(No Model.) 3 Sheets—Sheet 1.

J. H. SCHNARRENBERGER.

ADDING AND SUBTRACTING MACHINE.

No. 418,930. Patented Jan. 7, 1890.

Fig. 1

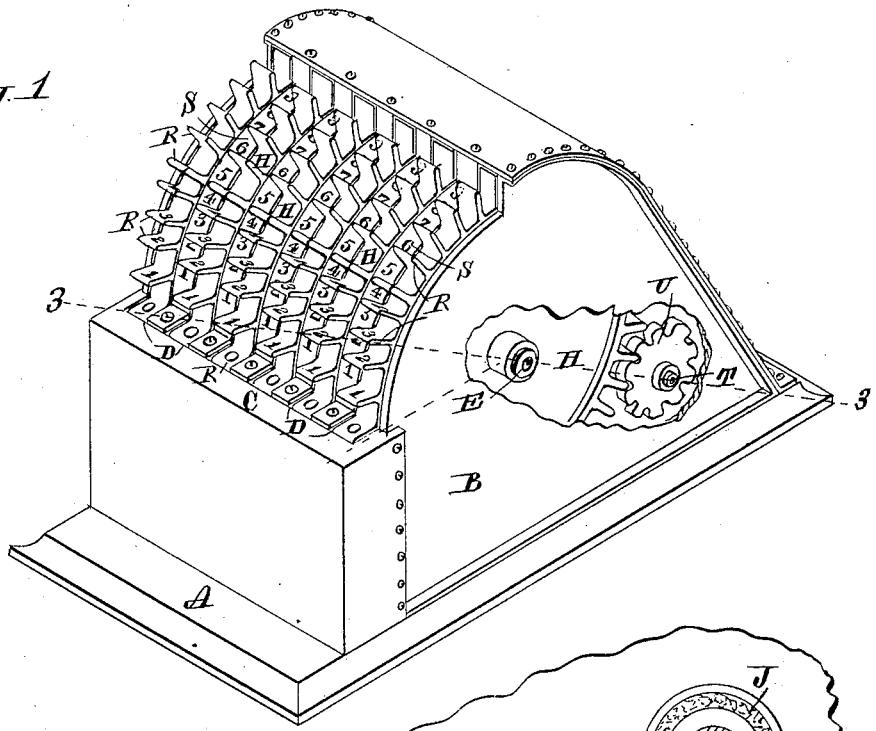
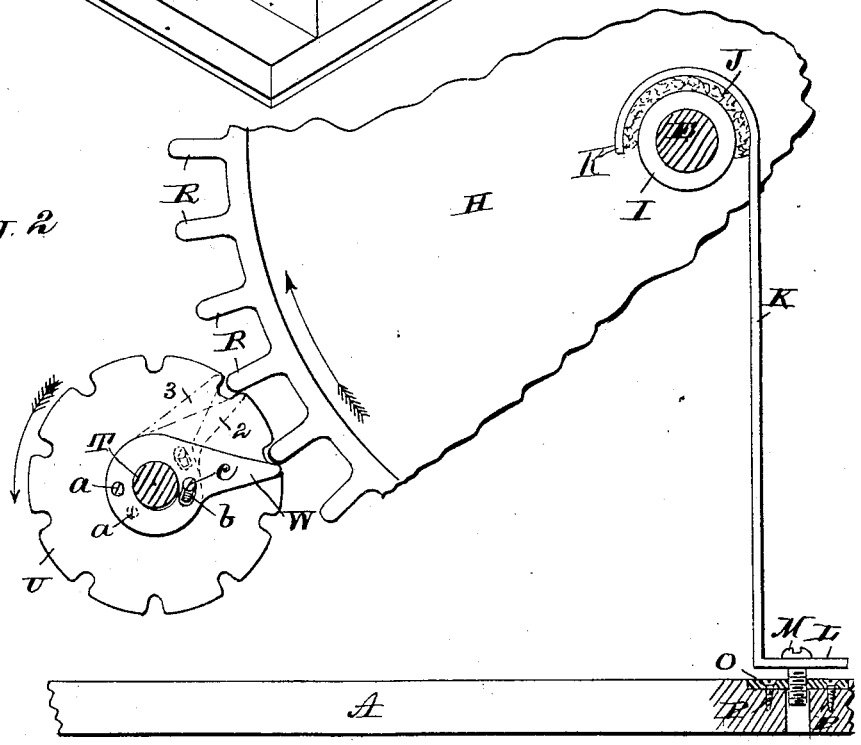


Fig. 2



Witnesses,
G. M. Gridley
Warren O. Hull.

Inventor
Jacob H. Schnarrenberger,
By his Attorney
H. A. Toulmin,

(No Model.) 3 Sheets—Sheet 2.

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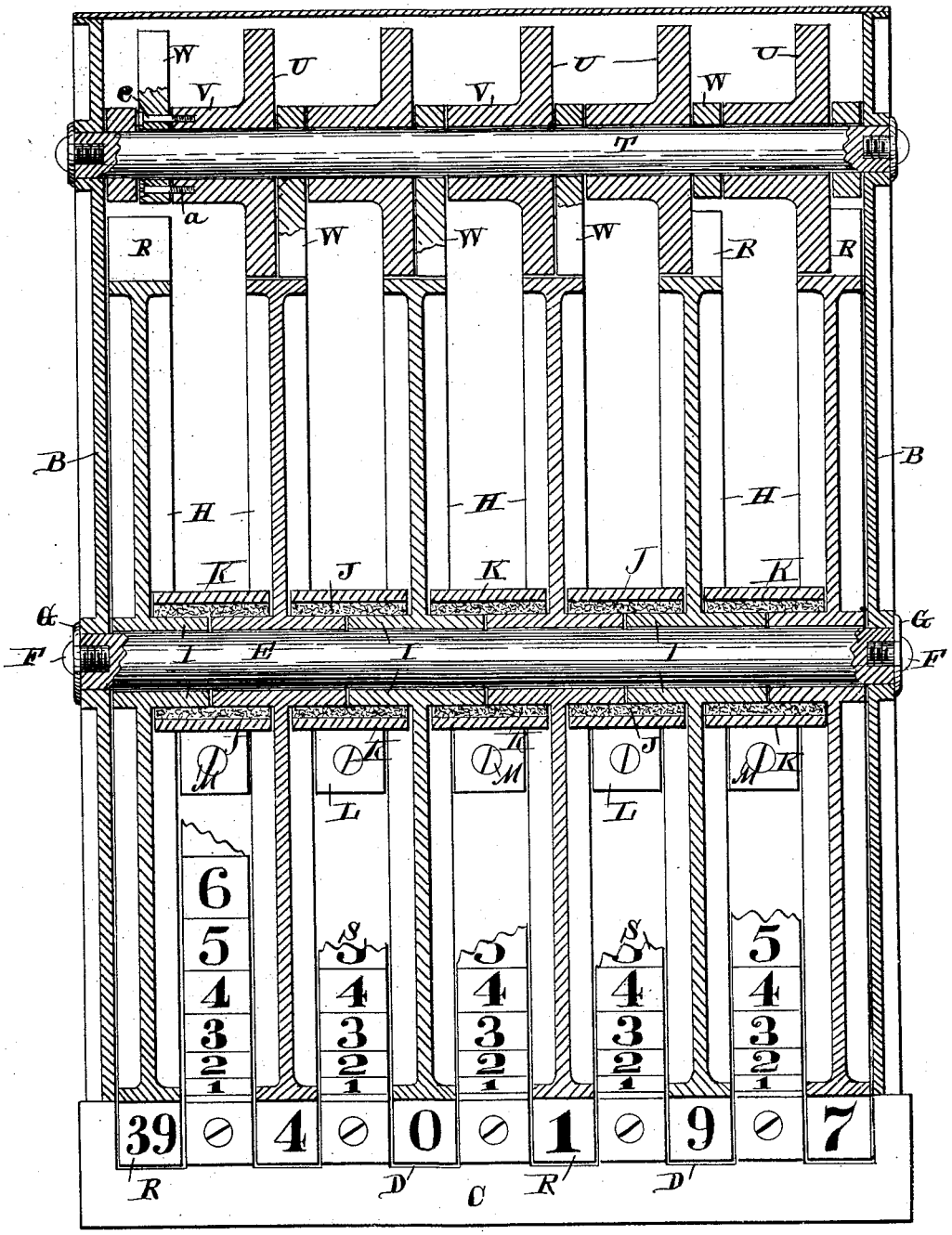
Fig. 5



Witnesses
G. M. Gridley
Warren Hull.

Inventor
Jacob H. Schnarrenberger,
By H. A. Toulmin,
Attorney.

(No Model.) 3 Sheets—Sheet 3.

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Fig. 4

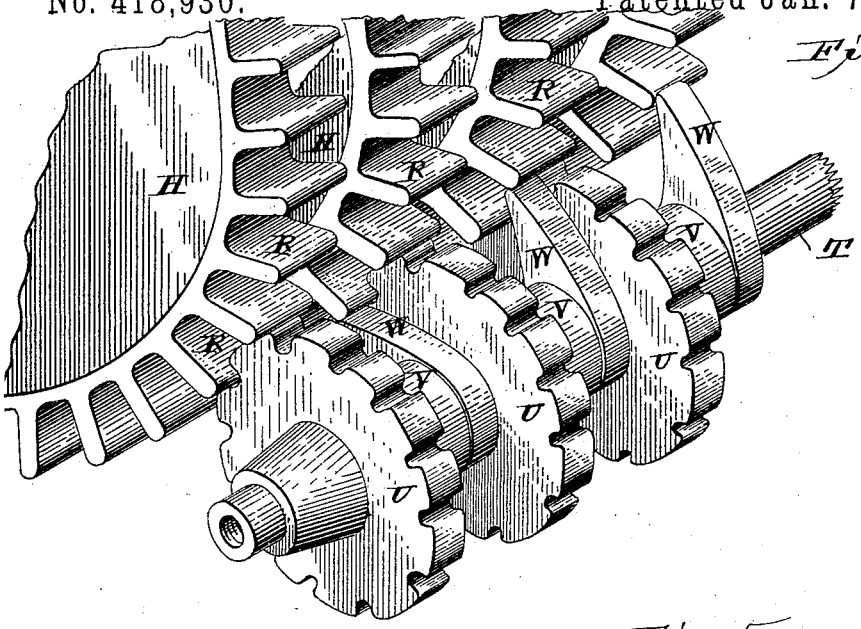
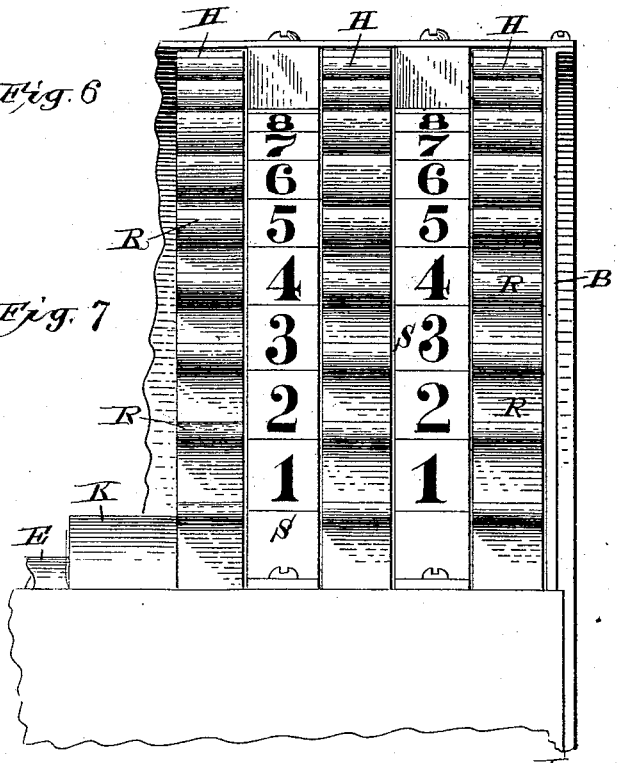


Fig. 5



.05
.11
1.20
1.20
19.80
22.36

Fig. 6

22.36
11.23
11.13

Fig. 7

Witnesses
G. M. Gridley
Warren Hull.

Inventor,
Jacob H. Schnarrenberger,
By A. A. Toulmin,
his Attorney.

UNITED STATES PATENT OFFICE.

JACOB H. SCHNARRENBERGER, OF SPRINGFIELD, OHIO, ASSIGNOR OF ONE-HALF TO THOMAS REYNOLDS, OF SAME PLACE.

ADDING AND SUBTRACTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 418,930, dated January 7, 1890.

Application filed February 1, 1889. Serial No. 298,350. (No model.)

To all whom it may concern:

Be it known that I, JACOB H. SCHNARRENBERGER, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Adding and Subtracting Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in adding-machines, the purpose of which is to unerringly add together figures in one or more columns and also to subtract figures in one or more columns.

The invention consists in the peculiarities hereinafter described, and more fully pointed out in the claims.

In the accompanying drawings, forming a part of this specification, and on which the same reference-letters and figures indicate the same or corresponding parts, Figure 1 represents a perspective view of my improved adding-machine entire, part of the casing being broken away to show a portion of the motion-transmitting mechanism; Fig. 2, a sectional view of the arbor, showing a portion of one of the adding-disks in elevation and the motion-transmitting device in elevation, as also the friction device; Fig. 3, an enlarged sectional view on the line 3 3 of Fig. 1, showing the parts partly in plan; Fig. 4, a perspective view of the motion-transmitting mechanism and portions of two of the disks, looking toward the rear of the machine; Fig. 5, a front view of two of the indicator-strips and of three of the adding-disks adjacent thereto; Fig. 6, a diagram of an example in addition, and Fig. 7 a diagram of an example in subtraction.

The letter A designates the base of the frame, which is made of wood or metal, vulcanized rubber, or other material, and upon this base, or formed with it, is a casing B, which incloses the mechanism, as suggested in Figs. 1 and 3, and also forms bearings for the shafts or arbors. The style and finish of these parts may vary with the taste of the maker. The casing B is formed with a ledge or offset C, having notches D, through which pass the projections on the adding-disks. This ledge constitutes a gage at which to adjust the figures of the disks involved in any particular example, and at which point they are read, as will be more fully explained farther on.

In the casing is mounted an arbor E, preferably secured against rotation by screws F and washers G, arranged as seen in Fig. 3. On this arbor are rotatably and independently mounted the adding-disks H, having hubs I of sufficient length to space the disks from each other.

In order to prevent the disks from passing beyond the desired point as the result of momentum when given a movement by the hand, I prefer to apply to them a frictional device in the nature of a brake, which can be adjusted to exert more or less frictional pressure against some convenient part of the disks, as may be required, or to take up the wear. The form of device preferred for this purpose is clearly shown in Fig. 2, in which J designates a strip of felt or similar material, and K a plate curved at its upper end to fit over the hubs I, with the felt intervening, and formed with a foot L at its lower end to receive a screw M, by which the felt is drawn more or less forcibly against the hubs I. A plate O, secured by screws P to the base B, serves as a nut for the screw M. From Fig. 3 it will be seen that the several strips of felt and the several plates K are arranged so that each of them will engage with or operate upon the adjacent portion of the hubs of each of two disks. While this arrangement is not essential, I yet prefer it for its convenience.

Each disk H is provided with a suitable number of teeth or projections R—forty of such projections in the present instance—and these projections, as more clearly seen in Fig. 2, are fashioned somewhat after the shape of gear-teeth, so that they will more properly mesh with the similarly-shaped notches in the gears or gear-wheels which enter into the construction of the motion-transmitting mechanism. I also prefer to place the figures, or groups of figures which the disks bear, upon these projections, and hence construct them large enough to accommodate figures of ample size for easy reading, and I also prefer to utilize these projec-

tions as the means through which to take hold of the disks with the hand to rotate them. I do not desire, however, to be understood as intending to say that my invention is limited to so constructing the adding-disks and their projections, for it is obvious that the disks may be modified in respect to the place and manner of applying the figures, and in the provision of means for readily taking hold of them to rotate them.

In Fig. 1 it will be observed that the upper sides of the projections R alone bear the figures. These figures are arranged in groups from 0 to 9, inclusive, and in the present instance each disk has four such groups or forty projections, save the last disk to the left, which, while it has forty projections, or the same number of projections as each of the other disks, yet has the projections numbered from 0 to 39, inclusively and progressively, as distinguished from being arranged in groups.

The letter S designates the scale or indicator figures arranged in groups agreeing with the groups of figures on the disks, as aforesaid, with the exception of the omission of 0 from such indicator or scale figures. These indicator or scale figures are preferably placed upon the face of segmental strips of metal or other material secured to or forming a part of the casing and extending from the ledge C upward and between the disks, the figures commencing with 1 just above the ledge and ending with 9 near the upper terminus of the strips.

In operating the machine the operator looks to the scales immediately to the left of the units, tens, or hundreds column, or the disk representing such columns, respectively, for the figure which he desires to add, and opposite to which figure will be found the projection of the adding-disk, which should be moved within the slot D, as will presently more fully appear.

I will now refer to the motion-transmitting mechanism or devices heretofore alluded to. Of these devices, T designates a shaft, by preference fixedly mounted in the casing after the manner of the mounting of the arbor E, as seen in Fig. 3. On this shaft are freely mounted a number of gear-wheels U, one for each adding-disk save the last disk to the left. Each of these wheels is formed with or has attached to it a sleeve V, and to the sleeve is connected an arm W adjacent to the next adding-disk to the left, and which arms engage at intervals with the adding-disks save the units-disk, or the one to the extreme right. This arrangement is clearly illustrated in Fig. 4, from which it will also be observed that there is no arm W for the units-disk and no gear-wheel U for the last disk to the left. I have said that the arms W are connected with the sleeves V of the gear-wheels U. It is preferred to make this connection such as will admit of a short movement of the arm in a rotary direction independent of the gear-wheel to which it is attached, for a purpose which will be more clearly understood after I have described the operation of the motion-transmitting devices. This I will now proceed to do. In the first place the purpose of the motion-transmitting devices is to enable each disk to operate the disk immediately to the left thereof at certain intervals—for instance, to enable the units-disk to so operate the tens-disk, the tens-disk to so operate the hundreds-disk, and so on. It will be understood that each disk meshes with the adjacent gear-wheel U, so that the rotation, say, of the units-disk will rotate its gear-wheel U, and as each gear-wheel U (in the present instance) has one-fourth as many teeth as each disk a gear-wheel will rotate once at each quarter-rotation of such disk. The parts are so arranged that as 9 on the units-disk passes beneath the ledge C and 0 approaches and reaches the plane of said ledge the arm W will rotate the tens-disk one space or move it until 0, carried by it, will descend from the ledge and 1 take its place. The same operation will occur between the tens-disk and the hundreds, and so on through the series, the gear-wheels and the arms acting to transmit the motion from one to the other of the disks. This is the means by which a sum too large to be indicated by one disk is carried over to the next disk to the left, so that such sum will be indicated by the disks collectively.

Referring now to the provision of independent movement between the arms W and their respective gear-wheels, I would remark that it sometimes occurs, though not often, that one of the arms W, after having moved a disk one space in the manner above described, will come to rest while yet slightly within the rotary path of the next lower projection R of such disk, and will therefore be subject to a slight rotary movement by the next lower projection when the operator shall come to move such disk by the hand, so as to add such figure as may occur in the column to agree with such disk. The result of this is to instantly rotate the gear-wheel to which said arm is attached a slight distance, but sufficient to cause such gear-wheel to in turn slightly move its adjacent disk, resulting in moving the figure of such last disk slightly below the ledge, when such figure should not be disturbed. To overcome this is the object of the slight independent movement between the arms and their disks, so that such slight incidental movements of the arms will not affect their disks. This will be clearly understood by referring to Fig. 2, in which the arm W, as shown in full lines, is about to engage with its adjacent disk, and in which the second position of the arm, designated by dotted lines 2, illustrates the position to which the arm has moved and the distance it has carried the disk, while the dotted lines desig-

nated 3 show the position to which the arm is incidentally moved by the disk when next directly operated by hand. From this it will be seen that the gear-wheel U would be moved by the movement of the arm from the position 2 to 3 were not the arm capable of moving independently of the gear. The preferred form of construction for this end consists in pivoting the arm to the end of the sleeve at *a*, elongating the opening in the arm which fits over the shaft T, and slotting the arm at *b* to receive a stud or screw *c*, fitted into the end of the sleeve. By these means the arm may move independently of the gear-wheel U the length of the slot *b* when engaged on its under side by a projection R of a disk.

I will now proceed to give an example of the operation of addition as performed by this machine, referring to the diagram Fig. 6. Place 0 of each disk at the reading-point, being within or near the notches D, and then move the units-disk toward you until the projection opposite the numeral 1 of the adjacent indicator-strip occupies the position just occupied by 0 of that disk. Then again so move the units-disk until the projection R opposite the numeral 5 of said indicator reaches the reading-point. This will show 6 at the reading-point upon the units-disk. Then likewise manipulate the tens-disk, first moving the projection opposite the numeral 8 on the indicator to the reading-point, then the projection opposite the numeral 2 to said point, and again the projection opposite the said numeral 2, and, lastly, the projection opposite the numeral 1 of the indicator. Pass on to the hundreds-disk, and likewise move it until the projection opposite the numeral 9 of the indicator reaches the reading-point, then the projection opposite the numeral 1, and then the next projection opposite the numeral 1, and, finally, move the thousands-disk until the projection opposite the numeral 1 of the indicator reaches said reading-point. The sum will be 2,236.

I have also stated that the machine may be used for subtracting, and this matter I will now explain.

Let it be supposed that 1,123 is to be subtracted from 2,236, as in the diagram Fig. 7. In the above example the disks show 2,236 at the reading-point. Take hold of the units-disk and turn it backward until the 6 reaches the numeral 3 on the indicator-strip, 3 being the figure to be subtracted from 6, which will show 3 at the reading-point. Next turn the tens-disk backward until the 3 is opposite the numeral 2 of the indicator, which will bring 1 at the reading-point. Next turn the hundreds-disk backward until the numeral 2 is opposite 1 of the indicator, which will bring 1 to the reading-point. Lastly, turn the thousands-disk backward until 2 is opposite the numeral 1 of the indicator, which will also bring 1 to the reading-point. Then the machine will read 1,113.

It will be noted that in adding, the projection of the adding-disk, which should be moved to the reading-point, is the projection which is opposite the figure on the indicator which agrees with the figure to be added. The same rule applies in operating the machine to subtract, except that it is performed in the inverse order—that is to say, the figure on the indicator which agrees with the figure of the subtrahend is the one to which the figure of the minuend indicated on the disk at the reading-point is moved. Of course the minuend must first be exhibited by the machine as a prerequisite to the operation of deducting the subtrahend therefrom.

I contemplate making the adding-disks and the gear-wheels of vulcanized rubber, and as much of the other mechanism as may be found practicable.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an adding-machine, the combination, with the frame, an arbor mounted therein, a series of rotatable disks mounted on said arbor, a shaft, gear-wheels mounted on said shaft, and a radial arm carried by each of said gear-wheels and having a short rotary movement independent of its gear-wheel, and arranged to operate said disks by engaging therewith during a short period of the rotation of said arms.

2. In an adding-machine, the combination, with the frame, a shaft mounted therein, and independent adding-disks mounted thereon and provided with projections in the nature of gear-teeth, of another shaft mounted in said frame, gear-wheels mounted thereon and meshing with said projections and having an elongated hub at one side thereof, an arm pivoted to each of said hubs at one side of the shaft and movable a short distance in a rotary direction independent of said hub, each arm being opposite to the next disk to the left of the gear-wheel by which it is carried, whereby when one disk operates the next through a gear and an arm the operated disk may be further rotated by hand without affecting the first-named disk.

3. In an adding-machine, the combination, with the frame, an arbor mounted therein, and disks rotatably mounted on said arbor and having hubs which are adjacent to each other, of strips of soft material placed against the said adjacent hubs of the disks, and plates adjustably secured to the frame and bearing upon said soft material and overlapping the hubs of two disks, substantially as described.

4. In an adding-machine, the combination, with the frame, two shafts mounted therein, one carrying a series of independently-rotatable disks and the other a like series save by one, of independent gears which engage said disks, a radial arm pivoted to each of said gears and having a short independent rotary

movement and engaging at intervals in their rotation with said disks, respectively, save the units-disk, figures arranged in groups and carried by said disks, save the last to the left, the figures of which are arranged in progressive series, indicator strips or surfaces located substantially between said disks and bearing indicator-figures from 1 to 9, inclusive, and a reading-place established on said frame, said disks being rotatable by hand.

In testimony whereof I affix my signature in presence of two witnesses.

JACOB H. SCHNARRENBERGER.

Witnesses:

WARREN HULL,

G. M. GRIDLEY.