March 3, 1931. G. O. DEGENER 1,794,368

COMPUTING MACHINE

Original Filed Sept. 1, 1922

Fig. 1.

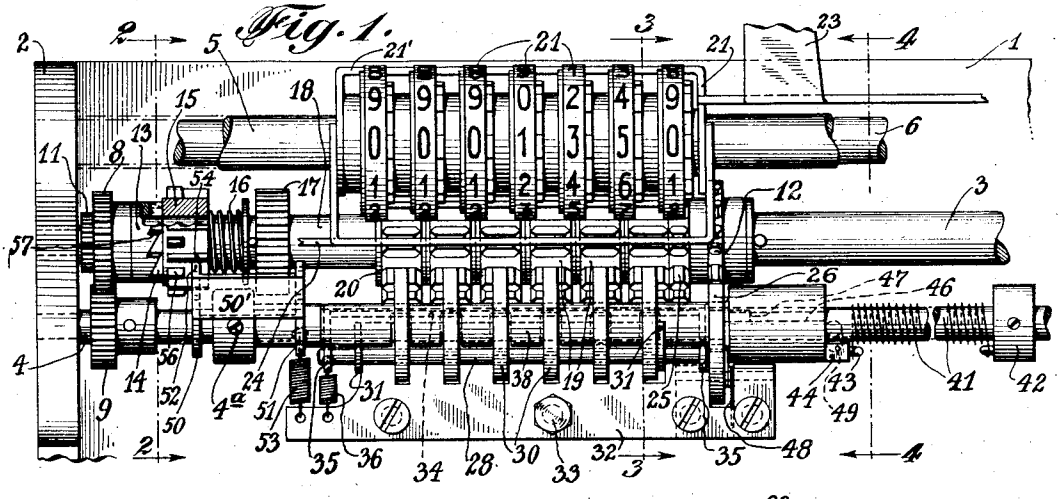


Fig. 2.

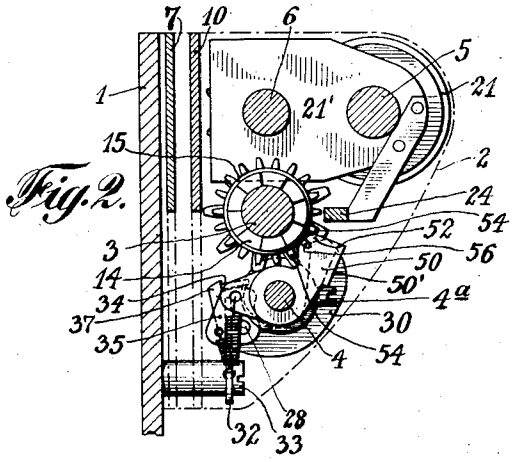
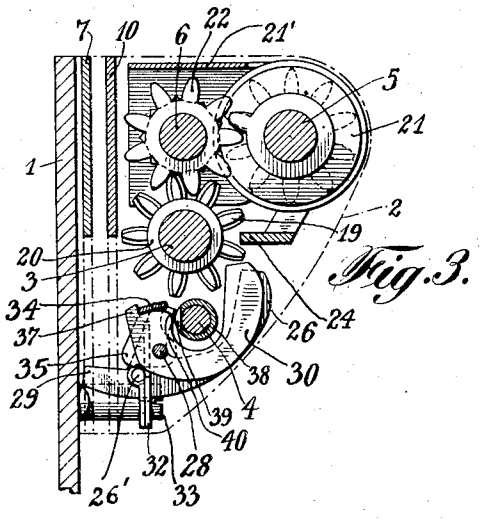


Fig. 3.



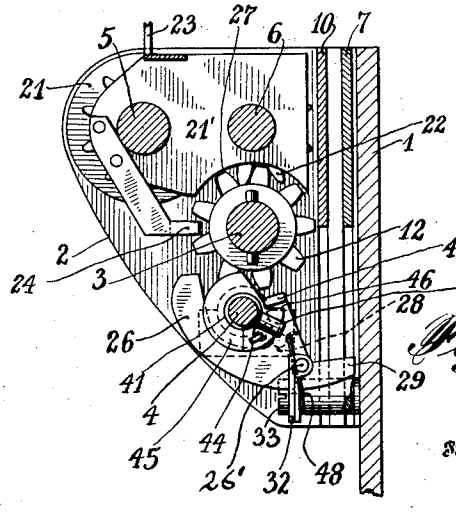
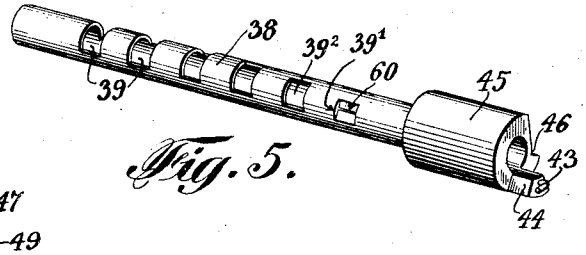


Fig. 4.

Fig. 5.



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1,794,368

UNITED STATES PATENT OFFICE

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COMPUTING MACHINE

Application filed September 1, 1922, Serial No. 585,630. Renewed July 28, 1927.

My present invention relates to computing machines and more particularly to the totalizer or accumulator mechanism and associated parts of machines for adding and subtracting.

It is desirable to allow certain tolerances in the numerous gears making up a totalizer mechanism, both to provide a smooth, easy and relatively frictionless operation and to reduce the expense of manufacture. In an apparatus of this type, in the case of a transfer operation involving a number of digits, in the extreme case, in adding 1 to 999,999, or subtracting 1 from 00000 the final number wheel in the gear train may move through but a small fraction of a unit after the slack or back lash has been taken up in the succession of series-connected gears, so that the operation of the machine would be inaccurate. Moreover, the transfer gears would in this event assume a spiral lag interfering with the ease and sometimes with the possibility of the step by step return of the number wheel carriage.

It is an object of my invention to provide effective and dependable means for aligning the transfer gears to compensate for the lag, without adding to the length of the key stroke, without placing an undue load upon the finger in the case of a key-operated machine, and without affecting the sharpness of the automatic return stroke of the mechanism.

In the preferred embodiment of the invention, aligning pawls are provided for the transfer gears and a single operating member for actuating them consecutively. Preferably, the operating member is actuated by a coil spring into which energy is stored during the operative stroke, the operating member being released near the end of the stroke, to respond to the expansion of the spring and move the pawls for effecting the aligning operation.

In the preferred specific construction, a separate and distinct aligning pawl is provided for each transfer gear, said pawls being pivoted about a common rod and the operating member comprises a tube having a succession of slots of graduated lengths or equivalent cam actuators for shifting the pawls into aligning position.

In the preferred type of construction, the driving force is transmitted through a one-way clutch to the master wheel and a pawl functions to restrain the return of the master wheel, so that the clutch will slip without affecting the position of the master wheel, during the return of the operating mechanism after each key actuation.

To assure accurate positioning of the driven clutch teeth at the end of the return stroke, with respect to the driving clutch teeth, in order to guard against jamming or gain or loss of a tooth at the clutch, I prefer to provide a stop pawl for the driven clutch member, which serves particularly to eliminate the effects of backlash in the intermediate gearing through which torque is transmitted from the clutch gear to the master wheel. Since it is desirable for accuracy to provide the clutch gear with 18 or some other multiple of nine driving teeth, the clutch gear pawl may, however, engage teeth between those corresponding to teeth of the master wheel, that is, it may lock upon half points and thereby block the master wheel against proper alignment by the master wheel locking pawl. I overcome this difficulty by the simple expedient of arranging the clutch gear pawl to coact with a portion of the clutch gear beyond the driving teeth having but nine teeth thereat, spaced to correspond with those on the master wheel.

In the accompanying drawings in which is shown one of various possible embodiments of the several features of this invention,

Fig. 1 is an elevation of the totalizer mechanism and associated parts of an adding machine,

Figs. 2, 3 and 4 are views in transverse cross-section respectively, along the lines 2—2, 3—3 and 4—4 of Fig. 1, and;

Fig. 5 is a perspective view of the aligning pawls operating cam tube.

Referring now to the drawings, I have shown an embodiment of the invention as constituting a part of the preferred form of computing machine shown in the copending patents of Maurice Samburg and Julius C. Hoch-

man, Nos. 1,609,205 and 1,609,206 of November 30, 1926, only so much of the prior preferred mechanism being indicated in the drawings, as is found desirable for complete understanding of the present invention.

In the drawings, I show the rear wall 1 of the computing machine casing having end walls 2 only one of which appears on the drawing, between which are mounted the operating shaft 3, the control shaft 4, the number wheel carrying shaft 5 and the number wheel idler shaft 6. Within the casing adjacent the rear wall 1 thereof is the control plate 7, which performs a full stroke for each key operation and carries racks (not shown) meshing with idler gears 8 on the operating shaft 3, said gears meshing with pinions 9 fixed on the control shaft 4 to cause the latter to rotate through the same angle of rotation for each computing key actuation. The control plate and shaft serve through mechanism not material to the present invention and not shown, to effect the operation of the step by step escapement, the full stroke mechanism and other controlling and safeguarding features.

The operating plate 10 in front of the control plate has racks near its ends (not shown) coacting with the gears 11 on the operating shaft 3, and is so related to the number keys (not shown) that it moves through a range proportional to the number value of the key to rotate the operating shaft and with it the master wheel 12 thereon through a proportionate angle for correspondingly advancing the totalizer wheel.

The mechanical driving connection from the gear 11 to the master wheel 12 is through a one-way nine-tooth clutch, one element 13 of which is preferably rigid with gear 11 and the coacting element 14 of which is preferably an integral part of the clutch gear 15 to be described more fully below, the clutch being maintained normally closed by a compression coil spring 16 encircling the operating shaft. The torque is transmitted to the master wheel driving gear 17 by a counter shaft (not shown) including a reversing gear for subtraction. The master wheel driving gear 17 is fixed at one end of a sleeve 18 encircling the operating shaft and rigidly connected at its opposite end to the master wheel 12.

Upon sleeve 18 are mounted the succession of transfer gears 19 maintained by a shoulder 20 turned on the sleeve 18, against shifting laterally away from the master wheel 12. The usual number wheels 21 are disposed in a carriage 21′ and are in mesh with the usual set of number wheel actuating or idler gears 22, the carriage having a finger piece 23 by which it may be shifted for tabulating, the master wheel in each position entering into registry with the corresponding number wheel actuating gear. The carriage also has an aligning bar 24 shown broken away and extending to the left therefrom to enter between teeth of the transfer gears 20 that are beyond the range of the carriage when the latter is shifted away from the normal position shown in Fig. 1.

The mechanism thus far described is fully shown in the copending applications referred to above.

The master wheel is preferably formed as shown with interrupted teeth, the inner segments 25 coacting with the number wheel actuating gears and the outer segments 12 coacting with the master wheel locking pawl 26, the carriage being cut away as at 27 to permit shifting past the master wheel. The pawl 26 preferably lies in the same plane as the master wheel teeth, is pivoted upon a rod 26 and has an integral tail 29 extending rearward into the path of movement of the control plate 7, so that the pawl will be positively moved about its pivot 26 near the extremity of each operative stroke to enter into engagement between the teeth of the master wheel for effectively locking the latter against overthrow.

According to the present invention, I provide a set of aligning pawls 30, one for each transfer gear, said pawls being pivoted upon a rod 28. The rod 28 is preferably supported in bearing ears 31 rising from a bearing plate 32 screwed as at 33 to the back plate 1.

The aligning pawls 30 are normally maintained in coaction with the corresponding transfer gears, preferably by a single bail 34 extending transversely of the pawls, the arms 35 of the bail being pivoted to the rod 28. A single coil spring 36 connected at one end to arm 35 of the bail and at the other end to the bearing plate 32 serves to urge said bail against integral lugs 37 on the aligning pawls to maintain the latter in operative coaction with the transfer gears, thereby maintaining the transfer gears in line, so that the carriage can be freely shifted.

The bail is automatically lifted by that pawl 30 engaged with the first transfer gear when any carrying operation is to be performed. All other pawls are freed by thus lifting the bail and the carrying resistance is, therefore, the same for a carrying operation into any number of wheels.

For effecting the aligning operation of the transfer gears, I provide a single operating tube 38 fitted over the control shaft 4 and having a set of apertures 39 of graduated length, one corresponding to each of the transfer gear aligning pawls. A shoulder 40 on each of the transfer pawls extends adjacent the associated slot in the operating tube when said pawls are in normal position as shown in Fig. 3.

Energy is stored for actuating the operating tube of the aligning pawls during the operative stroke, to be released near the end of said operative stroke. For this purpose, I

provide a spring 41 coiled about the control shaft 4 and secured thereto at one end by adjustable collar 42, the other end of said coil spring being secured as at 43 preferably to a sector lug 44 on the hub 45 formed at the end of the operating tube. To restrain the operating tube and with it one end of the spring against rotation, while the other end of the spring 41 rotates with the control shaft, thereby to store energy, I provide a notch 46 extending longitudinally of the hub 45 into which extends preferably a tongue 47 upstanding from the master wheel pawl 26. A spring 48 presses at one end against the bearing plate and at the other, against the master wheel pawl to urge the tongue 47 into firm coaction with the notch 46, and also to keep the master wheel pawl out of engagement with the master wheel.

A pin 49 extends outward from the control shaft 4 and normally engages one side of the sector lug 44. This pin rotates with the control shaft, away from the lug 44 in a counterclockwise direction (Fig. 4) during the operative stroke, and is followed by the segment as soon as the tongue 47 releases the operating tube, the pin 49 thereafter during the return stroke of the parts to operative position, serving by its coaction with lug 44 to return the operating tube to its initial position.

The concentric large diameter of hub 45 on operating tube 38 serves to hold the master wheel pawl into engagement throughout the return stroke. It is only when home position is nearly reached, during the upward movement, that the notch 46 in the hub moves into alignment with tongue 47 and the spring on the master wheel pawl withdraws the pawl and locks the operating tube.

In the preferred embodiment, I provide a pawl for retaining the clutch gear 15 against rotative shifting relative to the master wheel, due to backlash in the driving train, while still allowing longitudinal shifting along the shaft, during the return stroke of the mechanism, and for preventing jamming of the clutch or loss of a tooth thereof. The pawl, as shown, preferably consists of a U-shaped stamping, the two legs 50 and 51 of which are pivotally mounted upon control shaft 4, one leg 50 constituting the pawl proper whose tooth 52 coacts with clutch gear 15, the other leg 51 extending into proximity of bearing plate 32 and being connected thereto by a spring 53 which maintains the pawl tooth in operative coaction with the clutch gear. The clutch gear preferably has eighteen or some greater multiple of 9 driving teeth for accurate operation, but has only 9 teeth 54 in the path of operation of the locking pawl 50 to assure arrest of the clutch gear in a definite position and only in correct phase relation with respect to the master wheel, and eliminating any loss by the backlash in the counter shaft gearing (not shown) which connects the master wheel and the clutch gear. I accomplish this result by the simple expedient of milling away parts of alternate teeth in the eighteen-tooth clutch gear embodiment shown, so that the clutch pawl will coact only with a longer tooth 54 at a portion of the length thereof beyond the range of the milled teeth 56.

Preferably the stroke of the machine keys is such as to afford a small amount of lost motion or slack 57 between the driving gear 11 and the clutch gear 15 to be first taken up in operation before driving of the clutch gear commences. By this arrangement, as appears more fully below, the danger of jamming by end to end contact of the clutch teeth and the inaccuracy from possible shifting of a tooth are obviated and the clutch operation is rendered easier than when a hard bottoming construction is employed.

In operation, the operating plate 10 through the driving gear 11 rotates the driving clutch teeth 13 to first take up the lost motion and then to rotate the clutch gear 15 and through the eighteen driving teeth and countershaft mechanism (not shown) the torque is transmitted to master wheel driving gear 17 and through sleeve 18 to the master wheel 12, locking pawl 50 throughout the operation clicking over the clutch gear 15. At the same time, the control plate 7 moves downward through its full stroke and through idler gear 8 and pinion 9, it rotates the control shaft 4. During the downward stroke of the key, the spring 48 of the master wheel locking pawl 26 urges the tongue 47 thereon into the notch 46 in the tube hub 45 and thereby firmly retains the latter against rotation, while the control shaft rotates to thereby store energy in spring 41, the pin 49 on the control shaft moving therewith in counterclockwise direction away from restrained sector lug 44. When a carrying operation is to take place, the bail 34 is lifted by the first aligning pawl which is shifted laterally by the movement of the transfer gear 20 coacting therewith, thus freeing the aligning pawls 30 from coaction with the other transfer gears, so that shoulders 40 extend through adjacent slots 39 in tube 38 into contact with the control shaft 4. All of the transfer gears are thus freed for the carrying operation.

As the control plate reaches the end of its downward stroke, it depresses the tail 29 of the master wheel pawl and urges the latter into coaction with the master wheel to prevent overthrow. The tongue 47 on the master wheel pawl 26 also moves out of coaction with the groove 46 in the hub 45 and the spring 41 which has been energized during the operative stroke of the key now expands and rotates the operating tube, the lug 44 thus advancing therewith to contact the

previously advanced pin 49 on the control shaft. In the rotation of tube 38, the end 60 of slot 39 first shifts the associated aligning pawl 30 about pivot 28 to urge the tooth thereof into coaction between the teeth of the carrying gear 20, thereby to effect alignment thereof, and in view of the staggered positions of the slot ends 60 on the operating tube, the aligning pawls will thus be consecutively urged into coaction with the transfer gears to align the latter. This occurs near or at the very bottom of the stroke. Due to the stepped construction of the aligning tube, it will be seen that the aligning spring has substantially undiminished power for aligning each transfer wheel consecutively, as the full power of the spring operates on only one aligning pawl at a time. Since the escapement (not shown) does not work until a portion of the up stroke has been completed, the carrying gears are in full aligned position when escapement takes place, thus ensuring positive carriage escapement. After each slot 39 has moved past the corresponding pawl tail, the solid portion of the tube thereafter coacting with the pawl maintains it in mesh with the gear.

When the aligning pawls are all in home position, the bail automatically returns to the operative position shown in Fig. 3 by the operation of spring 36, thereby preventing any release of the aligning pawls when no carrying is being done. During the return of the operating parts to original or home position by the action of the return spring (not shown), the master wheel locking pawl 26 will prevent back rotation thereof, as well as of the driving gear 17 that is rigidly connected to the master wheel. Through the countershaft portion (not shown) connecting the driving gear 17 to the clutch gear 15, the latter will be held against displacement beyond that due to backlash. In the return of the parts to home position, the clutch overruns. Specifically, the clutch gear 15 shifts toward the right by the pressure due to the inclined clutch tooth sides and as the end of each tooth is reached, the spring 16 thus compressed, returns the clutch gear 15 to meshed position. During the return stroke, the spring pawl 50 maintains the clutch gear 15 against rotation, and at the end of the return stroke, screw stud 4^a on shaft 4 engages the transverse element 50′ on the clutch gear pawl and positively positions the gear 15, the motive power for this solid lock being derived from the main return spring (not shown) operating on the control shaft, to permit the further small movement of the driving clutch member 13 beyond bottoming position with respect to clutch element 15. Thus, it will be seen that there is no possibility of end to end abutment of the clutch teeth nor is there any danger of the clutch locking one tooth beyond correct position and introducing an error into the totalizer. The clutch gear pawl 50, held rigid by screw stud 4^a, locking the clutch gear 15, maintains the complete train of gearing against any undesired displacement.

In the return of the control shaft, the pin 49 moves therewith in clockwise direction (see Fig. 4) to its original position, pushing the sector lug 44 and with it the tube 38 to the original position shown in Fig. 3 in which the slots 39 in the tube are again in the range of the aligning pawl tails 40, the bail 34, however, maintaining them in operative position displaced from said slots.

It will be seen that as the control plate returns, the spring 48 returns the master wheel pawl 26 to the home position out of engagement with the master wheel as shown in Fig. 4 with its lug 47 in coaction with notch 46 in the tube hub 45.

Since as set forth, the control shaft returns the operating tube 38 to home position by engagement of pin 49 with sector lug 44, the spring 41 does not function in this operation and is not placed under any extra tension, so that the energy of the return spring of the machine is in no way opposed by the spring that furnishes the energy for the aligning function.

I claim:

1. In a totalizer mechanism, in combination, transfer-gear aligning means, and means for actuating the same by energy stored during the operative key stroke and released near the end of said stroke.

2. In a totalizer mechanism, in combination operating means, a set of transfer gears, aligning members associated therewith, means actuated during the operative stroke for storing energy to actuate said aligning members, and means for releasing said energy near the end of the operative stroke.

3. In a totalizer, in combination operating means, a set of transfer gears, aligning pawls, means urging said pawls into coaction with said transfer gears, spring means to furnish the aligning force for said pawl members, means to store energy in said spring means during the operative stroke, and means to release said energy near the end of said operative stroke for setting said pawl members into operation.

4. In a totalizer, in combination, a set of transfer gears, aligning means therefor normally retained in operative position, means actuated at the beginning of a carrying operation for releasing said aligning pawls, a spring, means to store energy in said spring during the operative stroke, and means actuated near the end of an operative stroke for releasing said spring to actuate said aligning means.

5. In a totalizer, in combination, a set of transfer gears, aligning pawls therefor, a spring for actuating said aligning pawls,

means to store energy in said spring during an operative key stroke, a control element executing an identical stroke for the actuation of each computing key, and means actuated by said control member near the end of its stroke to subject the aligning pawls to the force of the spring for effecting the transfer gear aligning action.

6. In a totalizer, in combination, a set of transfer gears, aligning pawls therefor, an operating member for said pawls, a spring for actuating said operating member to set said aligning pawls, means to store energy in said spring during an operative key stroke, a restraining element for said operating member, a control element executing an identical stroke for each totalizer operation, and means actuated by said control member to release said restraining means, whereby said spring will then actuate said operating member to bring said pawls into aligning position.

7. In a totalizer mechanism, in combination, a set of transfer gears, aligning pawls therefor, a pivoted spring pressed bar urging said aligning pawls into operative position, said transfer gears operative during a carrying action for displacing an aligning pawl, and an operating member for returning the displaced pawl or pawls to aligning position near the end of an operative key stroke.

8. In a totalizer, in combination, a set of transfer gears, aligning pawls therefor, a member normaly urging said aligning pawls into coaction with said transfer gears, said transfer gears operative at the beginning of a transfer action for displacing said aligning pawls, a rotary pawl operating member for returning said pawls to effect the aligning action at the end of a carrying operation, and spring means for rotating said pawl operating member.

9. In a totalizer mechanism, in combination, a set of transfer gears, aligning pawls therefor, an operating member for said aligning pawls, a spring connected to store energy during an operative key stroke for actuating said operating member, a restraining pawl for holding said operating member against displacement, a control member executing an identical stroke for each totalizer operation, and arranged to trip said restraining pawl near the end of the operative stroke, whereby said spring will thereupon actuate said pawl operating member to cause said pawls to perform the aligning action.

10. In a totalizer, in combination, a set of transfer gears, aligning pawls therefor, a holding member for retaining said pawls in operative position, said transfer gears arranged to displace said pawls for permitting a carrying action, an operating member for returning said pawls to perform the aligning action, a spring energized during the operative stroke for actuating said operating member, restraining means for said operating member, a control member executing the identical stroke for each computing key, said means releasing said restraining element near the end of the operative stroke.

11. In a totalizer, in combination, a set of transfer gears, a supporting rod, aligning pawls pivoted thereon, a rotary operating tube having cam notches coacting with said pawls to urge them in succession to perform their aligning operations.

12. In a totalizer, in combination, a set of transfer gears, a supporting rod, a set of aligning pawls pivoted thereon, a spring-pressed holding bar for retaining said pawls in operative coaction with said transfer gears and automatically displaceable from operative position at the commencement of a transfer action, and a rotary tube formed with cam notches coacting with said pawls to urge the latter successively into aligning position.

13. In a totalizer, in combination, a set of transfer gears, aligning pawls therefor, a rotary pawl-operating member having cam means for urging said pawls into aligning action successively, a spring for actuating said operating member, and means operating at a predetermined period in the cycle of operation for releasing energy of said spring for actuating said operating member.

14. In a totalizer, in combination, a set of transfer gears, aligning pawls coacting therewith, a single operating member for said pawls, stop means restraining said operating member against movement, a spring for actuating said operating member, means to store energy in said spring during an operative key stroke, and means to release said stop member near the end of the operative key stroke for the actuation of said operating member by the expansive action of said spring.

15. In a totalizer, in combination, a master wheel, a set of transfer gears coaxial therewith, a master wheel stopping pawl, aligning pawls for said transfer gears, a rotary operating member for said aligning pawls, a spring for actuating said rotary operating member, means associated with said master wheel pawl to restrain said operating member against rotation, means to store energy in said spring during the operative stroke, and means to actuate said master wheel stop pawl near the end of the operative stroke to lock said master wheel and concurrently therewith to release said operating member, whereby said spring becomes effective for alignment of said transfer gears.

16. In a computing machine, in combination, a control shaft, a set of transfer gears, aligning pawl means for coaction with said transfer gears, an operating tube on said control shaft having cam means for coaction with said aligning pawl means to operate the latter, and means for actuating said op-

erating tube at the end of a carrying action.

17. In a computing machine, in combination, a shaft, a set of transfer gears, aligning pawls therefor, a rod pivotally supporting all the said pawls and to one side of said shaft, an operating tube upon said shaft having slots of graduated length in the path of portions of said pawls, whereby upon rotation of said tube, said pawls will be urged in succession into coaction with said transfer gears to align the latter.

18. In a computing machine, in combination, a shaft, a set of transfer gears, a rod parallel to said shaft, a set of aligning pawls pivotally mounted upon said rod for coaction with said gears, a bail member coacting with said pawls to normally maintain the same in mesh with said transfer gears, an operating tube upon said shaft, said tube having slots of graduated lengths, said aligning pawls releasing said bail at the commencement of a carrying action and means to rotate said tube for bringing said pawls consecutively into aligning operation.

19. In a computing machine, in combination, a set of transfer gears, a shaft, a rod parallel to said shaft, a set of aligning pawls pivotally mounted upon said rod for coaction with said gears, a master wheel, a pawl for coaction with said master wheel, an operating tube for said aligning pawls mounted upon said shaft and having slots of graduated lengths, each corresponding to a portion of an aligning pawl, a spring connected to said tube, means to store energy in said spring, said master wheel pawl having a portion coacting with said tube to prevent rotation of the latter under the influence of said spring, and means operating in identical manner upon the actuation of any key, and effective at the end of the operative stroke to shift said master wheel pawl, locking the same, and for releasing said tube to operate the aligning pawls.

20. In a computing machine, in combination, a control plate effecting an identical stroke for each operating key, a control shaft, geared to said control plate to be rotated thereby, a set of transfer gears, a rod, a set of aligning pawls pivotally mounted upon said rod for coaction with said transfer gears, a master wheel, a pawl mounted on said rod for coaction with said master wheel, an aligning tube surrounding said control shaft and having slots of graduated lengths, for coaction with parts of said aligning pawls, a coil spring connected at one end to said control shaft and at the other to a portion of said tube, said master wheel pawl having a tongue coacting with a portion of said tube to restrain the latter, whereby energy will be stored in said spring during an operative key stroke, said master wheel pawl having a portion in the path of movement of said control plate to be shifted thereby near the end of the operative stroke thereof to arrest the master wheel and concurrently therewith to release the tube, whereby the aligning action will thereupon take place.

21. In a computing machine, in combination, a shaft, a set of transfer gears, a set of aligning pawls therefor, an operating tube for said aligning pawls mounted upon said shaft, restraining means for said tube, a coil spring connected to said tube at one end and to said shaft at the other, whereby energy will be stored in said spring during the rotation of said shaft, while the tube is restrained, and means for releasing said restraint near the end of the operative key stroke.

22. In a computing machine, in combination, a control shaft, a tube mounted thereon, a master wheel, a master wheel pawl pivoted adjacent said tube, a tooth on said master wheel pawl, a shoulder on said tube coacting therewith to restrain said tube against rotation, a spring encircling said shaft and connected to said tube at one end and to said shaft at the other, an end lug on said tube, a pin on said shaft normally urged against said lug by said spring, and means actuating said master wheel pawl at the end of the operative stroke for locking the master wheel and concurrently releasing the tube.

23. In an adding machine, in combination, a master wheel, a gear having a greater number of teeth than said master wheel, axially aligned therewith and rotating in unison therewith for transmitting torque thereto, a stop pawl for preventing reverse movement of said gear, said gear being constructed and arranged to afford clearance for said pawl to prevent locking of said master wheel in non-aligned position.

24. In a computing machine, in combination, an operating shaft, a master wheel thereon, a pawl therefor, a gear coaxial with said master wheel and rotating in unison therewith for driving the same, said gear having a multiple of the number of teeth on the master wheel, and a pawl for restraining said gear against return movement, successive tooth portions in the path of said pawl corresponding to successive master wheel pawl locking positions.

25. In a computing machine, in combination, an operating shaft, a sleeve thereon, a master wheel at one end of said sleeve, a master wheel driving gear near the other end of said sleeve, a clutch on said operating shaft, a clutch gear coacting therewith having a multiple of the number of teeth on said master wheel, means for transmitting the torque from said clutch gear to said driving gear, a pawl coacting with said clutch gear to prevent reverse movement thereof, said clutch gear having only nine equidistant teeth in the path of operation of said pawl, whereby said pawl can arrest said clutch

gear only in positions corresponding to accurately aligned positions of said master wheel.

26. In a computing machine, in combination, an operating shaft having a gear at one end, a clutch member coacting therewith, a clutch gear complementary to said clutch member, a driving gear, a sleeve rigid with said driving gear, a master wheel near the opposite end of said sleeve, a spring interposed between said sleeve and said clutch gear to maintain the latter normally closed, said clutch gear having eighteen driving teeth, alternate teeth terminating short of the remainder, a pawl coacting with said clutch gear beyond said shorter teeth, and a spring maintaining said pawl in active position.

27. In a computing machine, in combination, a casing, a control shaft journaled in the ends thereof, an operating shaft, a master wheel and a set of transfer gears thereon, a fixed bearing plate between the ends of said control shaft and adjacent thereto, a master wheel pawl, a set of aligning pawls, rod means supported in said bearing plate on which said pawls are pivoted, a restraining bail for said aligning pawls, a spring anchored to said bearing plate to maintain said bail in operative position, said aligning pawls releasing said restraining bail at the commencement of a carrying action, a gear beyond the transfer gears for transmitting the torque to the master wheel, a pawl coacting with said gear, and a spring anchored to said bearing plate for maintaining said pawl in operative position.

28. In a computing machine, in combination, a totalizer, a casing therefor, transfer gear aligning means therefor, an escapement for said totalizer in said casing, and means for actuating said transfer gear aligning means before said escapement.

29. In a computing machine, in combination, a totalizer, a transfer gear aligning means therefor, means for actuating the same near the end of the operating key stroke by energy stored during said stroke, an escapement for said totalizer, and actuating means therefor operating near the beginning of the return stroke of the mechanism.

30. In a computing machine, in combination, an operating shaft having a gear, a clutch member rigid therewith, a clutch gear complementary to said clutch member, a pawl coacting with said clutch gear to accurately position the same at the end of an operating stroke, and means actuated from the driving mechanism to positively urge said pawl into position at the end of the return stroke.

31. In a computing machine, in combination, a control shaft, an operating shaft, a gear on said latter shaft, a clutch member rigid therewith, a clutch gear complementary to said member, a pawl coacting with said clutch gear and a pin rigid with said control shaft to posivitely engage and shift said pawl into locking position at the end of the return stroke.

32. In a totalizer mechanism, in combination, individual transfer gear aligning means, spring means actuated during the operating stroke for storing energy to actuate said aligning means, and means to apply the full power of said spring to the aligning means one at a time.

33. In a totalizer, in combination, a set of transfer gears, aligning pawls therefor, a spring for actuating said aligning pawls, means for storing energy in said spring during an operating key stroke, means to release the energy of said spring, and means to apply the full power of said spring to said aligning pawls, consecutively.

34. In a totalizer, in combination, a set of transfer gears, a support, aligning pawls pivoted thereon, a rotary operating member having a cam element coacting with said pawls to urge them consecutively to perform their aligning operation, spring means for actuating said operating member and in turn actuated during the operative stroke for storing energy therein, and means for releasing stored energy, whereby the full power of the spring will be applied for actuating the aligning pawls consecutively.

35. In an adding machine, in combination, a totalizer, operating means, a ratchet clutch for transmitting force from said operating means to said totalizer, said clutch having a driving and a driven element, means for maintaining the teeth of said clutch from normally closing a small gap between the coacting driving sides thereof in the driving and driven clutch element, to provide clearance therebetween to be taken up before the driven element is rotated.

36. In a computing machine, in combination, a driving gear, a ratchet clutch member rigid therewith, a cooperating ratchet clutch member, totalizer mechanism to be driven from the latter, means for positively positioning said two ratchet clutch members to maintain slight rotary displacement therebetween with respect to the bottomnig or driving position, whereby at the beginning of an operative stroke, the clearance will first be taken up prior to the driving of the cooperating clutch gear, and at the end of the return stroke, said clearance will again be established and limited by said positive positioning means.

37. In a computing machine, in combination, a totalizer, a master wheel therefor, number of wheels, transfer gears, aligning pawl means for said transfer gears, an operating member for said aligning pawls, a pawl means actuated from the operating mechanism for engagement with said master wheel to prevent overthrow thereof, a

spring for said aligning pawl operating member energized during the operating stroke, said pawl means retaining said operating member and being released therefrom substantially concurrently with locking thereby of the master wheel to release the energy stored in the spring for operating the aligning pawls.

38. In a computing machine, in combination, a totalizer including a master wheel, an overthrow prevention pawl for coaction with said master wheel, means for actuating said pawl at the end of the actuating stroke, and a rotary sleeve including a lug thereon for maintaining said pawl in operating coaction with said master wheel throughout the return stroke.

39. In a computing machine, in combination, a totalizer including a master wheel, transfer gears, aligning pawls for said transfer gears, a cam member for actuating said aligning pawls consecutively near the end of the operative stroke, a spring for operating said cam member and connected to be energized during said operative stroke, an overthrow prevention pawl for said master wheel, said pawl having means for restraining said cam member during the operative stroke of the machine against operation by said spring, and means for actuating said overthrow prevention pawl to concurrently lock said master wheel and release said cam member for actuating said alignment pawls by the force of said spring, said cam member having means functioning throughout the return stroke of the mechanism to maintain said pawl in master wheel locking position.

40. In a totalizer mechanism, the combination of transfer gear aligning means, and means for actuating the same by the sudden release of energy stored during the operative key stroke.

41. In a computing machine attached to a typewriter, the combination of a totalizer, transfer gears, aligning means therefor and means for actuating the latter independently of the typewriter mechanism by energy stored during the operative key stroke.

42. In a totalizer mechanism the combination of a set of transfer gears, aligning members associated therewith, and means actuated during the operative stroke to first store energy sufficient for operation of said aligning members and then to suddenly release said energy.

43. In a totalizer the combination of a set of transfer gears, aligning means therefor normally retained in operative position, means actuated at the beginning of a carrying operation for releasing said aligning pawls, a spring, means to store energy in said spring during the operative stroke and means to suddenly release said spring for actuating said aligning means.

44. A totalizer mechanism comprising the combination of a set of transfer gears, aligning pawls therefor adapted to be displaced by the transfer gears during a carrying action and a single means urging all of said aligning pawls into operative position.

45. In a totalizer the combination of a set of transfer gears, a set of aligning pawls therefor, adapted to be displaced at the commencement of transfer actions, and means coacting with said pawls to urge the latter successively into aligning position.

46. In a totalizer the combination of a master wheel, a set of transfer wheels, a master wheel stopping pawl, aligning pawls for said transfer wheels, an operating member for said aligning pawls, a spring for actuating said operating member, means associated with said master wheel pawl to retain said operating member, means to store energy in said spring during the operative stroke and means to actuate said master wheel stop pawl near the end of the operative stroke to lock said master wheel and concurrently therewith to release said operating member, whereby said spring becomes effective for alignment of said transfer gears.

47. A computing machine including totalizer mechanism, means for effectively operating the latter in accordance with the numerical value of the key stroke, control mechanism identically operated by each key, and an alignment mechanism operated wholly and directly from the control mechanism thereby assuring uniform alignment without regard to the specific key depressed or the speed of depression thereof.

48. In a computing machine the combination of a totalizer, a master wheel, means for effectually operating the latter in accordance with the numerical value of the operated key, control mechanism identically operated by each key, and a master wheel stopping pawl operated by said control mechanism in synchronism with said operating means.

49. In a computing mechanism the combination of a totalizer, a master wheel, means for effectually operating the latter in accordance with the numerical value of the operated key, said means including a driving clutch, a driven clutch, a transmission train connecting said driven clutch with said master wheel, and means for stopping and holding said master wheel, said transmission train and said driven clutch in a predetermined position.

50. In a computing machine a totalizer, a master wheel, actuating means including a driving clutch for effectually operating the latter in accordance with the numerical value of the operated key, control mechanism identically operated by each key, said actuating means and said control mechanism being arranged for movement from home

position during the downstroke of the key operated and back to home position during the upward motion of said key, in combination with a driven clutch, a transmission train connecting said driven clutch with said master wheel, means for stopping and holding said master wheel, said transmission train and said driven clutch in a predetermined position, said stopping and holding means preventing undesired backward rotation of the master wheel, the transmission train and the driven clutch due to the return movement of the actuating and control mechanism to their home position.

51. In a computing machine the combination of a totalizer including a master wheel, means for effectively operating the latter in accordance with the numerical value of the operated key, and an overthrow prevention pawl for coaction with said master wheel, said pawl actuated at high speed near the end of the actuating key stroke.

52. In a computing machine the combination of a totalizer, a master wheel, means for effectually operating the latter in accordance with the numerical value of the operated key, control mechanism identically operated by each key, a master wheel stopping pawl operated by said control mechanism in synchronism with said operating means, and an alignment mechanism operated wholly and directly from the control mechanism, thereby assuring uniform alignment without regard to the specific key depressed or the speed of depression thereof.

Signed at New York, in the county of New York and State of New York, this 11th day of July, 1922.

GUSTAVE O. DEGENER.