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K. B. W. KIEL

SELECTING MECHANISM FOR CALCULATING MACHINES

Serial No. 355,383

BY A. P. C.

Filed Sept. 4, 1940

2 Sheets-Sheet 1

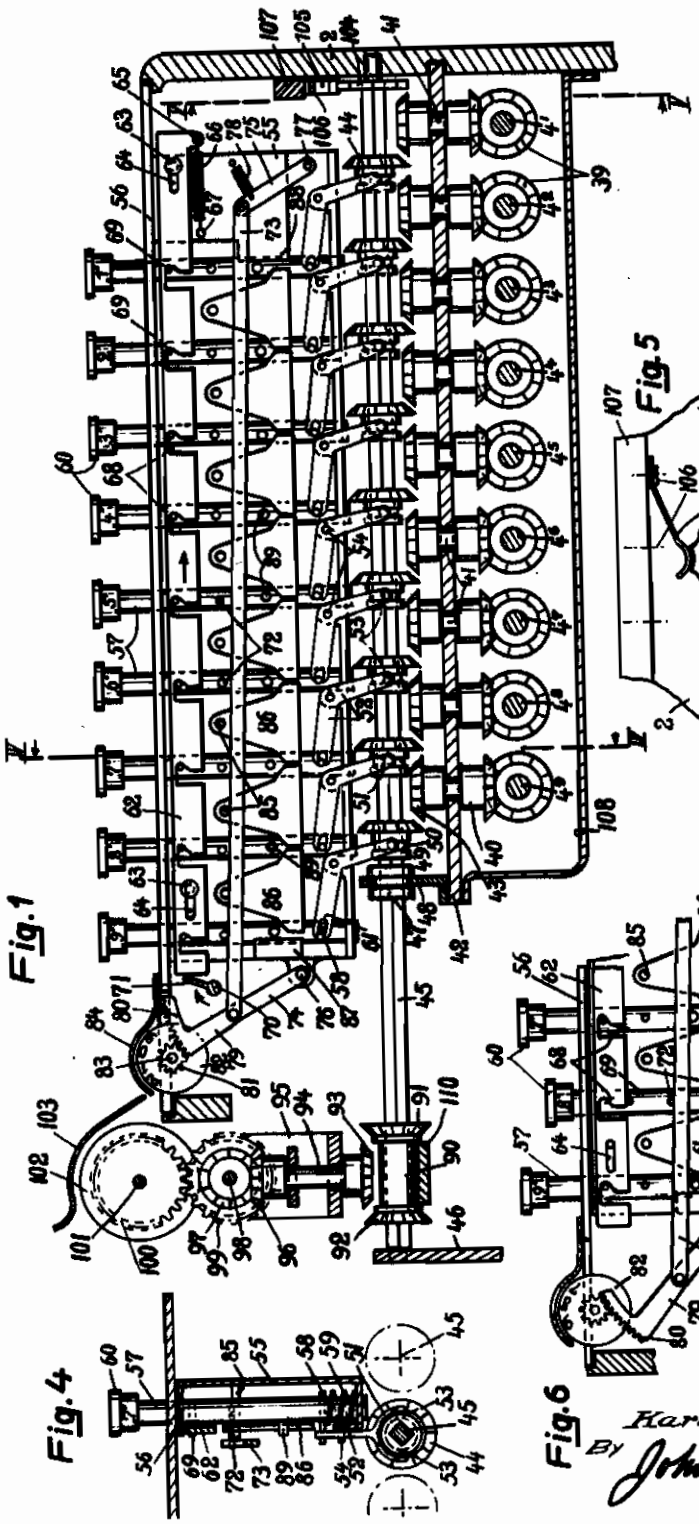

Fig. 1

Fig. 4

Fig. 5

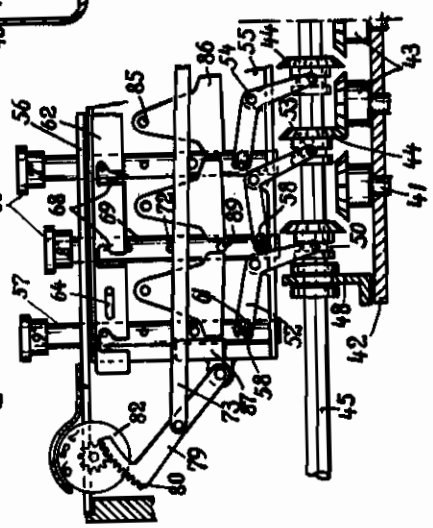

Fig. 6

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Fig. 3

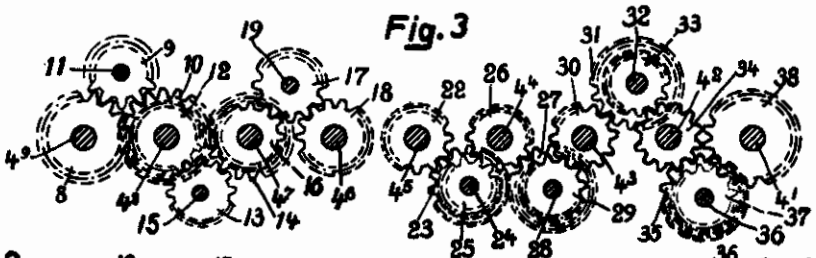
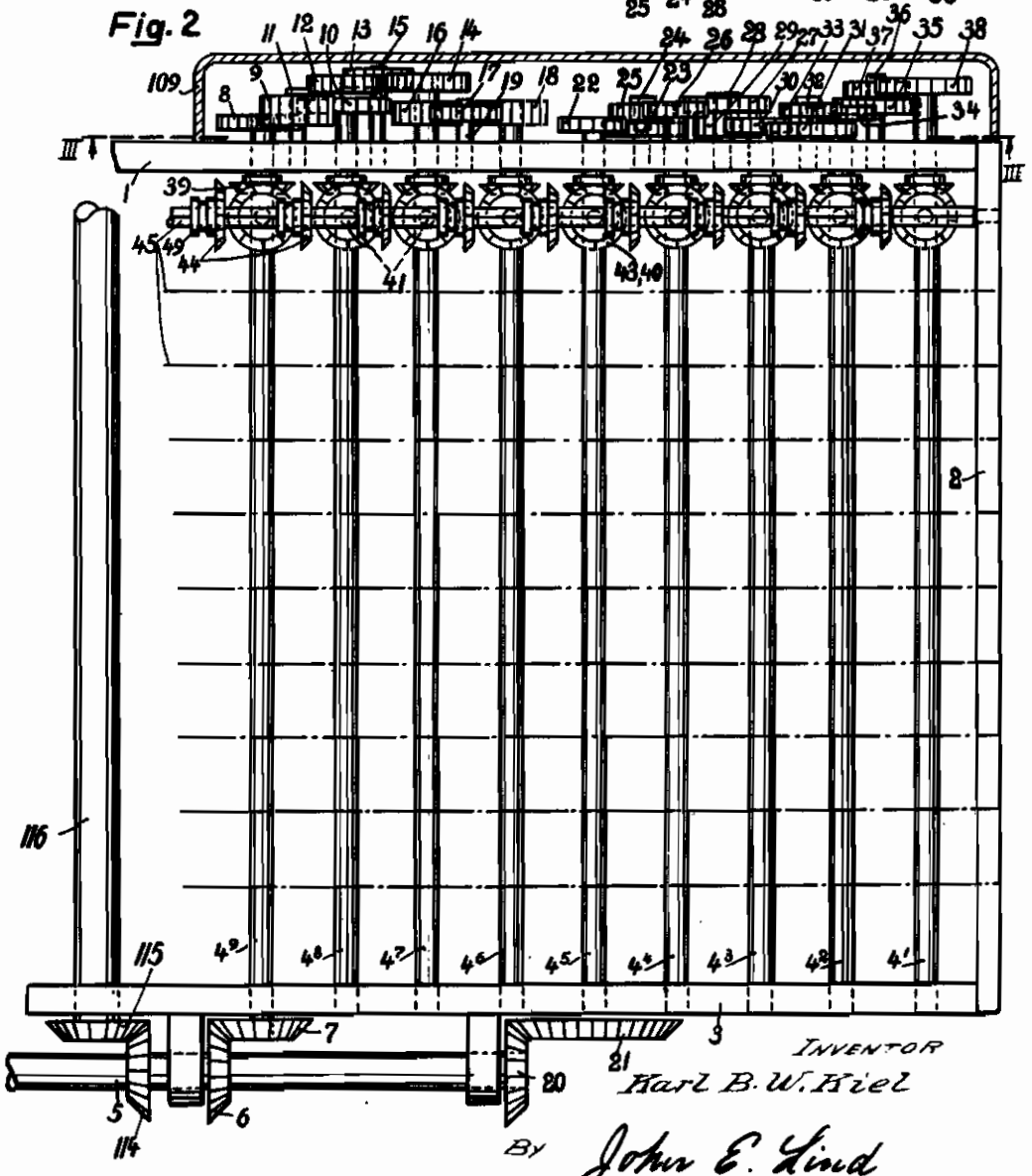


Fig. 2



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ALIEN PROPERTY CUSTODIAN

SELECTING MECHANISM FOR CALCULATING MACHINES

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This invention relates to a new and improved selecting mechanism for calculating machines.

It is an object of the invention to provide a simplified gear mechanism for the selecting operation in order to make the operation of the calculating machine quieter and avoid the knocking noises, especially during rapid calculation speeds, noticeable in certain types of machines, as, for example, the Odhner and Thomas types.

A further object of the invention is to provide the totalizer actuator shafts with gearing shiftable by the keys into mesh with coordinated gearing driven by the main calculating shaft and such coordinated gearing is calibrated so as to rotate during a machine cycle in direct proportion to the key value.

It is a further object to provide the above mentioned coordinated gearing upon shafts which extend transversely of the machine and provide one of such shafts for each transverse row of keys. In the usual type of machine having nine keys in each bank there will therefore be nine of these shafts and they will have a rotation ratio with respect to one another as 1:2:3:4:5:6:7:8:9 in correspondence with the keys respectively having the values from "1" to "9."

A further object of the invention is to provide a construction wherein the main gearing elements may be permanently encased in oil.

A still further object is to provide means which will positively prevent the operation of more than one key in each bank and which therefore protects the selecting gearing provided.

A further object is to provide a clearing mechanism operable upon depression of a key to clear the other keys in the same bank in order to protect the selecting gearing provided or operable to clear the entire keyboard.

With the above and other objects in view which will appear from the detailed description below, the invention, in a preferred modification which is not to be interpreted in a limiting sense, is shown in the drawings, in which:

Fig. 1 is a partial cross sectional view through a calculating machine illustrating particularly the selecting mechanism according to the invention.

Fig. 2 is a top plan view, partly diagrammatic for greater clarity and also with the keyboard, keys and associated parts removed illustrating particularly the selecting gearing of the selecting mechanism.

Fig. 3 is a sectional view taken on section line III—III of Fig. 2, with the casing removed, showing the cooperating gears for securing the proper rotation ratios for the selecting gearing.

Fig. 4 is a partial sectional view taken on section line IV—IV of Fig. 1.

Fig. 5 is a partial sectional view taken on section line V—V of Fig. 1, and

Fig. 6 is a view of a portion of Fig. 1 showing the position taken by certain elements upon depression of the "8" key.

The frame of the machine consists of the two side walls 1 and 3 and the front wall 2. In the two side walls are located the shafts 4^1, 4^2, 4^3, . . . 4^9. These shafts are so driven that they revolve in the ratio of 1:2:3:4:5:6:7:8:9:. Thus while shaft 4^1 makes one revolution, shaft 4^2 makes two and shaft 4^9, for example, nine revolutions. These shafts are driven from the main shaft 5, which makes a complete revolution for each computation.

The main shaft 5 is driven from the main gear shaft 116 which extends across the machine by means of bevel gears 114 and 115. The main gear shaft 116 is driven by the driving motor in any desired manner. For example, the main gear shaft 116 can be connected with the drive of the machine as described in the application Ser. No. 117,952, filed December 28, 1936.

The main shaft 5 is connected with shaft 4^9 by means of a pair of bevel gears 6 and 7, which in view of the fact that the bevel gears 6 and 7 possess the same number of teeth (in the present form 16 teeth each) turn with the same number of revolutions as shaft 5. At the other end of shaft 4^9 a spur gear 8 is fixed, which meshes with an intermediate gear 9 which in turn meshes with spur gear 10. The intermediate gear 9 is mounted on a shaft 11 which is fastened on the side wall 1 of the frame. Inasmuch as the spur gear 8 in the present form has sixteen teeth and the spur gear 18 eighteen teeth, the relation of revolutions between the two shafts 4^9 and 4^8 is 9:8, so that while shaft 4^9 executes a full revolution, shaft 4^8 makes only $\frac{8}{9}$ of a revolution.

Beside the spur gear 10 another spur gear 12 is located on shaft 4^8, which by means of an intermediate gear 13 rotates a spur gear 14. The spur gear 14 is fastened on shaft 4^7, while the spur gear 13 is freely mounted on an axle 15 which is secured to the side wall 1 of the frame.

The teeth of the spur gears 12 and 14 are in the proportion of 7:8, with the result that while shaft 4^9 executes a complete revolution, shaft 4^7 executes $\frac{7}{8}$ of a revolution. On shaft 4^7 is located, moreover, a spur gear 16, which meshes with an intermediate gear 17 which in turn meshes with a spur gear 16 which is secured to shaft 4^6. The intermediate gear 17 is freely

mounted on axle 19 which is fastened on the side wall 1 of the frame. Inasmuch as the number of teeth of the spur gears 16 and 16 is in the proportion of 12:14, shaft 4^6 executes $\frac{6}{7}$ of a revolution while shaft 4^9 executes a complete revolution.

It is easily understood that the propulsion of shaft 4^5 could be effected by a proper series of gears between the shafts 4^6 and 4^5. However, in order to avoid an injurious play of teeth, shaft 4^5 is driven directly from the main shaft 5, that is, by means of the bevel gears 20 and 21. The ratio of the teeth on the two bevel gears 20 and 21 is 5:9 (the bevel gear 20 has in the present form fifteen teeth and gear 21 twenty seven teeth). Therefore, while shaft 5 or 4^9, respectively, executes a complete revolution, shaft 4^5 executes only $\frac{5}{9}$ of a revolution.

At the free end of shaft 4^5 there is fixed a spur gear 22 which meshes with a spur gear 23. The spur gear 23 is freely mounted on axle 24, which is fastened on the side wall 1 of the frame, and it, in turn, meshes with a spur gear 25. The spur gear 25 meshes with another spur gear 26 which is fastened on shaft 4^4. The ratio between the gears 22, 23, 25 and 26 is such that the revolution of shafts 4^5 and 4^4 is in the proportion of 5:4. In the present form this is effected by giving spur gear 22, twelve teeth, spur gear 23, fifteen teeth and to spur gears 25 and 26 twelve teeth each. Thus shaft 4^4 will execute $\frac{5}{9}$ of a revolution during a complete revolution of shaft 4^9.

Spur gear 26 on shaft 4^4 meshes with another spur gear 27 which is freely mounted on axle 28 which is fastened on the side wall 1 of the frame. With spur gear 27 there is connected another spur gear 26 which meshes with spur gear 30 which is on shaft 4^3. The ratio between the spur gears 26, 27, 29 and 30 is so determined, that the ratio of revolutions of shafts 4^4 and 4^3 is 4:3. For this purpose spur gear 27 has sixteen teeth and the spur gears 29 and 30, twelve teeth each in the present form. During a complete revolution of shaft 4^9 shaft 4^3 will execute $\frac{3}{9}$ of a revolution.

Spur gear 30 meshes with a spur gear 31 which is freely mounted on axle 32, which is fastened on the side wall 1 of the frame. With spur gear 31 is connected another spur gear 33, which meshes with a spur gear 34, which is fastened on shaft 4^2. The number of teeth of the spur gears 30, 31, 33 and 34 is so determined that the ratio between the revolutions of shafts 4^3 and 4^2 is 3:2. For this purpose, spur gear 31 has eighteen teeth and the spur gears 33 and 34, twelve teeth each in the present modification. While shaft 4^9 executes a complete revolution, shaft 4^2 executes only $\frac{2}{9}$ of a revolution.

Finally, the spur gear 34 meshes with a spur gear 35 which is located on axle 36 which is fastened on the side wall 1 of the frame. With spur gear 35 is connected a spur gear 37 which meshes with a spur gear 38, which is mounted on shaft 4^1. Inasmuch as spur gear 35 in the present form has sixteen teeth, spur gear 37 twelve teeth and spur gear 36 eighteen teeth, the ratio between the revolutions of shafts 4^2 and 4^1 is 2:1. During a complete revolution of shaft 4^9, shaft 4^1 executes only $\frac{1}{9}$ of a revolution.

On each of shafts 4^1, 4^2, 4^3, . . . 4^9 there are fastened at equal spaces from one another bevel gears 38 corresponding in number to the banks of keys. In the present modification 10 banks of keys have been provided for and in accordance therewith there are arranged on each shaft 4^1, 4^2, 4^3, . . . 4^9, ten bevel gears 39. These bevel gears 39 which in the present modification have nine teeth each mesh each with a bevel gear 40. The bevel gears 40 are fastened on shafts 41 which are mounted in the frame plate 42. As may be seen from Fig. 1 the bevel gears 40 are coordinated with the bevel gears 43, which are fastened on the upper ends of the shafts 41.

The bevel gears 43 are coordinated with the bevel gears 44 which are arranged non-rotatably but slidably on the square cross sectional totalizer actuator shafts 45 of the calculating mechanism. Inasmuch as in the present modification a calculating machine with a 10-bank selecting mechanism is provided, there are consequently, ten of these actuator shafts 45 of the calculating mechanism. In Fig. 2 only one of them has been shown while the other nine are indicated diagrammatically by the dot and dash lines. On each actuator shaft 45 of the calculating mechanism there are arranged nine bevel gears 44 coordinated with the nine bevel gears 43. The actuator shafts of the calculating mechanism are journalled partly in the front wall 2 of the frame and partly in the frame plate 46. In order to prevent bending of the actuator shafts 45 of the calculating mechanism, they are furnished with casings 47 journalled in the frame plate 46.

Each bevel gear 44 is furnished with a collar 49 having an annular groove 50 in which the pins 53 on the forked ends 51 of an elbow lever 52 engage. The levers 52 are pivoted at 54 on the frame 55. Corresponding to the ten actuator shafts there are provided ten banks of keys. Each bank has a U-shaped frame 55, which is fastened on a strip-like cover plate 56. In each bank of keys, there are nine key stems 57 arranged to slide axially, each being furnished with a radially projecting pin 58. A compression spring 59 bears at one end against this pin while the other end rests on the lower horizontal portion of the frame 55. These springs 59 tend to hold the key stems 57 in their initial upper position and the upper ends of the stems are furnished with the key knobs 60. The pins 58 engage the forked ends 61 of the elbow levers 52, so that when a key is pressed down the bevel gear 44 coordinated therewith meshes with the gear 43 designed to cooperate therewith.

In order to maintain the key in depressed position, each bank of keys is provided with a locking bar 62, which is slidably mounted on the frame 55 of each bank of keys by means of the fastening screws 63 extending through appropriate slots 64 in the bar 62. A spring 66 is secured to each bar 62 at 65 at the right hand end as seen in Fig. 1 while the other end of the spring is fastened to the frame of the bank of keys at 67.

Bar 62 is provided with slots 68 having the shape shown on Figs. 1 and 6. A pin 69 provided on each key stem 57 extends into the slot 68 coordinated therewith. Now when a key is pressed, the corresponding bar 62 is moved against the traction of its spring 66 because of the peculiar cut of the slot 68 and any key in the same bank of keys which may be locked in depressed position is released. This prevents gear damage. As soon as the pin 69 of the actuated key has cleared the slot 68, the bar 62 returns to its initial position under the force of its spring 66 and is positioned over the pin 69 of the pressed key and locks such key so that it is maintained in depressed position. As a result and by virtue of this, the coordinated bevel gear 44 is also held in mesh with the coordinated gear 43. In Fig. 6 the "8" key is shown in depressed position.

The same figure shows the corresponding bevel gear 44 on the corresponding actuator shaft 45

of the calculating mechanism in mesh with the bevel gear 43 which is moved by shaft 4^8.

The clearance of the keyboard can be effected by rotation of the shaft 70 which carries a bar 71. The bar 71 extends across all the bars 62, so that by a turning of shaft 70, in the direction of the arrow shown in Fig. 1, all the bars 62 are moved and brought to clearance position.

The device for showing the value set up in the keyboard may be made in a great many ways. In the present modification a pin 72 is fastened on each key stem 57 for this purpose and each pin projects into the field of movement of an inclined bar 73 for each bank of keys. Each bar 73 is pivotally connected to two levers 74 and 75 which in turn are pivotally connected at 76 and 77, respectively, to the frame 55. A draw spring 78 acting on the lever 75 tends to hold the bar 73 in the initial position shown in Fig. 1. Lever 74 carries by means of an extension 79 a toothed segment 80, which meshes with the small gear 81 of a numeral drum 82 mounted on shaft 83. The value of a key depressed may be read in the sight window 84 since, as is obvious, the inclined position of the bar 73 will cause the segment 80 and consequently the numeral drum 82 to move proportionately to the key value.

In order to avoid disturbances and damage in the operation of the machine on pressing down two keys of the same bank of keys, the following arrangement is provided.

Between each two adjacent key stems 57, a swivelling plate 86 pivoted at 85 is placed with the lower end thereof shaped as shown in Figs. 1 and 6. The plates 86 assume normally the position shown in Fig. 1, with a space between the end plates and the abutments 87 and 88 provided on both sides. The space at each end added together corresponds substantially to the diameter of a bolt 89 provided on each key stem 57. Now, if any key is pressed, the bolt 89 thereon, as can be seen from Fig. 6, will enter between the plates which lie in its field and cause the plates 86 on each side to form a closed row without gaps thereby preventing actuation of another key in the same bank. On the other hand, if two keys should be pressed at the same time by mistake, the free space between the plates 86 would not permit two bolts 89 to enter at the same time between the plates. Thus the operator would be forced to release the key pressed down with the other by mistake, so that the desired setting can take place.

It must be mentioned, also, that in the present modification the bevel gears 40 and 43, as well as the bevel gears 39 have each nine teeth while the shiftable gears 44 have ten teeth.

On each actuator shaft 45 of the calculating mechanism, a gear mounting 90 is slidably but non-rotatively mounted and it carries at its ends the bevel gears 91 and 92. These bevel gears 91 and 92 have like the cooperating bevel gear 93 ten teeth each. The bevel gears 93 are fixed on shafts 94 which are vertically positioned. These shafts 94 and gears 93 are located in the carriage of the calculating mechanism. Only the subframe 95 of the carriage is shown. Each of the shafts 94 is provided at its upper end with a bevel gear 96 which meshes with a bevel gear 97 having the same number of teeth. The gear 97 turns freely on a shaft 98 mounted in and extending through the carriage of the calculating mechanism. The gear 97 is connected with a spur gear 99 which meshes with spur gear 100. The spur gear 100 is freely rotatable on a shaft 101 which is mounted in the carriage of the calculating mechanism. The spur gear 100 acts by means of a planet gear mechanism, not shown, on the coordinated numeral drum 102. The movement of the planet gear takes care of the tens transfer and this mechanism can be arranged as described, for example, in British Patent 450,599.

The gear mountings 90 are controlled by the shift bar 110 which is actuated in well known manner. This bar 110 for the shifting of the carriage has moved the mountings 90 into the neutral position shown in Fig. 1. During the various calculations, whether addition, subtraction, multiplication, or division, as the case may be, the bar 110 will bring the gears 91 or the gears 92 into mesh with the gears 93.

The operation is believed to be clear without further explanation. If, for example, as shown in Fig. 6, the "8" key is pressed in a bank of keys, the coordinated gear 44 is meshed with its cooperating gear 43. Such gear 43 is driven from the shaft 4^8 through the coordinated gears 40 and 39. In accordance with the explanation set forth above, the shaft 4^8 would execute $\frac{8}{9}$ of a revolution in each cycle of the machine, i. e., with each complete rotation of the main shaft 5. This means that the corresponding gear 43 rotates in each cycle the gear 44 eight teeth, so that actuator shaft 45 makes $\frac{8}{10}$ of a revolution. Let us assume that the multiplier is "4", then the shaft 45 is rotated 3.2 times while the main shaft executes four cycles. This means that the numeral drum 102 is turned 3.2 times through the medium of gears 91, 93, 96, 97, 99 and 100, so that in the sight window 103 a "2" will show while the numeral drum 102 of the next higher decimal position will show a "3" in its sight window which is taken care of by the tens transfer mechanism.

In order to insure that the shafts 45 do not turn because of vibrations and the like, a stop disk 104 is provided on each shaft 45, which, as shown in Fig. 5, is provided on its periphery with ten indentures with which a leaf spring 105 cooperates. The leaf springs 105 are secured by means of screws 108 to a bar 107 mounted on the frame.

The gears which are in constant mesh are encased in oil for permanent lubrication and the oil-tight casings 108 and 109 are provided for this purpose. Due to the peculiar construction provided, the main gearing elements may be located within the oil-tight casings provided.

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