W. WRIGHT.

COMBINED TYPE WRITING AND COMPUTING MACHINE.

APPLICATION FILED JAN. 30, 1912.

1,243,374.

Patented Oct. 16, 1917.

2 SHEETS—SHEET 1.

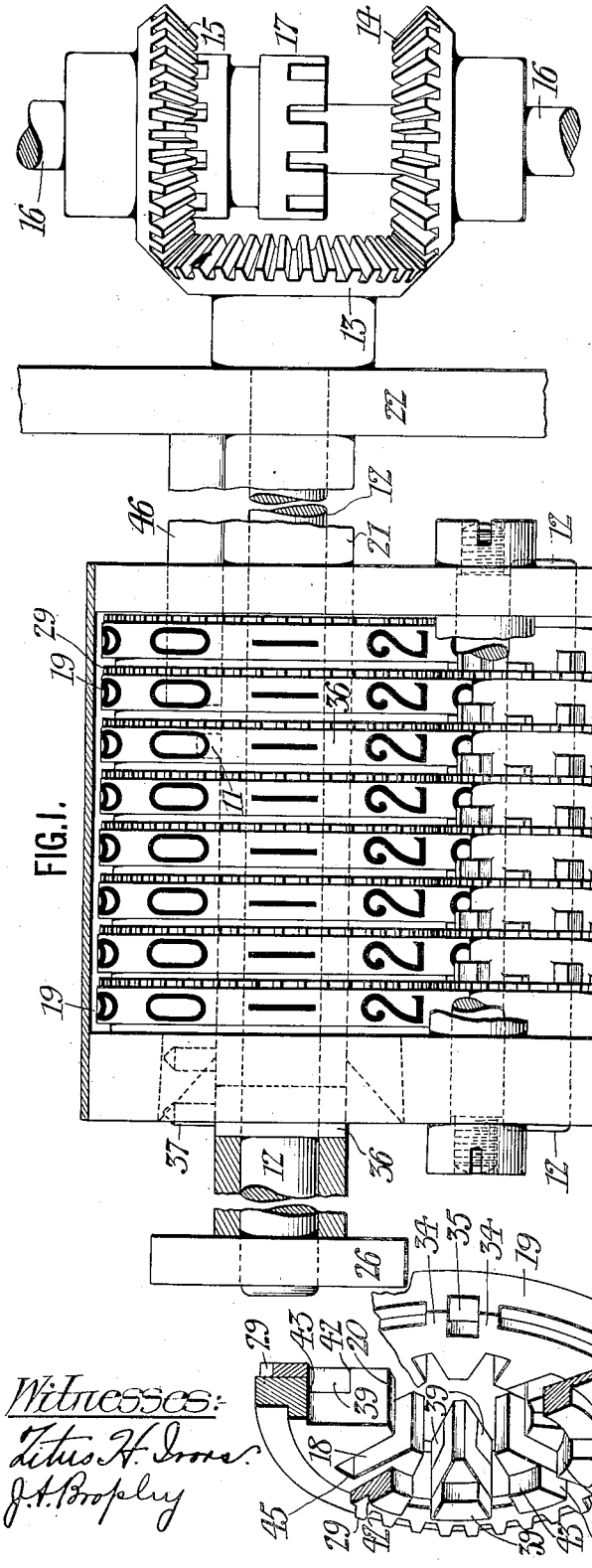


FIG. 1.

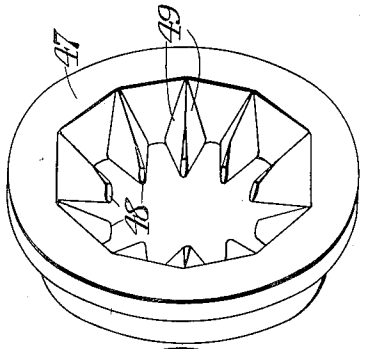


FIG. 7.

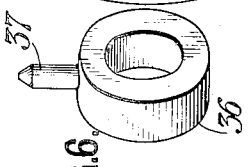


FIG. 6.

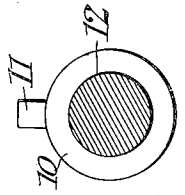


FIG. 5.

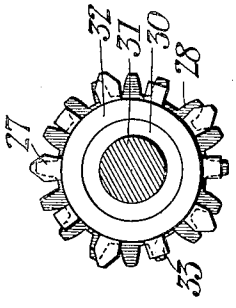


FIG. 4.

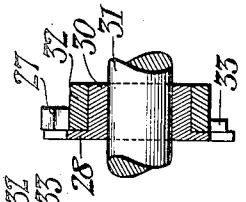


FIG. 3.

FIG. 2.

Witnesses:
Titus H. Sooy.
J. A. Brophy

Inventor:
Walter Wright
by Bob Attorney
his Attorneys

W. WRIGHT.

COMBINED TYPE WRITING AND COMPUTING MACHINE.

APPLICATION FILED JAN. 30, 1912.

1,243,374.

Patented Oct. 16, 1917.

2 SHEETS—SHEET 2.

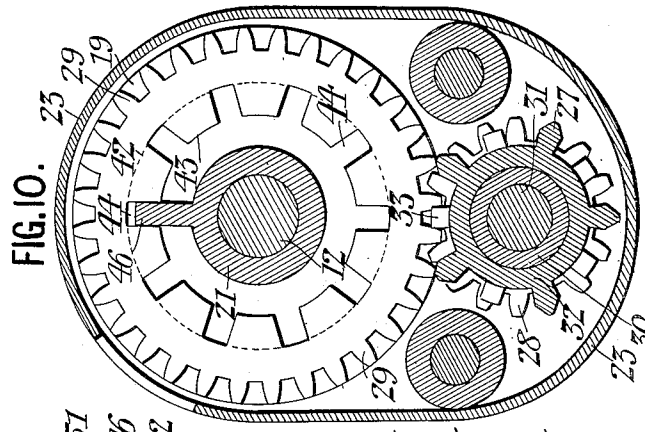


FIG. 10.

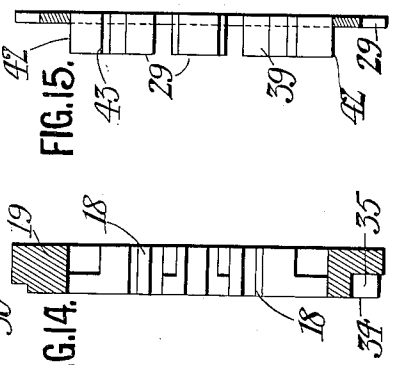


FIG. 15.

FIG. 14.

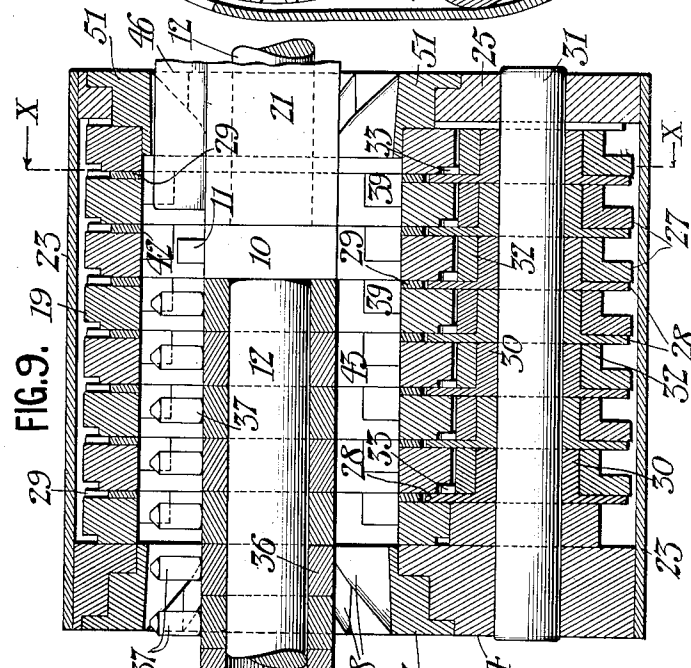


FIG. 9.

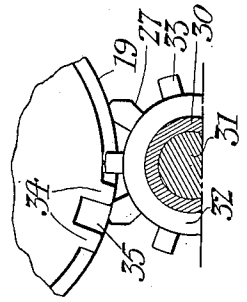


FIG. 13. 4th Position

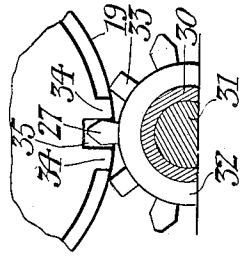


FIG. 12. 3d Position

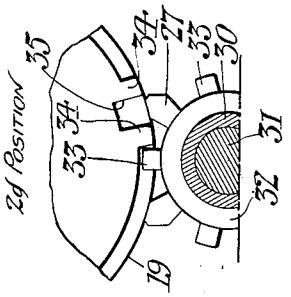


FIG. 11. 2d Position

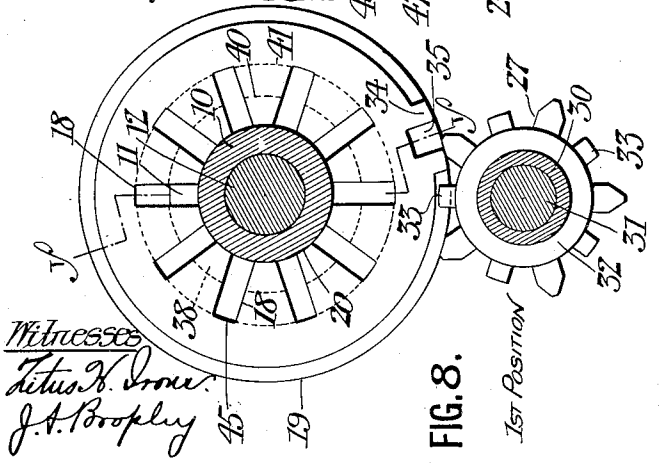


FIG. 8. 1st Position

Witnesses
Titus B. Droze
J. A. Bropley

Inventor:
Walter Wright
by B. B. Stickney
his Attorneys

UNITED STATES PATENT OFFICE.

WALTER WRIGHT, OF NEW YORK, N. Y., ASSIGNOR TO UNDERWOOD COMPUTING MACHINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

COMBINED TYPE-WRITING AND COMPUTING MACHINE.

1,243,374. Specification of Letters Patent. Patented Oct. 16, 1917.

Application filed January 30, 1912. Serial No. 674,383.

To all whom it may concern:

Be it known that I, WALTER WRIGHT, a citizen of the United States, residing in New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Combined Type-Writing and Computing Machines, of which the following is a specification.

Certain features of this invention relate to machines in which Geneva movements are employed, especially counting machines and computing machines, where this movement may be employed for carrying tens or transferring from one dial wheel to another. These features of the invention are illustrated in connection with the form of computing device which is disclosed in my pending application No. 642,183, filed August 3, 1911.

In said application is illustrated a Geneva movement comprising a mutilated gear which is adapted to move ten steps at each revolution, and a Geneva pinion having ten teeth, which rotates a fifth of a revolution at each operation thereon of said mutilated gear. In a counting machine or computing machine, it is usual to employ many dial wheels assembled side by side and connected by tens-carrying trains; and it sometimes happens that tens are carried concurrently through many or all of the dial wheels in the set. Where the tens-carrying devices are of the Geneva movement style illustrated in said application, it is necessary to form the parts quite accurately, so that when tens are carried along the whole set of wheels the last wheel of the set may not be given an incomplete movement. One of the objects of the present invention is to provide simple and inexpensive means for avoiding the necessity of accurate manufacture, and for permitting play in the Geneva trains without incurring the objection of the play being multiplied from wheel to wheel.

To this end I make in each Geneva train a provision for lost motion in such a manner that notwithstanding such lost motion or play, a full movement of the dial wheel of next higher denomination is assured in each instance.

As set forth in said application, the Geneva pinion in each instance was connected by an ordinary pinion to an ordinary gear, the latter being associated with the dial wheel of next higher denomination, and the pitch diameters of the connecting pinion and gear are proportioned as one to two.

In carrying out the present improvements, I retain the connecting pinion and gear unchanged, but the pitch diameter of the mutilated gear in the Geneva train is disproportioned to the pitch diameter of the Geneva pinion; the gear being made oversize and the pinion being made undersize. The mutilated driving gear therefore is rendered capable of effecting a full movement of the Geneva pinion through one-fifth of a revolution, while said driving gear is moving through less than one-tenth of a revolution, and hence a full movement of the dial wheel of next higher denomination is assured, even though in any case the first driving gear should fail to move a complete tenth of a revolution. Hence, if tens are carried along the entire set of dial wheels, the last dial wheel will be sure to move a full stroke.

In the present form of the invention the mutilated driving gear acts upon two of the Geneva pinion teeth, and one of the latter teeth in each pair is preferably narrowed, to permit a substantial amount of lost motion of the mutilated driving gear during its full stroke of one-tenth of a revolution. The timing of the parts is such that at the beginning of the tens-carrying stroke of said mutilated gear, it stands with one of its teeth locking a pinion tooth; the lost motion of said gear being utilized to release said tooth. At the completion of the tens-carrying stroke of said gear, the other one of its teeth, after the completion of the stroke of the pinion, and at the final portion of a stroke of the gear, moves to a position to lock the same pinion tooth on the other side thereof; the device being thus especially useful in machines employed for both addition and subtraction, as well as for other purposes.

In said application, each dial wheel was shown not fixed to its connecting gear, but movable relatively thereto; the dials being however locked to their connecting gears by means of couplers, each having coupling pins to enter notches in both dial and gear, thereby coupling them together. These coupling pins were also utilized to hold the couplers against accidental rotation when they emerged from the computing head during the travel of the latter. According to

certain of the present improvements, preferably only a single coupling pin is used on each coupler, and provision is made at the side face of the adding head for re-alining any couplers whose positions may have become disturbed when outside of the adding head; thus conducing to the simplicity and low cost of manufacture of the device.

In the accompanying drawings,

Figure 1 is a front elevation of an addition and subtraction computing head.

Fig. 2 is a perspective view of a Geneva train and its connecting gears.

Fig. 3 is a section through a Geneva pinion and its associated connecting pinion.

Fig. 4 is another view of the same.

Fig. 5 shows a master wheel employed in computing operations.

Fig. 6 is a perspective view of a coupler.

Fig. 7 is a perspective view of an annular comb having beveled teeth for realining the couplers.

Fig. 8 is a sectional view illustrating the relative positions of the members of the Geneva movement at the beginning of the tens-carrying stroke of the mutilated gear.

Fig. 9 is a longitudinal sectional elevation of a computing head.

Fig. 10 is a section on the line *x*—*x* of Fig. 9.

Figs. 11, 12 and 13 illustrate successive stages in the movement of the Geneva train from the Fig. 8 position to the completion of a tens-carrying operation. In these views a modified form of locking tooth is shown, in which the sides are chamfered or undercut, so as to give a more nearly rolling contact when engaged by the teeth on the dial wheel.

Fig. 14 is a sectional view on the line *y*—*y* of Fig. 8.

Fig. 15 is a sectional view of a gear which forms part of the connection between a Geneva train and the dial wheel of next higher denomination.

The master wheel of the computing mechanism comprises a hub 10 and preferably a single tooth 11, said hub fixed upon a shaft 12 between the ends of the latter; one end carrying a pinion 13, by which the master wheel is intermittently rotated variable distances. In one kind of machine, the pinion 13 meshes with opposite bevel pinions 14, 15, mounted loosely upon a drive shaft 16 controlled by the numeral keys, a double clutch 17 being splined to the shaft 16 and adapted to move into and out of engagement with internal clutches provided upon the pinions 14, 15, whereby the direction of rotation of the master wheel may be reversed for subtraction. The tooth 11 of the master wheel may engage any of a series of ten notches 18 formed internally in each of a gang of dial wheels 19, each of which has an internal bore 20, of a size to fit loosely upon the hub 10 of the master wheel, and upon a fixed tubular support 21 projecting from a part of the framework 22 and surrounding the master wheel shaft 12. The dial wheels may therefore slide along over said hub and said tube 21; and the nest or gang of dial wheels, seen at Figs. 1 and 8, may be given a step-by-step movement in any suitable manner, as for instance, in connection with the letter-feeding movements of the carriage of a typewriting machine, as shown in my pending application, No. 640,798, filed July 27, 1911. By this means the dial wheels are rotated one by one, as the keys of the typewriter or computing machine are operated.

Preferably, the dial wheels are confined in a carriage, comprised in a casing 23 and end plates 24, 25, which may be supported and operated in any suitable manner. The shaft 12 passes entirely through the carriage from end to end, and at its opposite end is supported in a portion 26 of the framework.

The tens-carrying mechanism includes four wheels connecting each dial wheel with the wheel of higher denomination. These four wheels include a Geneva lock pinion 27 and a transfer pinion 28 fixed thereto, and meshing with a gear 29 on the dial wheel 19 of next higher denomination, or, in other words, the pinion 28 meshes with a gear 29 at the left of that dial wheel 19 which is engaged by the Geneva pinion 27 which is fixed to said transfer pinion 28. The transfer pinions 28 have hubs 30, whereby they are loosely mounted upon a shaft 31 mounted at its ends in the end plates 24, 25 of the computing carriage or head; and the Geneva pinions 27 may have hubs 32 surrounding and fixed to the hubs 30, as seen at Fig. 3. Each pair of pinions at Fig. 3 forms a unit, and is revoluble independently of the other units on the shaft 31.

Every other tooth on the ten-tooth Geneva pinion 27 is offset preferably by thickening the same; and by reason of being offset, two of these teeth may stand in engagement with the periphery of dial wheel 19, Fig. 8, while a thin tooth 33 between said thick teeth laps over the side of said dial wheel in position to be engaged by either of two teeth 34, forming a mutilated gear on the side of each dial wheel 19. By means of this mutilated gear the Geneva pinion is turned one-fifth of a revolution, while the dial is turning from "9" to "0", once in each revolution. Each dial wheel is cut away or recessed at some appropriate place, as 35, to form a mutilated gear to mesh with the thick or offset tooth 27 as the Geneva pinion is being driven. At the completion of each of the intermittent operations of the Geneva pinion, the latter stands in locking relation with the dial wheel, seen at Fig. 8,

and hence neither the Geneva pinion 27 nor the transfer or connecting pinion 28 can rotate.

It follows that the dial wheel gear 29, with which said transfer pinion 28 is in mesh, is also prevented from rotation. In other words, each dial wheel is locked against rotation by reason of its connection with the Geneva pinion of next lower denomination.

The gear 29, associated with each of the dial wheels 19, is not permanently fixed thereto, but is loosely mounted with reference thereto, to the end that there may be independent relative movement thereof at certain times, as will presently appear. Each of the dials, taken with its associated gear, may be regarded as forming a pair; and each of these pairs, at the left of the master wheel 10, is temporarily coupled by a series of coupling devices; and each of these coupling devices preferably consists of a hub 36 and a spoke or tooth 37, Figs. 6 and 9, loosely mounted upon master wheel shaft 12. It will be seen that each dial wheel 19 has a hub 38, while each gear 29 has a hub-portion 39 which surrounds said hub 38 and fits loosely thereon. It will also be seen that said hub 38 is formed by recessing the dial wheel; the inner and outer walls of the recess being designated as 40 and 41. The hub 39 of the gear 29 fits loosely in said recess, and the face of 29 sets up close to the side of the dial wheel. At Fig. 10, the outer periphery of the hub 39 is marked 42, and the inner periphery thereof is marked 43. The distance from 42 to 43 is the same as from 41 to 40, so that the hub 39 of the gear can fit loosely in the recess in the dial wheel. The hub 39 of the gear has ten notches 44, through which the teeth 37 on the couplers may freely pass; and it will also be understood that the notches 18 in the dial wheel are lengthened outwardly to points marked 45, Fig. 8, for the purpose of permitting the passage of the teeth 37 of the couplers.

By referring to Fig. 9, it will be seen that the teeth 37 on each coupler fit not only in the notches 18 of the dial wheels 19, but also in the notches 44 of the gears 29. In other words, the teeth 37 fit into both hubs 38 and 39 simultaneously, both hubs being notched for the purpose, and the notches in one registering with those in the other. Hence the members 19 and 29 in each pair are temporarily coupled together by the coupler 37, and each coupler is loose upon the shaft 12 and rotatable independently of the other couplers. Hence the Geneva mechanism is effective to carry tens to the wheel or wheels of higher denominations than that upon which the master wheel 10 is acting.

It will further be noticed that the tooth 11 of the master wheel is too short to enter any of the notches 44 in the gear, and hence the master wheel, when directly turning any dial wheel, cannot turn the gear with which said dial wheel is immediately associated. In fact, the last mentioned gear remains stationary during such action of the master wheel, being held against rotation by reason of its engagement with the transfer pinion 28 and consequent connection to the Geneva wheel 27, which is locked by the dial wheel 19 of next lower denomination. While all of the dial wheels to the left of the master wheel are locked, there is nothing to prevent the master wheel from turning the dial wheel with which it directly engages, and, of course, the latter may operate the tens-carrying train, and tens may be carried upon all the wheels of higher denomination concomitantly. The wheels of lower denomination than the master wheel are locked against rotation by a locking bar or key 46 fixed upon the stationary tube 21 in position to pass through the registering notches 18 in the dial wheels and 44 in the gears. Hence all of the wheels 19 and 29 are positively locked against rotation except the wheel 19 which is directly in mesh with the master wheel 10, 11, while the Geneva locks are also capable of carrying the tens from said master wheel throughout the remainder of the gang or set.

The driving gear is over-size, that is to say, the pitch diameter (coinciding with periphery 19) of the mutilated driving gear (comprising the two teeth 34) is more than twice the pitch diameter of the Geneva pinion 27, and hence less than one-tenth of a revolution of the mutilated gear is required in turning the pinion one-fifth of a revolution. In other words, less than a full stroke of the mutilated gear will give a full stroke to the pinion; the full stroke of said gear consisting of its movement through one-tenth of a revolution as the dial moves from "9" to "0."

In adding, the parts may normally stand at the Fig. 8 position, with the first tooth 34 locking a Geneva pinion tooth. The pinion tooth 33 which normally stands in the path of 34, is narrowed so as to permit the initial portion of the movement of the mutilated gear to occur while the pinion remains stationary; such movement unlocking the tooth 27, that is, bringing the notch between the teeth 34 opposite said tooth 27, as at Fig. 11. The gear then drives the pinion; the midway position of the latter being seen at Fig. 12, at which point it is traveling at accelerated speed. After the conclusion of the movement of the Geneva pinion, the driving gear completes its movement to a position to enable the last tooth 34 to lock the pinion tooth, as at Fig. 13. Hence the pinions are positively locked against accidental rotation; and tens may

be carried along a whole system of computing wheels without liability of lag of the wheels of higher denomination; and the wheel of highest denomination may in some cases complete its movement slightly before the wheel of lowest denomination completes its movement.

It will be seen that the teeth 27 on all the Geneva pinions may be made to fit quite loosely against the peripheries 19 of the several dial wheels, without liability of the lost motion being multiplied, since even if a Geneva pinion does not communicate an absolutely full stroke to the next higher mutilated gear, still the latter will be sure to communicate a full stroke to the next succeeding driving gear, because no driving gear needs to turn quite a full stroke in order to make the next higher driving gear complete a full stroke, as has been explained. In Figs. 11, 12 and 13 the teeth 27 are shown as chamfered or undercut to give a rolling contact. This is slightly modified from Fig. 8; both forms have been found useful.

In subtracting, the Geneva train starts from the Fig. 13 position and moves through the positions at Figs. 12 and 11 to the Fig. 8 position.

It will be seen that the invention is of special utility in machines in which it is necessary to carry tens or transfer along a system of computing wheels, and it is, of course, adapted to a great variety of computing machines, as well as other machines.

When the invention is applied to a counter, where the units wheel is the only means for actuating the wheels of higher denominations, the gears 29 may, of course, be fixed to the dial wheels, and the coupler omitted, as well as the master wheel 10.

As the adding head 23 moves along with the typewriter carriage toward the right at Fig. 1, the couplers 36 will be exposed and left free to turn outside of the computing head; but they are not liable to be turned very far accidentally. Means is provided for re-alining or positioning them automatically. This re-alining means is in the nature of a directrix seen at Fig. 7, which is in the form of an annular guide comb comprising a ring 47 and ten inwardly projecting radial teeth 48, which are equally spaced, and are each beveled on opposite sides at 49, so that outwardly flaring openings are presented to the coupling teeth 37 as they enter the computing head. The bevels 49 serve as directrices to bring the coupling pins 37 into alinement with the notches 18 in the computing wheels.

This directrix is fitted into the left-hand end plate 24 of the casing or frame of the computing head. As there may be occasion to slide the computing head toward the left, so that the couplers may emerge from the right-hand end of said computing head, there is also provided a similar directrix 51 in the right-hand end plate 25 of the computing head, with its guide openings flaring outwardly or in the opposite direction from those of the directrix 47.

Variations may be resorted to within the scope of the invention, and portions of the improvements may be used without others.

Having thus described my invention, I claim:

1. An intermittently moving Geneva train comprising a mutilated drive gear having provision for moving at each step one or more aliquot parts of a full revolution, and a pinion whose number of teeth is equal to the number of said aliquot parts and which is driven a double tooth-space at each operation thereon of said drive gear; the pitch diameters of said drive gear and said pinion being disproportionate, the drive gear being oversize and the pinion being undersize; certain of the teeth in said train being narrowed to permit lost motion, whereby a gear tooth may move independently of the pinion to position to lock the latter against turning.

2. An intermittently moving Geneva train comprising a mutilated drive gear having provision for turning at each movement one or more full tenths of a revolution, and a ten-tooth pinion driven a fifth of a revolution at each operation thereon of said drive gear, the pitch diameter of said pinion being substantially less than half the pitch diameter of said mutilated gear, and certain of the teeth in said train being narrowed to permit said driving gear to operate said pinion fully in substantially less than one-tenth of a revolution of said driving gear.

3. A series of connected Geneva trains, each comprising a mutilated drive-gear having provision for turning at each movement one or more full tenths of a revolution, and a ten-tooth pinion driven a fifth of a revolution at each operation thereon of said drive-gear, the pitch diameter of said pinion being substantially less than half the pitch diameter of said mutilated gear, said trains connected by pinions and gears mounted in couples, the connecting gears fixed to their respective mutilated gears, and the connecting pinions fixed to their respective Geneva pinions; the pitch diameter of each connecting pinion being half that of the gear to which it is coupled.

4. A series of connected Geneva trains, each comprising a mutilated drive gear having provision for turning at each movement one or more full tenths of a revolution, and a ten-tooth pinion driven a fifth of a revolution at each operation thereon of said drive gear, the pitch diameter of said pinion being substantially less than half the pitch diameter of said mutilated gear, and certain of

the teeth in said train being sufficiently narrowed to permit said driving gear to operate said pinion fully in substantially less than one tenth of a revolution of said driving gear; said trains connected by pinions and gears mounted in couples, the connecting gears fixed to their respective mutilated gears, and the connecting pinions fixed to their respective Geneva pinions; the pitch diameter of each connecting pinion being half that of the gear to which it is coupled.

5. The combination with a system of dial wheels, of Geneva carry-over trains, each Geneva train comprising means for accelerating the movement of its pinion, so that less than a full movement of the driver communicates a full movement to the computing wheel of next higher denomination, certain teeth in each Geneva pinion being narrowed to permit a substantially lost motion of the driving gear.

6. The combination with a system of dial wheels, of Geneva carry-over trains, each Geneva train comprising means for accelerating the movement of its pinion, so that less than a full movement of the driver communicates a full movement to the computing wheel of next higher denomination, certain teeth in each Geneva pinion being narrowed to permit a substantially lost motion of the driving gear, and provision being made enabling the teeth of the driving gear to lock the pinion of the Geneva train.

7. The combination with a system of dial wheels, of Geneva carry-over trains, each Geneva train comprising means for accelerating the movement of its pinion, so that less than a full movement of the driver communicates a full movement to the computing wheel of next higher denomination, certain teeth in each Geneva pinion being narrowed to permit a substantially lost motion of the driving gear, and provision being made enabling the teeth of the driving gear to lock the pinion of the Geneva train at both the beginning and the end of the stroke of the driver.

8. The combination of a gang of computing wheels having hubs formed with internal teeth or notches, a series of loose gears having internal teeth or notches to register with those in said hubs, an internal master wheel or device having a tooth to engage the notches in the computing wheel hubs, but incapable of engaging the notches in the gears, couplers each having a notch-engaging tooth to couple a computing wheel to its associated gear, provision being made for relative movement in axial direction between the gang of computing wheels and both the master wheel and the couplers, said gang and said master wheel being relatively movable to positions where said coupling teeth are free from the computing wheels, and a directrix to guide said coupling teeth back again into mesh with said computing wheels.

9. The combination of a gang of computing wheels having hubs formed with internal teeth or notches, a series of loose gears having internal teeth or notches to register with those in said hubs, an internal master wheel or device having a tooth to engage the notches in the computing wheel hubs, but incapable of engaging the notches in the gears, couplers each having a notch-engaging tooth to couple a computing wheel to its associated gear, provision being made for relative movement in axial direction between the gang of computing wheels and both the master wheel and the couplers, said gang and said master wheel being relatively movable to positions where said coupling teeth are free from the computing wheels, and a directrix in the form of an annular comb having inwardly projecting teeth beveled on their outer sides to present flaring openings to the coupling teeth, to guide them into mesh with the computing wheels.

10. The combination of a computing head, a gang of computing wheels therein and having hubs formed with internal teeth or notches, a series of loose gears having internal teeth or notches to register with those in said hubs, an internal master wheel having a tooth to engage the notches in the computing wheel hubs, but incapable of engaging the notches in the gears, couplers each having a notch-engaging tooth to couple a computing wheel to its associated gear, provision being made for relative movement in axial direction between the gang of computing wheels and both the master wheel and the couplers, said gang and said master wheel being relatively movable to positions where said coupling teeth are free from the computing heads, and opposite directrices at the ends of said computing head, to guide said coupling teeth into mesh with said computing wheels.

11. In a computing machine, the combination with a computing wheel carrying a gear tooth, of a wheel associated therewith carrying a tooth coöperating with said first tooth, and arranged to be advanced by said first tooth more slowly than the pitch ratios of the computing wheel and associated wheel would indicate and then more rapidly than such ratios indicate.

12. In a computing machine, the combination with a computing wheel carrying a gear tooth, of a wheel associated therewith carrying a flat sided tooth which contacts with said first tooth near its base whereby it is moved more slowly than the pitch ratio of the wheels indicate, and later the base of the second tooth is driven by the end of the first tooth so that it moves more rapidly than the pitch ratio indicates.

13. In a computing machine, the combina-

tion with a computing wheel carrying two gear teeth, of a carry-over wheel driven thereby comprising alternate flat sided and cut away teeth, said flat sided teeth arranged to be driven by the teeth on said computing wheel first at the tip so as to turn the carry-over wheel relatively slowly and then at the base so as to turn said carry-over wheel rapidly, said cut away teeth tending to feed said carry-over wheel more nearly at a normal speed.

14. In a computing machine, the combination with a series of computing wheels, of a coöperating series of carry-over wheels, the whole forming a computing train, two teeth on each of said computing wheels (save one), alternating flat sided and cut away teeth on said carry-over wheels set apart and providing lost motion for said computing wheel teeth, said flat sided teeth arranged to be struck first at the top and then at the bottom to cause an accelerating movement of wheels, and said cutaway teeth driven nearly normally by said computing wheel teeth, and cam surfaces on the computing wheels beyond their teeth forming with the cut-away teeth Geneva locks which become operative only after said lost motion is taken up by overthrow.

15. The combination with a wheel having teeth thereon, of a gear adjacent said wheel having teeth thereon, and a second wheel having teeth thereon struck from a pitch circle below size and also teeth thereon struck from a pitch circle of proper size, said sets of second wheel teeth meshing respectively with the first-mentioned teeth of the wheel and gear.

16. The combination with a wheel adapted to move in aliquot units of a revolution, of a mutilated peripheral surface on said wheel forming one member of a Geneva lock, a second wheel having teeth coöperating with the uninterrupted portions of said surface to be locked by said first wheel, a tooth on said first wheel, a tooth on said second wheel adapted to be driven by said first wheel tooth, the arrangement of said teeth being that said second wheel is unlocked, turned and re-locked by said first wheel during less than one of said aliquot portions of the revolution of said first wheel, and a wheel driven by said second wheel and turned an aliquot portion of a revolution at each operation of said second wheel.

17. The combination with a wheel moving in aliquot units of a revolution, of an unbroken peripheral arc on said wheel, a tooth on said wheel at the end of said peripheral arc, a second wheel having teeth thereon to coöperate with said peripheral arc, whereby said wheel is locked, a tooth on said second wheel adapted to be struck by the tooth on said first wheel, the unbroken surface on said first wheel holding said second wheel locked during part of every one of said aliquot movements, said unbroken surface cut away so as to release said second wheel to be revolved in an aliquot portion of its revolution, and an unbroken surface on said first wheel adapted to lock said second wheel again in said same aliquot movement of the first wheel so that less than an aliquot movement of the first wheel gives a complete aliquot movement to said second wheel, and a third wheel meshing with said second wheel so that any aliquot movement of said second wheel gives a complete aliquot movement to said third wheel.

18. In a computing machine, the combination with a numeral wheel adapted to be moved in aliquot portions of a revolution, of a second wheel coöperating therewith to form a Geneva lock, and means for completely unlocking, operating and locking said Geneva lock wheel in considerably less than one of said aliquot portions of a revolution.

19. In a computing machine, the combination with a computing wheel adapted to be moved in aliquot portions of a revolution, of a series of similar computing wheels, a carry-over wheel forming a Geneva lock with said first computing wheel, a gear on said carry-over wheel positively engaging the adjacent computing wheel for turning said computing wheel, and teeth on said Geneva lock wheel driven by said first computing wheel so as to completely operate said carry-over wheel in considerably less than the aliquot movement necessary to bring one value on said computing wheel to position where the adjoining value was, so that the computing wheel turned by said carry-over wheel will be turned thereby to an aliquot portion of a revolution before said first-named computing wheel completes its turning through a similar aliquot portion of a revolution.

20. The combination with a wheel adapted to be moved in aliquot portions of a revolution, of a wheel coöperating with said wheel to be turned thereby intermittently and forming a Geneva lock therewith, said coöperating wheel completely given one of its intermittent motions during less than one of said aliquot movements of said first-named wheel so that said coöperating wheel is locked at the beginning of one of said aliquot movements, is completely locked before the end of said aliquot movement, and is turned between the intervals in which it is locked.

21. The combination with a wheel adapted to be moved in aliquot portions of a revolution, of a peripheral surface on said wheel, a tooth adjacent to the end of said peripheral surface, a coöperating wheel having teeth bearing on said peripheral surface and adapted to enter a niche in said peripheral surface, another tooth on said

second wheel, the space between said locking teeth and said other tooth being considerably greater than the width of the tooth on said first wheel so that said first wheel first completely unlocks, then moves idly, then turns, then moves idly, and then locks said second wheel, all of said movements of said first wheel being completed in considerably less than one of said aliquot movements.

22. In a computing machine, the combination with a computing wheel, of a smooth peripheral surface on said wheel, a carry-over wheel having teeth riding on said smooth peripheral surface, a gear on the adjacent computing wheel higher in denomination, a gear on said computing wheel meshing with said higher denomination gear, means for coupling one of said gears to the wheel to which it belongs, a tooth fast on the portion of said carry-over wheel having said locking teeth adapted to ride in a niche in said smooth surface on the computing wheel, a tooth on said computing wheel extending from said niche so as to intercept said carry-over wheel tooth once in a revolution but after said computing wheel has made a considerable portion of its aliquot movement from one numeral to the next, and a smooth surface on said computing wheel arranged to engage another tooth on said carry-over wheel considerably before said aliquot movement is completed, but considerably after the turning by said carry-over wheel tooth has been completed.

23. In a computing machine, the combination with wheels and members adapted to be coupled thereto, of a shaft extending through said wheels, couplers each comprising a spoke riding on said shaft, and a beveled directrix outside of the computing wheel arranged to coöperate with each of said spokes and turn said couplers to aline with internal teeth on said wheel.

24. In a computing machine, the combination with a gang of computing wheels and gears therefor, of carry-over wheels, gears therefor meshing with said computing wheel gears, couplers for causing each gear to travel as a unit with its associated wheel in one of said sets of wheels, a spoke on each coupler, internal teeth on the wheels and gears to coöperate with said coupler, a master-wheel engaging said computing wheels *seriatim* to turn them, said couplers being stationary with reference to the plane of the master-wheel, and a directrix having a beveled face alined beyond the last computing wheel to coöperate with the spoke on each coupler to positively aline each coupler with said last computing wheel as it engages therewith during the *seriatim* movement.

25. In a computing machine, the combination with a gang of computing wheels and couplers therefor, relative to which said computing wheels slide, of a directrix at each end of said gang for positively alining said couplers with the outside computing wheel.

26. The combination with a system of dial wheels, of Geneva lock carry-over wheels connecting said dial wheels, teeth on said Geneva lock wheels and said dial wheels adapted to allow lost motion, and teeth on said two kinds of wheels so related to each other that the lost motion is not multiplied from one wheel to the next.

27. In a computing machine, the combination with computing wheels, of carry-over devices for driving each wheel solely by the wheel below, clearances between said wheels and said devices permitting sufficient lost motion to allow the parts to work freely and easily, teeth on said computing wheels and said carry-over devices, whereby the computing wheels drive each other through said devices, and members on which said teeth are formed holding said teeth in such relation to the centers of curvature from which said teeth are struck that an acceleration of motion from wheel to wheel is produced of such an amount as to be substantially equal to the lost motion throughout the entire string of computing wheels.

WALTER WRIGHT.

Witnesses:
B. GOLDBERG,
K. FRANKFORT.