June 11, 1935. O. J. SUNDSTRAND 2,004,495

TRANSFER MECHANISM

Original Filed Oct. 25, 1923 2 Sheets-Sheet 1

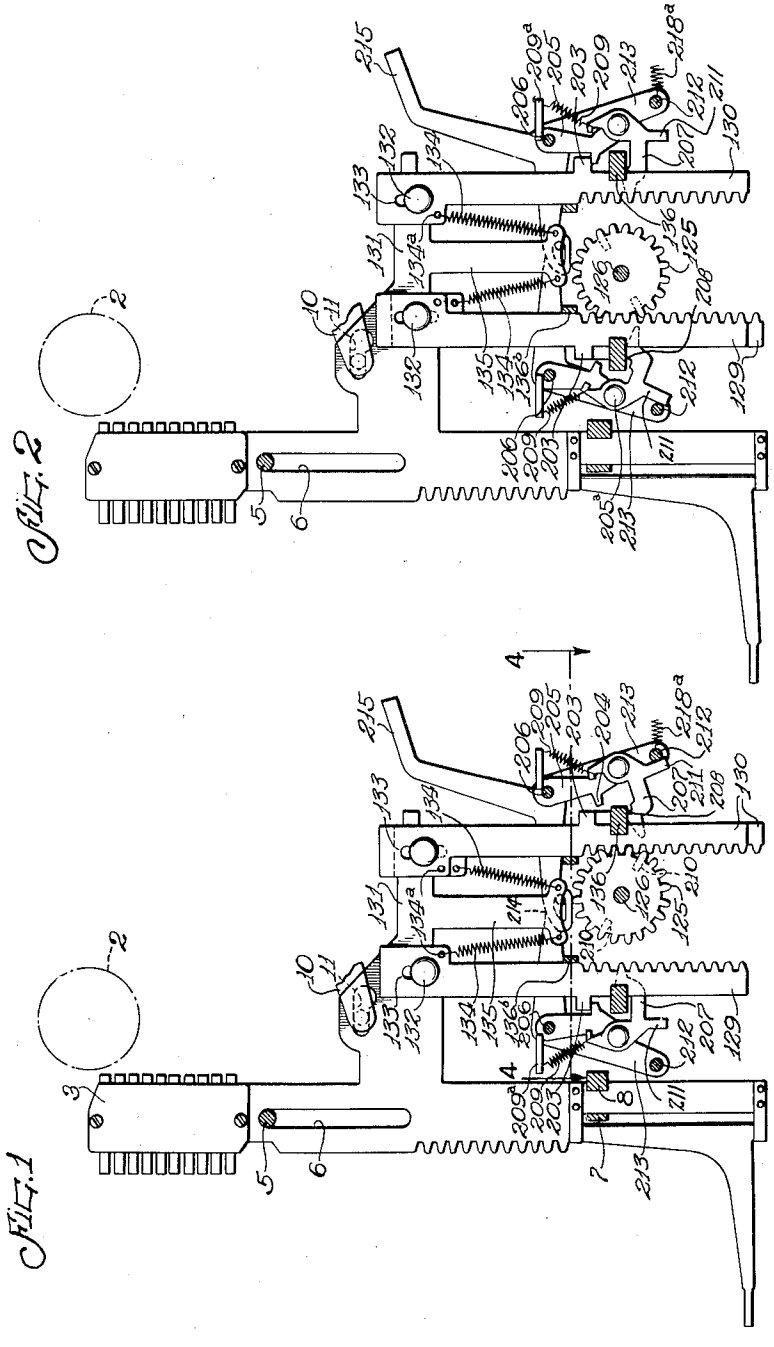


Fig. 1

Fig. 2

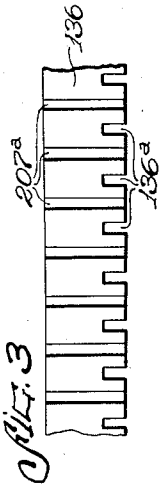


Fig. 3

Inventor
O. J. Sundstrand
By Churchill Parker & Carlson
Attorneys

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Fig. 4

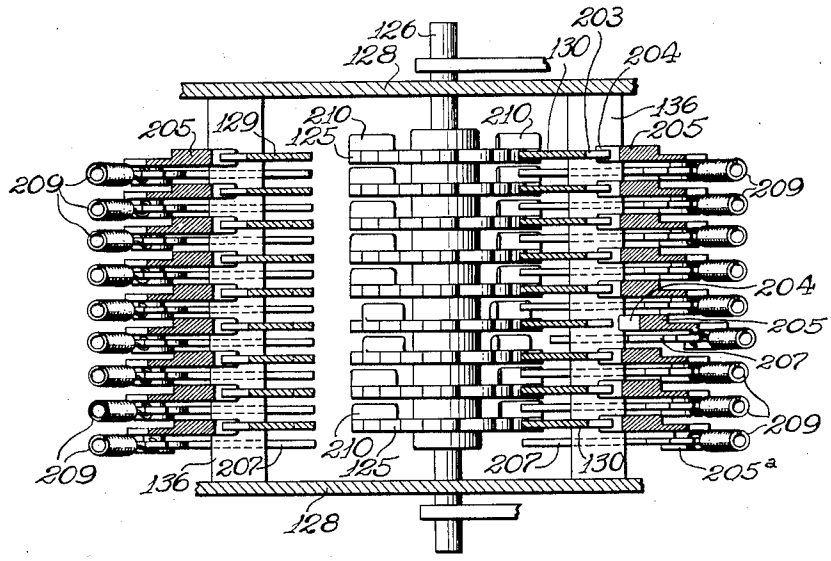
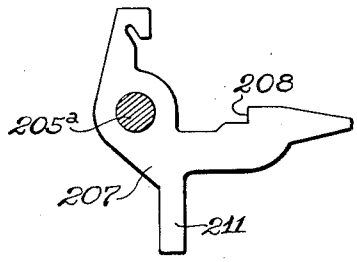


Fig. 5



Inventor
O. J. Sundstrand
By Churchill Parker & Carlson
Attorneys

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UNITED STATES PATENT OFFICE

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TRANSFER MECHANISM

Oscar J. Sundstrand, Rockford, Ill., assignor, by mesne assignments, to Underwood Elliott Fisher Company, New York, N. Y., a corporation of Delaware

Original application October 25, 1923, Serial No. 670,665. Divided and this application May 6, 1933, Serial No. 669,633

10 Claims. (Cl. 235—137)

This invention relates to mechanism for transferring from one numerical order to another, as, for instance, in carrying from the units order to the tens order in decimal computing machines, and in carrying from the farthings order to the pence order in a computing mechanism operating upon the non-decimal system used in English currency.

Among the salient objects of the invention are to provide a mechanism which shall be operable with a minimum amount of power and with maximum speed, which shall not require extreme accuracy of manufacture, which shall not be liable to casual misoperation, which may be easily assembled, and which is thoroughly reliable and accurate.

This application is filed in compliance with an official requirement of division of my application Serial No. 670,665, filed October 25, 1923 now Patent Number 1,965,611.

While my application Serial No. 670,665 discloses a direct subtraction mechanism operating upon the decimal system, it should be understood that the present invention is not limited to direct subtraction mechanism, nor to computing mechanism operating upon the decimal basis.

In the accompanying drawings,

Figure 1 is a fragmental right-hand elevation illustrating the computing mechanism at the end of an addition cycle in which carrying occurred.

Fig. 2 is a similar view to show the parts at the end of a subtraction cycle in which carrying has occurred.

Fig. 3 is a fragmental underside view of a carrier cross bar.

Fig. 4 is a horizontal section on line 4—4 of Fig. 1.

Fig. 5 is a detail view of a dog comprised in the mechanism.

While the invention is herein disclosed as embodied in a machine of the Sundstrand type, it will be understood that the present invention is not limited to use in machines of that character.

The numeral 2 denotes a platen which, while herein shown as cylindrical, may be of other forms. 3 are vertically reciprocatory slides or type bars, one such bar being provided for each numerical order. The bars are arranged compactly side by side and are guided near their upper ends by means of a transverse rod 5 fixed in the framework of the machine, said rod extending through vertically elongated openings 6 in the type bars. The lower ends of the type bars are located between and guided by two transverse fixed bars 7 and 8, the latter being slotted to receive the rear edges of the type bars.

The means herein shown for vertically moving each type bar 3 into and out of printing position comprises an arm 10 carrying a headed stud that lies in an elongated opening 11 in the type bar.

The computing mechanism comprises a series of pinions 125 rotatably mounted upon a transverse shaft 126. The shaft 126 is supported for sliding movement longitudinally of the machine in guide plates 128 (Fig. 4) which form part of the stationary framework of the machine. The set of pinions 125 (of which there is one for each type bar 3) is located between two sets of racks or actuators 129 and 130. A rack 129 and a rack 130 are connected to each type bar 3 in the manner to be presently described, and the set of pinions 125 is arranged to be moved into mesh with either set of racks.

Addition is accomplished by means of the set of racks 130. When an item is to be added, the pinions are moved forward into neutral position between the two sets of racks before the type bars 3 are raised, and are moved rearwardly into mesh with the racks 130 just before the bars 3 are moved downwardly. Addition therefore occurs in the down stroke of the racks 130, the extent of rotation of the pinions depending, of course, upon the extent of movement of the racks.

Subtraction is effected by means of the set of racks 129, the pinions being moved into mesh with said racks just before the latter descend. Subtraction thus takes place in the down stroke of the racks.

The upper end of each rack is attached to a rearwardly extending portion 131 of one of the type bars 3 by means of a headed pin or stud 132 extending through a vertically elongated opening 133 in the rack. A contractile spring 134 attached at its upper end to the rack at 134a and at the lower end to a downwardly-extending portion 135 of the type bar tends to move the rack downwardly with relation to the type bar one tooth space for transfer purposes. The backs of the racks slide in grooves 136a (Fig. 3) in stationary guide bars 136. The part 134a of the rack being virtually a short lever arm, the spring 134 tends to turn the rack on the stud 132 as a pivot, and thus serves to hold the rack in place in its guide groove 136a. However, in order to prevent the rack from being pulled out of place in case the pinion teeth should stick thereto when the pinion is being moved to central position between the sets of

racks, I provide a rod 136b fixed in the framework and extending adjacent to and transversely of the racks. Normally, there is clearance between the racks and said rods 136b.

The guide bars 136 are located directly opposite the point of tangency of the racks to the pinions, and hence serve effectively to guide the racks. Even if the racks were slightly bent or bowed, or if there were a tendency to move in a non-rectilinear path, they would be compelled to reciprocate in proper relation to the pinions.

Referring now to the transfer mechanism: There is a set of transfer devices for the racks 130 to carry amounts from one numerical order to the next higher order in operations involving addition, and a set of transfer devices for the racks 129 to carry amounts from one numerical order to the next higher order in operations involving subtraction. The extent of downward movement of the racks is limited (except in the transfer operation) by contact of the lugs 203 on the racks with stop lugs 204. When an amount is to be transferred from one order to the next higher order, the stop lug 204 for the rack belonging to such higher order is withdrawn, thereby allowing that rack to descend under the action of its spring 134 until its lug 203 stops against the bar 136 as indicated in the right-hand portion of Fig. 1 and the left-hand portion of Fig. 2. The extent of such further descent of the rack is just sufficient to turn the pinion for that rack through the distance of one tooth. Each stop lug 204 is formed on a pawl 205 which is suspended from a pivot 206 in the framework of the machine, said pivot being above the pinions 125. To the lower end of each pawl 205 is pivoted at 205a a dog 207 having a tooth 208 adapted to engage the edge of the adjacent bar 136. The dog 207 lies within a groove 207a (Fig. 3) in the bar 136. A contractile spring 209 normally holds the tooth 208 in engagement with the bar 136, the stop lug 204 being then in position to support the corresponding rack. The springs 209 are anchored to a stationary part 209a.

The means for disengaging the tooth 208 from the bar 136 consists of two diametrically opposite lugs 210 fixed to each pinion. (Two lugs 210 are provided because each pinion has twenty teeth.) When the amount registered by a pinion reaches "9", continued rotation of the pinion as the rack descends brings one of the lugs 210 against the end of the dog 207 associated with the next higher rack, thereby depressing the dog until the tooth 208 is clear of the bar 136, whereupon the spring 209 (assisted by the downward pressure of the rack) pulls the dog and the pawl 205 away from the last mentioned rack until a lug 211 on the dog stops against a restoring rod 212. The lug 204 is then out of the path of said rack of next higher order, and the latter therefore moves down one tooth space under the influence of its spring 134, the rack being stopped by the bar 136.

In Fig. 4 the hundreds pinion has tripped the dog 207 which is pivoted to the pawl 205 that normally supports the thousands rack, whereupon the spring 209 connected to said dog has withdrawn said pawl, thus allowing the thousands rack to descend one tooth-space. The amount accumulated on the pinions is now 000001100.

In the next cycle of operations of the machine the pawl 205 and the dog 207 are restored to their normal position by the rod 212, there being one such restoring rod for each of the sets of transfer mechanism. Each rod 212 is carried by two bell crank levers 213 which are pivoted in the framework of the machine at 206. The bell crank levers at each side of the machine are connected for simultaneous swinging movement by a pin and slot connection, as shown at 214. The restoring rods 212 are simultaneously moved toward and away from each other by means of two arms 215 each formed integral with one of the bell crank levers 213, said arms 215 being operated as fully explained in said application Serial No. 670,665. In the operation of the machine the arms 215 are depressed, thereby causing the rods 212 to move toward each other to restore any transfer devices that may have operated in the last preceding cycle. A contractile spring 218a returns the rods 212 to the normal position shown in Figs. 1 and 2. Such normal position is determined by contact of the bell crank levers 213 with the stop rods 136b.

It will be seen that the restoring rod engages the dog below its pivot 205a and thus assists to force the inner end of the dog up into engagement with the inner edge of the bar 136, where the dog is normally held by the spring 209.

When the type bars are raised for a printing operation, the racks do not begin to rise until the studs 132 engage the upper ends of the elongated openings 133. Those racks, however, which have descended below the normal position, in order to effect a transfer, rise practically simultaneously with the type bars, and thus are lifted before the stop lugs 204 are restored to normal position by the rod 212. So, also, the movement imparted to the type bars during the enforced blank or spacing stroke is sufficient to raise the lugs 203 to permit the placing of the stop lugs 204 thereunder.

It may be here stated that when any pinion stands at zero, one of the lugs 210 on said pinion lies directly beneath one of the dogs 207 associated with the set of racks 130 if the amount accumulated is a debit or positive amount, or directly beneath one of the dogs 207 associated with the group of racks 129 if the amount accumulated be a credit or negative amount. Therefore, when a total is to be printed, those racks which mesh with the pinions standing at zero cannot rise, the remaining racks rising until the rotation of their pinions brings the lugs 210 thereon into contact with the respective dogs 207. The type bars 3 are then in position to print the total amount accumulated on the pinions.

In operation, the tooth 208 of the dog 207 is disengaged from the bar 136 by pressure of the lug 210 against the upper side of the end of the dog. The axis 126 of the pinion, the end of the dog, and the pivot 205a of the dog are in the same plane, hence the pressure of the lug 210 against the end of the dog is directly exerted to produce pivotal movement of the dog. There is practically no sliding or camming action of the lug 210 against the dog, but on the contrary the downward movement of the lug produces downward movement of the end of the dog 207.

The construction herein shown may be viewed as an improvement upon the construction disclosed in the Sundstrand Patent No. 1,198,487, issued September 19, 1916. That patent dis-

closes a rack which is a part of or is rigidly attached to the type bar. A lug 157 on the combined rack and type bar normally rests upon the lug 158 of the transfer slide 159. The lug 157 is pressed against the lug 158 through the action of the springs 35c which hold the type bars in their normal position. These springs are necessarily of considerable strength, hence the lugs 157 are pressed against the lugs 158 with relatively great force. Consequently, the springs 163 that draw the slides 159 rearwardly must be relatively strong. As a result, the teeth 161 on the transfer dogs 160 are normally held against the edge of the plate 162 with relatively great pressure. The transfer lugs 164 on the adding pinions must therefore exert considerable pressure against the ends of the dogs 160 in order to disengage the teeth 161 from the plate 162.

In the construction herein disclosed, the racks are formed separately from the type bars and are held in their normal position by means other than the means utilized to hold the type bars in their normal position. Since the racks are formed separate from the type bars, the pressure of the lugs 203 against the lugs 204 is only that due to the action of the springs 134, which springs may be made relatively light. Consequently, the power required to withdraw the lugs 204 from beneath the lugs 203 is almost negligible. The springs 209 may therefore be made only sufficiently strong to hold the teeth 208 normally in engagement with the bar 136 and therefore but little power need be exerted through the transfer lugs 210 against the ends of the dogs 207 to cause operation of the transfer mechanism.

Referring to the left-hand portion of Fig. 1, it will be noted that the pivot 206 of the dog 205 is located forwardly of and above the lugs 203 and 204; consequently, when the dog 207 is disengaged from the bar 136, the downward pressure of the lug 203 tends to cause the pawl 205 to swing forwardly so as to carry the lug 204 out from under the lug 203.

In the present construction, the bar 136 serves several important functions. It forms a substantial and positive stop to limit transfer movement of the rack when the pawl 205 slips out from under the lug 203. In addition to providing guide grooves 136a for the racks and guide grooves 207a for the transfer dog 207 the inner vertical face of the bar 136 serves as the abutment which is engaged by the tooth 208. Thus it will be seen that the points at which the rack and the transfer dog are guided are very close together and close to the point where the transfer lug 210 exerts its force, and that there is no liability of the parts springing or bending out of place.

It will be seen that the bar 136 which limits the downward movement of the rack in a transfer operation is also the part that guides and is engaged by the transfer dog 207 and that it is located close to the point at which the transfer lug on the pinion operates on the transfer dog. This is a decided improvement over the construction shown in the before-mentioned Sundstrand Patent No. 1,198,487, where the parts 4 and 5 which limit the downward movement of the rack in transfer operations is separate from the transfer mechanism, the construction being thus subject to the variations which are practically inevitable in machining and assembling operations and those due to wear.

As hereinbefore stated, the restoring rod 212 of the present construction assists to force the dog into engagement with the bar 136, whereas in the construction shown in the prior Sundstrand patent the restoring rod 165 does not assist in swinging the dog 160 into engagement with the plate 162.

I claim as my invention:

1. In a transfer mechanism, a spring-actuated rack having a lug thereon, a pivoted pawl adapted to support said lug against the pressure produced by the rack, said pawl being so pivoted with relation to the point of application of the pressure of the rack as to tend to swing out of supporting relation to the rack, a dog pivoted on said pawl and having a tooth, a part against which said tooth is adapted to engage, a pinion carrying a projection arranged to disengage said tooth from said part, and a spring attached to said dog and serving to draw the dog rearwardly and assisting to swing the pawl out from under said lug when said tooth is disengaged from said part.

2. In a transfer mechanism, a rack having a lug thereon, a pivoted pawl adapted to support said lug, said pawl being so pivoted with relation to said lug as to tend to swing out of supporting relation to the rack, a dog pivoted on said pawl, a part normally engaged by the dog, a pinion carrying a projection arranged to disengage the dog from said part, and a spring attached to said dog and serving to draw the dog away from said part and swing the pawl out from under said lug when the dog is disengaged from said part.

3. In a transfer mechanism, a rack tending to move, a member adapted to restrain said rack, a dog pivoted on said member and having a tooth, a part against which said tooth is adapted to engage, a pinion carrying a projection arranged to disengage said tooth from said part, and a spring attached to said dog and serving to draw the dog away from said part when said tooth is disengaged from said part, whereupon said member becomes disengaged from the rack, said part then serving to limit movement of the rack.

4. In a transfer mechanism, an actuator tending to move, a member adapted to restrain said actuator, a dog pivoted on said member, a stationary part normally engaged by the dog, a pinion carrying a projection arranged to engage one end of the dog to disengage the dog from said part, and spring means serving to withdraw the dog from said part when the dog is disengaged from said part, whereupon said member becomes disengaged from said actuator, said stationary part then serving to limit movement of the actuator, the axis of the pinion, said end of the dog and the pivot of the dog being normally in approximately the same plane.

5. In a transfer mechanism, the combination of a rack, a bar having a guide groove for the rack, means including a dog for holding the rack in normal position, said bar having a guide groove for the dog, and a pinion arranged to disengage the dog from the bar and thus release the rack, said bar serving to limit movement of the rack when the latter is released.

6. In a transfer mechanism, the combination of a rack, a bar having a guide groove for the rack, means including a dog for holding the rack in normal position, said bar having a guide

groove for the dog, and a pinion arranged to disengage the dog from the bar and thus release the rack, said bar serving to limit movement of the rack when the latter is released, said bar being located directly opposite the point of tangency of the rack and the pinion.

7. In a transfer mechanism, the combination of a rack, a bar having a guide groove for the rack, means for holding the rack in normal position, and a pinion arranged to disable the holding means and thus release the rack, said bar serving to limit movement of the rack when the latter is released, said bar being located directly opposite the point of tangency of the rack and the pinion.

8. In a transfer mechanism the combination of a rack, a bar having a guide groove for the rack, means including a pivoted dog for holding the rack in normal position, said bar having a guide groove for said dog, a rotatable pinion journaled on an axis which, in conjunction with the pivoted axis of said dog, defines a plane substantially normal to the plane of said rack, said pinion being arranged to contact said dog substantially in the before-mentioned plane to disengage the latter from the bar and thus release the rack, and said bar serving to limit movement of the rack when the latter is released.

9. In a transfer mechanism the combination of a rack, a bar to guide the rack, a pawl pivotally mounted above the bar and arranged to support the rack in normal position, a pinion rotatably mounted in juxtaposition to said rack, a dog pivoted on said pawl substantially in the plane defined by said bar and the pivotal axis of said pinion, said dog being arranged to engage said bar to maintain said pawl in rack supporting position, and a lug on said pinion arranged to contact said dog substantially in the before-mentioned plane to disengage said dog from said bar and thus release the rack, said bar serving to limit movement of the rack when the latter is released.

10. In a transfer mechanism the combination of a rack, a bar to guide the rack, a pawl pivotally supported above the bar and arranged to hold the rack in normal position, a rotatable pinion, a dog pivoted on said pawl substantially in the plane defined by said bar and the axis of said pinion, said dog being adapted to engage said bar to maintain said pawl in rack supporting position, said pinion being effective to contact said dog substantially in the before-mentioned plane to disengage said dog from said bar and thus release the rack.

OSCAR J. SUNDSTRAND.