

Feb. 3, 1931.

E. BREITLING

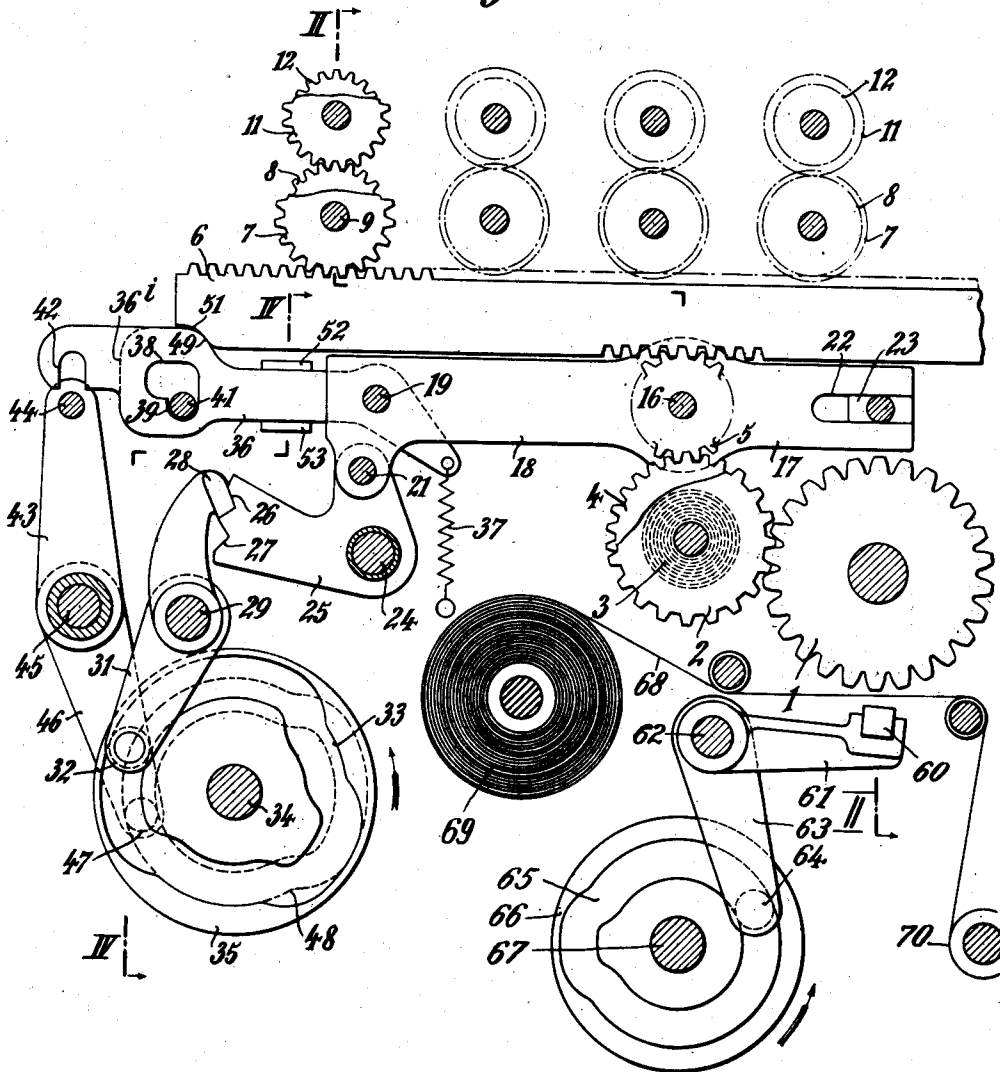
1,790,790

ZERO PRINTING DEVICE

Filed Sept. 17, 1929

7 Sheets-Sheet 1

Fig. 1.



Inventor
Ernst Breitling
By *Frederick K. K.*
Attorney.

Feb. 3, 1931.

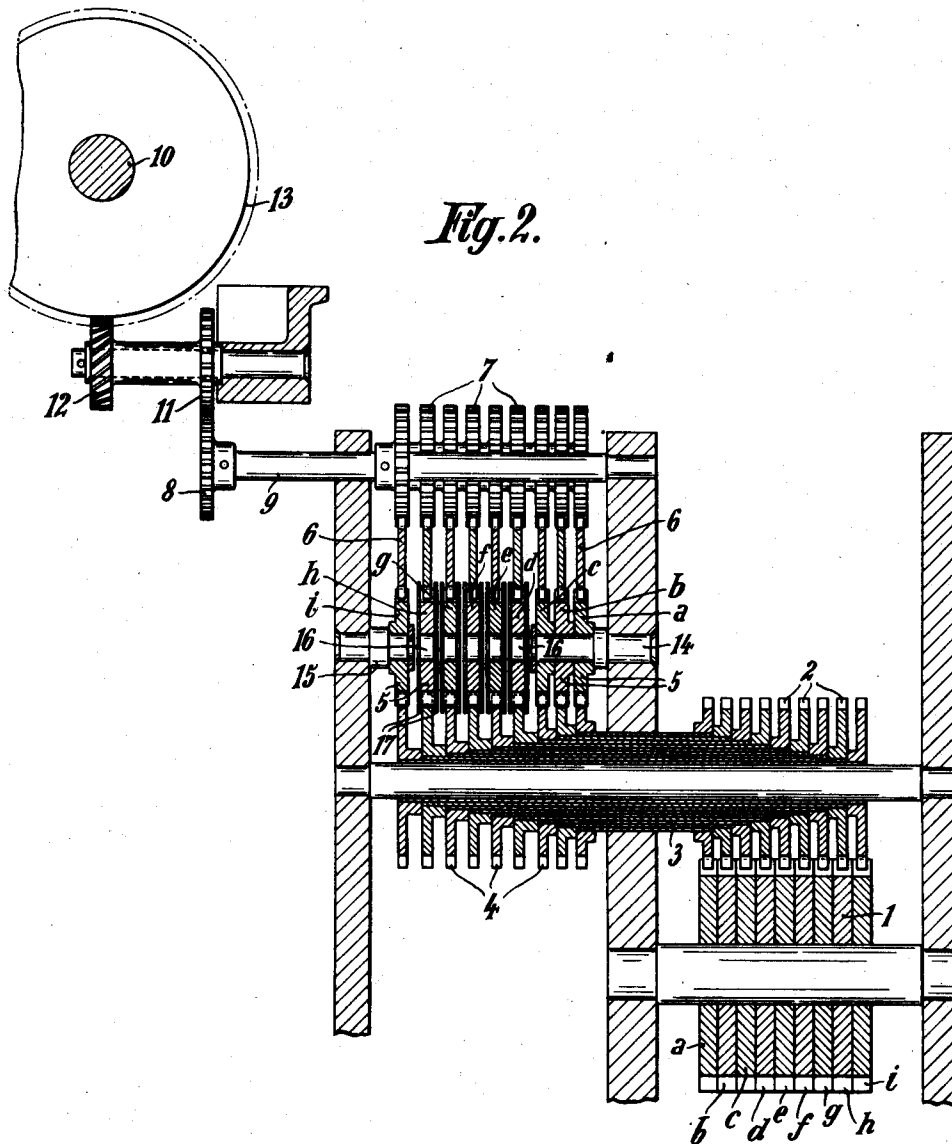
E. BREITLING

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7 Sheets-Sheet 2



Inventor
Ernst Breitling
By Knight Bros.
Attorneys

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E. BREITLING

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Fig. 3.

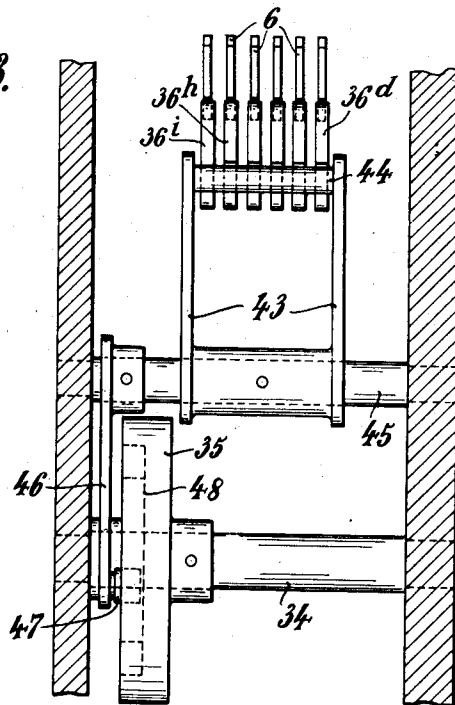
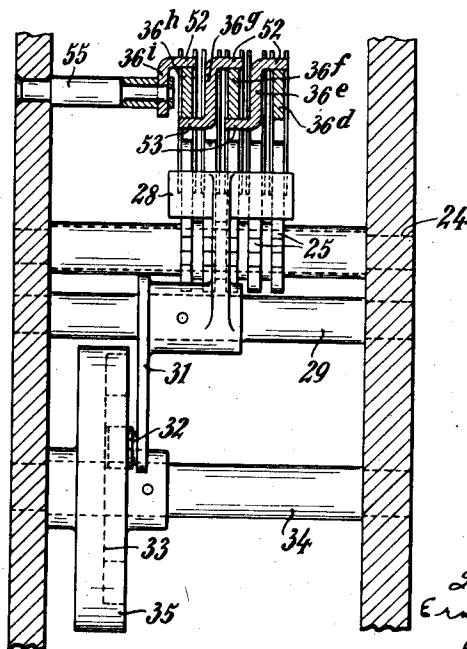


Fig. 4.



Inventor
Ernst Breitling
By *Knight-Ryan*
Attorneys

Feb. 3, 1931.

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Fig. 9.

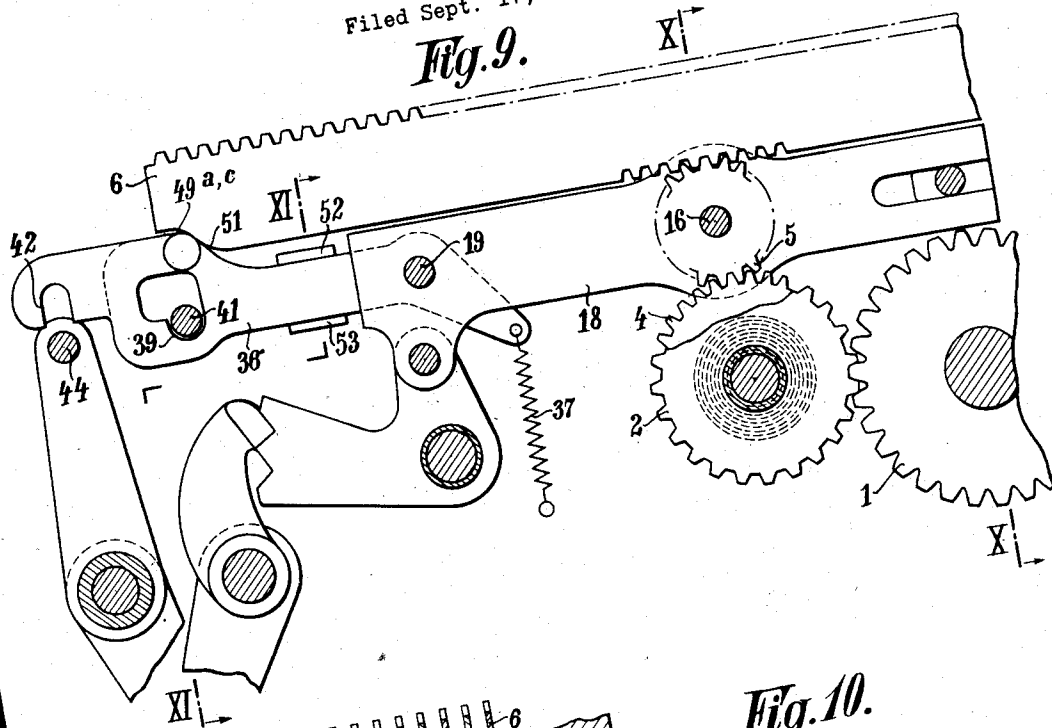
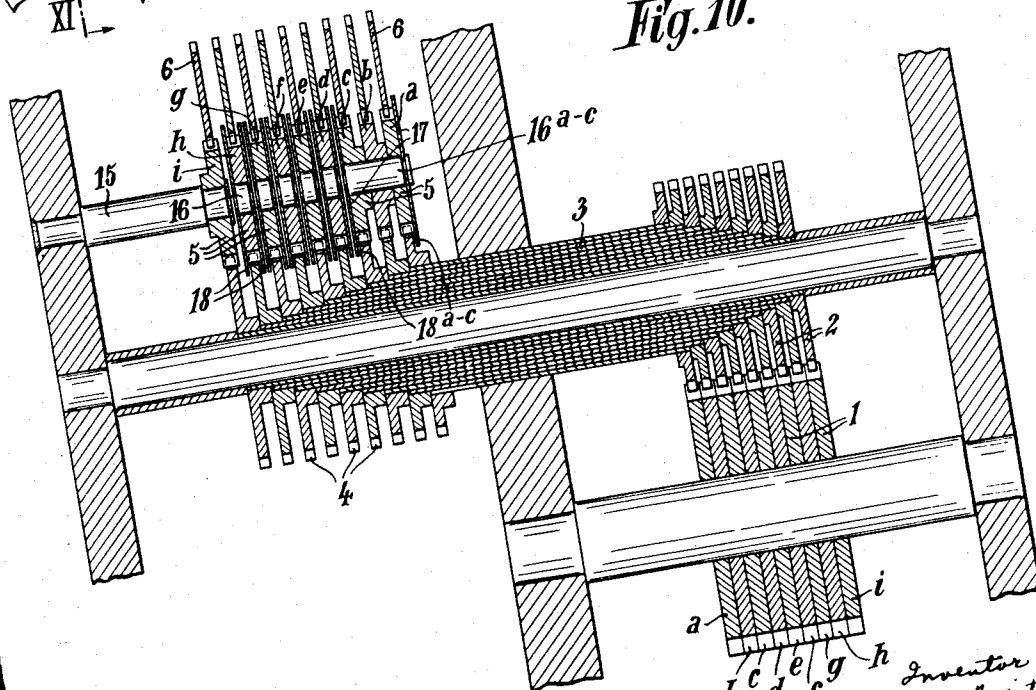


Fig. 10.



Inventor
E. Breitling
By Knight Bros.
Attorney.

Feb. 3, 1931.

E. BREITLING

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Fig. 11.

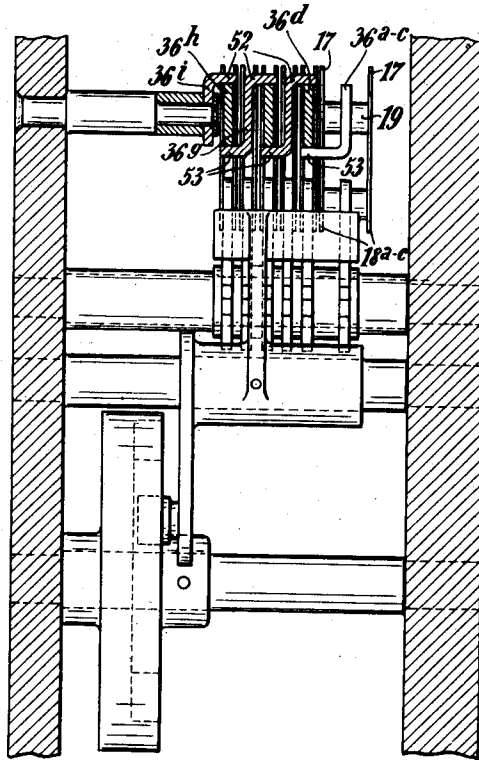


Fig. 12.

2	1	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0	0
57	*	*	*	*	*	*	*	*	57
	9	9	9	9	9	9	9	9	
	9	8	8	8	8	8	8	8	
1i	1h	1g	1f	1e	1d	1c	1b	1a	

Inventor
Ernest Breitling
By Knight Bros.
Attorneys.

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E. BREITLING

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Fig. 13.

Sa-Y-∞*****0.50	35260
Sa-V-∞*****0.00	35261
Sa-T-∞*****0.00	35262
Sa-S-∞*****35.76	35263
Sa-R-∞*****45.72	35264
Sa-P-∞*****5.00	35265
Sa-N-∞***3456.00	35266

Fig. 14.

Sa-Y-∞*****0.50	35260
Sa-V-∞***** **	35261
Sa-T-∞***** **	35262
Sa-S-∞*****35.76	35263
Sa-R-∞*****45.72	35264
Sa-P-∞*****5.00	35265
Sa-N-∞***3456.00	35266

Fig. 15.

Sa-Y-∞*****0.50	35260
Sa-V-∞*****Clear	35261
Sa-T-∞*****Clear	35262
Sa-S-∞*****35.76	35263
Sa-R-∞*****45.72	35264
Sa-P-∞*****5.00	35265
Sa-N-∞***3456.00	35266

Fig. 16.

2	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0
x	x	x	x	x	x	C	l	e
	9	9	9	9	9	9	9	9
9	8	8	8	8	8	8	8	8

1^o 1^b 1^a

Inventor
Ernest Breitling
By Knight & Allen
Attorneys

UNITED STATES PATENT OFFICE

ERNST BREITLING, OF ESSEN, GERMANY, ASSIGNOR TO FRIED. KRUPP AKTIENGESELLSCHAFT, OF ESSEN-ON-THE-RUHR, GERMANY

ZERO-PRINTING DEVICE

Application filed September 17, 1929, Serial No. 393,183, and in Germany September 28, 1928.

This invention relates to zero printing devices for the printing mechanism of calculating machines, of the type in which the type carrier has two different positions with respect to the printing line, for printing zero and for not printing zero, or for printing clear. Whereas in the known devices of this kind the special movement required for adjusting the particular type carrier to the clear or zero position is accomplished by complicated interlocks, according to the present invention it is accomplished by a differential drive, to which the type carrier, the amount setting member and the shifting device for adjusting to the clear or zero positions are connected.

The drawing shows several embodiments of the invention.

Fig. 1 is a side view of one form of the device,

Fig. 2 is a section on the line II—II of Fig. 1, viewed from the left,

Fig. 3 is a view from the left of a portion of Fig. 1,

Fig. 4 is a section on the line IV—IV of Fig. 1,

Fig. 5 is a fragmentary view of the type carriers, showing the arrangement of the type on the various type carriers.

Figs. 6 to 8 are side views of the three forms of type carriers,

Fig. 9 is a side view of a modified form of the invention,

Fig. 10 is a section on the line X—X of Fig. 9, viewed from the left,

Fig. 11 is a section on the line XI—XI of Fig. 9,

Fig. 12 is a fragmentary view of the type carriers of this modification, showing the arrangement of the type,

Figs. 13, 14 and 15 are three fragmentary views of record strips showing various forms of records, and

Fig. 16 is a fragmentary view of a modified form of the type carriers.

Type wheels 1 (Figs. 1 and 2) of the nine places of the printing mechanism, hereinafter designated *a* to *i*, are connected to toothed wheels 11 by toothed wheels 2, telescoped tubes 3, toothed wheels 4, pinions 5,

rack bars 6, and toothed wheels 7 and 8, fixed upon separate shafts 9 journaled in the printing mechanism housing. Toothed wheels 11 are joined by connecting hubs to worm wheels 12, which mesh with amount setting members 13 mounted upon the main shaft 10 of the setting mechanism of the machine. In every operation of the machine the setting members 13 are shifted directly from the amount set by the previous operation to that set by the new operation. Through the described connections the type wheels 1 are also positively adjusted.

In the form of the invention shown in Figs. 1 to 8, the pinions 5^a—5^e and 1ⁱ, that is, those of the three lowest places and the highest place, are journaled upon stationary shafts 14 and 15, while the pinions 5^d—5^b, that is, the pinions 5 of the fourth to eighth places from the right, are constructed as differential wheels. For this purpose the wheels 5^d—5^b are each mounted upon a pin 16 (Figs. 1 and 2) between side plates 17 of a support or slide 18. These slides are formed of the side plates 17, the pin 16 rigidly connecting them together, and two other pins 19 and 21. At their right ends the side plates 17 are provided with slots 22 receiving a stationary guide piece 23, while at their left ends they are pivoted by pins 21 to bell crank levers 25 pivotally mounted upon a stationary pin 24. The free ends of bell crank levers 25 are provided with two recesses 26 and 27, with which a common locking beam 28 (Figs. 1 and 4) cooperates. The locking beam 28 is borne by a two-armed lever 31 journaled on a shaft 29 and having at the end of its lower arm a roller 32 running in a cam groove 33 (Fig. 1) of a disk 35 secured upon the drive shaft 34. The cam groove 33 is shaped to produce two swinging motions of lever 31 for each rotation of shaft 34.

Each slide 18^a—18^b (Fig. 1) has a coupling or shifting member 36 in the form of a link pivoted to the pin 19. Each coupling 36 is under the influence of a tension spring 37 connected to its right end and has at its left end an angular slot 38, 39 cooperating with a stationary rod 41. Each of the cou-

plings has an extension provided with an open slot 42 cooperating with a swinging rod 44 mounted on two arms 43 (Figs. 1 and 3). The two arms 43 are rigidly fixed to a shaft 45, to which there is also fixed a downwardly directed arm 46, having at its end a roller 47 running in a cam groove 48 in the cam disk 35. Each coupling 36 is arranged beneath the rack bar 6 of the corresponding order. When the latter is in its initial position, an inclined surface 49 on the upper side of coupling 36 is held by spring 37 in a correspondingly formed recess 51 of the rack bar 6, whereby the vertical part 39 of the angular slot receives the rod 34 and locks the coupling 36, together with the slide 18 and the differential pinion 5, against displacement. When the corresponding rack bar 6 is moved out of its initial position, by the setting of an amount, the coupling 36 is pressed down against the action of its spring 37, so that the portion of the slot 39 leaves the rod 41, while the open slot 42 moves over the swinging rod 44. Also in this position of the coupling 36 the slide 18 is locked against undesired motion.

As can be seen from Fig. 4, the coupling 36^a has on its upper edge a bent-over lug 52, which extends over the coupling 36^d, and on its under edge the coupling 36^a has a bent-out lug 53 extending under the coupling 36^d. In the same manner the coupling 36^c is connected with its neighboring couplings 36^d and 36^b. It can be seen that whenever one of the couplings 36^b—36^e is depressed by movement of the corresponding rack bar 6 out of its zero position, all of the couplings 36 lying to the right of the depressed coupling are carried down by the over and under lapping lugs and come likewise into engagement with the swinging rod 44 and out of engagement with the locking rod 41.

The highest place, which, like the three lowest places lacks a slide 18, has nevertheless a lever 36^f similar to couplings 36. This lever is mounted on a stationary stud 55 and has a bent-over lug 52 extending over the neighboring coupling 36^b. The lever 36^f has no projection at its left end with a slot 42 like the couplings 36 (Fig. 1); it serves simply to carry down the couplings 36^b—36^e into working position, upon movement of the rack bar 6^f.

The type wheels are divided into twenty-six parts and have a double series of type, for printing at two places. Only one platen 60 is shown in the drawing and this is mounted upon arms 61 secured to a rock shaft 62. A downwardly extending arm 63, likewise secured to shaft 62, has at its end a roller 64 engaging in cam groove 65 of a cam disk 66 fixed to a drive shaft 67. A record strip 68 passes between the platen and the type wheels and is wound from reel 69 onto reel 70.

There are three kinds of type wheels 1.

Type wheels 1^a—1^c are shown in Fig. 6; they have the ordinary series of type 0 to 9 and are only for printing these characters, for the printing mechanism is advantageously arranged for printing values in dollars and cents.

Type wheels 1^d—1^h (Fig. 7) of the next five places to the left have, besides the series of numbers 0 to 9, a star sign, which comes next to zero. These five type wheels are the ones which are adjusted for printing "zero" or "clear". When they are adjusted for printing "clear", the star sign is printed. Instead of the star sign any other sign may obviously be used, for example, a dash, cross, or the like, or, as is usually the case, there may be no character whatever printed for the clear position.

The type wheel 1ⁱ (Fig. 8) of the highest place has besides the series of numbers 1 to 9 a star sign, which follows after the number 1. The zero is here replaced by the star, because a zero is never printed as the initial figure of an amount. It can be seen from Fig. 5, which shows the relative arrangement of the type to the printing line 57, that when all slides 18 are in their initial positions, the type wheels 1^a—1^c and 1ⁱ, which do not take part in the "zero" and "clear" adjustment, and are normally simply adjusted by the rack bars 6, are displaced one unit with the type wheels 1^d—1^h, which are adjusted for "clear" and "zero" and are shown in the clear position.

If one of the middle type wheels is moved out of the clear position in accordance with a digit of an amount, it shows at first a number one unit less than this digit; it must therefore be turned one unit further, as must all the type wheels 1^b—1^d to the right of it, if these have not been adjusted to any amount, in order to bring the zeros of the latter type wheels to the printing line, instead of the stars. This occurs in a manner which will be understood from the following example.

Assume the printing mechanism to be in the position shown in Fig. 1 and that the amount 60023.04 is to be set and printed. At the beginning of the operation, with the locking beam 28 in the recess 26, the setting members 13 turn for the said amount. In this operation only the type wheels 1^e, 1^d, 1^c, and 1^a are adjusted, namely, for the amounts 6, 2, 3 and 4, so that the type wheel 1^e presents to the printing line the type 5, the type wheel 1^d the type 1, and the type wheels 1^c and 1^a the types 3 and 4. The type wheels 1ⁱ, 1^h, 1^g, 1^f, 1^e remain with the star sign presented to the printing line and the type wheel 1^b with the zero to the printing line.

It is now necessary to move the type wheels 1^a—1^e one unit further, in order to bring to the printing line, instead of the types 5 and 1, the types 6 and 2, and instead of the sta.s

of type wheels 1^e and 1^f, the zeros. By the adjustment of the amounts upon the type wheels 1^e and 1^d, the rack bars 6^e and 6^d (Figs. 1 and 2) were moved out of their initial positions, so that the couplings 36^e and 36^d were displaced by the cooperation of the inclined surfaces 49 and 51 and thereby brought out of engagement with the locking bar 41 and into engagement with the swinging bar 44. Since the coupling 36^e has a lateral lug 52 projecting over the neighboring coupling 36^f (Fig. 4) and a lug 53 of coupling 36^e projects under coupling 36^f, the couplings 36^f and 36^e are displaced, although their rack bars 6 remain in starting position. Now the bell crank lever 25 is released by the locking beam 28 and immediately the swinging rod 44 is moved to the right by cam 35. At this time the slides 18 which are coupled with rod 44, namely, the slides 18^e—18^d, are carried to the right, whereby the corresponding differential pinions 5 roll along rack bars 6 and move their type wheels 1 one unit further. Whereupon the locking beam 28 is again thrown into the recesses 26 or 27, depending upon the positions of the bell crank levers 25, in this case in the recesses 26^a and 27^{a-c}, which results in an exact alinement of the type wheels 1. Now the type wheels stand in the positions corresponding to the amount set; the two highest places having no amounts present the star signs to the printing line.

After the printing is accomplished, the bell crank levers 25 are released by the locking beam 28 and thereupon the rod 44 swings back to the left. At the end of the operation the locking beam 28 is again thrown into the bell crank levers 25, now in the recesses 26 in all orders, so that until the next operation of the machine all the type wheels 1^b—1^d present to the printing line either a star or number which is one unit less than the corresponding digit of the amount set in the preceding operation.

The engagement of the selected couplings 36 with the rod 44 remains as before; it changes, however, upon setting a new amount, in dependence upon the adjustment of the rack bars 6, in such a manner that the couplings 36 whose rack bars 6 are moved back to the initial position, that is, in those places which contain a zero in the newly set amount, are released by the inclined surfaces 51 and go back into their initial positions under the action of springs 37, unless they are held down in working position by the over-lapping or under-lapping lugs 52, 53 of a higher place. All slides 18 included in the new amount are coupled with the rod 44, so that the supplemental rotation of the corresponding type wheels 1 for one unit takes place in the manner described.

The locking beam 28 is thrown against the bell crank levers 25 twice during each opera-

tion, the first time, after the coupled slides 18 have been moved to the left by swinging rod 44, this for the purpose of alining the type wheels, the second time, after the completion of the printing and the return of the slides 18 to their left-end-positions. After it is thrown in the second time, the locking beam 28 remains in while the machine is idle and during the setting of the new amount by setting members 13, in order to ensure an exact adjustment of the couplings 36 with respect to rods 44 and 41 during the new amount setting. In order to give the couplings 36 an easy action, the slots 42, 39 are slightly wider than the diameter of rods 41, 44 and the alinement of couplings 36 is such that the slots can move over the rods with play on both sides.

Fig. 13 shows a control strip printed by the arrangement described. The zeros of the three places at the extreme right are printed, even when no amount whatever has been set. The control strip then shows stars in the six places to the left and zeros in the three places to the right. It can easily happen in this case, that a zero is read as a 6 or a 9, so that it is overlooked that this item was for a zero value. In order to exclude this possibility, the arrangements according to Figs. 9 to 12 have the three places to the right so constructed that they print a clear sign, whenever none of the type carriers of these three places, or those to the left have been adjusted to an amount. On the other hand they print zeros when any one of the three type carriers to the right has been adjusted to an amount, even though no amount has been set in any of the places to the left. The type of record made by this arrangement is shown in Fig. 14. In this way the clear sign, in this case a star, appears in all places, upon printing a complete zero item and the zero items stand out clearly on the record of the control strip or printed check.

Instead of the arrangement according to Figs. 1 to 8, in which the pinions of the three places to the right, 5^a—5^c, are mounted on a stationary pin, in the arrangement according to Figs. 9 to 12, the pinions 5^a—5^c are journaled upon a pin 16^{a-c} extending across two side plates 17 (Fig. 10) of a frame 18^{a-c}, similar in side view to the slides 18^d—18^h. Upon the pin 19 (Fig. 9) of this frame is pivoted a coupling 36^{a-c}, which cooperates with an inclined surface 51 of the rack bar 6^a of the second place from the right in the same way as in the fourth to eighth places from the right. The coupling 36^{a-c} has also two lateral projections 49^a and 49^c, which cooperate with the inclined surfaces 51 of the rack bars 6^a, 6^c of the first and third places from the right. Also a bent-out lug 53 (Fig. 11) of coupling 36^{a-c} engages under coupling 36^d of the fourth place.

The type wheels 1 of the first to eighth

places from the right have the same type arrangement, as can be seen from Fig. 12. They all have besides the zero a star for the clear sign, like the type wheels 1^a—1^b of the arrangement according to Figs. 1 to 8. These stars of the type wheels are presented to the printing line in the initial position of the device. Therefore if no amount is set on the type wheels, the clear sign, in the form of a star, appears in all places, see Fig. 14, lines 2 and 3. If an amount is set on one of the type wheels 1^a—1^b, all places to the left print a star, all places to the right print a zero. For example, if the type wheel 1^a is moved five units, the type 4 is first presented to the printing line. However, by the movement of rack bar 6^t, the coupling 36^t is depressed, and with it, by means of the lugs 53, 52, the couplings 36^e and 36^d, and all come into engagement with the rod 44. At the same time, by means of the lug 53 of coupling 36^{a-c} engaging under coupling 36^d, the former coupling is also brought into engagement with the rod 44, so that the frame 18^{a-c} bearing the three pinions 5^a—5^c is also coupled to the rod 44. When this rod receives its driving motion to the right, the type wheels 1^a—1^f are displaced one unit by the couplings 36 which have been thrown in, so that the type wheel 1^f prints a 5, the type wheels 1^a—1^e zeros and the type wheels 1^g—1ⁱ, which did not take part in the supplemental motion, print stars (**5000.00). On the other hand if an amount is adjusted only on one of the three type wheels to the right, 1^a—1^c, then, regardless of which of these three places receives this adjustment, the coupling 36^{a-c} is connected with rod 44, through the action of the corresponding inclined surface 51 upon one of the projections 49^a—49^c. The record then shows stars in the places 1^d—1ⁱ and in the three places to the right zeros or the number set. For instance, if the number 5 was set in the second or third place from the right, the record shown in the first or sixth lines of Fig. 14 is made. If the complete zero item frequently occurs, for example, in drawing the individual totals from a plurality of used and unused counting mechanisms at the close of business, and if it is necessary to make these items stand out more clearly from the record than they do in Fig. 14, the type carriers of the three places to the right are formed in the manner shown in Fig. 16. In this case the stars are replaced by the letters *c*, *le* and *ar*, so that the word "clear" appears upon the control strip in printing complete zero items, see Fig. 15.

Having described my invention, I claim:

1. In a printing mechanism for calculating machines, a type carrier having a clear position and positions corresponding to the numbers 0 to 9, means for differentially moving said type carrier in accordance with amounts set, and means for adjusting said type carrier into zero or clear position, comprising a

shifting device, and a differential drive connected to said type carrier, said setting means and said shifting device.

2. A printing mechanism as recited in claim 1, in which said differential drive comprises a pinion interposed between said setting means and said type carrier, a pin on which said pinion is journaled, and a movable support for said pin, and driving means for moving said support to impart a motion of one unit to said type carrier, in an additive or subtractive sense, the movement of said support by said driving means being under the control of said shifting device.

3. In a printing mechanism for calculating machines, a type carrier having a clear position and positions corresponding to the numbers 0 to 9, means for setting said type carrier in accordance with amounts set comprising a rack bar, a pinion geared thereto, and connections between said pinion and said type carrier, a pin upon which said pinion is journaled, a slide, movable parallel to said rack, upon which said pin is supported, driving means, a coupling controlled by said rack for connecting said slide to said driving means, said driving means being adapted, when coupled, to move said slide to impart a motion of one unit to said type carrier.

4. In a printing mechanism as recited in claim 3, a stationary member adapted to be engaged by said coupling in its uncoupled position to lock said slide in one position, said coupling being adapted to positively connect said slide to said driving means in its coupled position.

5. A printing mechanism as recited in claim 3 in which said driving means comprises a swinging rod, a stationary member, said coupling having recesses adapted to engage said swinging rod and said stationary member respectively and alternatively, said recesses being slightly wider than the swinging rod and stationary member with which they cooperate, and means for positively holding said coupling member in such position that said swinging rod and stationary member enter their respective recesses with play on each side.

6. In a printing mechanism for calculating machines, type carriers having positions in sequence corresponding to clear and the numbers 0 to 9, means for differentially moving said type carriers according to amounts set, means for causing the type of said type carriers to print at the proper time in the operation of the machine, each type carrier being, between successive operations of the machine, in a position one unit lower than its corresponding digit in the number to which the machine was adjusted by the preceding operation thereof, means, operable subsequently to the setting of a new amount and before the printing takes place, for advancing by one unit all type carriers included

in the new number to which the machine has been adjusted, and means for retracting said last mentioned type carriers by one unit after the printing takes place.

7. A printing mechanism as recited in claim 6 in which the means for advancing the type carriers by one unit comprises shifting members, said shifting members being interconnected in such a manner that each controls shifting members of lower order than itself.

8. A printing mechanism as recited in claim 6 in which the means for advancing the type carriers by one unit comprises shifting members, alternate shifting members being provided with a lug overlapping the shifting member of the next lower order and a lug underlapping the shifting member of the next higher order, the intermediate shifting members being without such lugs.

9. A printing mechanism as recited in claim 6 in which the means for advancing the type carriers by one unit comprises a common shifting member for the three lower orders and individual shifting members for each higher order, said shifting members being interconnected in such a manner that each shifting member in said higher orders controls all shifting members of lower order than itself, including the three lower orders.

10. A printing mechanism as recited in claim 6 in which the means for advancing by one unit the type carriers of the three lower orders comprises three pinions in the three lower orders of said differential moving means, a common shiftable frame upon which said pinions are mounted, and means controlled by the setting of an amount in any of the three lower orders for shifting said frame.

11. In a printing mechanism for calculating machines, type carriers for a number of orders greater than 3, each having in sequence the positions clear and 0 to 9 inclusive, said type carriers being in the position clear when the machine contains no amount, means for differentially moving said type carriers according to amounts set, means for imparting a supplementary motion of one unit to the type carriers of the three lowest orders when an amount is entered in any of said orders, and means operable upon entering an amount in any higher order for imparting a supplementary motion of one unit to the type carriers of said higher order and all orders below it.

12. In a printing mechanism for calculating machines, type carriers for a number of orders greater than 3, each having in sequence the positions clear and 0 to 9 inclusive, said type carriers being in the position clear when the machine contains no amount, means for differentially moving said type carriers according to amounts set, means for imparting a supplementary motion of one

unit to the type carriers of the three lowest orders when an amount is entered, comprising a rack bar and pinion for each order, said pinions being geared to their respective type carriers, a shiftable frame upon which the pinions of the three lowest orders are mounted, separate slides upon which the pinions of the higher orders are individually mounted, driving means, means for individually coupling said frame and said slides to said driving means for imparting a supplementary motion of one unit to the respective type carriers, means whereby the coupling for said frame is controlled by any one of said racks of the three lowest orders, means whereby the couplings for said slides are controlled by the racks of their respective orders, and connections whereby each rack of said higher orders controls the couplings of all orders below it.

13. A printing mechanism as recited in claim 12 in which the coupling for said frame comprises a bar adapted to be engaged by the rack of one of said three lowest orders, lateral projections adapted to be engaged by the other two rack bars of said three lowest orders, and a lateral lug adapted to be engaged by the coupling of the slide next above said three lowest orders.

14. A printing device according to claim 11 in which the type carriers of the three lowest orders are provided in their clear positions with letters which together spell the word "clear".

The foregoing specification signed at Cologne, Germany, this 30 day of August, 1929.

ERNST BREITLING.