Oct. 6, 1964 G. W. R. HORNAUER ETAL 3,151,547

OSCILLATING PRINT WHEELS ON MOVABLE CARRIAGE

Filed Jan. 16, 1962 6 Sheets-Sheet 1

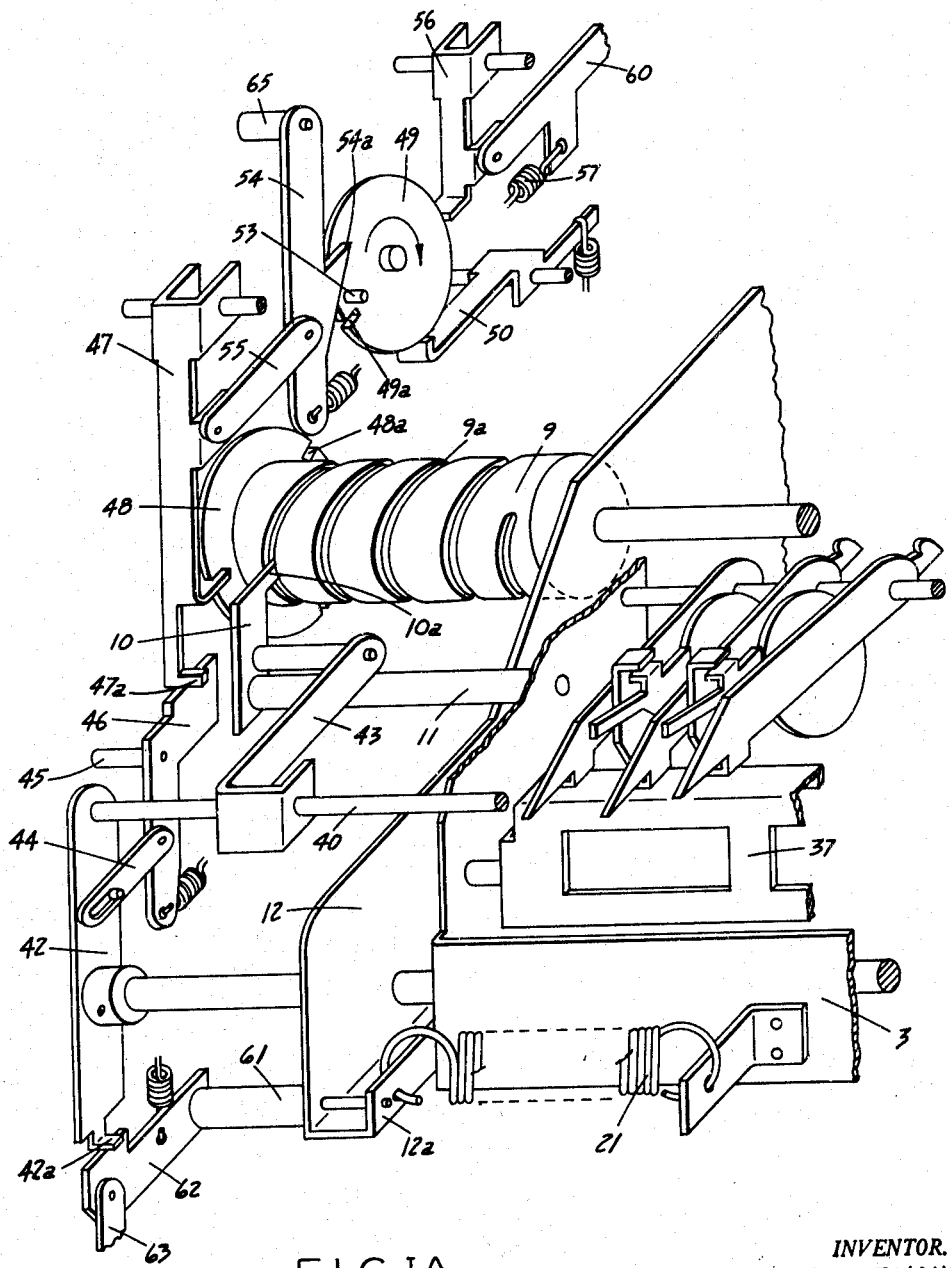

FIG.1A

INVENTOR.
GUNTER HORNAUER
HORST DENZIN

BY Clarence W. Martin
their agent

Oct. 6, 1964 G. W. R. HORNAUER ETAL 3,151,547

OSCILLATING PRINT WHEELS ON MOVABLE CARRIAGE

Filed Jan. 16, 1962 6 Sheets-Sheet 2

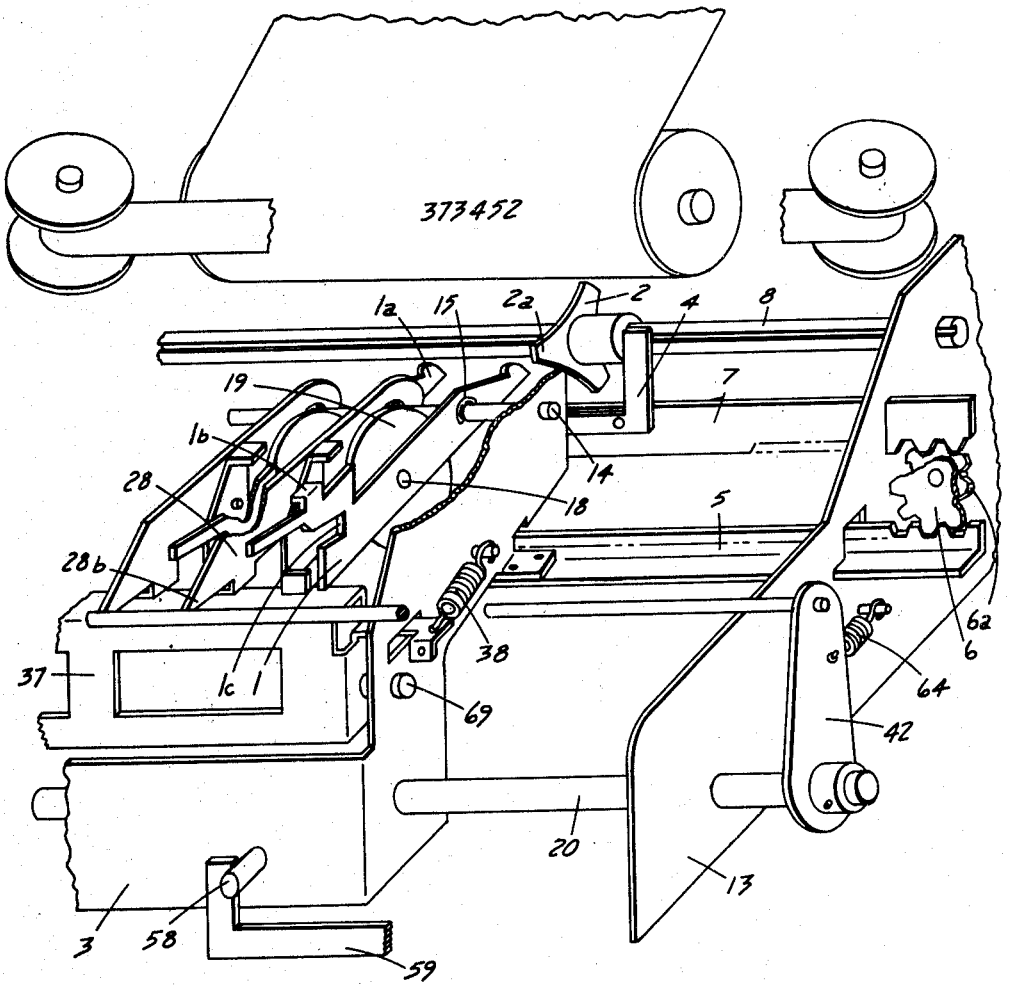

FIG. 1B

INVENTOR.
GUNTER HORNAUER
HORST DENZIN

BY Clarence W. Watson
their agent

Oct. 6, 1964 G. W. R. HORNAUER ETAL 3,151,547

OSCILLATING PRINT WHEELS ON MOVABLE CARRIAGE

Filed Jan. 16, 1962 6 Sheets-Sheet 3

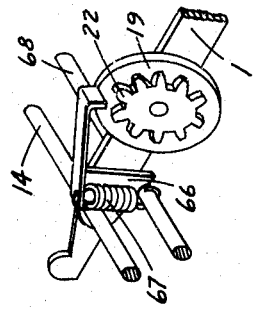

FIG.5

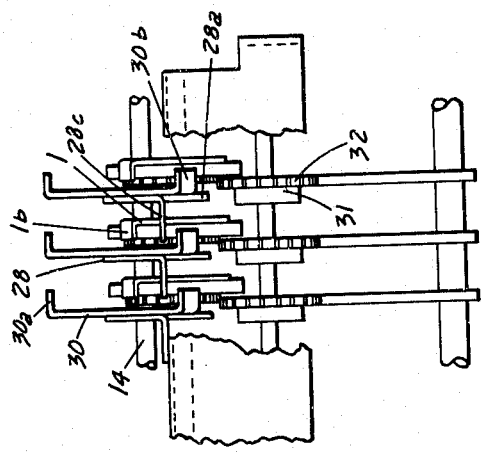

FIG.2A

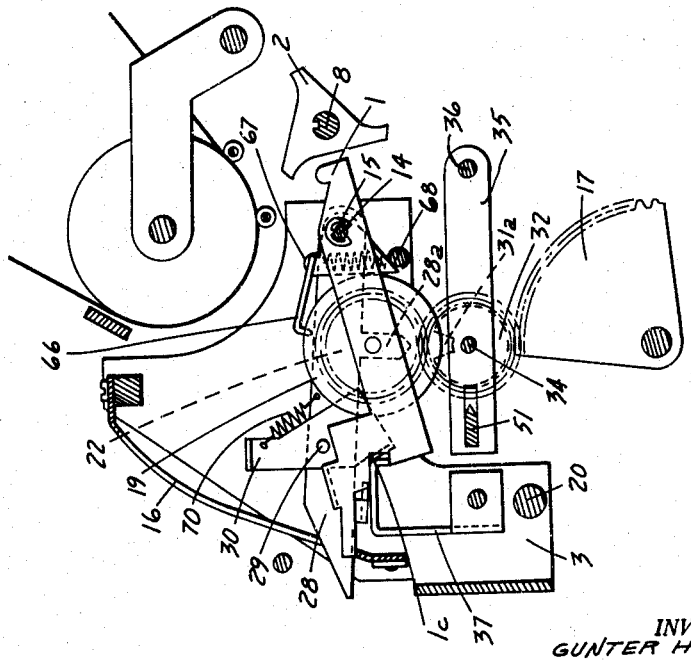

FIG.2

INVENTOR.
GUNTER HORNAUER
HORST DENZIN

BY Clarence W. Martin
their agent

Oct. 6, 1964 G. W. R. HORNAUER ETAL 3,151,547

OSCILLATING PRINT WHEELS ON MOVABLE CARRIAGE

Filed Jan. 16, 1962 6 Sheets-Sheet 4

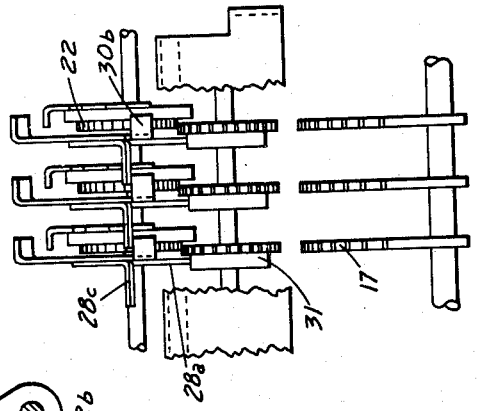

FIG 3A

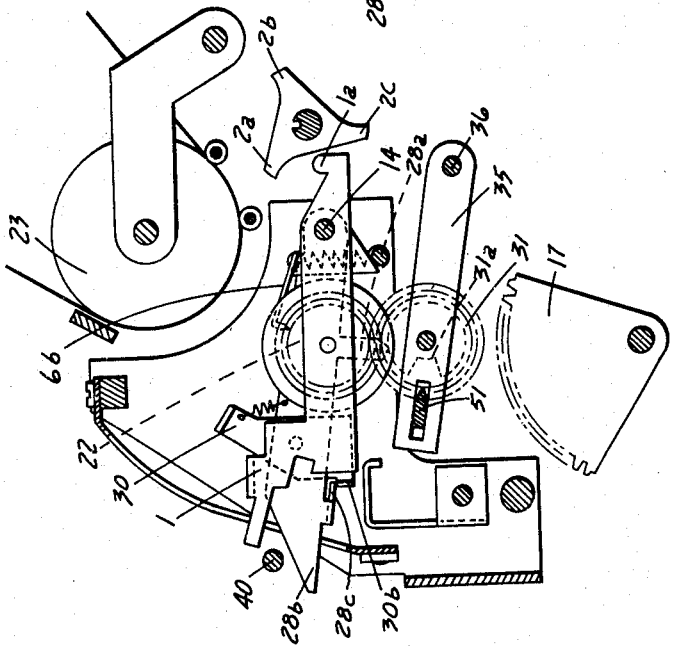

FIG 3

INVENTOR.
GUNTER HORNAUER
HORST DENZIN

BY
Clarence W. Martin
their agent

Oct. 6, 1964 G. W. R. HORNAUER ETAL 3,151,547

OSCILLATING PRINT WHEELS ON MOVABLE CARRIAGE

Filed Jan. 16, 1962 6 Sheets-Sheet 5

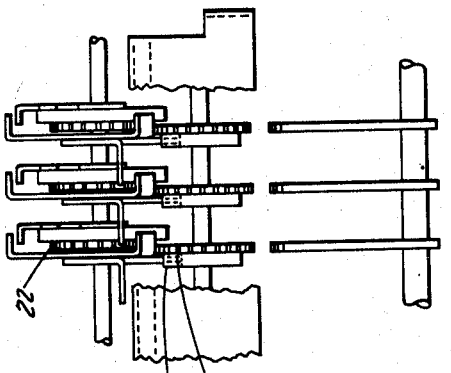

FIG.4A

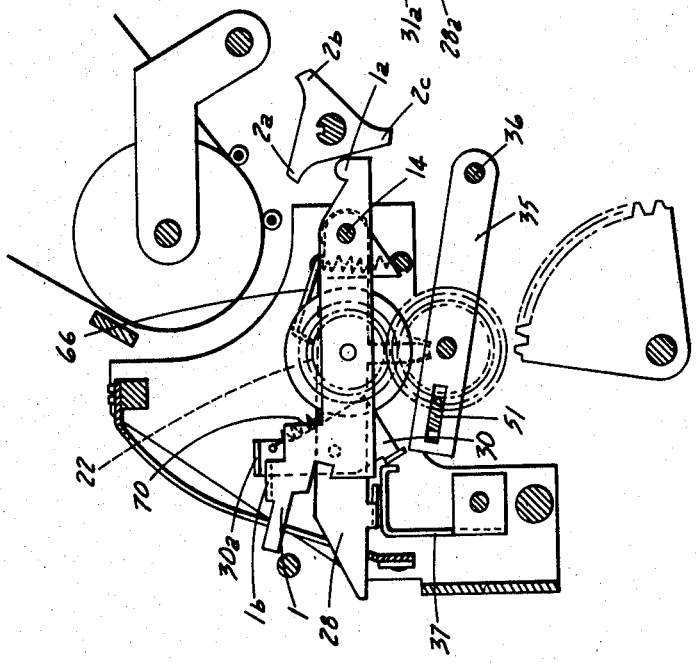

FIG.4

INVENTOR.
GUNTER HORNAUER
HORST DENZIN

BY Clarence W. Martin
their agent

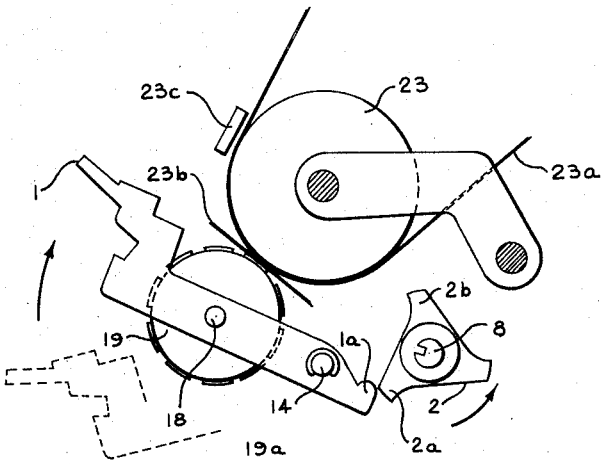

FIG. 6

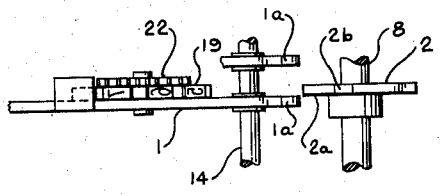

FIG. 7

United States Patent Office

3,151,547
Patented Oct. 6, 1964

3,151,547

OSCILLATING PRINT WHEELS ON MOVABLE CARRIAGE

Gunter Wilhelm Robert Hornauer, Berlin-Rudow, and Horst Georg Gunter Denzin, Berlin-Tempelhof, Germany, assignors to Hamann Rechenmaschinen G.m.b.H., Berlin, Germany, a corporation of Germany

Filed Jan. 16, 1962, Ser. No. 166,567
Claims priority, application Germany Jan. 27, 1961
7 Claims. (Cl. 101—96)

The present invention relates to printing mechanisms, and more particularly concerns print-out devices for calculating machines.

The spacing between the orders of a printed figure normally corresponds to the spacing of the ordinal elements of the calculating system. One method of reducing the space between the orders of the printed figure is to use converging levers; however, this expedient is limited in its application. The practical objections are that only a limited number of orders can be accommodated, the parts required are bulky as well as expensive, and the reduction in the spacing between the orders of the figure printed on the tape is limited by the width of the ordinal printing members.

A further characteristic of known printing mechanisms is that a print hammer is used in order to insure a clean print and to afford the possibility of suppressing non-significant zeros which precede the printed figure. Such print hammer mechanisms require a great number of parts, and the print hammer springs must be reset after each printing operation. Finally, resetting of the hammers imposes rather undesirable peak loads on the motor and articulated linkages.

According to the present invention a mechanism is provided whereby the spacing between the printed orders may be reduced at will to any predetermined distance, even to the magnitude of zero, if that should be desired. This is accomplished by locating a plurality of printing elements on one carriage, a single rotating print hammer on a second carriage, and correlating the movement of the carriages in continuous, counter-directional and proportional movements. Printing is accomplished by the consecutive actuation of the several printing elements and imposes a uniform load on motor and bearings. Shifting of the carriages at a speed of 8 to 15 milliseconds per order has been found practicable, and this permits the printing of 12 orders within 96 to 180 milliseconds. This constitutes an advantage even over mechanisms which print all orders simultaneously, because resetting is not required.

It is therefore a main object to provide an improved, high speed, printing mechanism.

Another object is to minimize the spacing between adjacent printed characters.

Another object is to print a number in a space which is less than the aggregate width of the printing members.

Still another object is to print a numeral against a stationary platen by moving the ordinal printing elements and a single print hammer transversely relatively to the platen.

A further object is to attain the last mentioned object and to move the printing elements relative to the print hammer.

A still further object is to terminate the printing operation automatically under the control of a zero non-print suppression mechanism.

Further objects and advantages will occur from the following description, given by way of example only,

when read in conjunction with reference to the following drawings in which:

FIGS. 1A and 1B are combined to form a partially exploded isometric view of the printing mechanism as seen from the right front of the machine;

FIGS. 2, 3 and 4 are views, partially in section, as seen from the right side of the machine, and showing the printing mechanism in various stages of operation;

FIGS. 2A, 3A and 4A are views as seen from the front of the machine, of the structure shown in FIGS. 2, 3 and 4;

FIG. 5 is an isometric view of a print wheel detent mechanism;

FIG. 6 is a right side view showing a print wheel in contact with the ribbon, paper and platen; and

FIG. 7 is a top view of the printing mechanism.

Referring to FIGS. 1A and 1B, a printing mechanism is disposed between two fixed frame members **12** and **13**. A plurality of members **1** is mounted for rocking movement on a shaft **14**, within a frame **3**, and maintained by spring clips **15** and a guide comb **16** (FIG. 2) in uniform spacing which corresponds to the spacing of the entry gears **17** of a calculating mechanism in a manner well known in the art. The printing members **1** carry printing dials **19** (FIG. 1B) which are rotatable about pivots **18**. The frame **3** comprises a first carriage which is slidably disposed on a shaft **20** and under the urgency of a spring **21** normally contacts an ear **12***a*. A gear rack **5**, riveted to the frame **3**, cooperates with a double gear **6**, **6***a*, the latter of which is engaged with a rack **7**. It will be obvious that any lateral movement of the frame **3** wil result in a counter-directional lateral movement of the rack **7**. A frame **4** comprises a second carriage which is integral with rack **7** and embraces a print hammer **2**, slidably disposed on a shaft **8**.

The lateral movement of the carriages **3** and **4**, as well as the rotation of the print hammer **2** is accomplished by means of the shaft **8**. A drive cylinder **9** is fixed on the shaft **8** by means of pins, having on its outer surface a convolute groove **9***a* which is engaged by a nose **10***a* of a follower **10**. The latter is pivoted on shaft **11** which is riveted to the carriage **3**. Therefore, movement of follower **10** and shaft **11** moves the carriage **3** and the print members **1** to the right. At the same time, due to the functional relationship between the carriage **3**, rack **5**, gear **6**, **6***a*, and rack **7**, the carriage **4** and the print hammer **2** are moved to the left. In the embodiment described here, the rise in the groove **9***a* is arranged to advance the print hammer **2** one print space to the left per ⅓ revolution of the shaft **8**.

Since the individual orders of a number are printed consecutively, the speed of the printing operation is reduced by not printing non-significant zeros. For this purpose a disabling lever **28** is provided in each ordinal printing system **1** (FIGS. 1B and 2), each lever being freely mounted on the shaft **14**. A latch **30**, pivoted at **29** on each lever **28**, may assume two positions, in one of which an ear **30***a* (FIG. 2A) lies in the same rotational plane with an ear **1***b* of the print member **1** so that clockwise rotation of the print member **1** results in a similar clockwise rocking of the disabling lever **28**. The disabling lever **28** has a sensing projection **28***a* which cooperates with sensing disc **31** which is integral with an intermediate gear **32**. The sensing disc **31** has a notch **31***a* which is so arranged that it underlies the sensing projection **28***a* of the disabling lever **28** when the respective entry gear **17** and the engaged intermediate gear **32** stand in the value position representing "0." The intermediate gears **32** are rotatably mounted on a shaft **34** carried by a rocking frame **35**.

An ear 30*b* (FIGS. 3 and 3A) of the latch 30 engages a respective ear 28*c* of the disabling lever 28 in the next lower order and forms thus the transfer bridge for all orders lying to the right of an entered value. If, by means of the sensing projection 28*a*, the disabling lever 28 is lifted, it carries a respective latch 30 along, and the ear 30*b* of the latch 30 which has been so lifted carries the ear 28*c* in adjoining lower order, so that the disabling lever 28 in the next lower order is also lifted unless it is already in a lifted position due to the action of the sensing nose 28*a* in its own order.

Gears 22 are attached to respective elements 19 (FIG. 5) which are engaged by detents 66 rotatably mounted on shaft 14 and urged by springs 67 against a shaft 68, the latter being fixed within the carriage 3. FIGS. 3, 3A, 4 and 4A show the detents engaged with gears 22 of the printing elements 19, for the purpose of securing the position of the elements 19 during the printing operation. At the same time the force of each spring 67 urges a respective printing system 1 counterclockwise against a bail 37.

A cam edge 28*b* (FIG. 3) of the disabling lever 28 cooperates with a bar 40 (FIG. 1B) in a rocker 42 which is rotatably mounted on the shaft 20. The rocker 42 is urged by a spring 64 into the normal position shown in FIG. 1B in which it is locked by a latch 62 (FIG. 1A) engaging an ear 42*a*. In this locked position, a lever 43, on the bar 40, withdraws the nose 10A of the follower 10 from the groove 9*a* of the drive cylinder 9. Likewise, a locking latch 46, which pivots on a shaft 45, is rotated clockwise by connecting link 44 and releases an ear 47*a* of a latch 47.

The shaft 8 is driven by means of a clutch 48 of conventional design. The clutch 48 is activated by a slip clutch 49 which is rotated clockwise. A pin 53 on clutch 49 contacts a cam edge 54*a* of a lever 54 on a shaft 65, moving a link 55 and the latch 47 to engage clutch 48. The rotation of the clutch 49 is temporarily arrested by a clutch dog 56 which responds to spring 57 as long as the carriage 3 stands out of its initial position. Upon return of carriage 3 to the position shown, a pin 58 on frame 3 contacts a hook member 59 and through linkages (not shown) draws a link 60 and the clutch dog 56 from engagement with clutch 49. At such time the clutch moves counterclockwise to a position where it is engaged by a main clutch dog 50.

The bail 37 is rotatably mounted on a shaft 69 which is fixed in the carriage 3. A spring 38 urges the bail 37 into the position shown in FIG. 1B; however, the bail 37 is also controlled by a mechanism (not shown) driven by the control clutch 49 which rocks the bail 37 counterclockwise into a second position where the bail 37 locks the print elements 1 in the position shown in FIG. 2 for the purpose of transfer of values.

A second purpose served by the bail 37 is that of rocking the latches 30 counterclockwise against the force of springs 70 (FIG. 4) or, by the same token, to serve as a rest for the print elements 1 in their elevated position.

The operation of the printing mechanism shall now be described with reference to the printing of a number. In the normal position, when there are no values in the entry gears 17 of the calculating mechanism, the rocking frame 35 is in the position shown in FIG. 2. The bail 37 enters the notch 1*c* and locks the print element 1 in the position shown. Let it now be assumed that the value 373452 is to be entered and printed. The first six entry gear segments 17 are rocked counterclockwise by an entry mechanism which is itself well known. The value representative movement of segments 17 is transmitted through the intermediate gears 32 and gears 22 to the print dials, or elements 19, during which movement neither the intermediate gears 32 nor the print dials are impeded.

After the value has been entered into the entry gears 17 of the calculating mechanism, a clutch lever 50 (FIG. 1) is withdrawn. Clutch 49 thereupon rotates clockwise and initiates the following interactions, given by way of example only, it being noted that the invention is directed toward the printing process and that the manner of entering values into the printing dials, or elements, is of no particular significance:

(1) The bail 37 (FIGS. 1 and 2) is rocked counterclockwise against the urgency of the spring 38 by linkages not shown, until the printing element 1 is released.

(2) A locking bar 51 in the rocking frame 35 (FIGS. 2, 3 and 4) is moved to the right and locks all intermediate gears 32.

(3) The rocking frame 35 is rotated clockwise around a shaft 36. Since the gears 22 which are attached to the print dials 19 are in mesh with the intermediate gears 32, this rocking motion moves the print elements 1 about shaft 14 into the position of FIGS. 3 and 4. At the same time, the sensing noses 28*a* of the disabling levers 28 either contact the circumferences of the sensing discs 31 or enter the notch 31*a* (FIGS. 3A and 4A) as the case may be according to previous descriptions. The movement of the rocking frame 35 therefore results either in moving the disabling levers 28 into the position shown in FIG. 3 or to that shown in FIG. 4, as the case may be. In the six orders into which the assumed number has been entered, the levers 28 are moved to the position shown in FIG. 3. In the 7th order, the first to contain a "0," the sensing projection 28*a* enters the notch 31*a* in the sensing disc 31 (FIGS. 4 and 4A) and the disabling lever 28 remains in the position shown in FIG. 4. This lever 28 subsequently serves as a determining factor in terminating the printing process.

(4) The bail 37 is now returned to its initial clockwise position by spring 38 (FIG. 1B).

(5) The rocking frame 35 is returned to the position shown in FIG. 2, permitting the intermediate gears 32 to re-engage the entry gears 17. The ears 28*c*, 30*b* and the print elements 1 lie on the bail 37.

(6) The locking bar 51 is returned to the initial position shown in FIG. 2.

(7) The pin 53 (FIG. 1A) on the control clutch 49 engages the clutch 48 by means of the lever 54, link 55 and the clutch control lever 47.

(8) The control clutch 49 is disengaged by clutch dog 56.

The rotation of the clutch 48 initiates the printing operation. As previously described, the nose 10*a* of the follower 10 follows the groove 9*a* in the drive cylinder 9 and pushes the carriage 3 to the right by means of the shaft 11 (FIG. 1A) This results in a rightward movement of the rack 5 and, through the dual gear 6, 6*a* the rack 7 is moved leftward. At such time the carriage 4 for the rotating print hammer 2 is moved toward the left. The print hammer 2 rotates counterclockwise and, moving into the area of the print member 1, strikes the ear 1*a* by means of an arm 2*a*. This forcibly rotates the print member 1 and its printing element 19 clockwise until the platen 23 is struck. Thus, the lowest digit "2" of the number 373452 is printed. As the shaft 8 continues to rotate it moves the carriage 3 farther toward the right and, correspondingly, the print hammer 2 farther toward the left until an arm 2*b* of the print hammer 2 strikes the ear 1*a* of the member 1 in the second order, causing again a forcible rotation and printing of the digit "5." The shaft 8 continues to rotate and to shift the carriage 3 and the print hammer 2 until the position is reached in which an arm 2*c* strikes the ear 1*a* of the member 1 in the third order, causing the printing of the digit "4." The remaining orders of the number are printed in the same fashion. After all digits of the number have been printed in this manner, the arm 2*a* of the print hammer 2 strikes the ear 1*a* of the member 1 in the 7th order (FIG. 4). The ear 1*b* of member 1 strikes the ear 30*b* of the latch 30 which is pivoted on the disabling lever 28. The disabling lever 28 is thus rocked

clockwise and the cam edge **28***b* (FIG. 1) strikes the bar **40** of the rocker **42**, causing the latter to rotate about shaft **20**. Since the rocker **42** limits the movement of the bar **40** printing of a zero is prevented and the lever **43** on the bar **40** withdraws the nose **10***a* of the follower **10** from the groove **9***a* of the drive cylinder **9**. The rocker **42** is locked in this position by the action of the latch **62** on a shaft **61** which engages an ear **42***a*. At the same time the locking latch **46** has been rocked clockwise by a connecting bar **44** to release the clutch control lever **47**. The latter engages the next notch **48***a* and disengages in the clutch **48**. The clutch **48** stops and the carriage **3**, now free to move, is pulled into its normal leftmost position by the spring **21**.

In restoring the carriage **3**, the spring **21** pulls the pin **58** (FIG. 1B) against the hook **59**, deflecting the latter to the left and by means of conventional linkages, moving the bar **60** against the urgency of the spring **57** for the purpose of disengaging the clutch dog **56** from the notch **49***a* of the control clutch **49**. The resultant terminal movement of the clutch **49** initiates the following (continuing) control functions:

(9) The bail **37** is rocked counterclockwise. This causes the print elements **1** to return into the position shown in FIG. 2, thus moving the gears **22** of the print elements **19** into engagement with the intermediate gears **32** and under the control of the entry gears **17**.

(10) The latch **62** is rocked counterclockwise by a link **63**, releasing the rocker **42** and permitting it to return under the force of the spring **64** (FIG. 1B) into normal position.

It is not necessary to provide a clearing mechanism for the printing mechanism because the printing elements **1** are re-engaged with the entry gears **17** which are subsequently returned to zero in conventional manner.

The printing operation having been completed, the printing mechanism is in its initial position ready to receive subsequent values which are to be printed.

What is claimed and desired to be secured by Letters Patent is:

1. A printing mechanism for office machines having a framework, print wheels, each settable in a predetermined character representative position and each carried on a respective lever, a work sheet mounted in said framework, and means for compressing printed information on said work sheet comprising:

(*a*) a first carriage in which said print wheels and levers are supported for straight line lateral shifting movement relative to said work sheet,

(*b*) a second carriage supporting a print hammer for straight line lateral shifting movement relative to said work sheet,

(*c*) means operable to continuously move the first and second carriages each at a respective continuous rate of speed relative to the work sheet, and

(*d*) drive means operable concurrently with said carriage moving means to drive said hammer consecutively into engagement with each and every one of a plurality of adjacent print wheel levers and to cause each print wheel to print said pre-determined character.

2. A printing mechanism as defined in claim 1 in which said first and second carriages are continuously moved in opposite directions relative to the work sheet.

3. A printing mechanism as defined in claim 1 in which the print hammer is slidably mounted upon a shaft driven in timed relationship with said first carriage moving means.

4. A printing mechanism for office machines having a framework, a platen mounted on said framework, and a medium for receiving printed information adjacent said platen;

(*a*) a first carriage mounted for discrete increments of shifting movement within said framework,

(*b*) a plurality of ordinally arranged members pivotally mounted on said carriage for movement from a normal position of rest to an active position,

(*c*) a printing element carried by each member, each element being differentially settable and operable upon movement of its respective member to an active position to print a character upon said medium,

(*d*) a second carriage mounted for discrete increments of shifting movement within said framework,

(*e*) a print hammer carried by said second carriage,

(*f*) means for moving said two carriages relative to said platen,

(*g*) driving means operable to cause said hammer to successively engage and move said members to said active position, the print hammer being mounted for rotation in said second carriage and striking a member during a respective increment of rotation thereof to move said member to active position, and the rate of rotation of said hammer being such that it rotates one increment during each increment of shifting movement of said first carriage.

5. A printing mechanism for office machines having a framework, a platen mounted on said framework, and a medium for receiving printed information adjacent said platen;

(*a*) a first carriage mounted for discrete increments of shifting movement within said framework,

(*b*) a plurality of ordinally arranged members pivotally mounted on said carriage for movement from a normal position of rest to an active position,

(*c*) a printing element carried by each member, each element being differentially settable and operable upon movement of its respective member to an active position to print a character upon said medium,

(*d*) a second carriage mounted for discrete increments of shifting movement within said framework,

(*e*) a print hammer carried by said second carriage,

(*f*) means for moving said two carriages relative to said platen,

(*g*) driving means operable to cause said hammer to successively engage and move said members to said active position, the print hammer being mounted for rotation in said second carriage and striking a member during a respective increment of rotation thereof to move said member to active position, the rate of rotation of said hammer being such that it rotates one increment during each increment of shifting movement of said first carriage,

(*h*) means for suppressing the movement of those members carrying elements standing in a non-significant printing mechanism, and

(*i*) means operable under the control of said suppressing means for terminating the operation of the printing mechanism.

6. A printing mechanism for office machines having a framework, a plurality of printing members each settable to a discrete one of a plurality of printing positions, a work sheet mounted in said framework, each printing member being mounted on a lever, and means for compressing printed information on said work sheet comprising:

(*a*) a first carriage in which said levers are supported for movement relative to said work sheet,

(*b*) a second carriage supporting a print hammer for movement relative to said work sheet,

(*c*) engaging means for operating said hammer to successively engage each and every one of a plurality of adjacent levers, and

(*d*) means operable during the operation of the hammer engaging means for continuously moving the first and second carriages each at a respective continuous rate of speed relative to the work sheet.

7. A printing mechanism for office machines having a framework, printing members each carried by a respec-

tive lever, a work sheet mounted in said framework, and means for compressing printed information on said work sheet comprising:

(*a*) a first carriage in which said levers are supported for movement relative to said work sheet,

(*b*) a second carriage supporting a print hammer for movement relative to said work sheet,

(*c*) engaging means for operating said hammer to successively engage each and every one of a plurality of adjacent levers, and

(*d*) means operable during the operation of the hammer engaging means for continuously moving the first and second carriages in different respective directions relative to said work sheet.

References Cited in the file of this patent

UNITED STATES PATENTS

943,444	McCool	Dec. 14, 1909
1,229,202	Potts	June 5, 1917
2,029,957	Trachtenberg	Feb. 4, 1936
2,047,505	Hausheer	July 14, 1936
2,080,649	Breitling	May 18, 1939
2,178,749	Fuller	Nov. 7, 1939
2,346,265	Mehan	Apr. 11, 1944
2,412,777	Chung	Dec. 17, 1946
2,505,729	Zenner	Apr. 25, 1950
2,757,775	Hickerson	Aug. 7, 1956
2,843,243	Masterson	July 15, 1958