Jan. 5, 1926. 1,568,800

C. C. COSS

COMPUTING OR MULTIPLYING MACHINE

Filed August 6, 1924 5 Sheets-Sheet 1

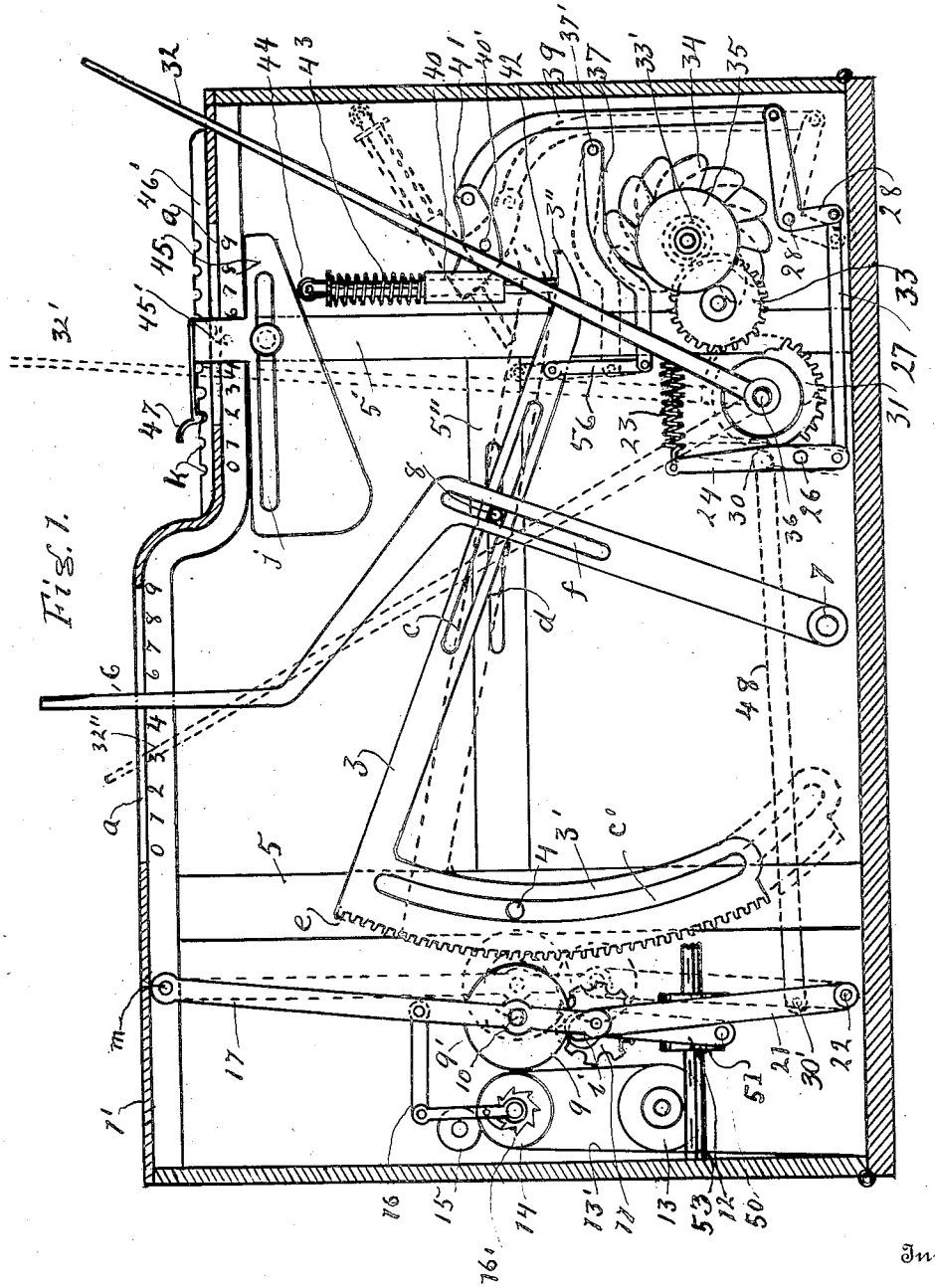


Fig. 1.

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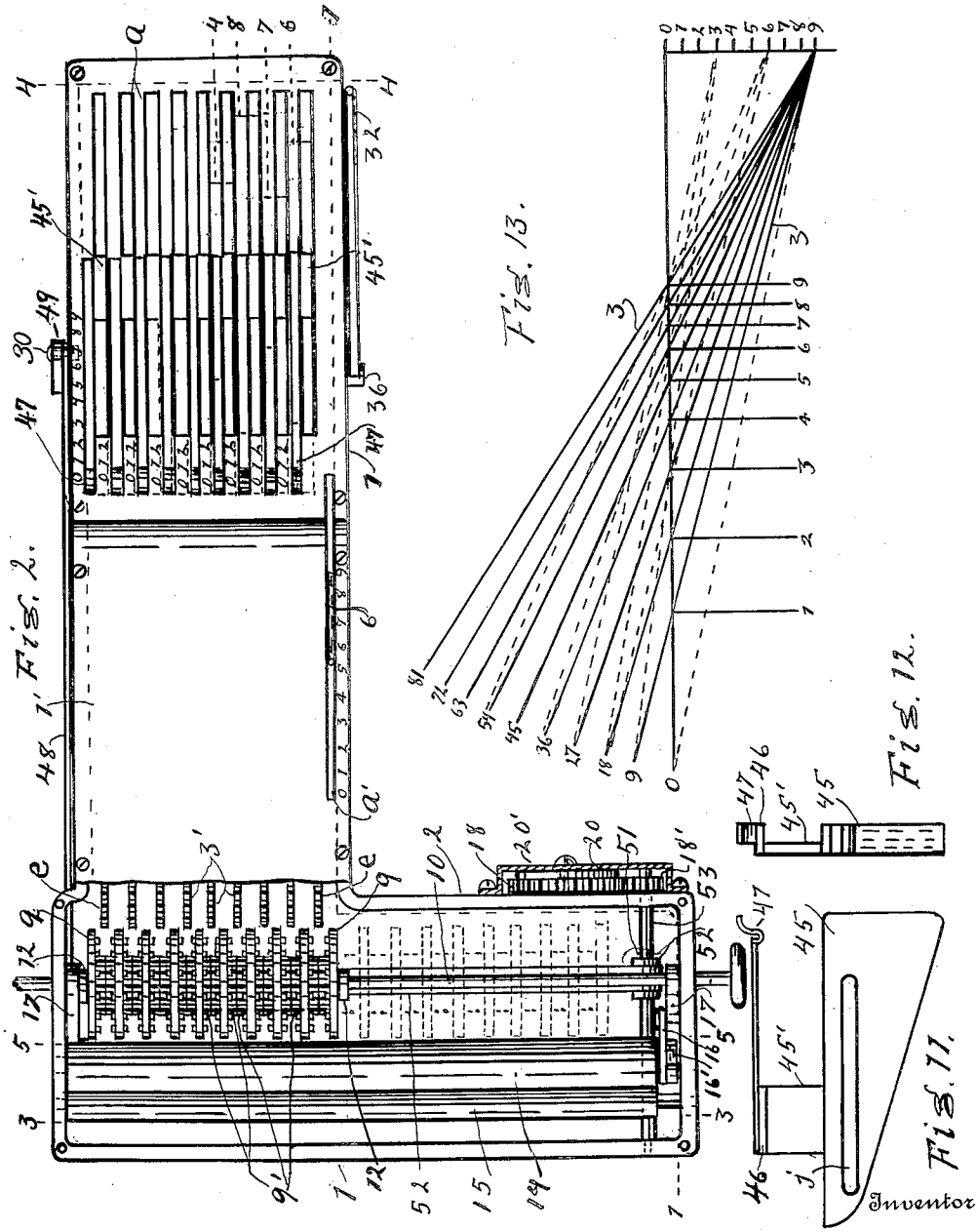


Fig. 2.

Fig. 13.

Fig. 12.

Fig. 11.

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COMPUTING OR MULTIPLYING MACHINE

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Fig. 1.

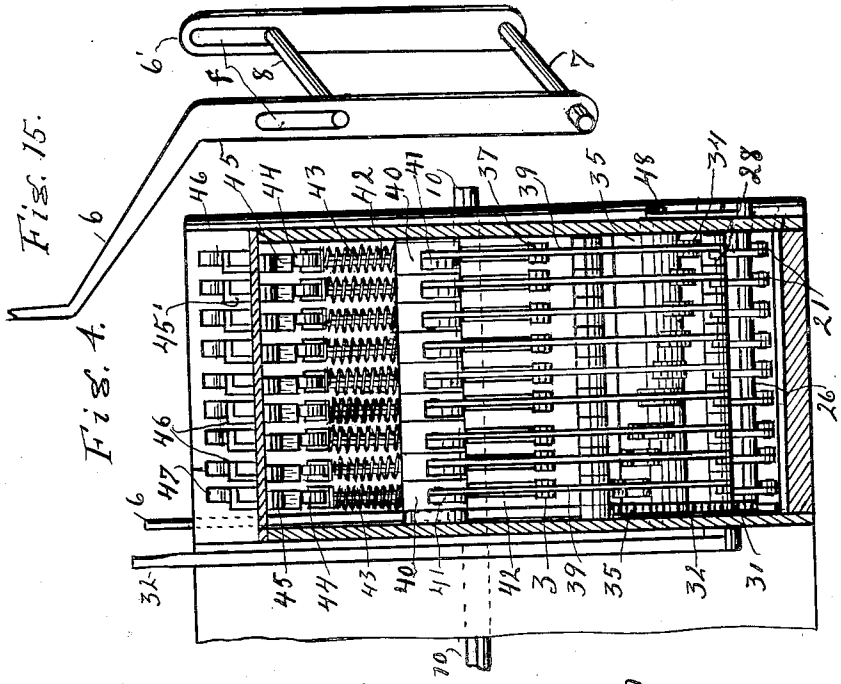
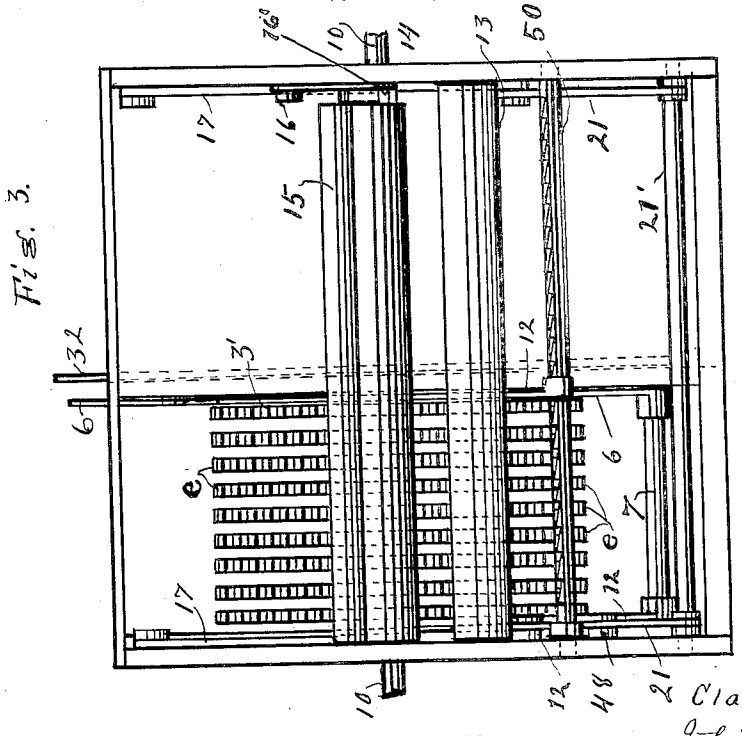


Fig. 4.

Fig. 3.



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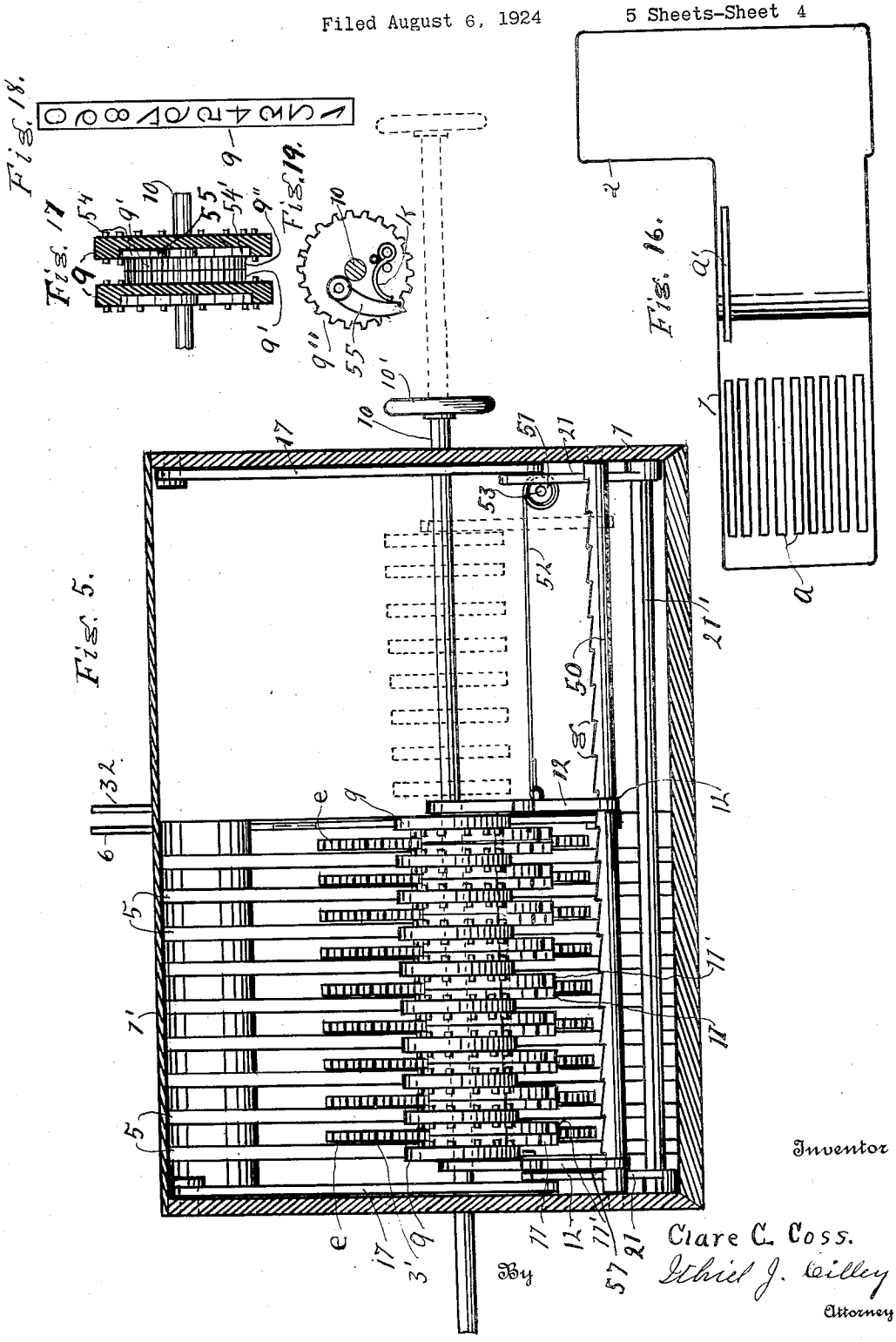
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COMPUTING OR MULTIPLYING MACHINE

Filed August 6, 1924 5 Sheets-Sheet 4



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COMPUTING OR MULTIPLYING MACHINE

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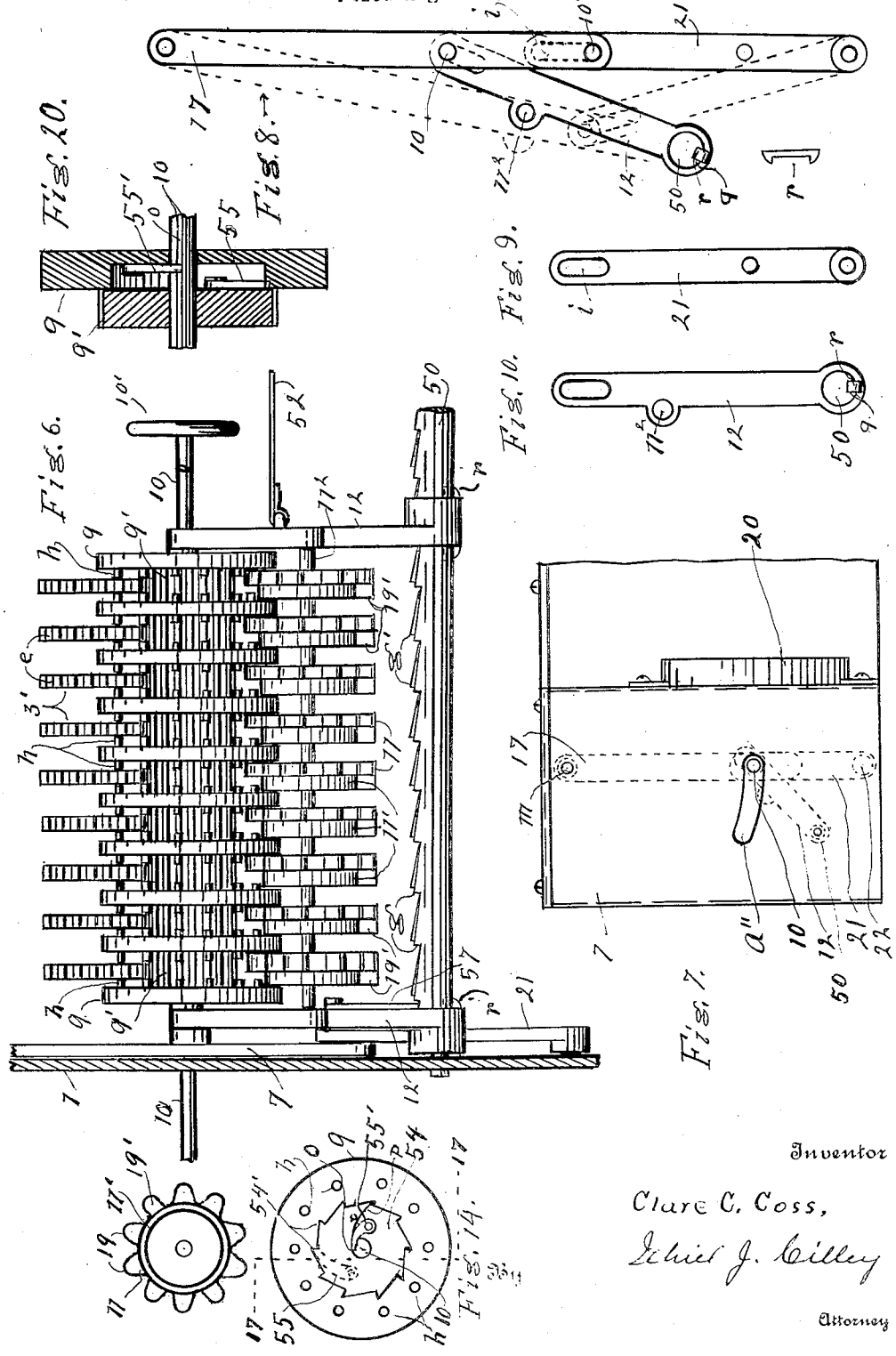


Fig. 10.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 6.

Fig. 7.

Fig. 14.

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Patented Jan. 5, 1926. 1,568,800

UNITED STATES PATENT OFFICE.

CLARE C. COSS, OF GRAND RAPIDS, MICHIGAN, ASSIGNOR OF ONE-HALF TO HOWARD R. JAMES, OF LAKE CITY, MICHIGAN.

COMPUTING OR MULTIPLYING MACHINE.

Application filed August 6, 1924. Serial No. 730,514.

To all whom it may concern:

Be it known that I, CLARE C. COSS, a citizen of the United States, residing at Grand Rapids, in the county of Kent and State of Michigan, have invented certain new and useful Improvements in Computing or Multiplying Machines, of which the following is a specification.

My invention relates to improvements in computing machines, and it has for its object the multiplying of one number, or series of numbers by another number or series of numbers and recording the proper product of said multiplication.

I attain this object by the mechanism and operation of parts shown and indicated in the accompanying drawings, in which Fig. 1 is a sectional side elevation of my machine taken upon the line 1—1 of Fig. 2. Fig. 2 is a plan of my machine with the front end of the cover removed to show the relative positions of the several operating elements of the machine. Fig. 3 is a sectional front elevation of the machine looking to the right from the line 3—3 of Fig. 2. Fig. 4 is a sectional elevation of the back end of the machine looking to the left from the line 4—4 of Fig. 2. Fig. 5 is a sectional elevation of the machine looking to the right from the line 5—5 of Fig. 2. Fig. 6 is a front elevation of the recording discs in the machine, and of their several operative parts, detached from the case of the machine. Fig. 7 is a side elevation of the front end of the machine showing a groove in which the disc carrying shaft is moved forwardly and backwardly when operating the machine. Fig. 8 is a side elevation of the several connecting bars that carry the recording discs and their actuating elements. Figs. 9 and 10 are detached elements in the make up of the several elements shown in Fig. 8. Fig. 11 is a side elevation, and Fig. 12 is an end elevation of the slide that controls the action of the multiplicand end of the actuating lever. Fig. 13 is a diagrammatical outline of the operation of the actuating lever in the process of multiplying numbers. Fig. 14 is a side elevation of one of the recording discs and its auxiliary actuating gears. Fig. 15 is a perspective of the main actuating lever and its several parts. Fig. 16 is a top plan of the machine on a smaller scale. Fig. 17 is a sectional elevation of the discs on the line 17—17 of Fig. 14 with the auxiliary operating elements removed and the direct operating gear wheels in place. Fig. 18 is an extended view of the periphery of the recording discs showing the recording figures thereon, Fig. 19 is a side elevation of one of the direct actuating gears showing a pawl thereon for actuating an adjacent disc. Fig. 20 is an enlarged sectional view on line 17—17 of Fig. 14.

Similar reference characters indicate similar parts throughout the several views.

In the construction of this machine I provide a case 1 having a broad front part for the storage and proper movements of the recording discs and their immediate operating parts crosswise of said front, to be hereinafter fully explained; and a narrow back part for the storage and proper operation of the operating levers 3, to be hereinafter fully explained in connection with their manner of operating the recording discs, etc. This case has a detachable cover 1′ with which it may be enclosed so as to protect the working parts of the machine from injury from outside causes, as the over collection of dust, and other foreign material.

Within the frame is constructed a series of partitions composed of the posts 5 and 5′ and the cross girts 5″, the latter being provided with slots *d* centrally located and extending longitudinally thereof for the reception and free movement of the bar 8, which also passes through the slots *c* in the operating levers 3, and the slots *f*—*f* in the regulating arms 6 and 6′.

The arm 6 is mounted upon the shaft 7, which shaft passes through the machine and has the arm 6′ mounted upon the other end thereof, as indicated in Fig. 15. The arm 6′ is contained wholly within the machine case, but the arm 6 passes upwardly through the case, and through the slot *a*′ in the cover of the case, within easy reach of the operator of the machine forming a lever for regulating the position of the bar 8. The figures, 1, 2, 3, 4, etc., indicate the numbers that are to be multiplied by, or, the figures in the multiplier, and the lever 6 is set at the figures that the multiplicand is to be multiplied by, progressively, as the multiplication is being carried on.

The operating levers 3 have segmental heads 3′ thereon, made integral therewith, and provided with gear teeth *e*, designed to mesh with the gear wheels 9′ for revolving the discs 9, to be hereinafter more fully described. Each lever 3 has a longitudinal slot *c* therein for the passage of the bar 8, as hereinbefore described, and the head 3′ has a segmental slot *c′* therein for the passage of the shaft 4, which is located directly back of the centers of the discs 9 and should exercise a slight degree of friction upon the head 3 for the purpose of holding the head always in the exact proper position, relative to the gear wheels 9′ to always mesh freely therewith, no matter what may be the position, vertically, of the head, or the position, longitudinally, of the girt 5″, of the bar 8. It will be understood that with the back end 3″ of the levers 3 held in fixed position by the gage rod 42 that adjusts the end of the lever to the multiplicand figure or numeral, the movement of the bar 8, longitudinally of the slot *d* will cause the heads 3′ of the lever to raise or lower accordingly.

I will now take up the description of the manner of manipulating the ends 3″ of the levers 3 for adjusting it to the desired numerals in the multiplicand column of figures. The gage rods 42 are adjusted to hold the ends 3″ of the levers 3 in the proper positions by means of the triangular guides 45, which are slidingly mounted upon the corresponding partition post 5′ in such a manner that they may be moved longitudinally of the case, as desired. Each guide has a thin neck 45′ which terminates in an overlapping head 46 that rests upon the bearing 46′, and has a spring latch 47 securely supported thereon and arranged to interlock with the desired notch, *k*, in the bearing 46′. The neck 45′ passes through the slot *a* in the top of the machine case, and one of said guides 45 and guide rods 42 are provided to act with each operating lever 3, thus each of said levers, of which there are nine, are operated independently of the other so far as the action of the guide 45 is concerned, though all of the levers 3 that are to be operated at a given time are actuated at once by the operation of the actuating lever 6 and the bar 8. The gage rod 42 is slidingly mounted in a supporting head 40 which is pivotally mounted upon the bearing 40′ so the rod may be drawn over out of contact with the end of the lever, as indicated by the dotted lines in Fig. 1. Each head 40 has a backwardly projecting arm 41 which is engaged by the connecting rod 39 with an angle lever 28, pivotally mounted on the shaft 28′, which is connected with the lever 24 by means of the connecting rod 27. The lever 24 is pivotally connected with the case at 26 and held in normal position against the gear wheel 31, by the spring 23, in such a manner that when the lever 32 is carried forward into the position indicated at 32′ the corresponding bearing 30 will be removed from behind the lever 24 and the spring 23 will draw the said lever backwardly upon the smaller hub periphery of the gear wheel 31 and the angle lever 28 will be operated to draw downwardly upon the connecting rod 39 and thus swing the head 40 around into the position hereinbefore described to free the end of the levers 3. Each gage rod 42 is held in normal longitudinal position in the head 40 by means of a spring 43, and is provided, at its upper end, with an anti-friction wheel 44 to travel upon the surface of the guide 45 with as little friction as possible.

When the lever 6 has been set to the desired multiplying figure, and the correspondingly sliding guide 45 has been properly set with the latch 47 engaging the desired notch *k* in the plate 46′ the lever 32 is drawn forwardly until it reaches the position indicated at 32′, when the head 40 will be swung over and the gage 42 will be removed from the end 3″ of the lever 3. Then the lever 32 is drawn further toward the position indicated at 32″ and the desired gear teeth on the wheel 31 will be made to mesh with the gear wheel 33, which gear wheel, meshing with the gear wheel shown in outline at 33′, will cause the hub 35 to revolve, and, with it, the cams 34 will be revolved into position to act upon the levers 37, pivotally mounted in the case at 37′, and connected with its respective lever 3 by means of connecting rods 56, (there being one of these levers, and of the cams 34 for each lever 3) and the corresponding lever 3 will be thrown around upon the bar 8 so that the gear teeth *e* on the head 3′ will mesh with the teeth on the gear wheels 9′ and will revolve the discs 9 into desired positions, as will be hereinafter more fully described.

The discs 9, and the gear wheels 9′ are mounted upon the shaft 10, which, in turn, is mounted in bearings at the lower ends of the swinging arms 17, the latter being pivotally mounted upon the sides of the case 1 at *m* so the lower ends thereof may be made to swing toward, and away from the heads 3′ of the lever 3. The lower end of these arms are pivotally, and slidably connected with the arms 21, as at *j*, and the levers 21 are connected with the lever 24 by means of the connecting rod 48 which is pivotally connected with the crank arm 49, as at 30, and with the arm 21, as at 30′, so that when the lever 32 is drawn forward a proper distance the arm 24 will draw the lever 21, and with it the arm 17, and the discs and gear wheels on the shaft 10, into position so the gear wheels 9′ will be made to

mesh with the gear teeth *e* on the heads 3′ of the levers 3 simultaneously with the swinging movement of the head 40, thus holding the levers 3 temporarily in place, so that when the said levers are made to oscillate upwardly and downwardly, as hereinbefore described, the gear wheels and discs on the shaft 10 will be made to revolve according to the relative positions of the bar 8, governed by the position of the lever 6, and of the gage rod 42, governed by the position of the sliding guide plate 45, which governs, positively, the distance to be traveled by the head 3′ of the lever 3, and the relative revoluble movement of the discs 9. Upon the periphery of the discs 9 is imprinted the first ten Arabic numerals, as indicated in Fig. 18. The discs 9 and the gear wheels 9′ are so mounted upon the shaft 10 that they may be made to revolve independently of each other on the shaft. Pins *h* are made to project from the inside of the two outside discs 9 and from both sides of each of the intermediate discs, and in one side of each disc except the left hand disc I form an opening 54 having ratchet teeth 54′, and pivotally mount a pawl 55 upon the gear wheels 9′ in position to freely enter the openings 54 and engage the ratchet teeth therein, as shown in Figs. 14 and 19, and more particularly in Fig. 17. The gear wheels 9′ are made to revolve separately from the discs 9, when desired, so that the discs may be carried around into normal positions, after each impression is taken, by revolving the shaft 10 until the pawls 55′, mounted in the openings in the discs, are made to engage the slot *o* in the shaft 10 when the revoluble movement of the shaft will carry each disc into its exact normal position. I provide a second set of gear wheels, 11 and 11′, made integral. The wheels 11 have a series of teeth 19 having valleys between them corresponding with the gear pins *h* on the discs so that these wheels revolve with the adjacent discs, while the wheel 11′ has but one tooth, 19′, which revolves the adjacent left hand disc one tooth with each full revolution of the right hand discs. The gear teeth 19 on the wheels 11, and the pins *h* on the discs must correspond, exactly, with the numerals imprinted upon the peripheries of the discs, to insure correct computations.

The pawls 55′ are actuated to properly engage the slot *o* in the shaft 10, by means of a properly mounted spring, as indicated at *p* in Fig. 14, and the pawl 55 is likewise actuated by a spring *k* to engage the sprocket teeth 54′.

The gear wheels 11—11′ are mounted upon a shaft 11^2 which, in turn, is mounted in the swinging arms 12, the upper ends of said arms being pivotally mounted upon the shaft 10, and the lower ends being slidingly mounted upon the shaft 50, which latter is revolubly mounted in the case 1. For actuating the shaft 50 through the swinging movements of the arms 12 I form a groove *q* in the lower surface of the shaft and insert a sliding key *r* therein and in a corresponding groove in the bearings of the arms 12 so the shaft must respond to each swinging movement of the arms. The upper surface of this shaft has notches *g* and *g′* formed thereon, so arranged that when the arms 12 are nearly to the extreme, relatively, left hand, or outward position the trip 57 will slide off of the notch *g* against the notch *g′* just before the impression is made upon a receiving sheet 13′, and when started back into position to engage the teeth *e* on the actuating heads 3′ the trip will slip off of the notch *g′* and be moved along, with the several discs until it engages the next notch *g*, and so on to the end of a problem. This is brought about by the spring 20 in the case 20′, and the shaft 53 upon which the pulley 51 is mounted. The ribbon 52 is mounted upon the pulley 51 with the other end connected with one of the arms 12, so that as soon as the latch 57 is freed from either notch, *g* or *g′*, the arms 12 and the several discs and gear wheels are drawn along to the next notch, and so on to the end of the pending problem. It will be readily understood that this action of the machine will require a shaft 10 of sufficient length to be moved endwise in the case the length of the frame 12—12, as indicated by the dotted outlines of said frame and the discs in Fig. 5. It will, also, be understood that the sidewise movement of the shaft 10, as hereinbefore described, will require the use of properly formed slots *a″* in the sides of the case 1, as indicated in Fig. 7.

To complete the operating construction of this machine I place a paper roll 13 in the case, and a printing roll 14 directly above the paper roll, over which the paper 13′ passes to receive the imprints from the discs 9 as they are forced against the paper with the action of the lever 32 when thrown backwardly into normal position and the arms 21 and 17 are thrown forward by the action of the lever 24 through the connecting rod 48. At 15 I have shown a pressure roll for holding the paper securely upon the surface of the roller 14 when said roller is being made to revolve by means of the links 16 and the pawl and ratchet mechanism shown at 16′, actuated by the swinging movements of the arms 17.

In Fig. 13 I have shown a diagrammatical outline of the operation of the machine. We will suppose that 9 is being multiplied by any one of the numerals in the multiplying column, and we have all of the quotients from 9 to 81. If 9 is being multiplied by 8 the quotient being 72, the 2 will be im-

printed upon the paper by the right hand operating disc and the action of the tooth 19′ on the wheel 11′ upon the next adjacent left hand disc will so place the dial that it will imprint the "7", and so on throughout a multiplying process.

To further carry out this illustration, we will presume that the back end of the lever 3 is placed at 6, if multiplied by 3 the quotient 18 will be registered. If by 6, 36 will be registered, and if by 9, 54 will be registered, and if the numeral 3 is multiplied by 6, 18 will be registered, and if by 9, 27 will be registered as the proper quotients, and so on throughout the entire line of multiplication. I have made use of the above mentioned numerals as multiplicands as they may all be readily registered in the same diagram, but the result must be the same, no matter what may be the multiplier or multiplicand.

It will be readily understood that with the shaft 10, and the discs and their actuating mechanism in their normal positions, as indicated in Fig. 2, it is an easy matter to adjust them longitudinally of the front of the case, as indicated by the dotted outlines in said Fig. 2.

The arms 21 are actuated by the connecting rod 48 which is connected at one end with the lever 49 on the shaft 26 that carries the crank arm 49, as at 30, and at the other end with the arm 21, as at 30′ on Figs. 1 and 2, there being one arm, 21, in the case at each side thereof, on the shaft 22, the rod 48 being connected with the arms 49 and 21 at the relatively upper side of the case, as indicated in Fig. 2. This connection is made, preferably, partly outside of the case as indicated in Fig. 1 and shown in Fig. 2, and, as hereinbefore stated, the arms or standards 17 are actuated by the arms 21 to carry the discs 9 toward, and away from the lever heads 3′.

Coming, now, to the process of multiplication, we take the problem "4836" as a multiplicand, and "346" as the multiplier. To make this multiplication the first four members 45′ at the right hand side of the machine, nearest to the lever 32, are placed in the positions indicated by the numerals 4, 8, 3, 6, these being the multiplicand numerals, and the lever 6 is carried over to 6 in its index column, and remains there until the lever 32 has been swung over into the position indicated at 32″ and back into normal position at 32, then the lever 6 is placed at 4, and the lever 32 is again carried over to 32″ and back again to normal; then the lever 6 is placed at 3 and the action repeated and the last quotient embodies the sum of all three quotients. In other words, each succeeding quotient after the first includes the sum of all preceding quotients, and when the last figure in a multiplier has been exhausted the product will include the sum of all of the multiplications.

It is to be understood that there is one cam 34 for each lever 3, and that these cams are so distributed that the first lever is fully operated before the next succeeding cam acts upon its respective lever, and so on throughout the entire series. That is to say, if a multiplicand contained the entire ten digits in Arabic numerals, and the members 45′ are set accordingly, when the lever 32 is swung over toward the front of the machine each lever 3, beginning at the right hand side of the machine, as shown in Fig. 6, will perform its full operation before the next succeeding lever will be affected by its actuating cam 34, thus the lever 32 will, necessarily, be carried over toward the front of the machine, or, rather, toward the position indicated at 32″ far enough to operate the same number of levers 3 as there are figures in the multiplicand, counting the action of one cam upon the levers 3 for each figure in the multiplicand.

This brings us to the matter of carrying over a surplus from one multiplication to the next figure in a product, which is as follows: Using the problem given above with 4836 placed as the multiplicand, and the lever 6 placed at the figure 6 in its index, for the first multiplication, the lever 32 is thrown over toward the point 32′ or 32″ far enough to actuate all of the levers covering these figures. Upon the first movement of the lever 32, and before the first cam 34 takes effect upon its corresponding lever 3 the lever 24 will be released and the spring 23, and connecting rod 48 will draw the shaft 10 into position so the gear wheels 9′ will be engaged by the head 3′ of the lever 3, then, as the lever is drawn further forward, the cams 34 will act upon the levers 37 successively, and the downward movement of the heads 3′ will revolve the gear wheels 9′ and with them the discs 9, but each disc will complete its revolutions before the next succeeding disc is acted upon at all by the heads 3′. When the first head 3′ is forced downwardly it causes the first disc 9 to revolve three full revolutions and six points over thus placing the disc in position to imprint the figure 6 upon the receiving pad, or paper, 13′. Each complete revolution of the first disc causes the auxiliary gear 11 to revolve one revolution, and the single tooth 19′ will move the next succeeding disc one tenth of a revolution, hence the three full revolutions of the first disc will turn the next succeeding disc three tenths of a revolution. As the lever 32 is brought further on its course forward the first disc remains in place and the second disc is made to revolve three full revolutions and eight tenths of another revolution, which added to the three tenths of a revolution caused by the over

movement of the first disc, brings the disc in position to imprint the figure 1 upon the paper 13′, and so on until the first quotient of 4836 multiplied by 6, namely: "29016" are in position to be impressed upon the paper, when the return of the lever 32 into normal position will force the shaft 10 forward into position to bring the discs in contact with the paper 13′ and record the said product thereon. After this product has been recorded the lever 6 will be placed upon the dial number 8 and upon the first forward movement of the lever 32 the disc will be slightly removed from the receiving paper 13′ and the shaft 50 will be turned into position to allow the discs and their supporting frame to slide one notch to the right when the same process is repeated except that the second product covers the two multiplications, and so on to the end of the example, the final product giving the sum of all of the multiplications added together.

It is evident that if a large numeral is to be multiplied by a large numeral, as 9 x 9, it will require much greater travel by the head 3′ of the lever 3 to properly adjust the discs 9, than if a small numeral is to be multiplied by a small numeral, as 2 x 3, and this is provided for by the position of the bar 8 thus: If multiplying by 9 the lever 6 is placed at 9 and the distance from the shafts 8 to the end 3″ of the lever 3 is diminished and that from the bar 8 to *e*, on the head 3′, is increased so as to compel the head 3′ to move its entire length, but if the multiplier is 2 the lever 6 is placed at 2 and the distance from 3″ to the bar 8 is increased, and the distance from the bar 8 to *e* is proportionately decreased and the movement of the head 3′ is lessened accordingly, and so on throughout the multiplier column.

Upon first thought it may be objected that the variations in the lengths of the radial lines between the shaft 8 and the head 3′ with the bar 8 placed at the extreme right hand position and the extreme left hand position in the slot *d* would so vary the necessary curvature of the head 3′ as to render the fixed curvature of the slot *c*′ inoperative except with the bar 8 in one fixed position, but this variance is fully compensated for: first by the shaft or pin 4, which holds the heads at all times in the same relative position with the gear wheels 9′ when these wheels are in position to properly mesh with the gear teeth upon the head 3′ of the lever 3, and, second, by the slight longitudinal movement of the lever 3 provided for in the use of the slot *c* upon the bar 8, which allows the bar 8 to remain stationary as a pivotal center, no matter in what position it may be in the slot *d*, during the entire vertical movement of the head 3′, either upwardly or downwardly while operating the discs in the process of any problem in multiplication.

To compensate for the longitudinally sliding movement of the arm 17 upon the arms 12 and 21, when they are being swung toward or away from the head 3′ of the lever 3, I form slots *i* in the upper ends of the arms 12 and 21, as shown in Figs. 8 and 9, so that the shafts 10 and 10′ may slide therein to allow of the free lateral swinging of the arms 12, 17 and 21.

The discs 9 and the gear wheels 9′ and 11—11′ should fit upon their respective shafts closely enough to avert the danger of their being made to revolve thereon independently of the action of the head 3′, so that when any of the gear wheels are thrown out of mesh they will retain their position upon the shaft to properly mesh when again brought together; but they should not fit closely enough to prevent their free movement upon the shafts when being made to revolve thereon by the head 3′, or when being slid longitudinally of their shafts towards and into the positions indicated by their dotted outlines in Fig. 5.

Having thus fully described my invention, what I claim as new in the art, is:

1. In a computing machine, an enclosing case, a shaft mounted crosswise of the case, operating arms mounted on said shaft and having slots therein, one of said arms passing upwardly through the cover of the case forming an actuating lever, partitions in the case having horizontally disposed slots therein, operating levers each having curved heads thereon and gear teeth on said heads, the levers and the heads each having slots therethrough, a bar passing through the slots in the partition, in the operating arms, and in the operating levers for supporting and adjusting the operating levers, a shaft near the back end of the machine, a segmental gear wheel on said shaft, a lever for operating said shaft, cams revolubly mounted in the case back of the said lever in position to be operated by the segmental gear wheel, levers and links connected to operate the operating levers from said cams, arms swingingly mounted in the case, shafts mounted in the free ends of said arms, and discs and gear wheels mounted on said shafts in position to be made to revolve by temporary engagement with the heads on the operating levers.

2. In combination with the elements covered in claim 1, a short vertical lever pivotally mounted in the case, a shaft upon which said lever is mounted, passing through the case and having a short lever upon the other end thereof, an offset upon the segmental gear in position to actuate said vertical lever, holding it in normal position when contacting it and releasing it when removed from contact therewith, a spring connected with the vertical lever to draw it out of normal position when released from the offset on the

segmental gear, and a connecting rod connecting the shorter lever with the swinging arms for swinging the disc gear into and out of mesh with the teeth on the operating lever heads.

3. A computing machine according to claim 1, in which the said lever and links connected to operate the operating levers from said cams, comprise a lever mounted in the case directly in the line of travel of each cam, one end of said levers pivotally mounted in the case and the other end connected by a link with the ends of the operating levers, and guides for adjusting said operating levers into operative positions.

4. In combination with the elements covered in claim 1, a vertically disposed lever pivotally mounted near the back end of the case, an offset on the hub of the segmental gear for holding said lever in normal position, a spring for drawing said lever out of normal position when said offset is removed from contact therewith, an angle lever pivotally mounted in the case back of the vertical lever, a rod pivotally connected with the lower end of the vertical lever and with the short arm of the angle lever, a gage head pivotally mounted in the case directly over the back end of each operating lever, an arm extending backwardy from the pivotal bearing of each of said heads, a connecting rod pivotally connected at one end with the end of a gage arm and at the other end with the long arm of an angle lever in such a manner that the swinging movement of the vertical lever will swing the gages into and out of contact with the ends of the operating levers, and guides for regulating the positions of the gages.

5. In combination with the elements covered in claim 1, gage heads pivotally mounted in the case immediately above the ends of the operating levers, a longitudinally movable gage rod mounted in each gage head, a spring for holding each of said gage rods in normal position in its head, means for throwing the gage heads over to remove the gage rods out of contact with the ends of the operating levers, guides for holding the gage rods in position upon the ends of the operating rods, and antifriction rollers in the ends of the gage rods to reduce friction when they are being swung onto or off of the guides.

6. In combination with the elements covered in claim 1, gage heads pivotally mounted in the case above the ends of the operating levers, guides for fixing the positions of the gages, said guides made triangular in form and having necks extending upwardly therefrom through slots in the case cover, a head extending sidewise from each of said necks, indented gages upon the case cover adjacent to heads, the indentions arranged to indicate the several numerals in a multiplicand, a latch upon each head arranged to be made to engage the desired indentions in the indented gages.

7. A machine according to claim 1, in which the heads of the operating levers have slots formed therethrough, and a bar is passed through the case and through the said slots for holding the heads in uniform relative positions with the gear wheels between the discs.

8. A machine according to claim 1 in which the arms swingingly mounted in the case and the shafts mounted therein comprise a pair of swinging arms pivotally mounted in the top of the case and depending downwardly, a pair of swinging arms pivotally mounted in the bottom of the case and extending upwardly to contact with the free ends of the upper arms, said lower arms having slots through the upper ends, a shaft revolubly mounted in the ends of the upper arms and passing through the slots in the lower arms, for carrying the discs and their connected gear wheels, a shaft mounted near the free ends of the lower arms, gear wheels mounted upon the said shaft in position to intermesh with the gear wheels on the recording discs, and means for swinging said arms to cause the disc gears to intermesh with, and to be released from the gear teeth on the operating lever heads.

Signed at Grand Rapids, Michigan, July 16, 1924.

CLARE C. COSS.