever 178 operated by a cam 179 on the main cam shaft through the medium of a cam follower 180 and a rigid link 180^a. Upon its release, the numeral flag 173^a returns to retracted position and again blocks the neutral bar 173 so that normal operation of the drive mechanism may be resumed in the next cycle of the machine.

The driving elements of the letter space registering train retain their permutational setting until disengaged by reoperation of the letter space signal key. Accordingly, upon each subsequent actuation of the character key with attendant operation of the character registering train to impart the character width registering step to the register drive shaft 10, a fixed increment

corresponding to the letter space is imparted to the shaft by the letter space registering train. In this way, the register is operated in a manner such as to provide an exact indication of the space to be occupied by the characters in the final composition.

In the normal operation of the machine for perforating character signals in the control tape, the register drive shaft is rotated in a forward direction so as to register the accumulative width of the successive characters. When it is necessary for any reason to cancel certain of the character signals in the control tape, the tape is fed backwardly step by step to aline the last unwanted signal with the punches of a perforating mechanism PM. This is done by first depressing the reverse feed key RF which sets the clutch 81 for driving the shaft 11 reversely as will appear presently. This shaft in turn drives the tape feed mechanism disclosed and claimed in my co-pending application, Serial No. 313,851, filed January 15, 1941. The operator then actuates in reverse order the same keys by which the signals were originally recorded in the control strip. As each key is operated, the tape is fed back one step and the clutches of the character registering train are set in a combination to subtract the proper amount from the total accumulated on the register. The key FF is now depressed to reset the clutch 81 for forward feed and a "rub-out" or "kill" key RO (Fig. 1) is operated once for each signal to be deleted. The flag for this key is arranged to position the punch control bars 141 for punching all hole positions in the strip or tape while the register control bars 142 are positioned to disengage all of the clutches of the character registering train and thus prevent operation of the register during the cancelling operation.

In the exemplary machine, forward and reverse operation of the tape feeding means and the registering mechanism is controlled by the keys FF and RF through the medium of control bars and flags including a forward feed control bar 181 (Fig. 4) and a reverse feed control bar 182 released for operation respectively by a forward feed flag 183 and a reverse feed flag 184 actuated respectively by the keys FF and RF. These flags are generally similar to the flags of the character keys, and in this instance are interconnected by a lever 186 pivoted between the bars and having its opposite ends engaging in notches in the respective bars. With this arrangement, movement of one bar to operated position automatically acts to restore the other bar to retracted position.

The function control bars 181 and 182 are utilized in the present instance for the purpose of disengaging the clutch 81 which drives the shaft 11 of the variable drive mechanism so as to prevent operation of the registering mechanism, and also for conditioning an auxiliary control bar 187 for setting the clutch in one or the other of its driving positions. The control bars 181 and 182 exert their controlling action on the clutch shifting mechanism by blocking the latch bar 99' in the same manner as the neutral bar above described. In other words, they permit the latch bar 99' to execute a limited forward movement, approximately a half stroke, which causes the shifter bar 91' to advance sufficiently to move the clutch element 81 into its intermediate or neutral position.

For conditioning the control bar 187, the control bars 181 and 182 are arranged to coact re-

spectively with oppositely projecting arms 188 and 189 of a detent member 190 pivoted on a vertical shaft 193^a above the control bar 187 and to move the detent member between alternate positions. The detent member is adapted to be held in either position by means of an over-center device including a flat leaf spring 191 anchored at one end on the machine frame and having its other end engaging in a notch in a plate 192 rigid with the shaft 190. Substantially midway of the arms 188 and 189 of the detent member is a radially projecting finger 193. Accordingly, upon operation of the control bar 182, the finger 193 is adapted to be interposed in the path of a shoulder 194 on the control bar 187 and by holding the bar in retracted position, it blocks the latch bar 99', thereby causing the clutch element 81 to be shifted to reverse position.

When the forward feed key is depressed, the forward feed flag 181 advances to partially block the flag 99' and rocks the detent finger 193 out of the path of the control bar 187 so that in subsequent operating cycles of the machine the control bar will be free to execute its full movement and thus unblock the latch bar 99'. Under these conditions, the clutch 81 is set in its forward driving position.

When the reverse feed key is operated, the reverse feed flag 184 advances and rocks the detent finger 193 toward blocking position. The finger does not engage the notch 194 at this time, however, as the flag 187 is in advanced position at this time having moved forwardly with the reverse feed flag and thus past the finger. When the control bars are retracted, however, the over-center spring 191 rocks the detent finger into the path of the shoulder 194 so that in all subsequent machine cycles the control bar 187 will be held in retracted position, thus effecting the shifting of the clutch 81 to reverse driving position.

As long as the coupling mechanism 58 remains set in reverse driving position, the register drive shaft 10 will be driven reversely each time a character key is operated to back space the control strip and subtract from the register the space increment represented by a previously perforated signal. The length of the step through which the shaft is moved is determined by the setting of the clutches of the character registering train and letter space registering train. The latter, of course, retain their previous setting while the former are set by the control bars 142 in accordance with the particular character key depressed. Thus the previously registered character width as well as the letter space increment will be canceled from the register so that it may indicate accurately the space remaining in the line.

In preparing a control strip or tape for typographical machines by means of the composing machine or perforator, herein shown and described, the operator initially inserts appropriate signals for setting the typographical machine for the particular letter spacing required by the composition. This is done by first depressing the letter space key and then an appropriate letter space numeral key which may be one of the character keys.

Upon depression of the letter space key the letter space signal is perforated in the control tape, the latch bars 99 to 99^c are shifted to active position for cooperation with the punch control bars 141, and the clutches for the primary driving elements 14 to 14^c of the letter

space registering train are all shifted to disengaged position. During this operating cycle the neutral bar 173 is released by the letter space numeral flag 173^a and acts to shift the clutch member 81 of the coupling mechanism 58 into neutral position so that the primary drive shaft remains stationary and no movement is imparted to the register drive shaft 10.

When the letter space numeral key is operated the machine executes the usual operating cycle and the corresponding letter space numeral signal is perforated in the control tape. At the same time the primary driving elements 14 to 14^c are conditioned for operation selectively in a combination corresponding to the signal perforated in the tape. This is accomplished by selectively engaging the clutches associated with these elements as determined by the setting of the control bars 141, the setting of the bars being transferred to the clutches by shiftable devices constituting a part of the transfer mechanism. Near the end of the cycle the latch bars 99 to 99^c are returned to inactive position in which they no longer cooperate with the control bars 141. The latter bars may thus perform their usual punch controlling functions in succeeding cycles without disturbing the set condition of the clutches of the letter space registering train. The letter space numeral flag 173^a and the neutral bar 173 are also restored to normal position and thus enable the clutch member 81 to drive the primary drive shaft 11 forwardly in succeeding operating cycles.

Having inserted the preliminary condition signals in the tape, the operator now proceeds to depress a succession of character and space keys to compose the matter to appear in the ultimate printed copy. Each character key when depressed releases the punch control bars 141 in predetermined permutational combinations to effect the perforation of corresponding permutational signals in the tape. At the same time the character key flags release the register control bars 142 in the permutational combination assigned to designate the width of the characters represented by the keys. The control bars of only one sub group advance at this time, however, depending upon the particular case shift key in operated position.

The permutational setting of the control bars 142 conditions the primary driving elements 14^a to 14^b of the character width registering train for operation in a like combination. For this purpose, the setting of the bars is transferred to the clutches for the primary driving elements by shiftable devices, in this instance the shifter bars of the transfer mechanism. The clutches are thus set selectively to connect the primary driving elements with the shaft 11 or to lock them stationary in a combination corresponding to the combinational setting of the control bars.

The above operations take place during the initial 60° of rotation of the main cam shaft 59 and thereafter the shaft 11, which constitutes the actuating member of the variable drive mechanism and which has a fixed range of movement, is operated through a single revolution. This movement is executed with uniform acceleration and deceleration. The primary driving elements which were clutched to this shaft, including the elements of both the character width registering train and the letter space registering train rotate with the shaft. The movements of the elements are combined by differential gearing and imparted to a variably mov-

able part, in this case the register drive shaft. The shaft is thereby moved through a step accurately proportioned to the set width of the character corresponding to the signal perforated in the tape and an increment is added to correspond to the letter space.

It will be seen from the above that the permutational setting of the clutches of the primary driving elements determines the length of the step to be imparted to the movable part by the movement of the actuating member through its fixed range. This is made possible by interconnecting the elements through a series of differential gear units which combine the movements of the various elements into proportionate movement of a single part such as the recorder drive shaft. Moreover, since the actuating member executes its movement with uniform acceleration and deceleration, the movable part is likewise uniformly accelerated and decelerated regardless of the amplitude of its movement. In this way the cumulative widths of characters and spaces entering into a composition may be accurately registered and the operator apprised at all times of the amount of the unfilled space remaining in a line. The operator may therefore readily determine when the line should be terminated.

At the end of the cycle above described in which the character signal is perforated in the control tape and after the variably movable part has been operated, the transfer mechanism acts to disengage the clutches of the character width registering train from the shaft 11 and to lock them all stationary. The clutches for the letter space registering train remain engaged, however, so that this part of the mechanism is enabled to operate in succeeding cycles to add the letter space increment to the character widths subsequently recorded.

If it is necessary at any time to delete certain of the character signals perforated in the control tape, the operator actuates the reverse feed key and then depresses successively the keys corresponding to the signals to be deleted. Under these conditions the control tape is fed reversely until each of the character signals to be blanked out is returned to the incoming side (right side as viewed in Fig. 1) of the perforating mechanism whereby these signals may be presented successively for the action of the punches in response to successive actuations of the rub-out key. It will be understood, of course, that forward feeding of the tape is restored by actuation of the forward feed key FF before the rub-out key is actuated. The depression of each character key in the manner above set forth sets the clutches of the character width registering train selectively in exactly the same manner as in normal composition.

However, as long as the reversing key remains operated, the clutch member 81 of the coupling mechanism 58 is shifted to reverse position in each operating cycle so that the shaft 11 rotates reversely. Due to this reverse rotation of the shaft 11 the register drive shaft 10 is moved in a reverse direction in steps accurately proportioned to the width of the character deleted. Thus the previously registered character widths are subtracted from the register so that the same may represent accurately the exact state of the composition. These reverse movements of the registered drive shaft are executed with uniform acceleration and deceleration in the same way as the forward movements of the shaft.

It will be apparent from the foregoing that the

invention provides a variable drive mechanism of novel and improved construction particularly suitable for variably operating an incrementally movable part such as is commonly used in typographical composing machines including control tape perforators, printers, line casting machines and typesetting machines. The mechanism as herein disclosed is particularly applicable to the operation of the register or indicator employed in such machines for totalizing and indicating the cumulative width of successive characters composed in a line. It is positive and extremely accurate in operation and particularly adapted for high speed operation. Moreover, it is of simple and compact construction and yet capable of adjustment to impart any one of a large number of different steps to the variably movable part.

The invention also provides novel means for controlling the incremental movements of a variably movable part such as an indicator or the like by an actuating member having a fixed range of movement. This control is exercised selectively through the medium of permutably operable shiftable devices, such as clutches interconnected by a novel combination of differential gearing. Moreover, the movements of the part are invariably executed in either direction with uniform acceleration and deceleration.

In another aspect, the invention further provides novel mechanism for selectively setting a group of clutches or the like in different permutational combinations together with keyboard apparatus for controlling such mechanism. The keyboard apparatus includes means for temporarily associating certain of the clutch setting elements with the main set of permutational elements of the apparatus and means for disabling the drive mechanism while this function is being performed.

I claim as my invention:

1. The combination with a driven shaft to be variably operated, of a power driven cyclically operated drive shaft, a plurality of rotary elements, selectively operable means for conditioning said elements to be driven by said drive shaft in different permutational combinations, and means drivingly connecting said elements with said driven shaft.

2. The combination with a driven shaft adapted to be rotated in incremental steps of varying length, of a drive shaft operated cyclically through a fixed angular step, a series of differentials arranged to drive said driven shaft, each of said differentials having a pair of terminal elements, and devices operable selectively for conditioning said terminal elements to be driven by said drive shaft in different permutational combinations to vary the length of the step imparted to the driven shaft in the rotation of the drive shaft through its fixed angular step.

3. The combination with a part to be moved in incremental steps of varying length, of an actuating member having a fixed range of movement, power driven means operable cyclically for moving said member through its fixed range, a plurality of driving elements, means for conditioning said elements for movement by said member selectively in different permutational combinations, and differentially operating means interposed between said elements and the part operative to move the part through a step proportioned to the combined movements of said elements by the actuating member.

4. The combination with a driven shaft adapt-

ed to be rotated in incremental steps of varying length, of a drive shaft operated cyclically through a fixed angular step, a series of clutches each having a driving member fast on said drive shaft and a driven member loose on the shaft, means for engaging the clutch members selectively in different permutational combinations, and differential gearing interposed between the driven clutch members and said driven shaft operative to rotate the driven shaft through a step proportioned to the combined movements of the clutch members by the drive shaft.

5. The combination with a part adapted to be moved in incremental steps of varying length, of an actuating member operated cyclically through a fixed range of movement, a series of differentials arranged to drive the part, each of said differentials having a pair of terminal elements and an intermediate element, a plurality of shiftable devices acting when in one position to render said member operative to impart a predetermined movement to one of said intermediate elements and when in another position to lock the element stationary, and selectively operable means for setting said devices in different permutational combinations to determine the length of the step to be imparted to the part in the movement of the actuating member through its fixed angular step.

6. The combination with a part to be moved in incremental steps of varying length, of an actuating member operated cyclically through a fixed range of movement, a plurality of differentials each having a pair of terminal elements and an intermediate element, selectively operable means for conditioning said terminal elements to be driven by the actuating member in different permutational combinations, and an additional differential having terminal elements drivingly connected respectively with the intermediate elements of said first mentioned differentials and having its intermediate element drivingly connected with the part to be moved.

7. The combination with a part to be moved in incremental steps of varying length, of an actuating member operated cyclically through a fixed range of movement, a plurality of differentials arranged to drive the part, each of said differentials having a pair of terminal elements and an intermediate element, means drivingly connecting the intermediate elements of said differentials with the part, and selectively operable means for conditioning the terminal elements of said differentials to be driven by said actuating member in different permutational combinations to determine the length of the step imparted to said part in the movement of the actuating member through its fixed range.

8. The combination with a part to be moved in incremental steps of varying length, of an actuating member operated cyclically through a fixed range of movement, a plurality of differentials arranged to drive the part, each of said differentials having a pair of terminal elements and an intermediate element, means drivingly connecting the intermediate elements of said differentials with the part, a plurality of shiftable devices each operative in one position to render the actuating member effective to drive one of said terminal elements and in another position to lock the terminal element against movement, and selectively operable means for operating said devices in different permutational combinations to determine the length of the step to be imparted to the movable part by the move-

ment of the actuating member through its fixed range.

The combination with a driven shaft adapted to be rotated in incremental steps of varying length, of a drive shaft operated cyclically through a fixed angular step, a series of differentials arranged to drive said driven shaft, each of said differentials having a pair of terminal gears, a series of gears slidably mounted on said drive shaft each meshing with one of the differential terminal gears, clutch teeth on said slidable gear operative to engage cooperating clutch teeth of an element fast on the drive shaft, other clutch teeth on said gear operative to engage cooperating clutch teeth of a stationary member, and selectively operable means for shifting said slidable gears to engage the clutch teeth with one or the other of the cooperating elements in different permutational combinations to determine the length of the step to be imparted to the driven shaft by the drive shaft in its cyclic operation.

10. The combination with a driven shaft to be variably operated, of a power driven cyclically operated drive shaft, a series of differentials each having terminal gears adapted for connection with the drive shaft, a second series of differentials having their terminal gears driven by the intermediate gears of differentials of said first series, and a third differential having its terminal gears driven by the intermediate gears of the differentials of the second series and its intermediate gear drivingly connected with the driven shaft, and selectively operable means for conditioning the terminal gears of said first series of differentials to be driven by said drive shaft in different permutational combinations.

11. In a machine of the class described, in combination, a power driven shaft, a first group of clutches adapted to be drivingly associated with said shaft in different permutational combinations, a second group of clutches adapted to be drivingly associated with said shaft in different permutational combinations, and differential gearing arranged to communicate the combined movements of said clutches to an incrementally movable part.

12. In a machine of the class described, in combination, a shaft to be rotated in incremental steps, a power driven shaft, a first group of elements adapted to be driven by the second shaft, a second group of elements adapted to be driven by the second shaft, independently operable means for conditioning the elements of each group to be driven by the second shaft in different permutational combinations, and differential gearing arranged to communicate the combined movements of said elements to said first shaft.

13. A selectively operable mechanism comprising, in combination with a part to be moved, an actuating member having a fixed range of movement, and means for transmitting the fixed movement of said member to said part to move the latter in steps of varying amplitude comprising, a transmission mechanism having a plurality of driving elements, a driven element operatively associated with said part, differentially operating means for combining movements imparted to selected ones of said driving elements into a single movement in said driven element, and means rendering said actuating member operative to actuate said driving elements selectively in different permutational combinations.

14. In a selectively operable mechanism, the combination of a part to be moved, an actuating

member having a fixed range of movement, means for transmitting the movement of said member to said part in steps of varying amplitude comprising, a differentially operating transmission mechanism having a plurality of driving elements, selectively operable means for conditioning said elements to be moved by said member in different permutational combinations, a driven element operatively associated with said parts and means for combining the movements imparted to the driving elements by said member in a single movement in said driven element.

15. In a selectively operable mechanism, the combination of a part to be moved, an actuating member having a fixed range of movement, and means for transmitting the movement of said member to said part in steps of varying amplitude comprising a transmission mechanism having a plurality of driving elements arranged for operative association with said member in different permutational combinations selectively, a driven element connected with said part, and differentially operating means for combining the movements imparted to selected ones of the driving elements by said member into a single movement in said driven element.

16. In a selectively operable mechanism, the combination of a part to be moved, an actuating member having a fixed range of movement, a plurality of devices arranged to be set selectively in any one of a plurality of different permutational combinations, and differentially operating means for transmitting the fixed movement of said member to said part in varying steps according to the permutational setting of said elements.

17. In a selectively operable mechanism, the combination of a part to be moved, an actuating member having a fixed range of movement, a plurality of elements arranged to be conditioned selectively to be moved by said member in any one of a plurality of different permutational combinations, and differentially operating means acting to transmit the combined movements of said elements to said part in varying steps according to the permutational combination of the conditioned elements.

18. In a cyclically operable machine of the character described, in combination, a rotatable shaft, drive mechanism for rotating said shaft in incremental steps in each regular operating cycle of the machine, said mechanism comprising a first group of clutches, means operable in each of said regular operating cycles to set said clutches selectively in different permutational combinations to determine the step to be imparted to said shaft, and a second group of clutches adapted to be set selectively in different permutational combinations each designating a predetermined increment to be added to the step imparted to the shaft by said first group of clutches.

19. In a cyclically operable machine, in combination, a shaft to be rotated in incremental steps, driving means for said shaft including a power driven shaft, a group of elements adapted to be conditioned to be driven by the driven shaft in different permutational combinations, gearing arranged to communicate the combined movements of said elements to said first shaft in each operating cycle, means for modifying the action of said driving means comprising a second group of elements adapted to be conditioned to be driven by said driven shaft in different permutational combinations, and gearing arranged to communicate the combined movement of said second group of elements to said first shaft di-

multaneously with the movement of the shaft by said first group of elements.

20. In combination, a driven shaft, a power actuated cyclically operated drive shaft, two groups of clutches associated with said drive shaft, means operative in each cycle for engaging the clutches of one of said groups with said drive shaft selectively in different permutational combinations, means operative for engaging the clutches of the other group with said drive shaft selectively in different permutational combinations, means for latching the clutches of said other group in engaged position throughout a plurality of operating cycles of the drive shaft, and gearing arranged to communicate the combined movements of both groups of clutches to said driven shaft in each cycle of said drive shaft.

21. In a cyclically operable machine of the character described, in combination, a rotatable shaft, drive mechanism for rotating said shaft in incremental steps in each regular operating cycle comprising a first group of clutches and a second group of clutches, means for setting the clutches of said first group selectively in different permutational combinations each representing a predetermined step to be imparted to said shaft, means for setting the clutches of said second group selectively in different permutational combinations each representing an increment to be added to the step imparted to said shaft by the first group of clutches, and means for disabling said first clutch setting means while said second clutch setting means is operating.

22. The combination with a cyclically operable shaft journaled on a stationary member, of a clutch having a driving element fast on the shaft, a driven element loosely mounted on the shaft and movable longitudinally thereof to engage either said driving element or said stationary member, power actuated means for shifting said driven element to either of its two positions, and selectively operable means for controlling said power actuated means to determine the position of the driven element.

23. The combination with a cyclically operable shaft journaled on a stationary member, of a clutch having a driving element fast on the shaft, a driven element loosely mounted on the shaft and movable longitudinally thereof to engage either said driving element or said stationary member, means for shifting said driven element to either of its positions comprising a shifter bar operatively connected to the element and extending generally parallel to the shaft, power actuated means for imparting endwise movements to the bar in either direction, and selectively operable means for controlling said power actuated means.

24. The combination with a cyclically operable shaft journaled on a stationary member, of a clutch having a driving element fast on the shaft, a driven element loosely mounted on the shaft and movable longitudinally thereof to engage either said driving element or said stationary member, means for shifting said driven element to either of its positions comprising a shifter bar operatively connected to the driven element, a support oscillating in a path generally parallel to said bar, a lever pivoted intermediate its ends on said support for movement with and independently of the support, said lever having one end operatively connected with the shifter bar, and means operable selectively to block the other end of said lever and thereby render the same

effective to move said shifter bar incident to the oscillation of said support.

25. The combination with a shaft adapted to be rotated in incremental steps of varying length, of a drive shaft operated cyclically through a fixed angular step, a series of shiftable clutch elements loosely mounted on said shaft, a corresponding series of clutch elements fast on said shaft each adapted to be engaged by one of said shiftable elements, clutch shifting means for each shiftable element including a shifter bar extending generally parallel to said shaft and operatively connected with the associated element, a lever pivoted intermediate its ends on an oscillating support and having one end operatively connected with the shifter bar, means for oscillating said support to move the pivotal point of said lever longitudinally of the shifter bar, said lever normally rocking on its pivot while the bar remains stationary, and selectively operable means for blocking the other end of said lever to prevent such rocking of the lever whereby the shifter bar is moved forwardly to engage the associated clutch element.

26. The combination with a shaft adapted to be rotated in incremental steps of varying length, of a drive shaft operated cyclically through a fixed angular step, a series of shiftable clutch elements loosely mounted on said shaft, a corresponding series of clutch elements fast on said shaft each adapted to be engaged by one of said shiftable elements, clutch shifting means for each shiftable element including a shifter bar extending generally parallel to said shaft and operatively connected with the associated element, a lever pivoted intermediate its ends on an oscillating support and having one end operatively connected with the shifter bar, means for oscillating said support, said lever normally rocking on its pivot while the bar remains stationary, a series of blocking elements adapted to be positioned for blocking the respective levers to prevent such rocking movement whereby the levers are rendered effective to advance their associated shifter bars to engage the clutches, and selectively operable means for operating said blocking elements.

27. The combination with a cyclically operable shaft journaled on a stationary member, of a clutch having a driving element fast on the shaft, a driven element loosely mounted on the shaft and movable longitudinally thereof to engage either said driving element or said stationary member, means for shifting said driven element to either of its positions comprising a shifter bar operatively connected to the driven element, a support oscillating in a path generally parallel to said bar, a lever pivoted intermediate its ends on said support for movement with and independently of the support, said lever having one end operatively connected with the shifter bar, a stop coacting with the other end of said lever to block the same upon movement of the support in one direction and thereby cause the lever to move the shifter bar so as to engage the driven clutch element with the stationary member, and a member adapted to be moved into position to block said one other end of the lever upon movement of the support in the opposite direction and thereby cause the lever to move the shifter bar so as to engage the driven clutch element with said driving element.

28. In a machine of the class described, in combination, a cyclically operable shaft, a driven shaft, a plurality of driving elements for driving

the last-mentioned shaft, a series of shiftable devices, one for each driving element operable to drivingly connect the elements with said cyclically operable shaft, a series of oscillating levers for shifting said devices, and means for rendering said levers effective selectively to shift said devices.

29. In a machine of the class described, in combination, a cyclically operable shaft, a driven shaft, a plurality of driving elements for driving the last-mentioned shaft, a series of shiftable devices, one for each driving element operable to drivingly connect the elements with said cyclically operable shaft, a series of oscillating levers for operating said devices, and selectively operable means for actuating said levers in different permutational combinations to operate predetermined ones of said devices.

30. In a machine of the class described, in combination, a cyclically operable shaft, a series of clutches each having a driving element fast on said shaft and a driven element movable into or out of engagement with the driving element, a plurality of clutch operating members, a group of control bars, manually operable keys for operating said control bars in different permutational combinations and for initiating the operating cycles of said shaft, and means operated in timed relation to the operation of said shaft for moving said clutch operating members into cooperative relation to the control bars to engage the clutches in a combination corresponding to the combination of bars operated.

31. In a machine of the class described, in combination, a cyclically operable shaft, a series of clutches each having a driving element fast on said shaft and a driven element movable into and out of engagement with the driving element, a plurality of permutably operable control bars, means for operating said bars in different combinations, and a plurality of clutch operating members one for each of said clutches coacting with said control bars to engage said clutches in combinations corresponding to the combination in which said bars are operated.

32. The combination in a machine of the class described having a series of clutches and a plurality of control bars adapted to be set in different permutational combinations, means for transferring the setting of said bars to said clutches comprising, an oscillating support, a series of levers one for each of the clutches pivoted intermediate their ends on said support for movement with and independently of the support, a shifter bar connecting one end of each lever with its associated clutch, and a latch bar operatively connected with the other end of the lever and cooperating with one of said control bars.

33. The combination in a machine of the class described having a series of clutches and a plurality of control bars adapted to be set in different permutational combinations, means for engaging the clutches in combinations corresponding to the setting of said bars comprising a support movable toward and from a normal rest position, a series of levers one for each of the clutches pivoted intermediate their ends on said support for movement with and independently of the support, a shifter bar connecting one end of each lever with its associated clutch, latch bars operatively connected with the other ends of the levers and cooperating with operated ones of the control bars to effect engagement of the associated clutch upon movement of said support away from rest position, and means coacting

with said latch bars upon movement of the support back to rest position for disengaging the clutches.

34. In a selectively operable mechanism, the combination with a part to be moved in incremental steps of varying length, of an actuating member having a fixed range of movement, power driven means operable cyclically for moving said member through its fixed range, drive mechanism including differential gearing drivingly connecting said member with the part to be moved, and shiftable devices coacting with said drive mechanism operable selectively for conditioning the mechanism to impart steps of different length to the part in response to the movement of said actuating member through its fixed range.

35. In a selectively operable mechanism, the combination with a part to be moved in incremental steps of varying length, of an actuating member having a fixed range of movement, power driven means operable cyclically for moving said member through its fixed range, drive mechanism including a series of differential gear units connecting said member with the part to be moved, and selectively operable means acting on certain of said units for conditioning the drive mechanism to impart steps of different length to the part upon movement of the actuating member through its fixed range.

36. In a machine of the class described, in combination, a shaft to be driven variably, a series of manually operable keys, drive mechanism controlled by said keys for turning said shaft through steps of varying length according to the key actuated, and control means for determining the direction in which said shaft is turned.

37. In a machine of the class described, in combination, a part to be moved, a series of manually operable keys, power driven mechanism selectively controlled by said keys for moving said part through steps of varying length according to the key operated, and auxiliary control means for determining the direction of movement of the part.

38. In a machine of the class described, in combination, a cyclically operable shaft, a reversible clutch for driving said shaft, a driven shaft, drive mechanism interposed between said shafts for variably rotating the latter shaft in each operating cycle of the first shaft, and means for operating said clutch to determine the direction of rotation of the driven shaft.

39. In a machine of the class described, in combination, a plurality of manually operable keys, a cyclically operable shaft, a reversible clutch for driving said shaft, a shaft to be driven in steps of varying length, a drive mechanism interposed between said shafts, means controlled by certain of said keys for adjusting said drive mechanism to determine the length of the step imparted to the driven shaft, and means controlled by other of said keys for operating said clutch to determine the direction in which said driven shaft is turned.

40. In a machine of the class described, in combination, a plurality of manually operable keys, a cyclically operable shaft, a reversible clutch for driving said shaft, a shaft to be driven in steps of varying length, a drive mechanism interposed between said shafts, means controlled by certain of said keys for adjusting said drive mechanism to determine the length of the step imparted to the driven shaft, means controlled

by other of said keys for operating said clutch to determine the direction in which said driven shaft is turned, and means for temporarily disabling said drive mechanism upon operation of said other keys.

41. In a machine of the class described, in combination, a plurality of manually operable keys, a cyclically operable shaft, a reversible clutch for driving said shaft, a shaft to be driven in steps of varying length, a drive mechanism interposed between said shafts, means controlled by certain of said keys for adjusting said drive mechanism to determine the length of the step imparted to the driven shaft, means operable to engage said clutch for rotating the first shaft in either direction, means controlled by other of said keys for conditioning said clutch engaging means for operation, and means for operating said clutch engaging means in response to each subsequent operation of one of the keys to adjust said drive mechanism.

42. In a cyclically operable machine, in combination, a manually operable keyboard, a shaft to be rotated in each machine cycle through steps of varying length, a drive mechanism for rotating said shaft, means responsive to the actuation of certain of said keys for initiating an operating cycle of the machine and for adjusting said drive mechanism to determine the length of the step to be imparted to said shaft, and means responsive to the actuation of other of said keys for initiating an operating cycle of the machine and for adjusting the drive mechanism to determine the direction in which said shaft is to be rotated in succeeding machine cycles.

43. In a cyclically operable machine, in combination, a plurality of manually operable keys, a shaft to be rotated in each machine cycle through steps of varying length, a drive mechanism normally operative in each machine cycle to rotate said shaft in one direction, a reversing device for reversing the direction of rotation of said shaft, means controlled by certain of said keys for initiating an operating cycle of the machine and for adjusting said drive mechanism to determine the length of step to be imparted to the shaft, and means controlled by other of said keys for initiating an operating cycle of the machine and for conditioning said reversing device for operation, said device operating in succeeding cycles to effect reverse rotation of the shaft.

44. In a cyclically operable machine, in combination, a plurality of manually operable keys, a shaft to be rotated in each machine cycle through steps of varying length, a drive mechanism normally operative in each machine cycle to rotate said shaft in one direction, a reversible clutch associated with said drive mechanism for controlling the direction of rotation of said shaft, clutch shifting means, means controlled by certain of said keys for initiating an operating cycle of the machine and for adjusting said drive mechanism to determine the length of the step to be imparted to the shaft, means controlled by other of the keys for initiating an operating cycle of the machine and for conditioning said clutch shifting means for operation, said clutch shifting means operating in succeeding machine cycles to engage said shaft for rotating the shaft reversely.

45. In a machine of the class described, a shaft, a variable drive mechanism for rotating said shaft in progressive incremental steps of varying length, and independent control means

for determining the direction of rotation of the shaft.

46. The combination with a shaft to be rotated in progressive incremental steps of varying length, of a drive mechanism for said shaft including a series of normally disengaged clutches, control means for engaging said clutches in different permutational combinations to determine the length of the step imparted to the shaft, a driving clutch for controlling the direction of rotation of the shaft, and means for setting said driving clutch selectively to drive the shaft in either direction.

47. In a keyboard operated machine, in combination, a series of clutches, a setting element for each clutch normally held in an inactive position, means responsive to the operation of one of the keys of the keyboard for moving said setting elements into active position, and means responsive to the operation of other of the keys for operating said elements to set the clutches in predetermined combinations.

48. In a keyboard operated machine, in combination, a series of clutches, a setting element for each clutch normally held in an inactive position, means responsive to the operation of one of the keys of the keyboard for moving said setting elements into active position and for disengaging the clutches, and means responsive to the operation of another of the keys for resetting the clutches and for restoring said setting elements to inactive position.

49. In a machine of the class described, in combination, a cyclically operable member, a series of elements to be operated by said member, a conditioning device for each element having an actuating member normally held in an inactive position, means operative in one cycle of the machine for moving the actuating members of said devices into active position, and means operative in the succeeding cycle of the machine for operating said devices through their actuating members to condition said elements for operation in predetermined combination.

50. In a cyclically operable machine, in combination, a series of clutches, a setting element for each clutch normally held in an inactive position, means operative in one cycle of the machine for moving said setting elements into active position and for disengaging all of said clutches, and means operative in the succeeding cycle of the machine for operating said elements to reset the clutches and for restoring the elements to inactive position.

51. In a machine of the class described, in combination, a series of clutches, a series of clutch actuating elements one for each of said clutches, means normally holding said elements in an inactive position, means for moving said elements to an active position, and means co-operating with said elements in their active position for selectively engaging and disengaging said clutches.

52. In a machine of the class described, in combination, a group of control bars operable in different combinations, a series of latch bars normally held in an inactive position, means for moving said latch bars from said inactive position to cooperate with said control bars, said means including a rocking member, a reciprocable member, power operated means for periodically advancing and retracting said reciprocable member, and means for shifting said reciprocable member into position to engage said rocking member in its advancing movement.

53. The combination of an element biased to a normal position but movable to an operated position, a latch operative to hold the element in operated position, a reciprocable member, power operated means for periodically advancing and retracting said member, and means for positioning said member to engage either said element or said latch.

54. In a machine of the class described, in combination, a set of control bars, a set of latch bars normally held out of association with said control bars, power actuated means for periodically operating said latch bars, and key controlled means for initiating the operation of said power actuated means and for moving said latch bars into operative association with said control bars.

55. In a machine of the class described, in combination, a cyclically operable main shaft, an intermediate shaft, a driven shaft, a driving clutch interposed between the main shaft and the intermediate shaft for driving the latter, a series of clutches interposed between the intermediate shaft and the driven shaft, said clutches acting when set in different combinations to drive the last mentioned shaft in incremental steps of varying length, a clutch setting element for each clutch of said series normally held in an inactive position, means operative in one cycle of the said main shaft for disengaging said main clutch and for moving the setting elements to active position, and means operative in the succeeding cycle of said main shaft for operating said elements to set the clutches of said series, for restoring the setting elements to inactive position and for reengaging the main clutch.

56. The combination with a part to be moved in progressive incremental steps of varying length, of a cyclically operated drive shaft, a drive mechanism interposed between the shaft and the part including a series of driving elements adapted to be driven by said shaft, selectively operable control means for conditioning said elements to be driven by the shaft in different permutational combinations to determine the length of the step imparted to the part, and means for interrupting the operation of said drive shaft in response to the operation of said control means.

57. The combination with a clutch having a driven element normally disposed in one driving position and shiftable to a neutral position or to an alternate driving position, shifting means including a periodically operated member, a first control bar operable to block said member against operation and thereby effect the shifting of the clutch element to its alternate driving position, a second control bar operable to block said member after partial operation and thereby effect the shifting of the clutch element to neutral position, and means for operating said control bars.

58. In a machine of the class described, in combination, a start-stop shaft, a variably operable shaft, a clutch interposed between said shafts for driving the second shaft, a plurality of keys each having a codal element for effecting a selective operation, means operated in response to the actuation of any one of said keys for initiating an operable cycle of said start-stop shaft, means operated in response to the actuation of certain of said keys for engaging said clutch to drive said second shaft, and means operated in response to the actuation of other of said keys for disengaging said clutch.

59. In a machine of the class described, in combination, a start-stop shaft, a variably operable shaft, a clutch interposed between said shafts for driving the second shaft, a plurality of keys each having a codal element for effecting a selective operation, means operated in response to the actuation of any one of said keys for initiating an operating cycle of said start-stop shaft, means operated in response to the actuation of certain of said keys for engaging said clutch to drive said second shaft, means operated in response to the actuation of other of said keys for disengaging said clutch, and means for latching said clutch in disengaged position.

60. In a machine of the class described, in combination, a start-stop shaft, a variably operable shaft, a clutch interposed between said shafts for driving the second shaft, a plurality of keys each having a codal element for effecting a selective operation, means operated in response to the actuation of any one of said keys for initiating an operating cycle of said start-stop shaft, means operated in response to the actuation of certain of said keys for engaging said clutch to drive said second shaft, means for latching said clutch in disengaged position, and means operated by said start-stop shaft in its succeeding operating cycle for disengaging said latching means.

61. In a cyclically operable machine, in combination, a start-stop shaft, a variably movable part, a drive mechanism including a series of elements interposed between said shaft and said part, a plurality of manually operable keys each having a codal element for selectively conditioning said elements for operation by said start-stop shaft in different combinations to determine the length of the step imparted to the variably operable shaft, means responsive to the actuation of any one of said keys for conditioning said elements and for initiating an operating cycle of said start-stop shaft, a function key, means controlled by said function key for determining the direction of movement of said variably movable part, and means operated in response to the actuation of said function key for initiating an operating cycle of said start-stop shaft and for disabling said drive mechanism during that cycle.

62. In a machine of the class described, in combination, a part operable cyclically in steps of fixed length and with uniform acceleration and deceleration, a part to be moved in incremental steps of varying length, a drive mechanism for imparting the uniformly accelerated and decelerated movements of said first part to said second part, and means for adjusting said drive mechanism to vary the length of the step imparted to the second part.

63. In a machine of the class described, in combination, a shaft to be driven in incremental steps of varying length, a drive shaft, power operated means for rotating said drive shaft cyclically with uniform acceleration and deceleration, a variable drive mechanism operatively connecting said shafts, and means for adjusting said drive mechanism to determine the length of the step imparted to the driven shaft, said step being executed with uniform acceleration and deceleration regardless of its length.

64. In a machine of the class described, in combination, a part movable cyclically in either direction from a normal rest position with uniform acceleration and deceleration, a part to be moved progressively in incremental steps of

varying length, a drive mechanism for imparting the uniformly accelerated and decelerated movements of said first part to said second part and in the same direction as said first part, and means for adjusting said drive mechanism to vary the length of the step imparted to the second part without altering the character of the movement.

65. In a machine of the class described, in combination, a part to be moved in incremental steps of varying length, a drive shaft, power operated means for rotating said shaft cyclically through a single revolution with uniform acceleration and deceleration, a plurality of elements arranged to drive said part, a like plurality of shiftable devices operable to condition said elements to be driven by said shaft, and selectively operable means for operating said devices in different permutational combinations to determine the length of the step imparted to said part, said step being executed with uniform acceleration and deceleration regardless of its length.

66. In a machine of the class described, in combination, a part to be moved in incremental steps of varying length, a drive shaft, power operated means for rotating said drive shaft cyclically through a single revolution with uniform acceleration and deceleration, a series of clutches each having a driving member fast on said drive shaft and a driven member loose on the shaft, means for engaging the clutch members selectively in different permutational combinations, and differential gearing interposed between the clutch members and said part operative in each rotation of the drive shaft to move the part with uniform acceleration and deceleration through a step proportioned to the combined movements of the clutch members.

67. In a keyboard controlled machine, in combination, a series of keys each having a codal element, a first control bar operable by one of the codal elements in response to the depression of its associated key, a second control bar operable by a different one of said codal elements in response to the depression of its associated key, a third control bar normally operable by either of the codal elements upon the depression of their associated keys, a latch adapted to coact with said third control bar to latch the bar in an inoperative position, means operable by said first control bar to move said latch into latching position, and means operable by said second control bar for withdrawing said latch.

68. In a keyboard controlled machine, in combination, a series of keys each having a codal element, a first control bar operable by one of the codal elements in response to the depression of its associated key, a second control bar operable by a different one of said codal elements in response to the depression of its associated key, a third control bar normally operable by either of the codal elements upon the depression of their associated keys, and a pivoted latch having a latch lug cooperating with said third control bar and oppositely projecting arms engageable respectively with said first and second control bar, said first control bar acting to rock the latch for positioning the latch lug in blocking relation to the third control bar and said second control bar acting to rock the latch to withdraw the latch lug from blocking position.

69. In a keyboard controlled machine, in combination, a series of keys each having a codal element, a first control bar operable by one of the codal elements in response to the depression

of its associated key, a second control bar operable by a different one of said codal elements in response to the depression of its associated key, a third control bar normally operable by either of the codal elements upon the depression of their associated keys, a pivoted latch having a latch lug cooperating with said third control bar and oppositely projecting arms engageable respectively with said first and second control bar, said first control bar acting to rock the latch for positioning the latch lug in blocking relation to the third control bar and said second control bar acting to rock the latch to withdraw the latch lug from blocking position, and yieldable means for retaining said latch in either position.

70. In a keyboard operated machine, in combination, a part to be moved in incremental steps of varying length, drive means for said part including a series of elements interconnected by differential gearing, a series of manually operable keys each having a codal element, a first set of control bars coacting with said codal elements and operable in a different combination for each key to effect a selective operation, a second set of control bars coacting with said codal elements and operable in a different combination for each key simultaneously with the operation of said first set of bars, and means cooperating with said second set of control bars to condition said elements for operation in a combination corresponding to the combination of bars operated.

71. In a keyboard operated machine, in combination, a part to be moved in incremental steps of varying length, drive means for said part including two groups of clutches interconnected by differential gearing, a series of manually operable keys each having a codal element, a first set of control bars coacting with said codal elements and operable in a different combination by each element to effect a selective operation and to set the clutches of one of said groups in a corresponding combination, and a second set of control bars coacting with said codal elements and operable in a different combination for each element to set the clutches of the other group in a corresponding combination.

72. In a keyboard operated machine, in combination, a part to be moved in incremental steps of varying length, drive means for said part including two groups of clutches interconnected by differential gearing, a series of manually operable keys each having a codal element, a first set of control bars coacting with said codal elements and operable in a different combination by each element to effect a selective operation, a second set of control bars coacting with said codal elements and operable in a different combination for each element, separate clutch actuating means cooperating with said two sets of control bars to set the clutches of said two groups, and means for retaining the clutches of one of said groups in set position.

73. In a keyboard operated machine, in combination, a part normally held in a rest position and movable to an operated position, a latch for holding said part in operated position, and common power actuated means for moving said part and for withdrawing said latch comprising a reciprocable member, means for periodically advancing and retracting the member, said member being normally effective to engage said latch to shift the same to withdrawn position, and key controlled means for positioning said mem-

ber to engage said part to move the same to operated position.

74. A machine for preparing control strips for typographical machines comprising, in combination, perforating mechanism operable to punch combinations of holes in a paper strip or the like, register means including a part adapted to be moved in steps of varying length, a main drive shaft, means for driving said part directly from said shaft including a series of rotatable elements interconnected by differential gearing, a series of manually operable keys each having a codal element, a first set of control bars coacting with said codal elements and operable in a different combination for each key actuated to selectively control the operation of said perforating mechanism, a second set of control bars coacting with said codal elements and operable in a different combination for each key actuated, and means cooperating with said second set of control bars to condition said series of rotatable elements for operation in a combination corresponding to the combination in which the control bars are operated.

75. A machine for preparing control strips for typographical machines comprising, in combination, perforating mechanism operable to punch combinations of holes in a paper strip or the like, register means including a part adapted to be moved in steps of varying length, a series of manually operable keys, power driven means selectively controlled by said keys for moving said part through steps of varying length according to the key operated, other means selectively controlled by said keys simultaneously with said power driven means for governing the operation of said perforating mechanism, and auxiliary control means operable to modify the action of said power driven means for reversing the directions of movement of said part without affecting the operations of said perforating mechanism.

76. A machine for preparing control strips for typographical machines comprising, in combina-

tion, perforating mechanism operable to punch combinations of holes in a paper strip or the like, register means including a part adapted to be moved in steps of varying length, an actuator for said part having a fixed range of movement, power driven means operable cyclically for moving said actuator through its fixed range, drive mechanism including differential gearing connecting said actuator with said part, shiftable members included in said drive mechanism adapted to be set selectively in different combinations for conditioning the mechanism to impart steps of different length to said part in response to movement of the actuator through its fixed range, and key controlled means for simultaneously initiating the cyclic operation of said actuator, selectively controlling said perforating mechanism and selectively setting said shiftable members.

77. In a machine for preparing control strips for typographical machines, the combination of perforating mechanism including a series of punches operable to punch permutational combinations of holes representing characters or the like in a paper strip, registering means including a pointer operable in incremental steps to indicate the cumulative widths of the characters represented by the signal combinations, a shaft for driving said pointer, a cyclically operable driving shaft, transmission mechanism providing a direct geared drive between said shafts, a series of keys each representing a character and operable when actuated to initiate an operating cycle of said driving shaft and to condition said punches for operation in a predetermined combination, and means controlled by each of said keys when actuated to condition said transmission mechanism for imparting to said first shaft and said pointer a step accurately proportioned to the width of the character represented by the key.

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