

March 23, 1954

J. H. GRUVER
PRINTING MACHINE

2,673,033

Filed July 22, 1948

6 Sheets-Sheet 1

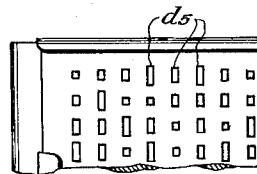
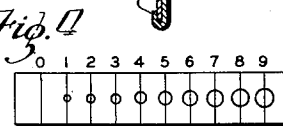
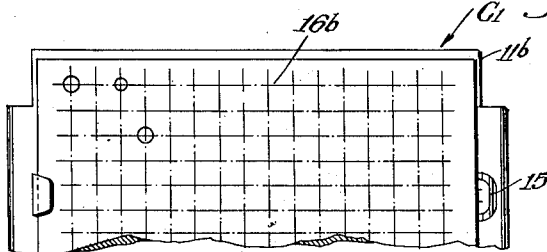
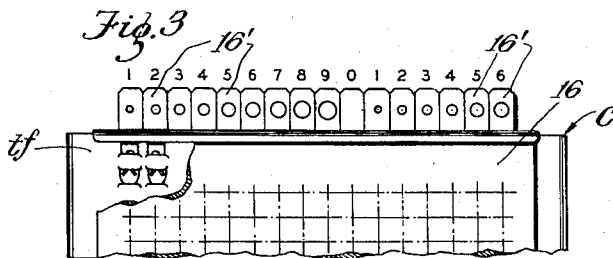
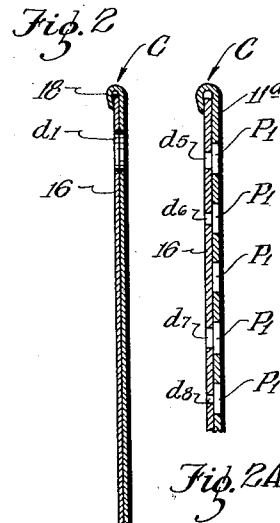
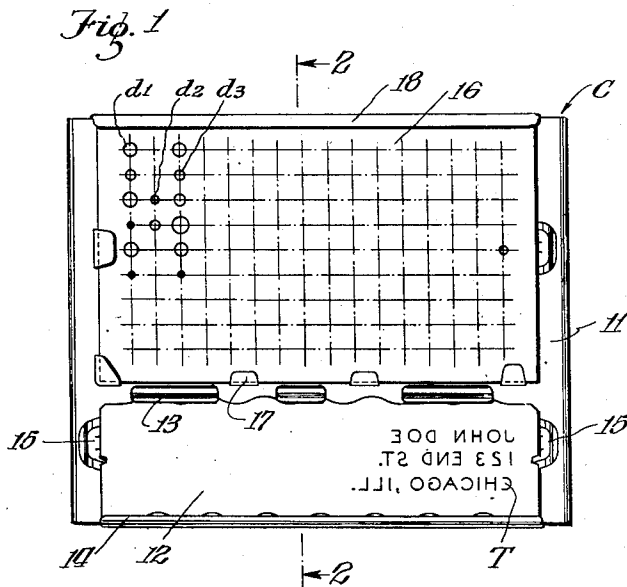


Fig. 3A

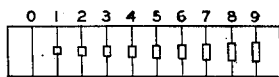


Fig. 6

Fig. 5
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March 23, 1954

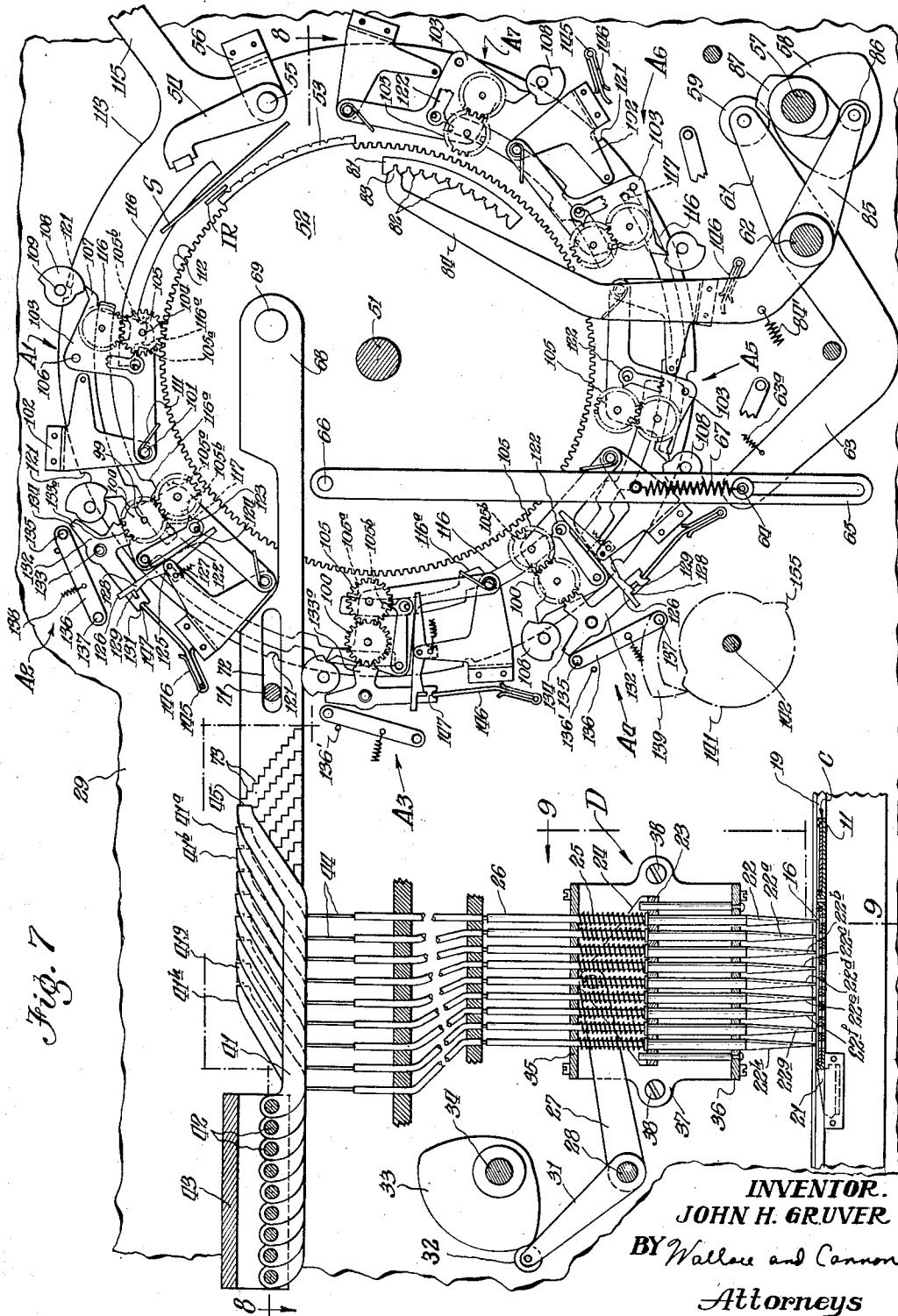
J. H. GRUVER

2,673,033

PRINTING MACHINE

Filed July 22, 1948

6 Sheets-Sheet 2



March 23, 1954

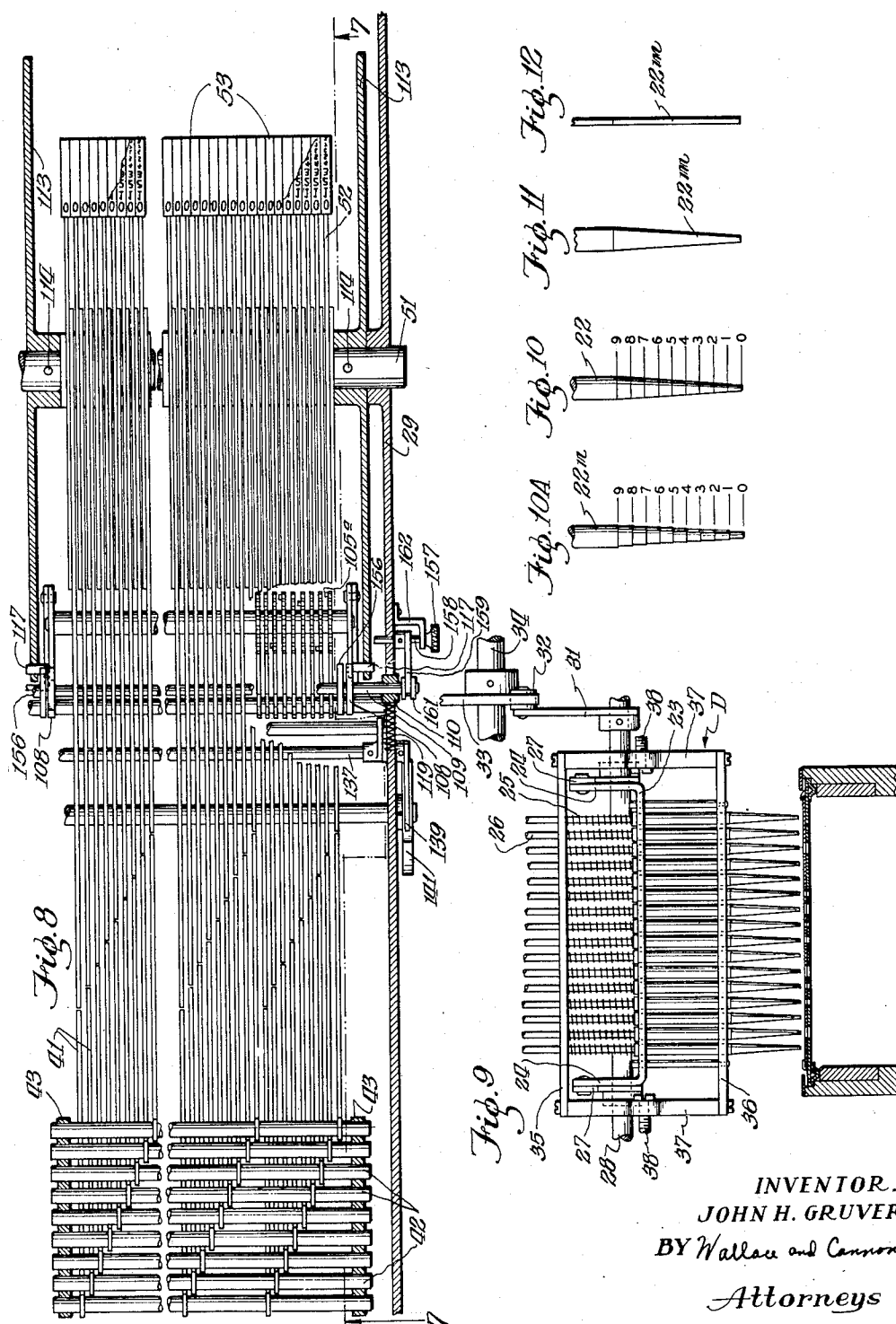
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2,673,033

PRINTING MACHINE

Filed July 22, 1948

6 Sheets-Sheet 3



March 23, 1954

J. H. GRUVER
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2,673,033

Filed July 22, 1948

6 Sheets-Sheet 4

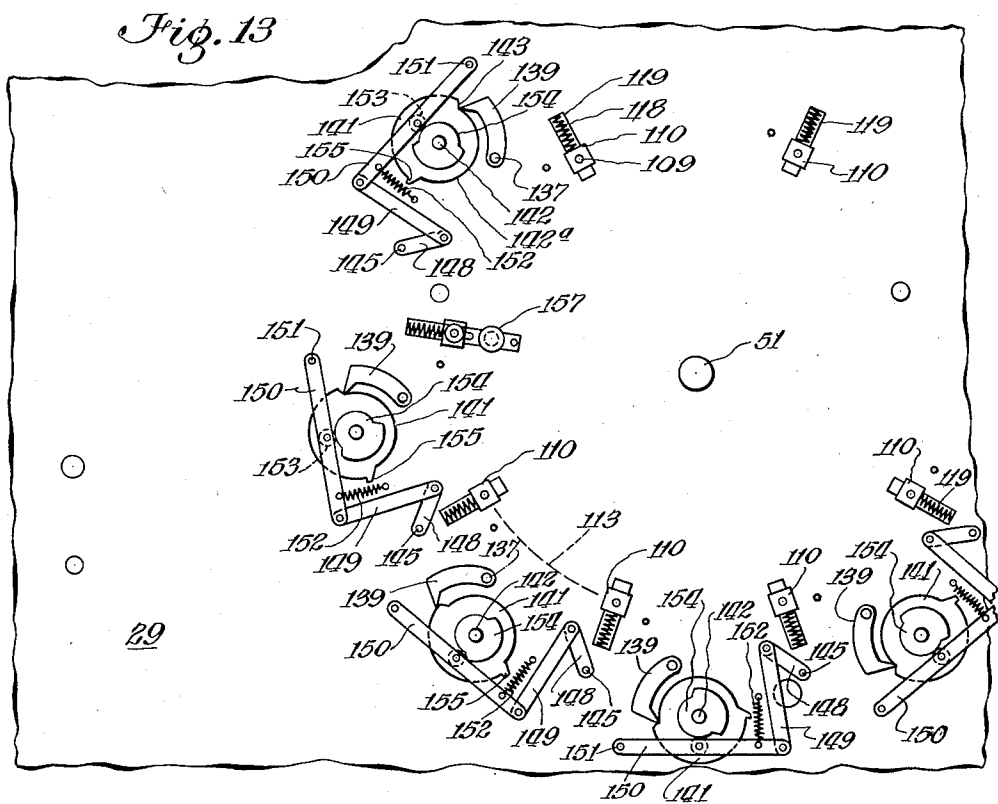


Fig. 14

GROSS PREMIUM	DIV.	NET PREMIUM	BROKERS COM.
1616.35	32.00	1584.35	200.00
JOHN DOE 123 END ST. CHICAGO, ILL.			

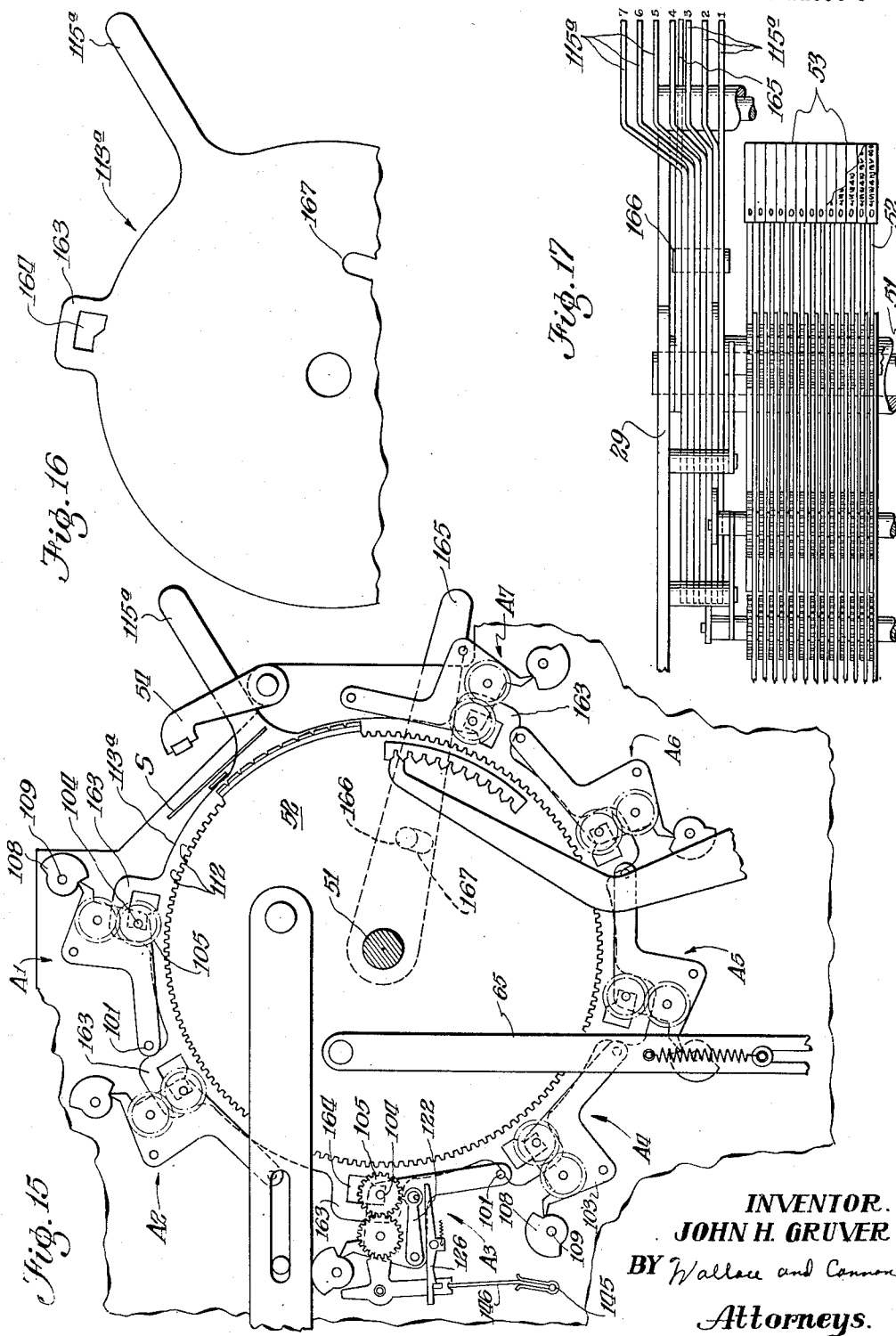
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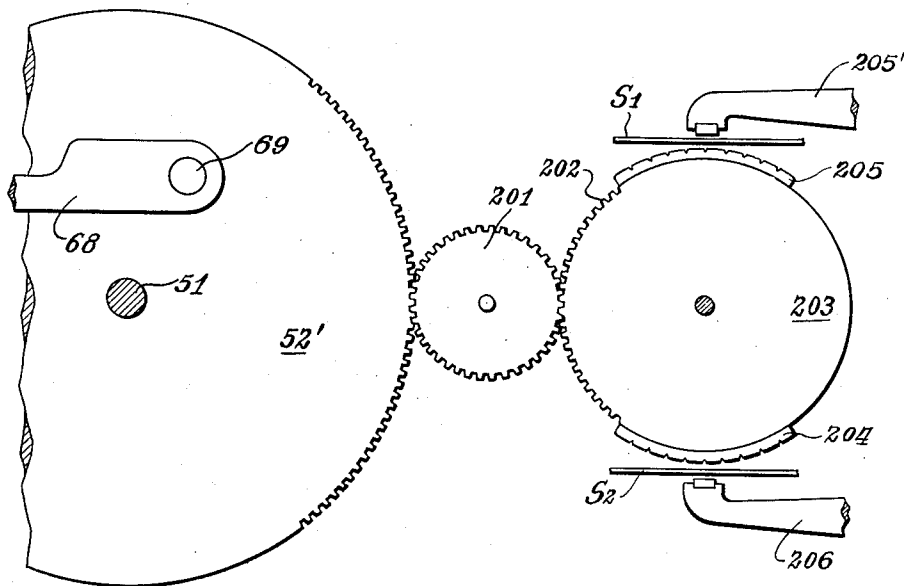
J. H. GRUVER
PRINTING MACHINE

2,673,033

Filed July 22, 1948

6 Sheets-Sheet 6

Fig. 18



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UNITED STATES PATENT OFFICE

2,673,033

PRINTING MACHINE

John H. Gruver, East Cleveland, N. J., assignor to
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mington, Del., a corporation of Delaware

Application July 22, 1948, Serial No. 40,185

21 Claims. (Cl. 235—61.9)

1

The invention relates to improvements in printing machines and more particularly to mechanisms for use therein and therewith, such as machines for printing variable numerical data, machines for accumulating, totalizing and printing such data, and kindred mechanisms, and a primary object of this invention is to provide such mechanisms to expedite preparation of business instruments and the like. In this connection it is understood that the term "business instruments" is used hereinafter in the generic sense with reference to a wide variety of sheets of which specific examples are insurance premium notices, checks drawn on banks, public utility bills, invoices, record sheets and the like.

An exemplification of printing machines of this kind to which the invention generally pertains is one wherein sheets of paper cut from a web, or sheets removed from a stack of pre-cut sheets, are fed past a printing position at which position impressions are made thereon from variably settable printing mechanisms set up under control of printing and control devices such as control cards or the like.

The machine of the present invention is primarily concerned with the printing of variable data, such as numbers, amounts of money and the like as distinguished from changeable data, such as names and addresses or constantly reoccurring (unchanging) data. Variable data of the type referred to herein are usually numerical accounting data, such as the amounts of premiums due an insurance company, the amount of a check drawn on a bank, or the amount of money due and credited to various agencies or individuals from the earnings of an employee. The variable data is by the present machine printed directly upon the notices, checks, etc., either before or after changeable and constantly reoccurring data has been impressed thereon. The impressing of changeable or constantly reoccurring data upon such sheets is not involved in the present invention; hence, it is sufficient to note only that such data usually consists of an identification such as a name and address and the names or titles of the various columns of variable data appearing on or to appear on the sheet and may involve the use of mechanism of a kind disclosed, for example, in United States Letters Patent No. 2,296,277, to Gollwitzer, dated September 22, 1942.

In instances where a business instrument such as an insurance premium notice or the like is to be impressed in a machine of the general character of that referred to above with such variable

2

data as "Gross Premium," "Dividend," "Net Premium" and like related data including perhaps, a "Brokers Commission" column, it usually is desirable and advantageous to accumulate and record a "total," at selected intervals, of the numerical data impressed upon a selected number of notices. Since each notice includes a plurality of variant columns of numerical data as above noted, a total may be desired for each column. In known prior mechanisms useful for impressing variable data upon sheets fed through the machine no means is provided to obtain these individual totals of various groups or columns of data other than to complete a run of a selected number of impressions under a specific column heading and then totalizing and returning the data impression mechanism to neutral or "zero" position and then running the sheets a successive number of times through the machine to permit totalizing of each column as it is completed. Obviously, such practices involve much time and effort and as a consequence much of the advantage derived from the use of such a machine is lost. It is therefore an object of the present invention to provide a variably settable printing mechanism with a plurality of manually or mechanically controlled and automatically actuated accumulator mechanisms each effective, when desired, to accumulate the variant digital data successively set up and printed upon the sheets under certain specified headings, so as to facilitate individual selective totalizing and subsequent printing of such totals on the sheet, or simultaneous totalizing of the data successively set up in all of the groups of a printing apparatus and subsequently printing all the accumulated totals upon the sheet simultaneously.

It is of course, a primary and salient object of the invention to provide a novel printing machine of simple and economical construction and efficient and positive operation and which will rapidly and accurately produce business instruments and the like. Hence other and further objects of the invention relate to the machine and to novel arrangements which may be incorporated therein to enable the aforesaid primary and salient objects to be realized.

Further objects related to the foregoing are to insure the production of neat impressions by aligning digital type characters entering into the printing operations in proper relation with each other; to enable totals of various groups of digital data printed or otherwise impressed on sheets passed through the machine to be accumulated; to insure that the printing of accumu-

lated totals is accurately accomplished by utilizing the accumulator mechanisms to set up the digital type characters for printing or otherwise making impressions of the totals; to insure accurate and complete restoration of the variably settable printing mechanisms embodied in the machine upon completion of the operating functions; and to provide a novel, efficient, positive, accurate and rapid mechanism of small and compact arrangement which is also simple and economical in construction and operation to accomplish the objects aforesaid.

Another object is to provide novel printing and control devices of the character that embody easily ascertainable identification tabs and replaceable means containing changeable data as well as a relatively large area suitable to be perforated to provide a multiplicity of rows of physical representations of digits 1 to 0 for cooperative engagement selectively by associated pins effective to determine the setting of variably settable printing and accumulating mechanisms associated with such devices.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments and the principle thereof and which I now consider to be the best mode in which I have contemplated applying that principle. Other embodiments of the invention embodying the same or equivalent principle may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a plan view of a typical sensing or control device employed in operation and control of the present machine.

Fig. 2 is an enlarged sectional view of the control device, taken on line 2—2 of Fig. 1;

Fig. 2A is an enlarged fragmentary sectional view, similar in part to Fig. 2, showing a modified form of control device;

Fig. 3 is a fragmentary view of the control device showing index tabs attached thereto.

Fig. 3A is a fragmentary view of another form of control device;

Fig. 4 is a chart of the code under which perforations are made in the control device;

Fig. 5 is a fragmentary view of a sensing and control device showing coded perforations rectangular in shape;

Fig. 6 is a chart of the code under which the perforations shown in Fig. 5 are obtained;

Fig. 7 is a vertical sectional view of the variably settable printing and accumulating mechanisms of the machine, and associated sensing and control mechanisms, the latter including a positioned sensing and control card such as is illustrated in Fig. 1;

Fig. 8 is a horizontal sectional view of the mechanism taken on line 8—8 of Fig. 7, showing intermediate portions of frequently duplicated elements eliminated;

Fig. 9 is a vertical sectional view of the sensing and control mechanism, taken on line 9—9 of Fig. 7;

Fig. 10 is a detail view of the sensing end of one of the sensing pins shown in Fig. 9, having markings associated therewith to illustrate potential positions assumed by the pin during use;

Fig. 10A is a similar detail view of an alternative form of sensing pin;

Figs. 11 and 12 are front and side views of the sensing portion of another modified form of sensing pin;

Fig. 13 is a side elevational view of the part of the machine housing the variably settable type wheels illustrated in Fig. 7, showing specified control mechanisms associated with related accumulator mechanisms;

Fig. 14 is an illustration of a business instrument containing variable printing produced by the present machine;

Fig. 15 is a fragmentary sectional view similar to the disclosure of Fig. 7, of a modified form of construction;

Fig. 16 is a fragmentary plan view of a control disc utilized in the mechanism shown in Fig. 15;

Fig. 17 is a plan view of the mechanism shown in Fig. 15; and

Fig. 18 is a diagrammatic view showing a modification of the printing mechanism for printing two sheets or webs of paper simultaneously.

The illustrated novel variable printing and accumulating apparatus which embodies the features of the present invention is adapted to print or otherwise impress variable data upon business instruments which may be in the form of sheets, or, either before or after printing, may be severed from a web of paper drawn from a roll. Operation of the apparatus, so as to effect proper setting of the variably settable printing mechanisms to cause sequential impressions of variable digital data upon the instruments, is primarily controlled through the correlated action of associated sensing mechanisms arranged to cooperate with control devices in the form of perforated cards which are sequentially fed to the machine. One such control device C is best shown in Figs. 1 to 3, inclusive, and it may include a frame 11 having a metallic plate 12 removably retained thereon at one margin by fixed retaining devices 13, a bead 14 at the lower edge of the frame, and yieldable or depressible retaining tongues 15. When one or the other of the tongues 15 is depressed the plate 12 may be slid endwise from the retaining devices 13 and the bead 14. Type characters T are, in this instance, embossed in the plate 12 so as to appear in relief on the exposed face thereof so that impressions may be made from the type characters when the printing and control device C is fed into printing relation with mechanisms within the machine and with which this invention is not concerned. A control card or plate 16 is retained on the remaining portion of the frame 11 by retaining devices 17 and a bead 18.

The plate or card 16 is preferably made of a strong sheet material such as sheet steel which will withstand repeated use without material deformation or enlargement of holes which are punched therein to represent data and to control operations in a manner to be described presently. The material may be a metal sheet other than steel of appropriate thickness and hardness, or it may be a plastic sheet, or a hard type of paper such as a plastic impregnated sheet. For limited reuse ordinary paper card stock may be satisfactory in special cases but generally a stronger material will be used. It will be understood that the term "card," as used hereinafter refers to a sheet or plate of durable material capable of withstanding repeated sensing operations without appreciable wear or deformation.

The control card 16 and underlying portion of the frame 11 are adapted to have holes such as d1, d2, d3 and so on formed therein preferably

in accordance with a code shown in Fig. 4 and explained in detail hereinafter, so as to afford control means or representations of data, and such holes or control means are utilized in the production of the variable data V on a business instrument such as is shown in Fig. 14, in a manner that will be described hereinafter. The holes in the control card 16 and the underlying portion of the frame 11 may be conveniently produced in a machine such as that disclosed in my copending application Serial No. 210,897, filed May 31, 1938. The holes may be round, of variable diameter, as shown in Figs. 1, 3A and 4, or rectangular, of variable length and uniform width, as shown at d5 in Fig. 5. When data represented by holes in the card 16 need to be changed the perforated card is removed and an unperforated card is substituted therefor, and this new unperforated card may then be perforated to afford holes representative of the data that are to be substituted for that which has been previously incorporated in the control device C. If this involves the making of perforations at positions not perforated on the former card, the frame 11 will also be perforated. Supplanted and unused perforations in the frame 11, in such instances, are covered and rendered ineffective by unperforated portions of the new card 16.

In the form shown in Fig. 2 the frame 11 of the control device C is perforated as at d1 only in the same positions, and preferably in the same punching operation, as the card 16. As noted above, the card 16 may be changed from time to time, a new code being punched therein and the frame 11 must be punched at least in all positions punched in the card, though it may have additional perforations covered by unperforated areas of the card.

As shown in Fig. 2A, the frame 11a may be prepunched with perforations P1 as large as the largest in the code, Fig. 4, at all possible data representing positions. In such case, the card 16 may be perforated as at d5, d6, d7, d8, the strength of the card being sufficient to control sensing operations to be described presently, independently of the frame or backing member 11a. By the use of a frame such as 11a, with all data representing positions prepunched, control cards 16 may be substituted at will without further operations on the frame or backing member.

The cards in the control devices are perforated to represent the digits in accordance with the code shown in Fig. 4. There, a plurality of perforations are aligned with a row representative of the digits 1 to 9. The holes progressively increase in size and the absence of a perforation is indicative of the digit zero. Each card 16 is of such a size that perforations may be provided therein to represent any digit or group of digits in any one or more of the potential positions indicated by the intersecting lines illustrated on the card shown in Fig. 1.

Thus, the card 16 shown in Fig. 1, has had perforations performed in selected positions in accordance with the code so that printing performed in the present apparatus, when under control of this card, will represent the various digital values to be entered under the various headings of an insurance premium notice of the character hereinbefore referred to as exemplary of a business instrument printed in the machine. The business instrument shown in Fig. 14, has columnar headings "Gross Premium," "Dividend," "Net Premium" and "Brokers Commission." Each column carries digital printing, the

impressions of which are controlled by the perforations in the cards 16. Hence, the number \$1616.35, appearing in the "Gross Premium" column on the business instrument may be represented on the control card 16, shown in Fig. 1, by a series of perforations in the first or left hand row and such perforations are sized in accord with the sizing of the digital perforations of the code of Fig. 4.

The next or second row from the left in the control card shown in Fig. 1 may be performed with sized perforations representative of the digital printing to appear under the heading of "Dividends" on the business instrument. As illustrated, if the dividend is \$32.00, the said second row on the control card will have no perforations at its two uppermost potential perforation positions while its third and fourth potential perforation positions will be performed with sized perforations representative of the digits 2 and 3, respectively. Similarly, the other rows of the potential perforation positions on the control card will be perforated to provide control means to effect the printing of the required digital data under the "Net Dividend" and "Brokers Commission" columns on the business instrument. If reference is made again to Fig. 1 it will be seen that the representations of digits as they appear thereof when read from top to bottom (thus, 536161) are in an order inverse to the manner in which the number is printed on the business instrument, being in the same order as the type of the printing devices.

The control devices C preferably include easily detachable index tabs 16' arranged on one edge thereof, each of which is formed with a perforation sized according to the teachings of the codes in Figs. 4 and 6. These tabs serve to identify and aid in selecting control devices C from a stack of similar devices and thus facilitate their being sorted and arranged in a desired alphabetical or numerical order in the file drawers or other containers in which they are kept. The tabs may be used also to control certain machine operations through sensing means as pointed out hereinafter.

Fig. 3A shows an alternative form of control device C1, wherein the frame 11b is modified to carry a card 16b which extends beyond the edge, occupying approximately the total area covered by the card 16 and the tabs 16' in Fig. 3. The upper edge portion of the card contains data representing positions corresponding to those shown on tabs 16', Fig. 3, and two additional rows of positions corresponding to the tab fastening area tf, making possible the provision of twelve horizontal rows of sixteen positions or a total of 192 sensing positions. It will be understood that the sensing means described below may be expanded to sense 192 positions, as in Fig. 3A, rather than 144 positions as in Fig. 1 or 160 positions (counting the 16 tabs as sensing positions) as shown in Fig. 3.

During the operation of the apparatus a supply of printing and control devices C are sequentially introduced into the machine from a magazine (not shown) from which they are withdrawn one at a time and are carried along a track 19 through the machine until they come to rest against a stop 21 in the position to be sensed by a sensing device D such as is illustrated in Figs. 7 and 9. When in this position, the card 16 of the control device C is located in vertical alignment beneath the sensing device which in the present instance includes spring pressed

7

headed sensing pins 22 each arranged respectively in vertical alignment with a potential position of a digital perforation in the control device. The pins 22 may be in the form of rods tapered towards a point at their lower or control device engaging ends, as illustrated in Fig. 10, or they may be fashioned from flat strips having their edges converge towards an end as at 22m, shown in Figs. 11 and 12.

Instead of converging gradually, the pins, either flat or round, may converge in steps to provide successive reductions in width or cross section as shown in Fig. 10A, at 22n.

In the instance of use of sensing pins like the rods 22, the perforations in the control cards 16 will be round as shown in the code illustrated in Fig. 4 but when the flat strips of Figs. 11 and 12 are employed, the perforations will be shaped substantially rectangular as illustrated in Fig. 6 which otherwise is like the code of Fig. 4 except that the controlling feature is the lengths of the perforations rather than their overall size. Irrespective of which form of sensing pins are used they are intended, during a sensing operation of the machine, to be moved downwardly in the manner to be described presently, during which movement those pins which are not in alignment with digital perforations in the control card 16 will abut said card and cease downward movement. Those pins having registering alignment with digital perforations in the control card will enter and pass through such perforations a distance determined solely by the size of the perforation. Thus, if a perforation in the control card is representative of the digit 5, such perforation will be of sufficient size to admit the sensing pin to a distance indicated by representative line marking 5 on the pin illustrated in Fig. 10 or to the appropriate shoulder, Fig. 10A. Where, for example, the perforation is representative of the digit 3 the pin will pass through said perforation until stopped by the controlling size of the perforation at the representative line marking 3 in Fig. 10. Similarly, each sensing pin entering a registering perforation will continue through such perforation until stopped by the limitation of the perforation size. Thus it will be evident that any digital representation or combination of digital representations perforated in the sensing card is represented with extreme accuracy in the ultimate positions of the registering sensing pins 22 when such pins have been thrust to their fullest extent through such perforations. The same operation applies to the modified sensing pins shown in Figs. 10A, 11 and 12.

Although I have described and illustrated the control card 16 as having sixteen vertical rows of nine digital positions each, the group of nine, or any other reasonable number of digits to be represented could be arranged in a horizontal row, the sensing means to be described below being arranged correspondingly. In other words there may be vertical rows arranged side by side with digit representing perforations aligned horizontally, or horizontal rows with corresponding perforations aligned vertically. Furthermore, combinations of sensing means at two or more positions or groups of positions may be employed to control a greater number of variable operators or operations than the number of positions on the control device which are sensed at a single sensing operation.

The mechanism provided in the machine for actuating the sensing pins is best shown in Figs. 7

8

7 and 9 and it includes a cradle fashioned from sheet material to provide an intermediate portion 23 and upwardly extending side walls 24. The intermediate portion 23 is perforated to receive freely therethrough the sensing pins 22, the enlarged heads of which are held normally against the top face of said portion by light compression springs 25, one surrounding each extension or guide stem 26 on each pin. The cradle side walls 24 are pivotally suspended from corresponding ends of a pair of arms 27 firmly fixed at their other ends to a rock shaft 28 journaled at its ends in the machine walls 29. The shaft 28 also carries a fixed lever 31 having a roller 32 at its free end arranged to ride upon the cam surface of an eccentric 33 secured to a driven rotatable shaft 34 in the machine. It should therefore be evident that upon rotation of the shaft 34, during operation of the machine and while a control card 16 is located beneath the sensing mechanism, the cradle is intermittently raised and lowered and when lowered enables the springs 25 to move the related pins downwardly towards the control card. Those pins that are registered with perforations in the control card enter the perforations distances depending upon the relative size of the perforations. Accordingly, the pins are positioned at variant elevations representative of the digital values of the perforations engaged. In order to minimize wear on the cards and to maintain the perforations accurate as to size, the springs 25 are designed to exert only light pressure on pins 22, merely for accurate sensing.

The pins and the cradle are of course guided so as to insure true vertical movement of the sensing pins and to this end the assembly is contained within and guided by a frame which may consist of top and bottom plates 35 and 36 respectively, and end walls 37. The end walls 37 may be secured to the machine walls 29 by screws 38 so as to thereby be held rigid, and the upper plate 35 is apertured to enable the guide stems 26 to extend upwardly therethrough. Hence the pins 22 are guided for vertical reciprocation in the frame and are thereby prevented from becoming misaligned or misplaced which must be avoided in order that accurate sensing of the control cards 16 may be accomplished. The top wall 35 of said frame also serves as a backing for the upper ends of the compressed springs 25 surrounding the pin stems 26. The tabs 16', Fig. 3, are sensed in a similar manner.

The sensing mechanism also includes a plurality of movable control fingers 41 best illustrated in Fig. 7, which are pivotally mounted on fixed rods as 42 mounted at their ends in a bracket 43 carried in the machine. There is one finger provided for each pin 22 and said fingers are operatively connected, one to each pin, so that each finger is moved about its pivotal mounting a distance determined solely by the distance to which its related pin penetrates a perforation in the control card 16. These connections preferably are established through Bowden cables 44 so as to afford the required flexibility in the mounting of the various parts of the machine in operative association with each other for, as is well understood, varied lengths of Bowden cables may be employed and inasmuch as these cables are flexible they may be directed as required in order to locate the control fingers and associated mechanisms at desired locations in the machine. Movement of selected fingers so positions the free ends 45 thereof that said ends are located so as to provide abutments or stops to limit movement

of associated mechanism to be described in detail hereinafter.

The sensing mechanism, including the movable fingers 41, is associated with variably settable type setting mechanisms effective during operation of the printing machine to successively set up variant digital data and impress such data upon the sheets fed through the machine in accordance with the data represented by the perforations in the control cards sequentially passed through and acted upon by the sensing mechanism.

As has been pointed out hereinbefore, the control card illustrated in Fig. 1 has nine potential perforation positions in each of its sixteen rows. The sensing pins 22 are likewise arranged in sixteen rows of nine each with one pin aligned with each potential perforation position. Consequently, the fingers 41 preferably are also arranged in groups of nine each with one of each group connected to one of the sensing pins in each row. Further, it should be understood at this time that although the illustrated control card 16 of Fig. 1 has sixteen rows of potential perforation positions, the present illustration discloses but a part of the complete printing mechanism and only such controlling fingers 41 and related mechanisms as are required for the present description and understanding of the machine operation.

Now, if reference is made again to Fig. 7, it will be noted that a sensing pin as 22 is connected through its Bowden cable to a control finger as 41 and that a sensing pin as 22a is connected to a control finger as 41a. Likewise, the remaining sensing pins 22b, 22c, 22d, 22e, 22f, 22g and 22h of a group of nine are connected respectively to the fingers 41b, 41c, 41d, 41e, 41f, 41g and 41h. The row of sensing pins 22 through 22h and the fingers 41 through 41h, thus constitute a single group of control elements available in the present disclosure to set up variably settable type printing elements for impressing the required data in, for example, the "Gross Premium" column of the business instrument shown in Fig. 14. Similarly each successive row of potential perforations in the control card 16 is intended to control actuation of a like row of sensing pins 22 and its related group of control fingers 41 for likewise setting variably settable type elements associated therewith. Thus, it will be understood that although the complete machine will have sixteen groups of fingers of nine fingers each and related variably settable type printing elements, corresponding to the sixteen rows of potential perforation positions, in the illustrated control card 16, only three of the groups of said fingers and type printing elements are illustrated inasmuch as the operations and functions of each group are identical and a description of one group will suffice as a description of all. For use with control elements having tabs as 16', Fig. 3, or having an extended control card 16b, Fig. 3A, additional sensing elements are provided, and additional operations may be controlled thereby.

It will be understood that although I have illustrated a complete unit to the right of the sensing pin assembly, Fig. 7, for setting up, printing and accumulating data obtained by the control and sensing means thus far described, the mechanism shown could be duplicated, for example, by arranging another complete unit such as is shown in Fig. 7 side by side with the unit shown. In this way the capacity of the machine could be increased, or more accumulators could be pro-

vided to take care of all data which might be sensed in all sixteen positions on control card 16. It is obvious, furthermore, that other combinations could be provided to duplicate functions, to print simultaneously at two or more places the same data, or different data from the same control device, or to sense separate data at other stations and set up type, print, and/or accumulate data in various ways.

Printing mechanism

A preferred embodiment of the variable data printing mechanism is best shown in Figs. 7, 8 and 13. The mechanism includes a main idler shaft 51 fixed at its ends in the side walls 29 of the machine, upon which are mounted for free rotation thereon a plurality of type wheels 52 each having a segment of type characters 53 on its periphery. Each segment of type characters includes digital type arranged consecutively from the digit 0 to the digit 9 and the type wheels are in the present instance arranged in groups of nine each to correspond with the grouping of the sensing pins and control fingers hereinabove described and with which the wheels are operatively associated in a manner to be described hereinafter. As best illustrated in Fig. 8, each type wheel 52 is fashioned from sheet stock of suitable thickness and the type wheels are spaced on the shaft 51 one from the other so as to afford working clearance between adjacent type wheels. Platens 54, each aligned with one of the type segments 53, are mounted for pivotal movement about a shaft 55 secured at its ends in brackets 56 carried on the inside faces of each frame wall 29. During printing operations of the machine, these platens are forcibly urged towards such type characters on the type segments as are disposed in printing position below an ink ribbon IR. Since the means for actuating the platens does not constitute a part of the present invention it is sufficient at this time to note only that the platens are selectively controlled and are actuated in timed relation to actuation of other mechanisms in the machine only at such times as it is desired to impress the variable data V set up by the type segments upon the sheets S being fed between the ribbon IR and the platens.

As noted hereinbefore, the type wheels 52 are freely rotatable on their common shaft 51 so as to be thereby individually positioned to locate a desired digital type character 53 in register with the ribbon IR. Such movement of the type wheels is effected through individual lost motion mechanisms including a common driven shaft 57 extending transversely between and journaled at its ends in the machine walls 29. As each of these mechanisms is identical one with the other only one such mechanism is shown and will be described in detail.

Thus, the driven shaft 57 carries a fixed cam 58 which is engaged on its peripheral edge by a roller 59 mounted on the end of one arm 61 of a bell crank lever freely pivoted on a common transverse bearing shaft 62 located closely adjacent to and extending parallel with the driven shaft 57. The other arm 63 of the bell crank has a lost motion connection at 64 with the longitudinally slotted lower end of a vertically disposed link 65, the upper extremity of which is pivotally connected at 66 with a type wheel 52. This link lies in the space between adjacent type wheels. A spring 67 tends to retain the link 65 in its lowermost position as determined by the position of the

11

arm 63 and normally would cause counterclockwise rotation of the connected type wheel 52 a distance responding to the total distance of descent of the arm 63 when the bell crank is rocked by the cam 58. However, since it is not intended that the type wheel 52 be rotated to the full extent indicated each time the bell crank moves through a cycle during machine operation, means under control of one of the fingers 41 and to be more fully explained hereinafter is provided which positively limits such counterclockwise rotation whereupon the bell crank arm 63 continues its downward cycle without descent of the link 65, the spring 67 permitting arm 63 to move downwardly with respect to the link 65.

A slidably mounted bar 68 lying in the space between adjacent type wheels 52 is pivotally attached by a rivet 69 to one face of each type wheel 52. Each of the bars 68 extends substantially horizontally beyond the periphery of its associated type wheel to dispose its free forward end opposite the end of one of the control fingers 41. A transverse rod 71 having its ends secured to the side walls of the machine extends through elongated slots in each of the sliding bars 68 to maintain the bars approximately in a horizontal plane and to guide them for reciprocatory sliding movement to and fro. When a type wheel 52 is in the position illustrated in Fig. 7, with its type character "0" aligned with the platen 54, the free end of the bar 68 associated therewith is in a position substantially abutting the end of a control finger 41. The free end of each bar 68 is provided with a series of stop shoulders or steps 73, each of which is adapted to coact with the end of the control finger associated with said bar, the particular stop shoulder in contact with the end of the finger depending upon the position of the finger.

When the machine is operated to rotate the cam shaft 57 through a cycle, a cycle being one complete revolution, bell crank 61—63 is moved to cause link 65 to move downwardly and sliding bar 68 to move to the left as viewed in Fig. 7. Movement of the bar 68 and type wheel 52 stops, however, when a stop shoulder 73 on the left end of the bar contacts the end of a control finger 41, further movement of the bell crank being permitted by the slot in link 65. If the sensing pin contacts an unperforated area on the control card, control finger 41 remains in its uppermost position and substantially no motion is imparted to the type wheel 52 or the sliding bar 68 associated therewith. If a small perforation representing the digit "1" is sensed, the finger 41 is lowered to engage the shoulder 73 on sliding bar 68 that is next to the top position, and the bar 68 is thus permitted to move to the left far enough to move associated type wheel 52 to a position where the digit "1" is in printing position. Similarly, if other digits are sensed, the control finger is positioned to stop the sliding bar 68 in proper position to dispose the appropriate printing characters beneath the platen 54.

It will be noted that when a sliding bar 68 is stopped from further movement to the left, by the engagement of a shoulder 73 thereon with the end of a control finger 41, the bell crank 61—63 continues to move in a counterclockwise direction, as viewed in Fig. 7, the left end thereof sliding downwardly in the slot in link 65. The spring 67 tends to move the bar 68 to the left and the type wheel 52 counterclockwise as far as possible, thus holding the appropriate shoulder in contact with the end of control finger 41.

12

The platen 54 is actuated by suitable means not shown, after the sliding bars 68 have moved as far to the left as permitted by fingers 41 thus positioning all the type wheels in printing position. This occurs while the bell crank roller 59 is riding on the high dwell of the cam 58. By the time the roller 59 leaves the high dwell the printing impression of the platen 54 has been completed and as the roller 59 moves into the low dwell of the cam 58 the bell crank 61—63 acts under the influence of a strong spring 63a, which causes the bell crank to follow the cam, upon the link 65 by abutment with the upper end of the slot therein to return link 65, type wheel 52 and sliding bar 68 to their initial or zero positions.

Since the printing mechanism includes accommodations to care for a nine order number in each group under the various columnar headings of the business instrument, it is necessary to provide means to align and retain the type characters making up such a nine order number so that a neat impression can be obtained. To this end each type wheel 52 carries a segment 81 on one of its faces formed with eleven internal teeth 82 each fashioned with inclined side edges to snugly receive, in the space between adjacent teeth, the nose portion 83 of a lock arm 84. The lock arm 84 is a part of a bell-crank freely rotatable on the transverse shaft 62. The other arm 85 of said bell-crank carries a roller 86 on its free end which rides upon the periphery of a cam 87 secured to the rotatable shaft 57. Thus, when the rotatable shaft 57 is in the rest position shown in Fig. 7, the bell-crank nose 83 is engaged between the first and second teeth 82 of the internally toothed segment 81 so as to thereby prevent inadvertent rotation of the type wheel. As soon as rotation of the rotatable shaft 57 is initiated, the roller rides off a high part of the cam 87 and into the drop thereof thus rocking the lock arm counterclockwise and withdrawing the nose 83 from its engagement between the teeth to thereby free the type wheel for counterclockwise rotation by action of the bell-crank 61—63 as previously described. When the type wheel reaches its limit of rotation and while the roller 59 of the bell-crank 61—63 is riding along the high spot on its cam 58, during which interval the platen 54 is actuated to impress the sensed type characters on the sheet S, the lock arm 84 moves clockwise to again engage its nose 83 in the gap between whatever teeth are in or approximately in registering alignment therewith. This action not only locks the type wheel against rotation during the printing operation but it effects alignment of the characters on adjacent type wheels and thus insures printing of all the characters in a straight line. About the time that the printing operation is completed, the roller 86 rides over the second high spot on the cam 87 and the lock arm again moves counterclockwise to disengage its nose so that the type wheel can rotate clockwise into its starting position in response to action of the bell-crank 61—63. A suitable spring 84' tends to rotate the lever 84 to cause the roller 86 to follow the cam 87.

Now, if a number such as the number 1616.35 appearing in the "Gross Premium" column on the instrument shown in Fig. 14 is to be printed, the first or lefthand row of potential perforation positions on the control card 16 shown in Fig. 1 will be perforated in accordance with the sized perforation of the code of Fig. 4 in such order that the perforations when read from top to bottom on said card will be in the order of 536161.

The remaining three potential perforation positions in the first row will not be perforated. When the control card is positioned in the machine beneath the sensing pins 22, as shown in Fig. 7, the sensing pin 22*h* in the first order will register with the perforation representing the digital character 5, the pin in the second order position will register with the perforation representing the digital character 3, and so on. Thus, upon machine operation, the pins enter the registering perforations to the extent determined by the coded perforations thus moving their connected control fingers downwardly so as to thereby locate their ends in alignment with the proper shoulder 73 on the end of the associated sensing bar 68. In the instant selection, the first finger 41*h* (which is the one farthest removed from the front of the group of fingers as illustrated in Fig. 7) will align with the fifth shoulder 73, counting from the upper edge of its associated (the first) sliding bar; and the second control finger, that is the finger identified as 41*g*, will be positioned with its end aligned with the third shoulder 73 on the associated or eighth sliding bar 68. Similarly, each finger in the group is positioned to be engaged by a shoulder on its associated bar in accordance with the size of the representative perforation in the control card 16. The absence of a perforation, as in the last three orders in the first row of the card 16 is representative of zero and the sensing fingers remain in the neutral or zero position illustrated in Fig. 7. Consequently, rotation of the driven shaft 57 results in counterclockwise rotation of such of the nine type wheels 52 of the selected group as are permitted to rotate by displacement of the related sensing fingers out of zero position. In the present disclosure, the type wheels for the last three orders will remain stationary thus leaving their zero type character 53 in printing position beneath the platens 54. The type wheel of the "hundredths" or first order will rotate until the fifth shoulder on its bar 62 abuts the end of its related control finger 41. This locates the type character "5" at printing position. Similarly, the "tenths" or second order type wheel will rotate to locate the type character "3" in printing position. To complete the description of the setting accomplished by the type wheels in this group, the third type wheel is rotated to cause printing of the selected digital character "6" in printing position, and the fourth, fifth and sixth type wheels, representative of "tens," "hundreds" and "thousands," respectively, are likewise rotated to position the digital characters "1," "6" and "1," respectively, in printing position. Thus, the nine type wheels in the group are positioned to print the digital characters 536161000 when read from rear to front in Fig. 7, which characters would appear on the sheet S in the correct order reading as follows: 0001616.35.

However, since the selected number 1616.35 is a six order number there is no need for printing the zeros of the seventh, eighth, or ninth orders. Consequently, suitable zero suppression mechanism may be provided in the machine to prevent the printing of such zeros as are of higher order than the highest order containing a significant digit on the sheet S. Mechanism to accomplish this purpose is shown and described in United States Patent No. 2,296,277, to Gollwitzer, dated September 22, 1942, and as it forms no part of the present invention it is sufficient to note only that such means may be provided either to render the platens 54 inoperative in those orders not re-

quired in an impression operation, or to further adjust the position of the type wheels independently of the sensing mechanism so as to move the "zero" character out of register with the platen. Of course, such zero suppressing mechanism is not required in the "tenths" or "hundredths" orders because these zeros are always printed in the orders pertaining to cents in sums of money.

Accumulator mechanism

Although each group of variantly settable type wheels and its associated sensing mechanism includes accommodations to care for a nine order number it is, of course, very infrequent that such a number is to be printed in the first instance on the sheet S. More frequently the number to be printed in the first instance does not exceed the sixth order. However, the present grouping provides accommodations to care for exigencies that may arise in the operation of accumulators one of which is associated with each group of nine orders as will be described hereinafter. Such accumulators are for the purpose of accumulating totals of amounts printed under each heading on successive business instruments and for setting up the type wheels 52 for printing the accumulated totals at selected intervals upon the sheet S, or on a separate sheet if so desired.

For the purpose of simplifying the disclosure and description, the variantly settable printing mechanism best illustrated in Fig. 7 is provided with but seven accumulator mechanisms, generally identified as A, on the theory that but seven groups of nine type wheels each constitute the complete printing machine although the control card 16 has sixteen rows of potential perforation positions and hence is capable of controlling the setting of sixteen groups of variantly settable type wheels of nine wheels each. The manner by which accommodation may be provided for sixteen accumulator mechanisms A will be better understood as the description proceeds. Each of the accumulators A is preferably of the type described in the aforesaid Gollwitzer Patent No. 2,296,277.

An accumulator mechanism A is provided for each of seven groups of nine variantly settable type wheels and each accumulator is intended to accumulate the amounts sequentially printed upon the sheet S by such type wheels during continuous operation of the printing mechanism. These accumulator mechanisms also are of such construction that at desired times they may be operated to set up the type wheels as 52 in their respective groups whereby totals accumulated therein may be printed on the sheet S.

In general, each accumulator mechanism A is supported in the machine for cooperative association with its group of type wheels 52 by a rod 101 firmly fixed at its ends in brackets 102 (only one shown) secured to the inside faces of the machine side walls 29. Each rod 101 carries a pair of accumulator side plates 103 which are freely pivoted thereon and are interconnected at an end by a shaft 104 so as to provide a rigid accumulator frame structure. The shafts 104 each carry nine accumulator wheels 105, in the form of gears, one for each type wheel in each group. Thus, the accumulator mechanism A-1 includes nine accumulator wheels one arranged for cooperative association with each of the nine type wheels in its associated group. Similarly, the accumulator mechanism A-2 has nine accumulator wheels 105, in the form of gears, one for each type wheel in the group immediately to the

15

rear of the group associated with the accumulator mechanism A-1 as viewed in Fig. 7. In a like manner, the remaining accumulator mechanisms A-3, -4, -5, -6, and -7 each have nine accumulator wheels 105 one in cooperative association with each type wheel 52 of its respective group. For convenience the various accumulator mechanisms are spaced at intervals around the type wheels 52, each group of type wheels being provided with appropriate gear teeth to mesh with its associated accumulator at the proper time.

Thus, it will be understood that one accumulator mechanism A is associated with and arranged to be operated by the variably settable type wheels in a single group of such wheels, and, as a consequence, each accumulator mechanism when rendered operative, in a manner and by a structural organization to be described hereinafter, will operate to accumulate totals of printings effected by repeated printing operations of the type wheels 52 of its associated group and inasmuch as each accumulator mechanism is identical with the others the following further description of these mechanisms is, unless otherwise stated, concerned with the structure and functions of but one such accumulator mechanism and is applicable to any one of those illustrated in various degrees of completeness.

The accumulator wheels 105 in the present instance are, as aforesaid, in the form of gears and are rotatably mounted on shouldered spacer collars each including a shoulder of sufficient thickness to accommodate an accumulator wheel. The collars are mounted on the shaft 104 about which therefore the accumulator wheels 105 are supported for rotation. The side plates 103 are, as aforesaid, connected together by the shaft 104 and also by a tie rod 106 to move as a unit and each side plate includes an ear 107 at its free end each of which may ride on the periphery of one of two cams 108 fast on a shaft 109 journaled in the slidable bearing blocks 110, Figs. 8 and 13, carried in the machine side walls 29, a spring 111 urging the ear 107 into engagement with the cam 108. The cam shaft 109, outwardly of the side walls, is intended to have a drive connection (not shown) with any suitable source of power in the machine so that it may be rotated one complete revolution each time the machine is operated to sense and print digital characters. In other words, the shaft 109 is arranged to rotate synchronously with the driven shaft 51.

These accumulator mechanisms normally are held in such positions that their gear wheels 105 are out of mesh with teeth 112 provided on the peripheries of the type wheels 52, such as is illustrated in the disclosures of the accumulator mechanisms A-2 to A-7, inclusive, Fig. 7. While in that position, they are ineffective. When any one of the accumulator mechanisms is to be made effective, mechanism to be now described in detail is actuated to locate the selected accumulator in a position so that its gear wheels 105 may, at required intervals, mesh with the peripheral teeth on the type wheels 52 of its related group.

One embodiment of mechanism for moving the accumulators into position to be effective to accumulate the digital counts successively impressed upon sheets passed through the machine is best illustrated in Figs. 7 and 8. There, discs 113 are firmly mounted on the type wheel shaft 51 preferably being secured by pins 114, so as to be rotatably movable in unison. One disc 113 is arranged near each side wall of the machine be-

16

yond the type wheels 52 which are, as previously noted, also mounted on said shaft but for free rotation. These discs are larger in diameter than the type wheels 52 in order that they may control the selection, engagement and disengagement of the various accumulators with their respective groups of type wheels. Each of the discs 113 is provided with one arcuate slot for each of the seven accumulators shown. These slots extend generally concentrically with the shaft 51 on which the type wheels 52 and the discs 113 are mounted, but each slot includes a depressed or inset portion 116a which acts as a cam to move the associated accumulator radially inward to mesh with teeth on the associated group of type wheels 52.

In order that the various accumulators may be selectively engaged, the arcuate cam slots 116 in the plates 113 are all of different contour as respects the position of the depressed or inset portion 116a. Movement of the plates may be imparted manually by means of a lever 115 attached to one of them, or if desired, a lever as 115 may be provided on each of the plates. The arcuate cam slots 116 are of such total length that they overlap, and therefore some of them are located farther radially from the shaft 51 than others. Corresponding cam slots are, of course, identical on the two plates 113 and each of the accumulators includes means to engage in a pair of companion cam slots. As shown in Fig. 7, the shafts 104 which support the accumulator gear wheels in accumulators A-1, A-4 and A-7 are extended beyond accumulator side plates 103 to engage at their ends in the respective cam slots 116 with which they register. Since the cam slots for the other accumulators A-2, A-3, A-5 and A-6 are located outward of the cam slots just mentioned, the corresponding shafts 104 on these four accumulator units do not directly engage the cam slots. Instead, a pin 117, Figs. 7 and 8, is carried by each of the side plates 103, extending outwardly therefrom to engage in cam slots 116 to control positioning of accumulators A-2, A-3, A-5 and A-6. Hence all of the accumulator mechanisms are engaged with a pair of cam slots on plates 113.

The inwardly offset portions in each pair of cam slots is so located that rotation of plates 113, as by lever 115, may selectively engage one and only one of the accumulators A with its associated group of type wheels 52. For example, as shown in Fig. 7, the gear wheel shaft 104 of accumulator A-1 is positioned in the offset portion 116a of related slot 116. Consequently accumulator A-1 is brought into mesh with type wheels 52 of its associated printing unit to accumulate totals entered into said printing unit by the sensing and control means associated therewith. The gear wheels 105 of the accumulator A-1 are meshed intermittently with gears on type wheels 52, such intermittent meshing being under the control of cam 108, as described above. Hence, as long as accumulator A-1 is set for operation, by appropriate positioning of plates 113 under control of lever 115, it will continue to accumulate totals from its associated printing unit and all other accumulators will remain in neutral position.

Should it be desired to accumulate totals entered into any of the other groups of type wheels, discs 113 are rotatably adjusted, through lever 115, to the selected position which will register the offset portion 116a of cam slots 116 controlling the selected accumulator mechanism with shaft 104 or pin 117 thereof, so that the selected

17

accumulator mechanism is carried inwardly out of neutral position toward its related group of type wheels. This same operation obviously renders accumulator A-1 inoperative because its pair of cam slots moves sufficiently to bring shaft 104 out of the offset portion 116a, thus lifting the accumulator to its neutral position.

The manner in which a total, accumulated by any of the accumulator mechanisms in the manner just mentioned may be printed will be described later after the operation of the accumulator mechanisms is discussed.

Because of the selective adjustment of the accumulator mechanisms described above, the operating cams 108 hereinbefore referred to, are carried on shafts 109 mounted in the slidable bearing blocks 110. By referring to the disclosure in Fig. 13, it will be seen that these blocks are slidable in radial slots 118 in the machine walls 29 and each is urged inwardly radially by a spring 119 which spring is of greater tension than springs 111 carried on and normally urging the accumulator frames outwardly radially about their pivots 101. Radial movement of the cam shafts 109 is controlled by the operation of plates 113 to select an accumulator as described above. Movement of the rotatably adjustable discs 113 which are formed with a series of peripheral recesses 121, one relatedly positioned with respect to each offset 116a in each slot 116, selects an appropriate shaft 109 for inward movement. The discs 113 are of a size as to dispose their peripheral edge in abutment with the surfaces of the cam shafts 109 so as to thereby hold said shafts at their most outwardly disposed position in the radial slots 118 against the tension of their springs 119. When the discs 113 are selectively rotated to locate a selected offset 116a in register with the accumulator shaft 104 or pin 117, on an accumulator mechanism, a related peripheral recess 121 is likewise located in register with the related cam shaft 109 so as to let the spring 119 carry said shaft inwardly radially and thereby maintain a working relationship between the cam 108 on said shaft, and the accumulator mechanism selected to be operated. Owing to the greater tension of the cam shaft spring 119, the cam is not urged into its outward position by any action of the spring 111 on the accumulator mechanism, which latter spring serves only to maintain the ears 107 in riding contact with the cam faces.

Now, when an accumulator mechanism is in the position illustrated, as at A-1, Fig. 7, rotation of the related cam 108 with the cam shaft 109 carries a rise on this cam into engagement with the ear 107 so as to thereby rotate the accumulator frame in such a manner that the accumulator gear wheels 105 are respectively engaged with peripheral teeth 112 on the type wheels 52 of its related group. The gear wheels 105 are so engaged with the teeth 112 immediately after the type wheels 52 have reached the end of their counterclockwise motion, as viewed in Fig. 7, by which time all of the type wheels will have attained the positions in which they are stopped by reason of shoulders 73 on their respective sliding bars 68 having moved against the ends of the respective control fingers 41 or; in other words, the type wheels 52 will be positioned to represent selected digital characters to be printed by the time the gear wheels 105 mesh therewith. Moreover, as will be explained in detail hereinafter, by the time the accumulator gear wheels 105 mesh with the teeth 112, the

18

platens 54 will have been actuated and in impression operation from the type characters set up will have been made.

The parts are so timed that immediately after the accumulator gear wheels are meshed with the teeth 112 on the type wheels, the type wheels 52 are unlocked through disengagement of the lock arm 84 and start to move clockwise as viewed in Fig. 7, to return to their initial or zero positions. Hence, since the type wheels 52 have been set up to represent selected type characters and as the accumulator gear wheels 105 are now meshed with said wheels, it follows that in the return of the type wheels to their zero positions rotation is imparted to the gear wheels 105 in an amount proportionate to the type characters to which the respective type wheels have been set to represent. Therefore, the digital amount represented by the type characters on the type wheels 52 and impressed on the sheet S will be set into the accumulator wheels 105. Means similar to those described fully in the aforesaid Gollwitzer Patent No. 2,296,277 are provided for locking the accumulator wheels 105 against accidental rotation at all times when they are out of mesh with the type wheels 52. Appropriate manual means may be provided also for returning the accumulators to zero position at any time.

It will be manifest that as successive digital values are entered into the accumulator gear wheels 105, more than ten digits will be entered onto a particular wheel and as the tenth digit is entered into a particular wheel it is necessary that a carryover be made into the order next higher to that to which a particular wheel pertains, and hence an arrangement which has been shown and described in the aforesaid Gollwitzer Patent No. 2,296,277, and now to be described briefly, is provided which will effect such carry-overs. For the purposes of disclosure and description only, the seven accumulator mechanisms illustrated herein have been shown with parts in various positions attained during operation and although the description is concerned with the structure and operation of but one of the seven accumulator mechanisms disclosed, since each is like the other, repeated reference will be made to the illustrated positions of various parts of different accumulator mechanisms.

Now, each accumulator gear wheel 105 has twenty teeth thereon, and two teeth at diametric positions thereon, which is to say, each of the teeth pertaining to the digit "0," are thickened, as indicated by the numbers 105a and 105b. Immediately after the type wheels 52 attain their rearwardmost or zero positions, the ear 107 rides off the rise on the cam 108, which holds the gear wheels 105 in mesh with the teeth 112, and thereupon the accumulator frame 103 is pivoted outwardly under the influence of the spring 111. In this movement the accumulator gear wheels 105 are demeshed from their cooperating type wheel teeth 112 and the accumulator mechanism is disposed in a position such as is illustrated of the accumulator mechanism A-2 in Fig. 7.

Dogs 122 are pivotally mounted on the tie rod 106, there being a dog 122 at the side of each accumulator wheel 105 to lie in the line of movement of the thickened portions of the teeth 105a and 105b. The dogs have relatively enlarged openings 123 therein near the free ends thereof and a rod 124 carried by the accumulator side plates 103 extends through all

of the openings 123 to limit the pivotal movement of the dogs 122 about the tie rod 106.

Another shaft 125 extends between extensions on the brackets 102 and mounted at spaced intervals therealong are pawls 126, there being a pawl 126 in alignment with each dog 122. Springs 127 are effective on the pawls 126 to engage an end of these pawls with the dogs 122 and to urge shoulders 128 on the other ends of the pawls into engagement with lugs 129 on arms 131 of carry segments 132 which are mounted on a shaft 133 that extends between the machine side walls 29; there, of course, being a carry segment 132 for cooperation with each pawl 126. Each carry segment 132 includes a medial arm having a gear segment 133a at its free end. These gear segments 133a are, respectively adapted to mesh with idler gears 100 mounted by a pin 99 on the side platen 103 and intermeshed with the corresponding accumulator gear wheels 105. Each carry segment 132 also includes an arm 134 which projects outwardly a sufficient distance to be engaged at selected times by a pin 135 carried by an arm 136 of a rocker mounted on a shaft 137 that is rotatably carried by the machine walls 29. A spring 138 is effective on the arm 136 to urge it and therefore the pin 135 outwardly away from the accumulator mechanism as the parts are viewed in Fig. 7.

The rocker shaft 137 extends to the outside of one of the machine walls 29, and, as best shown in Fig. 13, this extending portion of the shaft 137 carries a cam follower 139 which has its free end riding on the periphery of a cam 141 fast on a driven shaft 142. Shaft 142 is driven in timed operation with the printing means by drive means not shown. The periphery of this cam has a notch 142a therein, one end of which notch is defined by a radial edge 143 at the end of a dwell on the periphery of this cam.

A shaft 145 is journaled in the machine walls 29 and a comb spring 146, Fig. 7, is fast thereon intermediate these walls. The free ends of the teeth of this comb spring are respectively engaged in bifurcations 147 provided at the free ends of the arms 131 of the carry segments 132 so that each tooth of the spring 146 is effective on a particular carry segment. It is the spring 146 which supplies power to effect the entry of carries in a manner that will be described presently. In the course of a restoring operation, which will also be described presently, it would be necessary to overcome the effective force of this spring were it not for the fact that the following described arrangement is provided whereby the spring 146 is strongly tensioned only at the time it is to be effective to cause the entry of carries, and at all other times this spring is only lightly tensioned.

An arm 148, Fig. 13, is fast on the shaft 145 and a link 149 is connected thereto, this link also being connected to one end of a rocker 150 which is pivotally mounted at 151 on the outer face of a machine wall 29. A strong spring 152 is effective on the rocker 150 and urges a roller 153 thereon toward the periphery of a cam 154 fast on the cam shaft 142. At the time a carry is to be entered, the roller 153 rides onto a drop on the cam 154 whereupon through the link 149 and arm 148 the shaft 145 tends to rotate clockwise as it is viewed in Fig. 7 and 13. In this carry operation the full effect of the strong spring 152 is impressed on the comb spring 146, it being understood that, when the roller 153 rides on the high point of the cam 154 the spring 152 is only partly effective on the spring 146 which is at such times

only lightly tensioned. The increased tension impressed by the strong spring 152 on the comb spring 146 is maintained until the accumulator gear wheels 105 are meshed with the peripheral teeth on the type wheels 52, in the manner above described, but as soon as this is effected the dwell on the cam 154 engages the roller 153 and thereupon the spring 152 is only partly effective on the spring 146 wherefore the tension of this spring is reduced so that a restoring operation may be effected without being required to overcome strong tension on the spring 146 by the spring 152.

When an accumulator wheel 105 is in one of its two zero positions, either of the wide teeth 105a or 105b is located with respect to the dog 122 in the position in which the tooth 105a is shown in the accumulator mechanism A-1 in Fig. 7, which is positioned immediately beyond that in which the tooth 105a would be effective, upon movement of the accumulator wheel 105 counterclockwise, as viewed in Fig. 7, to pivot the dog 122. In this position the springs 127 act through the pawls 126 to move the dog 122 against the rod 124 which positions the dog 122 with their nose in the path of but behind the tooth 105a. Now, if it be assumed that a sensing pin 22 has passed through a perforation in the sensing card 16 representative of the digit 9 and that the corresponding accumulator gear wheel 105 has been meshed with the toothed periphery of its related type wheel 52 by reason of movement imparted to the accumulator mechanism through setting of the disc 113 and rotation of the cam 108 in the manner hereinabove described, the parts will be positioned to cause the gear wheel 105 to rotate counterclockwise immediately when the type wheel 52 starts its clockwise movement towards its neutral or zero position.

Thus when the printing operation has been completed and the type wheel 52 rotates clockwise from the position it assumed while the digit 9 was being printed on the sheet S, into its initial or zero position it will rotate the accumulator gear wheel 105, meshed therewith during this particular operation, counterclockwise in an amount representative of nine digits, thus advancing the wide tooth 105b on said gear wheel into a position wherein it will engage the dog 122 as soon as further movement is imparted to the accumulator gear wheel 105, such positioning of the accumulator gear wheel 105 being equivalent to a representation of 9. The gear wheel shown in the accumulator A-2, Fig. 7, has been illustrated as being in this position.

Immediately after the type wheel 52 has reached its neutral or zero position, the ear 107 on the accumulator mechanism rides off the rise on the cam 108 and thereupon the accumulator gear wheels 105 disengage the toothed type wheels 52 and move outwardly away from said type wheels into a position wherein the teeth of the idler gears 100 engage the teeth of the gear segments 133a, such engagement of these teeth being shown by way of illustration, in the accumulator A-3 of Fig. 7, which shows the movably mounted parts in the positions attained when the wheel 105 is disengaged from the type wheel 52. When no carry operation is to be effected, this engagement locks the accumulator wheels 105 against accidental movement.

If in the course of the sensing operations the next effective operation of the sensing pin 22 is to have caused the pin to pass through a perforation in a sensing card 16 representative of

the digit 4, this card being one succeeding that previously penetrated, and the appropriate type wheel 52 has been rotated counterclockwise into a position to have caused printing of the digital character "4" upon the sheet S, the illustrated accumulator gear wheel 105, as well as all others in said accumulator, will be pivoted back into engagement with the toothed periphery of the type wheels 52 and then as the type wheel 52 rotates clockwise to return from the position which it assumed while the digital character four was being printed to its neutral or zero position, the gear wheel 105 will have advanced counterclockwise in an amount equivalent to the representation of four digits.

In the course of the advancing of the gear wheel 105 from the position in which it is shown in the accumulator A-2, where it is carrying a representation of the digit "9," into the position assumed after the added representation of four, as just described and illustrated in the gear wheel of accumulator A-4, Fig. 7, the wide tooth 105b engaged the tapered nose on the free end of the illustrated dog 122 and pivoted this dog downwardly to the right as it is viewed in the accumulator A-4. Such pivotal movement of said dog 122 is effective on the end of the illustrated pawl 126 to pivot the shoulder 128 thereon from engagement with the lug 129 on the arm 131 of the illustrated carry segment 132. This frees the carry segment 132 of its latch connection with the pawl 126 for a very slight movement to the unlatched position thereof illustrated in the accumulator A-4, but this movement is so slight in practice that the teeth of the carry segment 132 are maintained in substantially the same relation with the teeth of the idler gear 100 with which they cooperate as these teeth would have occupied had not the shoulder 128 been disengaged from the lug 129.

The dog 122 and cooperating pawl 126 may be assumed to be those that cooperated with the accumulator wheel 105 which pertains to the "units" order. The carry segment 132, however, while it is under control of the aforesaid dog and pawl, is aligned with the next higher idler gear 100 and accumulator wheel 105 or, in this instance, the idler gear 100 and accumulator wheel 105 which pertains to the "tens" order.

When the accumulator wheel 105 with which the dog 122 cooperates advanced from the position in which it is illustrated in the accumulator A-3 into the position in which it is shown in the accumulator A-4, four digits were added to the nine already standing therein so that when the accumulator attains the position in which it is illustrated in the accumulator A-4 it is representing "13." However, an accumulator wheel 105 is only capable of representing the digits appearing in a single order so that when an accumulator wheel advances from the "9" position thereof as illustrated in accumulator A-2 into the "3" position thereof as illustrated in the accumulator A-4, it was necessary to carry the "1" in the "tens" order of "13" into the next higher or "tens" order. It was for this purpose that the shoulder 128 was disengaged from the lug 129, and when this shoulder disengaged this lug the arm 134 of the carry segment 132 pertaining to the "tens" order moved from a position maintaining a gap or clearance between the arm 134 and the pin 135 on lever 136 into a position as illustrated in the accumulator A-4 to close said gap or clearance, and it is the engagement of this arm 134 with the pin 135 that

maintains the teeth of the gear segment 133a in proper relation with the teeth of the accumulator wheel 105 that pertains to the "tens" order or, in other words, insures that when the accumulator moves outwardly away from the type wheels 52, a particular tooth on the gear segment 133a will engage this particular tooth notwithstanding the de-latching of the shoulder 128 from the lug 129. Prior to the time the parts attain the position in which the accumulator illustrated at A-4 is positioned, the accumulator has pivoted outwardly in the manner above described and in the course of this pivotal movement the teeth on the idler gear 100 move into meshing relation with the teeth of the gear segment 133a aligned therewith. By the time this intermeshing is established the roller 153 (Fig. 13) has ridden off the rise on the cam 154 and the arm 150 has been freed to the action of the spring 152 which, as explained hereinabove, is effective through the link 149 and the arm 148 to impress strong tension on the spring 146. Subsequently to the time just described wherein intermeshing of the idler gear 100 pertaining to the "tens" order with the gear segment 133a aligned therewith has been established, the radial edge 143 of the cam 141 moves, due to rotation of said cam, so that the cam follower 139 drops past said edge onto the inner dwell surface of the cam. Thus, the arm 136 is moved by its spring 138 from the position shown in the accumulator A-4 into engagement with the stop pin 136' associated therewith. In the course of such movement of the arm 136, which movement is counterclockwise, as viewed in Fig. 7, the pin 135 moves in a direction away from the arm 134 of the carry segment 132, and in the course of such movement the spring 146 is effective through the arm 131 of the carry segment 132 to rock the carry segment in a counterclockwise direction out of the position in which it is illustrated in the accumulator A-4, a distance equal to the spacing of its teeth, which rocking movement is effective to rotate the idler gear 100 sufficiently to advance the accumulator wheel 105 pertaining to the "tens" order in an amount equivalent to the representation of one digit thereon whereby the "1" of the above described entry "13" is entered in the "tens" order.

There may be instances in which long carries are to be effected. To illustrate, an accumulator wheel 105 may be standing in a position representative of the digit 9 prior to the time a carryover into such a wheel occurs. Upon entry of such carryover digit, the aforesaid accumulator wheel will thereupon move into a position representative of zero, and a carry must then be effected into the accumulator wheel 105 in the next higher order. In this event, the carry segment 132, which was tripped when the lower order accumulator wheel 105 passed from a position representative of the digit 9 to a position representative of zero, will immediately be rocked by its spring 146 without having paused at the intermediate position illustrated by the position of the wheel in accumulator A-4. This is because the lever 136 carrying pin 135 will have already moved into position against its stop pin 136' prior to the time the carry segment 132 is released by disengagement of the shoulder 128 on the pawl 126 from the lug 129 on the segment 132, the pin 135 having been moved to initiate the carry-entering operation as explained hereinabove. Hence, when a long carry is to be entered into a higher order accumulator wheel, such a

carry will take place immediately upon passage of the lower order accumulator wheel from a position representative of the digit 9 into a position representative of zero.

The above described operation of entering a carry into a next higher order occurs after the accumulation of any digital values that are to be accumulated in the order into which the carry is made and it also occurs prior to the end of a cycle of operation brought about by rotation of the driven shaft 57. Hence, by the time the driven shaft 57 comes to rest at the end of a cycle of operation of the mechanism, the accumulator wheels 105 of whichever accumulator mechanism A that was rendered operative through the setting of the discs 113, stand in positions representative of whatever values were entered therein in the course of such cycle of operation plus any values which were previously entered therein.

In the course of a cycle of operation succeeding that in which any carry or carries have been entered into the next higher order in the manner above described (it being understood that a carry over arrangement similar to that hereinabove described is associated with each lower order from which a carry may be made and with each higher order into which a carry may be entered) the carry segments 132, which were rocked into position to effect entry of such a carry, and the dog 122 which unlatched the pawl 126 to bring about such a carry operation are restored to their initial position as shown, for example, in the accumulators A-2 and A-3, this being brought about as follows:

Shortly after the start of the cycle of operation succeeding that above described, and subsequently to the time in such succeeding cycle at which the accumulator gear wheels 105 have been moved from the position where they are disengaged from the toothed type wheels 52 into a position wherein they are engaged with the toothed type wheels 52, as illustrated of the accumulator A-1, the rise on the cam 141 (Fig. 13) engages the roller 153 and pivots the rocker 148 upwardly whereby the tension of the comb spring 146 is lessened so that the strong tension applied thereon as above described need not be overcome during the restoring operation. The spring 146 however remains effective on the carry segments 132 until the accumulator wheels 105 are effectively meshed with the toothed type wheels 52 and in this way the accumulator wheels 105 are retained in whatever position into which they are advanced by reason of carry-over actions, it being apparent that such an arrangement insures accuracy of operation which is, of course, essential.

Immediately after the accumulator wheels 105 have been engaged with their aligned toothed type wheels 52 and the comb spring 146 has been freed of the strong tension in the manner described, the restoring operation of the carry-segments and other parts that moved in the operation, is quickly effected and this is brought about by the engagement of a rise 155 on the cam 141 (Fig. 13) with the cam follower 139 which rocks the arm 136 (Fig. 7) clockwise towards the accumulator mechanism to dispose the pin 135 in a position slightly closer to said mechanism than the position which this pin assumes while the cam follower is riding on the outer dwell of the cam 141. When in this position the pin 135 acts through the arms 134 to so dispose the arms 131 that the lugs 129 are below all of the shoulders

128. Therefore, the pawls 126 are all freed to the action of their spring 127 and this insures that the shoulders 128 will be disposed in latching position above the lugs 129. It will be noted that the rise 155 on the cam 141 extends slightly beyond the outer dwell of the cam 141 and that it is brief so that the cam follower 139 is quickly freed therefrom and when said follower moves into engagement with the high dwell of the cam 141, the pin 135 returns to what might be termed a normal position while the high dwell of cam 141 is engaged by the cam follower. This position of the pin 135 is such that if a shoulder 128 is disengaged from a lug 129 the relationship between the teeth 133a of the freed carry segment 132 will be maintained with the idler gear 100 connected to the aligned accumulator gear wheel 105, as has been described hereinabove. The just described restoring operation occurs intermediate of the time the accumulator gear wheels 105 are engaged with their aligned toothed type wheels 52 and the time the type wheel actuating lever 61-63 is effective to dispose the type wheels in positions representative of significant digits.

In the course of operation of the machine various amounts printed from the type wheels 52 are, as aforesaid, accumulated on the accumulator gear wheels 105 of any one or more of the accumulator mechanisms A, and usually at the end of a predetermined set of operations, which is commonly referred to as the end of a run, it is desired to print the total of the amount (of for example "Gross Premiums") that has been accumulated on the wheels 105, and to this end manually operable means are provided for causing the accumulator gear wheels 105 to be engaged with the type wheels 52 in such a way that the setting of the gear wheels 105 can be utilized to set up the type wheels 52 so that the total accumulated on the gear wheels 105 may be printed therefrom.

It will be remembered that the platens 54 are operated to perform a printing operation just prior to the time the type wheels 52 start their return movement in a clockwise direction, as viewed in Fig. 7. It will also be recalled that, when a total is being accumulated in the accumulator gear wheels 105, these wheels are engaged with the teeth on the type wheels 52 to pick up the digital setting of said type wheels 52 in the course of movement of the type wheels in a clockwise direction to their initial or zero positions after the platens have been operated. Now, since the platens 54 are to be utilized in a total taking operation to effect a printing operation from the type wheels 52, it follows that these type wheels must be set up prior to the time the platens are operated. Since no means is provided to vary the timing of the operation of the platens 54, they are operated at the same time in both a total taking operation and in normal operation. This therefore means that instead of the accumulator wheels 105 being engaged with the type wheels 52 during the clockwise movement of said type wheels such engagement must be effected earlier, namely, during counterclockwise movement of said type wheels 52.

It will also be recalled that the accumulator gear wheels 105 were meshed with the type wheels 52 by the action of an associated cam 108 which acted to rock the accumulator mechanism A in a clockwise direction at that time during the course of a cycle of operation when the type wheels 52

attained the end of their counterclockwise movement, as viewed in Fig. 7. Now, in order that the accumulator mechanisms may be rocked to engage its accumulator gear wheels 105 with the type wheels 52 prior to any counterclockwise rotation of the type wheels in a total taking operation, it is essential that some means be provided for so rocking the accumulator mechanisms at such time. Furthermore, in the course of a total taking operation it is essential that the accumulator gear wheels 105 be disengaged from the type wheels 52 when said type wheels move in a clockwise direction, as viewed in Fig. 7, for otherwise whatever total was taken from the accumulator gear wheels would be re-entered therein as the type wheels return to their initial or zero positions, it being understood that the setting of the various accumulator wheels 105 is utilized to arrest clockwise rotation of the type wheels 52 in the course of a total taking operation to set up the type segments 53, this being explained presently.

Now, since the cams 108 are formed to maintain the accumulator gear wheels 105 meshed with the teeth on the type wheels 52 during clockwise movement of said type wheels, it is necessary that the cams 108 be rendered ineffective in a total taking operation. Therefore, in order to provide means for rocking the accumulator mechanism A at the start of a total taking operation so as to engage its accumulator gear wheels 105 with the type wheels 52 and in order to prevent the cams 108 from improperly holding the accumulator gear wheels meshed with the type wheels 52 during clockwise movement of the type wheels 52 in the course of a total taking operation, another set of cams 156 (Fig. 8) are mounted on the cam shaft 109 one adjacent each cam 108. In order that the cams 108 may be rendered ineffective and the cams 156 rendered effective, the cam shaft 109 is mounted for axial movement in its radially slidable bearing blocks 110.

The cam shaft 109 is normally positioned to dispose the cams 108 in position to cooperate with the fingers 107 on the side plates 103 of the accumulator mechanism A. When, however, the cams 108 are to be moved from alignment with the said fingers 107, which is to be done in a total taking operation, movement of the cam shaft 109 may best be accomplished by manually grasping a finger piece 157, shown in Figs. 8 and 13, carried on the end of a guide stem 158 slidably guided in one of the machine walls 29, which stem carries a yoke 159 having its forked end embracing a grooved collar 161 firm on the end of the shaft 109. Movement of the stem 158 and consequently sliding movement of the shaft 109 in an axial direction is limited by abutment of the mounted end of the yoke 159 when moved in one direction with the face of the machine wall 29 and against a guide bracket 162 when moved in the other direction. Thus, it is apparent that selection of the cams 108 or 156 to be effective for rocking the accumulator mechanisms may be easily and effectively accomplished by shifting the shaft 109 longitudinally to thereby align the desired cam 108 or 156 with the finger 107 of the end plate 103. The cams 156 of course are like the cams 108 except that they are secured on the shaft 109 in what might be called a reverse position so that the low dwell on cams 108 is diametrically opposed to the low dwell on the cams 156.

To initiate a total taking operation an ac-

culator mechanism A, carrying the gear wheels 105 on which the total is accumulated, is rendered operable through rotation of the cams 156 by shifting the cam shaft 109 longitudinally as described above. Under the control of cam 156 the accumulator gear wheels 105 of said mechanism are meshed with type wheels 52 associated therewith and are actuated upon counterclockwise rotation of the type wheels. Thus in a manner to be described presently, the accumulator wheels control the distances to which said type wheels rotate counterclockwise so as to thereby set up the type segments 53 therein to print the totals accumulated in the accumulator mechanism A. Since there is no control device C in sensing position during a total printing operation, downward movement of the sensing pins 22 is not limited, consequently said pins move into their lowermost possible position during machine operation so as to thereby swing the control fingers 41 controlled thereby downwardly to position their ends in alignment with and for abutment by the lowermost or ninth shoulder 73 of the related sensing bars 68. Hence, the sliding bars 68 may move as far as may be necessary in the direction of the control fingers during counterclockwise rotation of the type wheels while a totaling operation is being accomplished.

If it be assumed that the accumulator mechanism A-1, which is illustrated in a position with its gear wheels 105 in mesh with the type wheels 52, has accumulated a series of digital counts previously printed by the type characters carried in such type wheels and that the cam shaft 109 has been shifted to align the cams 156 with the accumulator side plate fingers 107, the machine is now ready for operation to effect a printing of the accumulated totals. This is effected by initiating rotation of the drive shaft 57 through one cycle of operation which rotation tends to impart counterclockwise rotation to the type wheels 52. All of the accumulator gear wheels 105 that are off zero position are likewise rotated through their meshing engagement with the type wheels. Such rotation of the gear wheels 105, which is in a clockwise direction, continues until either of the wide teeth 105a or 105b engage a stop edge on the nose of the cooperating dog 122, which stop edges on the various dogs that are disposed in such a position that when a wide tooth rides into engagement therewith the accumulator gear wheel will have attained zero position.

It will be understood that each accumulator gear wheel 105 has two zero positions and this is due to the fact that it is desirable to make the accumulator gear wheels of a size such that proper sizing of the various parts can be maintained and proper interrelation between the size of the various parts may be established. Thus, each accumulator gear wheel instead of being provided with only ten teeth to cause the digits to be accumulated thereon in each revolution thereof, is provided with twenty teeth so that the digits are accumulated thereon in each half revolution thereof, such size of the gear teeth neatly fitting into the various other dimensions selected in the machine, even to the spacing of the perforations in the respective rows thereof on the card 16, and it is because of this sizing of the wheels 105 that two wide teeth 105a and 105b are provided on each wheel.

When the gear wheels 105 are individually stopped in zero position, the type wheels 52 meshing therewith are likewise selectively stopped in

their counterclockwise rotation and the proper type characters representative of the digits of the total accumulated on the gear wheels 105 are disposed in printing position beneath the platens 54, which are actuated to effect the printing operation prior to the time the drive shaft 57 has completed its cycle of operation.

When the drive shaft 57 completes its operating cycle the accumulator gear wheels, which are now in their zero positions, will have been moved out of mesh with the type wheels due to action of the controlling cams 156 and the type wheels will have returned to their initial positions of rest with all of their type characters in zero alignment. It should be observed that during the total taking operation involving for example, the accumulator mechanism A-1, other accumulator mechanisms A-2, etc., were held out of mesh with their related type wheels 105 by reason of the controlling slots 116 in the control discs 113. In the event any of these accumulator mechanisms have accumulated totals during machine operation the totals represented thereby can be set up in their related type wheels and printed in the same manner as described hereinabove, it being understood of course that the control discs 113 will have been shifted, so as to place the accumulator wheels 105 of such selected accumulator in mesh with the selected group of type wheels. Thus, all of the totals accumulated in any or all of the accumulators A during printing of the business instrument may be successively set up and printed.

There may be instances when it is desirable to render more than one accumulator mechanism effective for accumulating and/or printing totals during simultaneous operation of more than one group of type wheels. In that event a control mechanism such as is illustrated in Figs. 15, 16 and 17 may be utilized in lieu of plates 113 with their cams slots 116. In this modification, the construction and operation of the type wheels 52 and the accumulators A-1 to A-7 are the same as in the mechanism described hereinabove and consequently like numbers are used to identify corresponding parts; and it should be understood further, that operation of the parts illustrated is initiated and controlled in a like manner by control cards and mechanism like that employed in the control and operation of the previously described apparatus.

Referring now to the specific disclosure of Figs. 15, 16 and 17, it will be observed that the accumulator mechanisms A-1, A-2, etc., are individually controlled so as to be moved into or out of mesh with the teeth 112 of the type wheels 52 of the group to which they pertain. To this end an independent control disc 113a is provided for each accumulator mechanism. These discs are freely rotatable on the shaft 51 and they are grouped together on one side of the machine, preferably inside the machine wall 29, and each is formed with an operating extension 115a so that they may be selectively adjusted about the shaft 51 for the purpose of positioning an operatively associated accumulator mechanism in or out of mesh with the type wheels 52 of its related group. As best illustrated in Fig. 16, each control disc 113a has an extension 163 formed with an offset slot 164 into which an end of the gear wheel shaft 134 of an associated accumulator mechanism extends. These extensions 163 are, of course, differently positioned on each disc 113 so that while the operating extensions 115a are, as shown, in substantial register one with

the other for convenience of access, the extensions 163 are located in a position corresponding to the location of the accumulator mechanism to be controlled thereby. Thus, when the accumulator discs 113a are in the neutral position illustrated in Fig. 15, all of the accumulator mechanisms are positioned so that their gear wheels 105 are out of mesh with the type wheels 52. Now, any one of these accumulator mechanisms may be permitted to be swung inwardly about its pivot 101 to mesh its gear wheels 105 with its related type wheels by shifting its control disc 113a counterclockwise so as to thereby cause the shaft 164 to be positioned in alignment with inwardly disposed portion of the offset slot 164 with which it is engaged, to thereby free the selected accumulator mechanism for movement by the cam 108 or 156 associated therewith. Similarly all or any number of the accumulator mechanism may be rendered effective to accumulate digital counts successively set up by the variably settable type wheels 52 and also to effect setting up of the total accumulated in a total printing operation as related in the description of the previously described mechanism.

For printing a total from any accumulator, the cam shaft 109 is shifted axially to bring cam 156 rather than cam 108 into operation, as described above. If several accumulators are functioning simultaneously, as in the modification just described, the shaft 109 for each is shifted.

Sensing and control mechanism, including pins 22, levers 41 and other necessary elements may be provided if desired for throwing the various accumulators into operation or out of operation automatically. The tabs 16', Fig. 3, or one of the extra rows of perforations in an extended card 16b, Fig. 3A, may serve as control means. Since there are sixteen tabs, Fig. 3, or 48 extra control positions on the card 16b, Fig. 3A, numerous control functions obviously can be exercised. The various control plates 113a, Figs. 16 and 17 may be moved to operative or inoperative positions by connecting links such as 65 actuated by the cam and lever mechanisms previously described, operation being controlled by sensing pins, control fingers and sliding bars as fully described above. The axially movable cam shaft 109, used for rendering the accumulators effective to set up the type wheels 52 also may be automatically and selectively controlled by the same mechanism, suitable cams being provided as on plates 113a.

In many instances it may be necessary or desirable to have all seven of the accumulators functioning under manual control. For such operation it is desirable to have a single operating means to set all the control plates or discs 113a simultaneously in operating position. Accordingly, a totalizer lever 165 is mounted to pivot freely about shaft 51 which carries the type wheels. As shown in Figs. 15 and 17, a pin 166 is fixed in said lever to extend from one face of said lever through aligned slots 167 in each of the control discs 113a. The slots 167 are so located as to be in register when all the control discs are in their neutral positions. The pin 166 rests in the upper ends of the slots 167 when the control discs are in their neutral positions, so that any of the discs may be rotated counterclockwise (Fig. 15) manually or automatically to bring the associated accumulator mechanism into operation without moving pin 166 or lever 165. However, if it is desired to place all of the

accumulators in operation simultaneously by manual control, the lever 156 is rocked counterclockwise so that the pin 166 engages the upper ends of all the slots 167 and rotates all the discs 113a counterclockwise, thus causing cam slots 164 to bring all the accumulator mechanisms into association with their related type wheels 52. In a similar fashion, all of the accumulators may be rendered ineffective by pulling the lever 165 downwardly or clockwise, Fig. 15, so that the pin 166 will engage the lower ends of slots 167 and rotate all the control discs 113a to neutral positions.

It should be noted that necessary driving means, not shown, are provided for rotating cam shafts 34 and 57 in proper timed relation. Such mechanism preferably includes a one-revolution clutch such as that, for example, described in Gollwitzer Patent No. 2,296,277, mentioned above. Suitable drive means for the accumulator cam shafts as 109 and 142 also are provided and designed to drive these shafts, when the accumulators are functioning, in proper timed relation with respect to cam shafts 34 and 57. Suitable frame members are provided, detailed disclosure not being considered necessary.

Fig. 18 shows diagrammatically an arrangement for printing simultaneously on two webs or sheets instead of one. Instead of being provided with printing surfaces, the wheels 52' are gears which mesh with an intermediate gear 201. Intermediate gears 201 in turn mesh with gears 202 on large type wheels 203 carrying duplicate sets of printing elements 204 and 205. Suitable feeding means and positioning means, not shown, and duplicate platen means 205' and 206 for presenting sheets S1 and S2 to printing positions and effecting printing operations thereon are provided. The wheels 52' of course are operated under the control of sensing means in the same manner as type wheels 52, Fig. 7.

It will be apparent that by selective operation of the various accumulators, totals may be transferred from one accumulator to another in almost any manner desired, as by reading a total out of one accumulator into the type wheels 52, printing such total, and then entering the total just printed into another accumulator which is adjusted to read out and accumulate data from the type wheels. By the use of the tabs 16', or other control elements on the control device C, the transfer of data from one accumulator to another may be done automatically through the sensing and control means described above and the cam plates 113a and associated mechanisms which render selected accumulators effective and ineffective at the proper time.

It should be evident at this time that although but seven accumulator mechanisms A have been illustrated in the present disclosures, the number of accumulator mechanisms may be increased to any desired number, such as, for example, to a number that will afford an accumulator mechanism for such groups of variably settable type wheels 52 as may be required to provide a group for each row of potential perforation positions in the sensing card 16 of the control device C. Since the sensing card 16 has sixteen rows of potential perforation positions, sixteen accumulator mechanisms may be provided if desired to afford the maximum efficiency of the machine. This increased number of accumulator mechanisms may be accommodated, for example, by making the mechanisms smaller in proportion to the other parts illustrated or by enlarging

the diameter of the type wheels 52 and control discs 113 so as to enable the sixteen accumulator mechanisms to be spaced circumferentially therearound.

Thus, it should be apparent from the foregoing description that the mechanism of the present invention represents a marked advance over known types of corresponding mechanism such as, for example, that embodied in the machine shown in United States Letters Patent, 2,296,277, which has been referred to herein; that the instant mechanism will materially expedite the preparation of business instruments and the like, and that although various embodiments of the invention have been illustrated and described hereinabove, the invention is capable of variation and modification and hence is not to be limited to the precise details set forth but is to embrace such changes and alterations as fall within the purview of the claims.

I claim:

1. In a printing machine for use with a control device bearing control indicia including perforations of sizes varying progressively to represent different digital values, each perforation designating a particular digital value solely by the size of said perforation, the combination which includes a plurality of sensing devices arranged to be aligned with said perforations, means to operate the sensing devices to cause them to enter said perforations to an extent determined solely by the size of the perforations engaged, a plurality of variably settable control fingers arranged in a row and each associated with one of said sensing devices and movable into variant positions determined by the extent to which an associated sensing device enters a perforation, means to transfer proportionally the movement of the sensing devices to the related fingers, a plurality of variable digital printing wheels arranged in groups, movable bars arranged in a row opposite said fingers and connected one to each printing wheel and each being normally aligned with the end of one of said fingers so as to be under the control of said fingers, means operable to rotate the groups of printing wheels in one direction a distance determined by the bars engaging the ends of the related finger to set up said variable digital printing wheels for a printing operation, said means being operative to return the variable digital printing wheels to their initial positions after a printing operation has been accomplished.

2. In a printing machine arranged for operation under control of a control device perforated with holes of sizes varying to represent different digital values, each hole designating a particular digital value solely by the size of the hole, the combination of a plurality of sensing elements arranged to be correlated with said holes, means to operate the sensing elements to cause them to enter said holes to an extent determined solely by the size of the holes engaged, a plurality of variably settable control fingers arranged in a row and each movable along corresponding arcs into variant positions determined by the extent to which a correlated sensing element enters a hole, means to transfer proportionally the movement of the sensing elements to the related fingers, a plurality of rotatable digital printing wheels, bars arranged in a row and connected one to each of the printing wheels with the ends of the bars normally aligned with the ends of said fingers so that each of the bars is under the control of a related finger, means operable

31

to rotate the digital printing wheels in one direction a distance determined by the bars engaging the fingers in their variant set positions to set up said digital printing wheels at values equal to those represented by said fingers in their variant set positions, and means operable to print the digital values thus set up upon sheets passed through the machine, said rotating means being operable to return the variable digital printing wheels to their initial positions after the printing operation has been accomplished.

3. In a printing machine for use with a control device bearing control indicia including holes of sizes varying to represent different digital values, each hole designating a particular digital value solely by the size of the hole, the combination which includes a plurality of sensing devices arranged to be correlated with said holes in said control devices, means to operate the sensing devices to cause them to enter said holes to an extent determined solely by the size of the holes engaged, a plurality of fingers connected to said sensing devices so that each is movable into variant positions determined by and representative of the extent to which a correlated sensing device enters a hole, a plurality of rotatable digital printing means, a bar connected to each of the printing means with the end thereof normally aligned with and disposed opposite the end of a related finger, said bars each being adapted to sense the fingers in their variant positions, means operable to rotate the digital printing means in one direction a distance determined by the setting of the related fingers to set up said digital printing means, and means operable to print the digital values set up upon sheets passed through the machine, said rotation means being operable to return the variable digital printing means to their initial positions after the printing operation has been accomplished.

4. In a printing machine, control device sensing mechanism comprising a set of reciprocatory spring pressed pins, arranged to cooperate with holes of sizes varying progressively to represent different digital values in a control device fed through said machine, a plurality of fingers individually set by selected pins entering the control device holes, a plurality of reciprocally rotatable variably settable digital printing wheels arranged in groups, means to rotate said wheels, said means including a lost motion connection with each wheel, and movable bars connected to said wheels and arranged to coact with the fingers to selectively limit rotation of the printing wheels in one direction for setting said wheels to print digits upon sheets passed through the machine corresponding to the digits represented by the holes in the control device.

5. In a printing machine adapted to be controlled by a control device feedable through the machine and perforated with holes of sizes varying progressively to represent different digital values, each hole designating a particular digital value solely by the size of the hole, a plurality of sensing pins arranged to be correlated with the holes, means to operate the sensing pins to permit them to enter holes in said control device to an extent determined solely by the size of the holes engaged, a plurality of fingers each movable into variant positions determined by the extent to which a correlated sensing pin enters a hole, a plurality of variable digital printing wheels, a bar connected to each printing wheel for movement therewith and each adapted to be

32

engaged at one or another different points by the end of a related one of said fingers, and means operable to rotate the printing wheels in one direction a distance determined by the setting of the related fingers to set up said variable digital printing wheels to their initial positions, said printing wheels each assuming one or another different printing positions in said setup positions accordingly as the bar associated therewith is so engaged at a corresponding one or another point.

6. In a printing machine, a control card sensing mechanism comprising a set of reciprocatory spring pressed pins arranged to cooperate with holes of sizes varying progressively to represent different digital values in a control card fed through said machine, a plurality of fingers individually set by selected pins entering the control card holes, a plurality of reciprocally rotatable variably settable digital printing members arranged in groups, means to rotate said members, bars on said members arranged to coact with correlated fingers to selectively limit rotation of the printing members in one direction for setting said members to print digits upon a sheet corresponding to the digits represented by the holes in the control cards, means operable upon rotation of the printing members in each group in a reverse direction effective to accumulate the digital values printed upon said sheet during successive printing operations of said group, and means selectively operative to effect setting of the printing members to cause the accumulated values to be printed on said sheet.

7. In a printing machine of a kind having variably settable digital type carrying wheels, a control device sensing mechanism comprising, in combination, a set of reciprocatory pins arranged to cooperate with holes of sizes varying progressively to represent different digital values in a control device fed through the machine, a carriage in which said pins are mounted for normally retaining the pins out of cooperative relation with said control devices, power operated means operable to move said carriage into a position of adjustment, a spring associated with each pin operative to urge the pins toward the control device and press such pins as are in register with holes in said device through said holes to variant distances determined by the size of the holes while said carriage is in such adjusted position, a plurality of variably settable fingers, means mechanically connecting one finger with each pin so that the fingers move proportionally with the pins in a sensing operation, said fingers being movable into variably adjusted positions determined by the position of its related pin, and sliding bars carried by the type carrying wheels to sense the positions of said fingers for limiting rotation of said wheels in one direction to thereby set up the digital type carried thereon in accordance with the digital value set up by the control device.

8. In a printing machine of a kind having variably settable digital type carrying members, a control card sensing mechanism comprising, in combination, a set of reciprocatory pins arranged to cooperate with holes of sizes varying progressively to represent different digital values in a control device fed through the machine, means normally retaining the pins out of cooperative relation with said control devices, means operable to move said retaining means into a sensing position, means to urge the pins toward the control

device and press such pins as are in register with holes in said device through said holes to variant distances determined by the sizes of the holes while said retaining means is in said sensing position, and a variantly settable finger operatively connected with each pin, each of said fingers being movable through an arc into variantly adjusted positions determined by the position of its related pin so as to be engaged by means carried by the type carrying members for limiting rotation of said members in one direction so as to thereby set up the digital type carried thereon in accordance with the digital value set up by the control device.

9. In a printing machine of a kind having variantly settable type carrying wheels, a control card sensing mechanism comprising, in combination, a set of reciprocatory pins arranged to cooperate with holes of sizes varying progressively to represent different values in a control device fed through the machine, means normally retaining the pins out of cooperative relation with said control devices, power operated means operable to move said retaining means into a position of adjustment, resilient means associated with each pin operative to urge the pins toward the control device and press such pins as are in register with holes in said device through said holes while said retaining means is in such adjusted position, and a plurality of variantly settable fingers, one finger being operatively connected with each pin so as to move proportionally therewith in a sensing operation, said fingers being thereby movable into variantly adjusted positions determined by and representative of the position of its related pin, and bars carried by the type carrying wheels for engaging said fingers in the variantly adjusted positions thereof to thereby limit rotation of said wheels in one direction and set the same up in corresponding variant positions representative of different values.

10. In a printing machine, a variantly settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine selected in response to the setting of sensing mechanism contained in the machine and controlled by means of sensing and control devices sequentially fed through the machine, said variantly settable digital type printing mechanism comprising, a group of type wheels mounted for free rotation on a common axis, a type segment on each wheel, a driven rotatable shaft, a cam on said shaft, a link on each wheel, bell-cranks having a lost motion connection with said links operable by said cam while the shaft is rotating through a part of its cycle of operation to rotate the type wheels in one direction for distances depending upon the setting of the sensing mechanism so as to thereby set up the type segments in variantly adjusted positions to a digital value corresponding to that contained in the sensing devices, a latch associated with each type wheel, means on said driven shaft effective during rotation of the shaft to actuate the latch to lock the wheels against rotation while they are in their initial positions and in their variantly adjusted positions only so as to retain the type segments in alignment one with the other, said latch being ineffective during effective actuation of the bell-crank, means to effect printing of the digital value set up in said variantly adjusted type

wheels, said bell-cranks being effective to positively return the type wheels to their initial positions during the remaining operating cycle of the driven shaft, teeth on the peripheral edges of said type wheels, an accumulator mechanism having accumulator gear wheels, some of said wheels being adapted to mesh respectively with the teeth of each type wheel in the group during the return movement of the wheels into their initial positions to accumulate the digital values printed by the type characters of the type segments during successive sensing and printing operations, means including said accumulator mechanism, selectively operable to set up the variantly settable type wheels to cause the type segments thereon to print the digital values accumulated on the accumulator, and means to selectively mesh said accumulator gear wheels with said type wheel teeth.

11. In a printing machine of the character including a variantly settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine selected in response to the setting of sensing mechanism contained in the machine and controlled by means of control devices sequentially fed through the machine, said variantly settable digital type printing mechanism comprising a group of type wheels mounted for free rotation on a common axis, a type segment on the periphery of each wheel, a driven rotatable shaft, a cam on said shaft, a link on each wheel, bell-cranks having a lost motion connection with said links operable by said cam while the shaft is rotating through a part of its cycle of operation to rotate the type wheels in one direction for distances depending upon the setting of the sensing mechanism so as to thereby set up the type segments in variantly adjusted positions to a digital value corresponding to that contained in the control devices, means operative to effect printing of the digital value set up in said variantly adjusted type wheels, said bell-cranks being effective to positively return the type wheels to their initial positions during the remaining operating cycle of the driven shaft, and teeth on the peripheral edges of said type wheels, the combination of an accumulator mechanism having accumulator gear wheels some of which wheels are adapted to mesh respectively with the teeth of each type wheel in the group during the return movement of the wheels into their initial positions to accumulate the digital values printed by the type characters of the type segments during successive sensing and printing operations, means selectively operable to set up the variantly settable type wheels to cause the type segments thereon to print the digital values accumulated on the accumulator, and means to selectively mesh said accumulator gear wheels with said type wheel teeth.

12. In a printing machine of the character including a variantly settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine selected in response to the setting of sensing mechanism contained in the machine and controlled by means of control devices sequentially fed through the machine, said variantly settable digital type printing mechanism comprising, a group of type wheels mounted for free rotation on a common axis, a type segment on the periphery of each wheel, driven means operable to rotate the type wheels in one direction for distances depending upon the setting of the sensing mech-

anism so as to thereby set up the type segments in variably adjusted positions to a digital value corresponding to that contained in the sensing devices, means to lock the wheels in their variably adjusted positions so as to retain the type segments in alignment one with the other, means operative to effect printing of the digital value set up in said variably adjusted type wheels, said driven means being effective to positively return the type wheels to their initial positions after the printing of said digital value has been effected, and teeth on the peripheral edges of said type wheels, an accumulator mechanism related to each group of type wheels including accumulator gear wheels adapted to mesh respectively with the teeth of each type wheel in its related group during the return movement of the wheels into their initial positions to accumulate the digital values printed by the type characters of the type segments in each group during successive sensing and printing operations, means operable to set up the variably settable groups of type wheels to cause the type segments thereon to print the digital values accumulated on the accumulator, and means to selectively mesh said accumulator gear wheels with said type wheel teeth.

13. In a printing machine, a variably settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine, comprising sensing mechanism including control fingers contained in the machine and controlled by means of control devices sequentially fed through the machine, a group of type wheels mounted for free rotation on a common axis, a bar on each type wheel adapted to cooperate with the control fingers to limit rotation of the type wheels in one direction, a link on each wheel, bell-cranks having a lost motion connection with said links, means to rock said bell-cranks to rotate the type wheels in said one direction for distances depending upon the setting of the control fingers so as to thereby set up the type segments in variably adjusted positions to a digital value corresponding to that contained in the sensing devices, means to lock the wheels in their variably adjusted positions so as to retain the type segments in alignment one with the other, means operative to effect printing of the digital value set up in said variably adjusted type wheels, and said bell-cranks being effective to positively return the type wheels to their initial positions during the remaining operating cycle of the driven shaft.

14. In a recording machine of the character described, wherein a control means containing variably sized perforations is fed through the machine to be sensed and to initiate recording of data represented thereby, the combination of a group of individually mounted sensing pins, means for moving said group to sensing position, said pins having variable cross-sections at different points in the length thereof and being adapted to penetrate said perforations to a greater or less extent depending upon the size of said perforations, a plurality of stop bars each adapted to be set in various stop positions individually according to the extent of said penetrations, a plurality of type segments corresponding to the sensing pins, means resiliently urging each of said type segments to limiting positions determined by said stop positions, means cooperating with said type segments to complete a recording operation after said type segments have been

urged to said limiting positions, and a sliding bar carried by each of said type segments for movement therewith as the type segments move to said limiting positions, each of said sliding bars having an end with a plurality of differently located notches each allocated to a definite stop position which the corresponding stop bar may assume under control of the corresponding sensing pin.

15. In a printing machine of the character including plural groups of sensing means adapted to sense plural groups of data represented on a control device fed through the machine and assume variant positions representative of said data, the combination of rotatable plural groups of printing members mounted for selective movement to variable printing positions to present data for printing, means, including stop members operatively associated with the sensing means and controlled thereby to assume variant positions representative of said data, fingers carried by said printing members to engage the respective stop members in their variant set positions for simultaneously positioning said printing members in selective printing positions for printing said data, accumulator mechanisms arranged along the printing members for accumulating the data presented on respective groups of printing members, each of said accumulator mechanisms being movably mounted in position relative to a respective group of printing members for pivotal movement into and out of operative contact with said group of printing members for accumulating the data presented on said respective group of printing members, and selective rotatable means operatively arranged with and having a plurality of locking elements normally engaging said accumulator mechanisms for selectively placing any desired accumulator mechanism in an inoperative position with respect to said respective group of printing members.

16. In a printing machine of the character including plural groups of sensing means adapted to sense plural groups of data represented on a control device fed through the machine and assume variant positions representative of said data, the combination of plural groups of printing wheels mounted for selective rotary movement in a forward direction to variable printing positions to present data for printing, means, including stop members operatively associated with the sensing means and controlled thereby to assume variant positions representative of said data, fingers carried by said printing wheels to engage the respective stop members in their variant set positions for simultaneously positioning said printing wheels in selective printing positions for printing said data, accumulator mechanisms arranged along the printing members for accumulating the data presented on respective groups of printing wheels during return movement of the latter, each of said accumulator mechanisms being movably mounted in position relative to a respective group of printing wheels for pivotal movement into and out of operative contact with said group of printing wheels for accumulating the data presented on said respective group of printing wheels, and selective means having a plurality of locking elements operatively associated with each of said accumulator mechanisms for selectively holding any desired member of said accumulator mechanisms out of contact with said respective groups of printing wheels, said rotatable means being adapted by

its location to disengage the locking elements from the corresponding members of the accumulating mechanism to free the latter for operative contact with the printing members.

17. In a printing machine for successively printing digital data and totals of the same, a control mechanism comprising a plurality of control fingers variably settable in different positions representative of the digital data to be printed, a plurality of digital type wheels rotatably mounted in the machine for movement in a forward direction to set up digital data for printing, bars mounted on each of said printing wheels and each assigned to one of said fingers, means for rotating said wheels in said forward direction such that said bars advance toward said fingers in their set positions until the bars engage the fingers to thereby set up said wheels with data corresponding to the variant positions of said fingers, accumulators for the printing wheels, means to engage the accumulators with the printing wheels during return movement of the latter to thereby accumulate totals, and means operative during printing of the totals standing in the accumulators to engage the accumulators with the printing wheels just prior to the latter being advanced in a forward direction.

18. A printing machine according to claim 17 in which the accumulators are arranged along the type wheels for pivotal movement from respective fixed locations into and out of totalizing engagement with the type wheels, selectively shiftable means having locking elements in respective fixed locations thereon for holding the accumulators inoperative, said shiftable means by its movements being adapted to disengage said locking elements with respect to the accumulators to permit selected ones of the accumulators to engage the type wheels in a totalizing relation.

19. In a printing machine, a variably settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine selected in response to the setting of sensing mechanism contained in the machine and controlled by means of control devices sequentially fed through the machine, said variably settable digital type printing mechanism comprising, a group of rotatable type segments carrying type elements, a driven rotatable shaft, a cam on said shaft, a link on each element, bell-cranks having a lost motion connection with said links operable by said cam while the shaft is rotating through a part of its cycle of operation to rotate the type segments in one direction for distances depending upon the setting of the sensing mechanism so as to thereby set up the type segments in variably adjusted positions to a digital value corresponding to that contained in the control devices, a latch associated with each type segment operable to lock the segments against rotation while they are in their initial positions and in their variably adjusted positions only, so as to retain the type segments in alignment one with the other means operative to effect printing of the digital value set up in said variably adjusted type segments, said bell-cranks being effective to positively return the type segments to their initial positions during the remaining operating cycle of the driven shaft, and an accumulator mechanism having an operative connection with the type segments in a single-group during the return movement

of the segments in said group into their initial positions to accumulate the digital values printed by the type elements of the type segments during successive sensing and printing operations.

20. In a printing machine, a variably settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine selected in response to the setting of sensing mechanism contained in the machine and controlled by means of control devices sequentially fed through the machine, said variably settable digital type printing mechanism comprising, a group of type wheels mounted for free rotation on a common axis, a type segment on the periphery of each wheel, means operable through lost motion connection with said type wheels to rotate the type wheels in one direction for distances depending upon the setting of the sensing mechanism so as to thereby set up the type segments in variably adjusted positions to a digital value corresponding to that contained in the control devices, a latch means to lock said wheels against rotation while they are in their variably adjusted positions so as to retain the type segments in alignment one with the other, means operative to effect printing of the digital value set up in said variably adjusted type wheels, said lost motion operating means being effective to return the type wheels to their initial positions after the printing operation has been effected and an accumulator mechanism operatively associated with the type wheels in said group during the return movement of said wheels into their initial positions to accumulate the digital values printed by the type characters of the type segments during successive sensing and printing operations.

21. In a printing machine, a variably settable digital type printing mechanism of a kind that is set up to print digital values on a sheet passed through the machine selected in response to the setting of sensing mechanism contained in the machine and controlled by means of control devices sequentially fed through the machine, said variably settable digital type printing mechanism comprising, a group of type members mounted for free rotation on a common axis, a type segment on each member, a driven rotatable shaft, a cam on said shaft, a link on each member, bell-cranks having a lost motion connection with said links operable by said cam while the shaft is rotating through a part of its cycle of operation to rotate the type members in one direction for distances depending upon the setting of the sensing mechanism so as to thereby set up the type segments in variably adjusted positions to a digital value corresponding to that contained in the control devices, latch means arranged to lock the type members against rotation while they are in their initial positions and in their variably adjusted positions only, so as to retain the type segments in alignment one with the other, said latch means being ineffective during effective actuation of the bell-cranks, means to effect printing of the digital values set up in said variably adjusted type members, and said bell-cranks being effective to return the type members to their initial positions during the remaining operation cycle of the driven shaft.

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