No. 784,145. PATENTED MAR. 7, 1905.

F. C. DONECKER.

EDUCATIONAL DEVICE.

APPLICATION FILED AUG. 23, 1904.

2 SHEETS—SHEET 1.

FIG. 1.

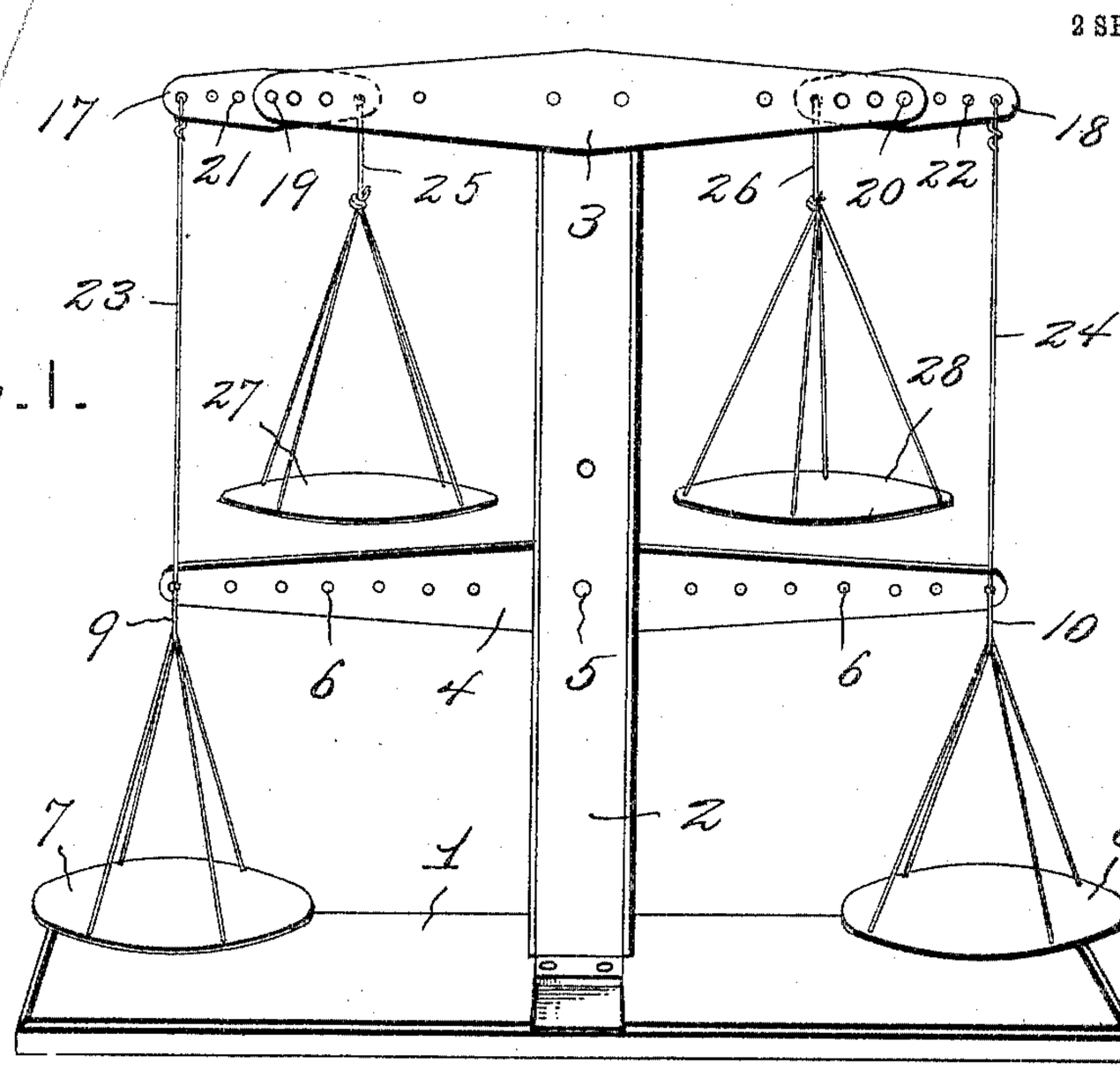
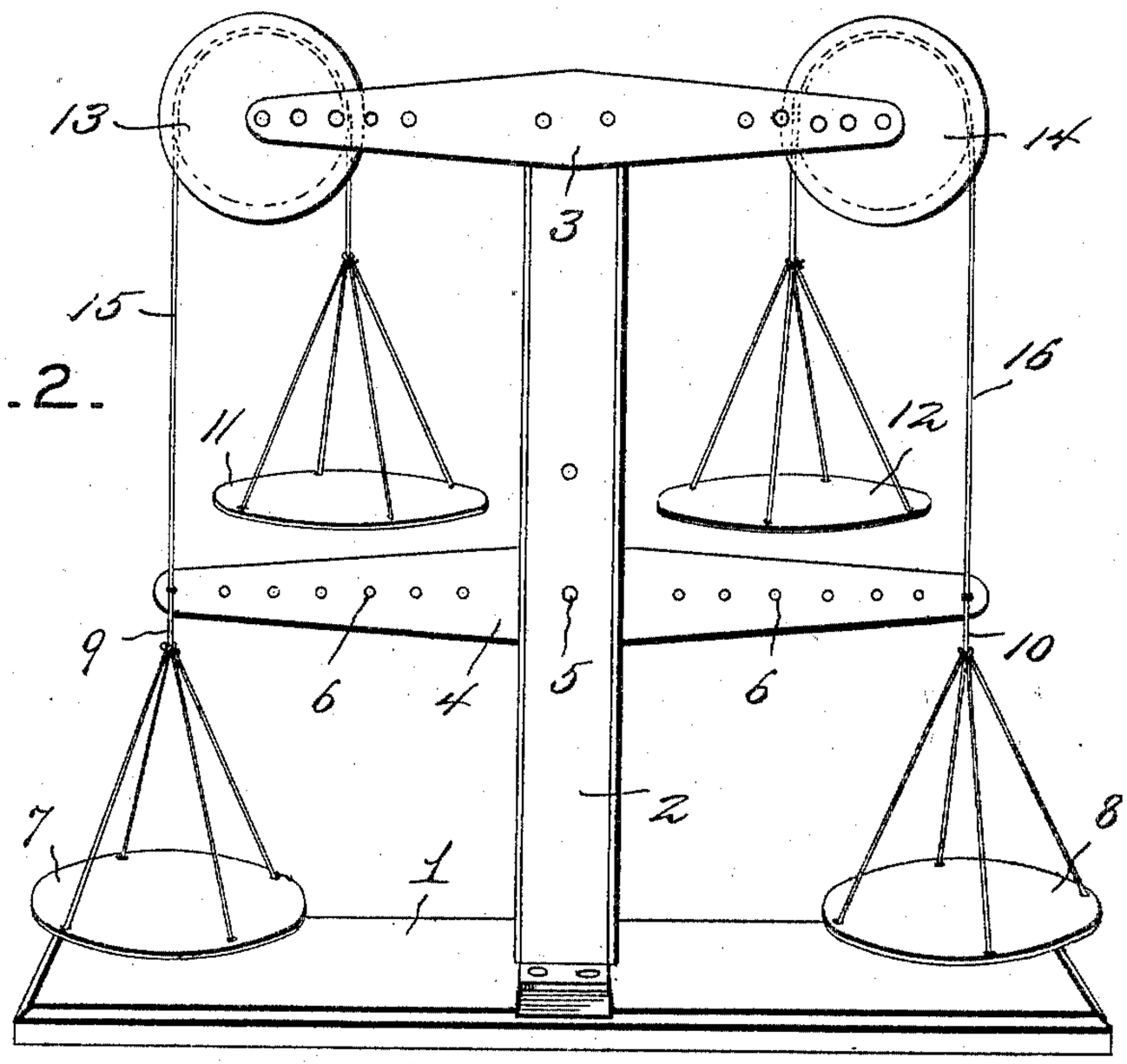


FIG. 2.



Witnesses
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2 SHEETS—SHEET 2.

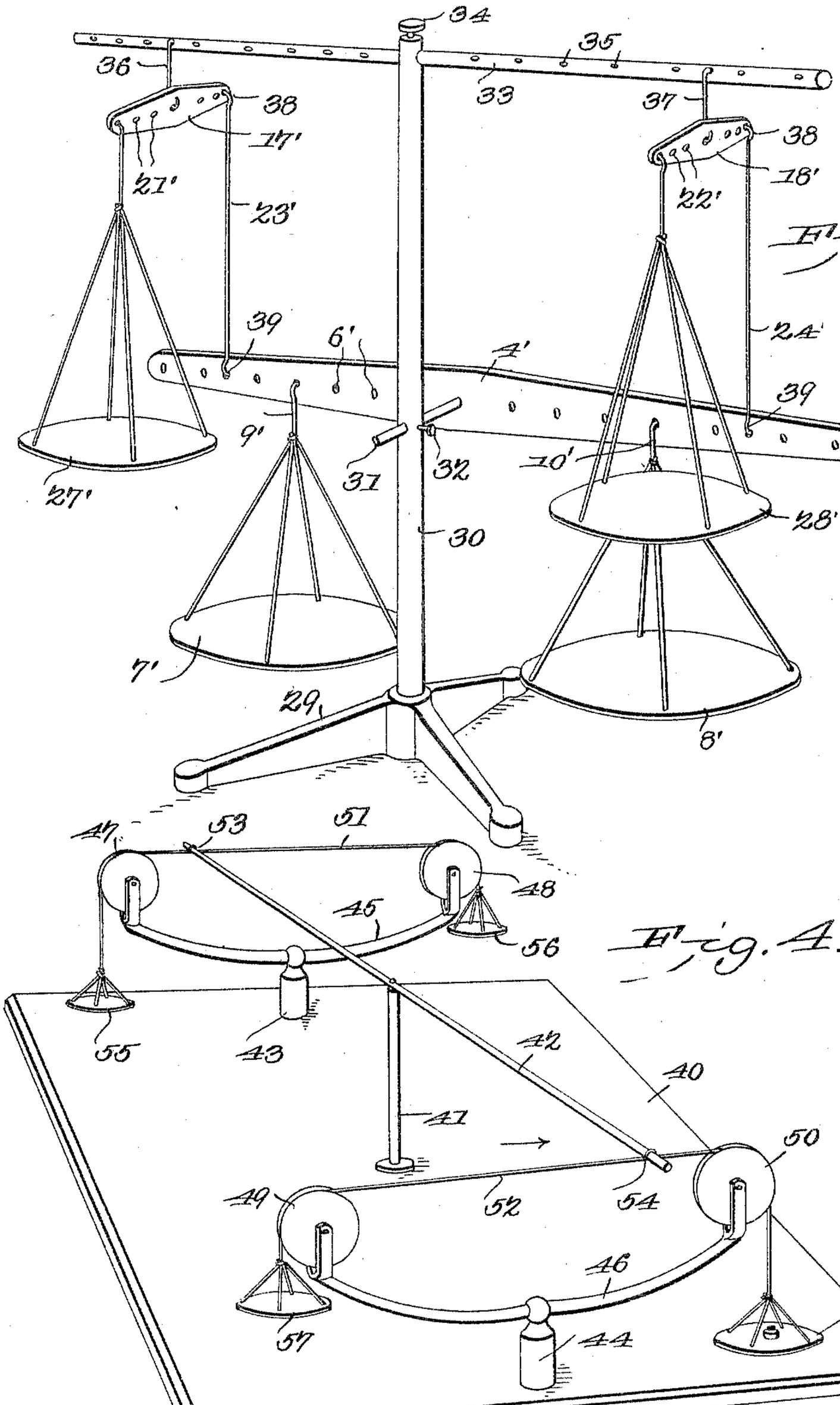

Fig. 3.

Fig. 4.

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No. 784,145. Patented March 7, 1905.

UNITED STATES PATENT OFFICE.

FRANKLIN CHRISTIAN DONECKER, OF CHICAGO, ILLINOIS.

EDUCATIONAL DEVICE.

SPECIFICATION forming part of Letters Patent No. 784,145, dated March 7, 1905.

Application filed August 23, 1904. Serial No. 221,877.

To all whom it may concern:

Be it known that I, FRANKLIN CHRISTIAN DONECKER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Educational Device, of which the following is a specification.

This invention relates to educational devices, and has for its object to provide a device of this character arranged to mechanically illustrate algebraic operations, particularly the theory of transposition in equations and the opposite character of positive and negative quantities.

With this object in view the present invention consists in the combination and arrangement of parts, as will be hereinafter more fully described, shown in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that changes in the form, proportion, size, and minor details may be made within the scope of the claims without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings, Figure 1 is a perspective view of an apparatus embodying the features of the present invention. Fig 2 is a similar view showing a modification in one of the elements of the apparatus. Fig. 3 is a perspective view of the preferred embodiment of the invention. Fig. 4 is a perspective view of another modified arrangement of the device.

Like characters of reference designate corresponding parts in each and every figure of the drawings.

Each of the first two embodiments of the apparatus shown in the accompanying drawings comprises a base 1, from the center of which rises a standard 2, having at its top a rigid cross bar or head 3. Substantially midway between the ends of the standard is a lever 4, fulcrumed to the standard, as at 5, substantially midway between the ends of the lever. Under certain conditions it may be desirable to have one arm of the lever longer than the other, and to provide for such a contingency the lever is provided throughout its length with a series of perforations 6, any one of which may be engaged with the fulcrum-pin 5. Suitable baskets or receptacles 7 and 8 are loosely hung from the opposite ends of the lever 4 by means of the respective hooked hangers 9 and 10, capable of being engaged with any of the perforations 6, so as to shift the positions of the baskets or receptacles. Other baskets or receptacles, 11 and 12, are supported by opposite ends of the cross head or bar 3.

One manner of supporting the baskets 11 and 12 has been shown in Fig. 2, wherein grooved pulleys 13 and 14 are rotatably mounted upon the respective extremities of the cross head or bar 3 and over which run independent cords 15 and 16, having their outer ends connected to the respective extremities of the lever 4, with the receptacles 11 and 12 hung from the inner ends of the respective cords.

In another form of the device, as shown in Fig. 1, independent levers 17 and 18 are fulcrumed upon the respective ends of the cross head or bar 3, as at 19 and 20, said levers being provided with longitudinal series of perforations 21 and 22, respectively, whereby said levers may be shifted upon their respective fulcrums. Cords 23 and 24 are connected to the outer ends of the respective levers 17 and 18 and to the corresponding ends of the lever 4, said cords being of a length to be stretched taut when all of the levers are in a substantially horizontal position. Other cords, 25 and 26, are connected to the inner ends of the respective levers 17 and 18, and baskets or receptacles 27 and 28 are hung from said individual cords.

It will of course be understood that the receptacles or baskets and the supports therefor are arranged so as to be normally balanced with the lever 4 in a substantially horizontal position, so that adding weight to and subtracting weight from any of the baskets or receptacles will cause an overbalancing of the apparatus and a consequent shifting of the levers and the relative positions of the several baskets.

The preferred embodiment of my invention has been shown in Fig. 3 and includes a base 29, from which rises a standard 30, which is pierced intermediate of its ends by an endwise-adjustable fulcrum-bar 31, which is ad-

justably held by means of a set-screw 32 piercing the standard and engaging the rod. As in the former constructions, the lever 4′ is fulcrumed upon the bar 31 and has the longitudinal series of openings 6′ whereby the lever may be shifted upon its fulcrum. Corresponding to the cross-heads 3 of Figs. 1 and 2 there is a cross-head 33, slidable in an endwise direction through an opening formed in the top of the standard at substantially right angles to the opening for the reception of the fulcrum-bar 31 there being a set-screw 34 piercing the top of the standard and engaging the cross-head 33 to hold the same in any adjusted position. This cross-head is provided with a longitudinal series of perforations 35. From the respective ends of the lever 4′ are hung pans or receptacles 7′ and 8′ by means of the hooks 9′ and 10′, which are designed for adjustable engagement with the perforations 6′ of the lever, so as to shift the positions of the pans upon said lever. Balances are hung from the opposite ends of the cross-head 33 and include the respective levers 17′ and 18′, which are disposed at substantially right angles to the cross-head instead of parallel therewith, as in Fig. 1. These levers are hung from the cross-head 33 by means of hangers 36 and 37, terminating at opposite ends in hooks for engagement with the perforations 35 of the cross-head 33 and the perforations 21′ and 22′ of the respective levers 17′ and 18′. Cords or suitable connections 23′ and 24′ depend from corresponding ends of the supplemental levers, each of said members being provided at its upper end with a hook 38 for adjustable engagement with the perforations of the adjacent supplemental lever and terminating at its lower end in a hook 39 for adjustable engagement with the perforations of the main lever 4′. Pans or receptacles 27′ and 28′ are hung from the other ends of the supplemental levers and may be adjustably hung from the perforations thereof. The difference between this form of the device and that shown in Fig. 1 of the drawings resides in the adjustable fulcrum 31, the adjustability of the cross-head 33, and the disposition of the supplemental levers at substantially right angles to the main lever instead of parallel therewith.

In explanation of the manner of using the several forms of my invention as illustrated in the accompanying drawings I will give three examples, as follows:

First. Subtraction of positive and negative quantities, or both. Problem: From $2w$ subtract $-5w$. Solution: Place two weights in pan or receptacle 28 and five weights in the pan or receptacle 7. Since subtraction is the process of finding what quantity must be added to the subtrahend to equal the minuend, weights are added to the side of the apparatus on which the five weights have been placed, so as to balance the apparatus. To balance the apparatus, it is found that seven weights in the pan 27 are required, from which it will be understood that the answer to the problem is $+7w$. (All weights used are equal.)

Second. Multiplication of quantities either positive or negative, or both. Problem: Find the product of -3 and -4. Solution: Having a device in balance with, say, for instance, fifteen weights in each of the pans 7 and 8, remove three groups of four weights each from the pan 8. Each group is one time -4. Since putting on weights is adding, or $+$, and taking off weights is subtracting, or $-$, having taken off three groups the operation is expressed by -3, and we are in position to measure -3 times -4. Having changed the right side, the change is measured on the left side, and it is found that a balance is restored by placing twelve weights in pan 27, thereby indicating that -3 times -4 equals $+12$.

Third. Simple equations — transposition. Problem: Given $2x - 10 = 50 - x$, to find the value of x. Solution: Equal unknown weights are used and so selected that two unknown weights in pan 27, ten grams in pan 7, fifty grams in pan 28, and one unknown weight in pan 8 will balance. This arrangement expresses $2x - 10 = 50 - x$. Transferring one unknown weight from pan 8 to pan 27 and the ten-gram weight from pan 7 to pan 28 leaves the device in balance and corresponds to the expression $2x + x = 50 + 10$ or when combined $3x = 60$, $x = 20$. Arranging the weights in pans 27 and 28 in three equal groups and removing two groups from each pan one unknown weight remains in pan 27 and twenty grams remains in pan 28, which illustrates and proves that the unknown weight or x equals twenty grams.

By transposing weights from one pan to another in various combinations the fundamental arithmetical and algebraic operations may be illustrated and proved.

While the three forms of the device shown in Figs. 1, 2, and 3 illustrate vertically-swinging levers, it is not necessary to employ a vertically-swinging lever only, as the lever may be mounted to swing horizontally, as shown in Fig. 4, wherein 40 designates a base from which rises a standard 41, with a horizontal swinging lever 42 fulcrumed midway of its ends upon the top of the standard 41. At opposite ends of the base are suitable posts 43 and 44, which support the respective cross-bars 45 and 46, with grooved pulleys 47 and 48 mounted upon the ends of the cross-bar 45 and other grooved pulleys 49 and 50 mounted upon the ends of the cross-bar 46. Flexible cords 51 and 52 are run over the respective pairs of pulleys and have their middles connected to the respective terminals of the lever 42, as indicated at 53 and 54, suitable pans or receptacles 55 and 56 being hung from the free ends of the cord 51 and other pans or re-

ceptacles 57 and 58 hung from the respective ends of the cord 52. In this arrangement of the apparatus a weight placed in one of the pans—say, for instance, that indicated 58—overbalances the pan 57 and draws the adjacent end of the lever from its intermediate normal position in the direction of the arrow, and to overcome this weight and produce a balance in the apparatus it is necessary to deposit a corresponding weight in one or the other of the pans or receptacles 56 and 57.

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

1. An educational device comprising a support having a cross-head, a lever fulcrumed upon the support below the cross-head, receptacles hung from opposite end portions of the lever, and balances hung from opposite end portions of the cross-head and including cords connected to the corresponding ends of the lever, and receptacles hung from the other ends of the cords.

2. An educational device comprising a support having a cross-head, a fulcrum-pin carried by the support below the cross-head, a lever supported upon the fulcrum-pin and capable of being shifted thereon, receptacles hung from opposite ends of the lever, and balances hung from the opposite ends of the cross-head and including cords connected to the corresponding ends of the lever, and receptacles hung from the other ends of the cords.

3. An educational device comprising a base, a standard rising therefrom, a cross-head carried by the top of the standard, a fulcrum-pin carried by the standard, a lever having a longitudinal series of openings for the individual reception of the fulcrum-pin, receptacles hung from opposite ends of the lever, and balances hung from the ends of the cross-head and including cords connected to the corresponding ends of the lever, and receptacles hung from the other ends of the cords.

4. An educational device comprising a support, a lever mounted thereon, and balances supported independently of the lever and connected to the respective ends of said lever.

5. An educational device comprising a base, a standard rising therefrom, a lever fulcrumed intermediate of its ends upon the standard, and balances supported independently of the lever and connected to the respective ends of said lever.

6. An educational device comprising a support, a cross-head thereon, a lever fulcrumed intermediate of its ends upon the support, receptacles hung from opposite end portions of the lever, and balances hung from the respective end portions of the cross-head, each balance having one end connected to the adjacent end of the lever and a receptacle at the opposite end of the balance.

7. An educational device comprising a support, a lever fulcrumed thereon intermediate of its ends, a cross-head carried by the support, receptacles hung from opposite end portions of the lever, intermediately-fulcrumed supplemental levers supported by opposite end portions of the cross-head, corresponding ends of the supplemental levers being connected to adjacent ends of the main lever, and receptacles hung from the other ends of said supplemental levers.

8. An educational device comprising a support, a lever fulcrumed intermediate of its ends thereon, receptacles hung from opposite end portions of the lever, a cross-head upon the support, intermediately-fulcrumed supplemental levers supported by the cross-head and disposed at substantially right angles to the main lever, each supplemental lever having one end connected to the adjacent end of the main lever and provided with a receptacle at its opposite end.

9. An educational device comprising a support, a main lever fulcrumed thereon, receptacles hung from opposite end portions of the main lever, a cross-head upon the support, intermediately-fulcrumed supplemental levers supported by opposite end portions of the cross-head and capable of adjustment thereon, each supplemental lever having one end connected to the adjacent end of the main lever and provided at its opposite end with a receptacle.

10. An educational device comprising a base, a standard rising therefrom and provided with transverse openings disposed at substantially right angles to one another, a rod adjustable endwise through the lower opening, a set-screw to fix the rod in the opening, a main lever fulcrumed intermediate of its ends upon the rod and shiftable therewith, receptacles hung from opposite end portions of the lever, a cross-head adjustable endwise through the other opening in the standard, a set-screw to adjustably fix the cross-head upon the standard, intermediately-fulcrumed supplemental levers supported by the respective end portions of the cross-head, each supplemental lever having one end connected to the adjacent end of the main lever and provided with a receptacle at its opposite end.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

FRANKLIN CHRISTIAN DONECKER.

Witnesses:
FRED M. WALKER,
FREDK. A. SPEIK.