

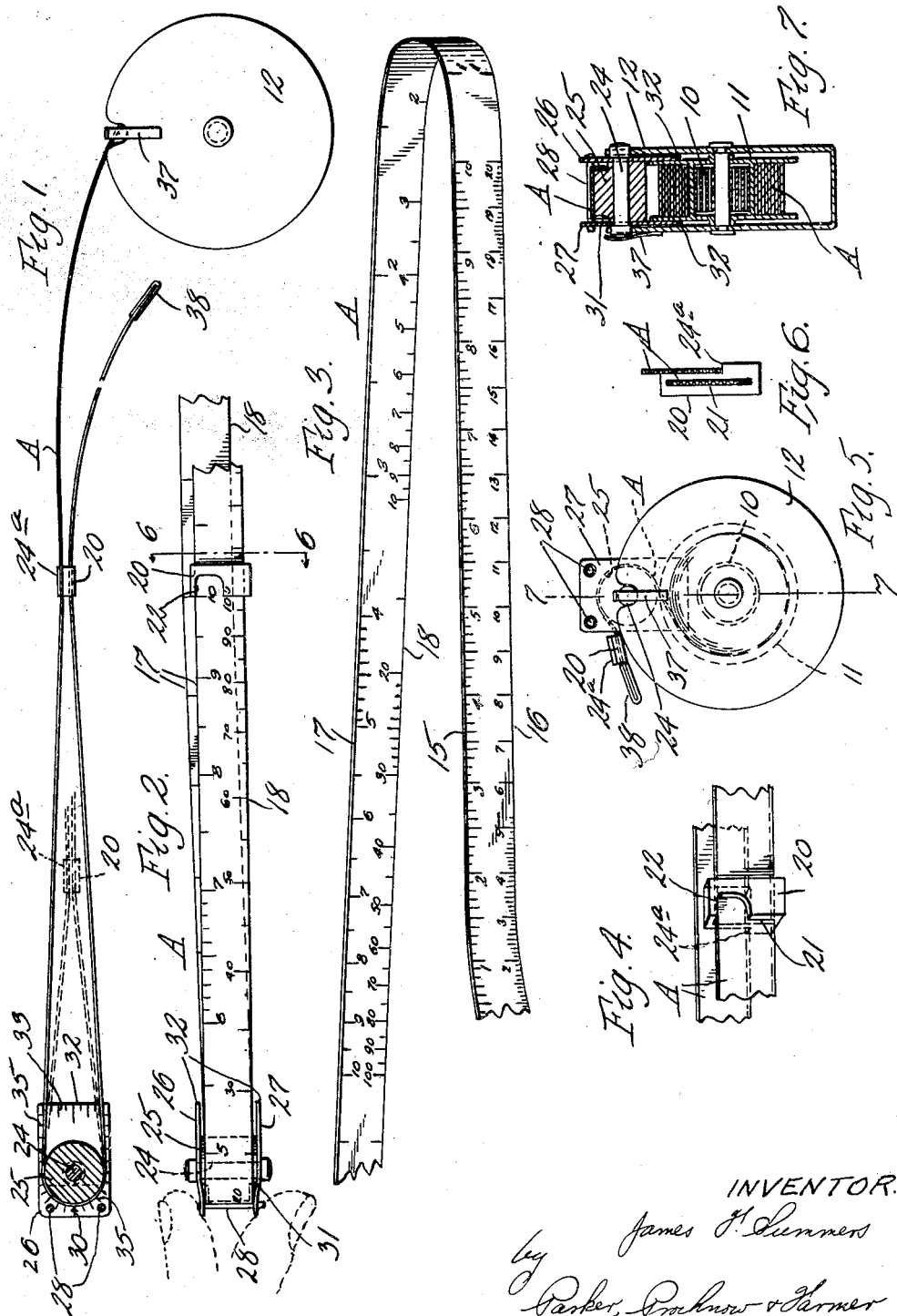
Nov. 28, 1933.

J. F. SUMMERS

1,936,998

CALCULATING DEVICE

Filed April 16, 1932



INVENTOR.

James F. Summers
by Parker, Robinson & Garner
ATTORNEYS.

UNITED STATES PATENT OFFICE

1,936,998

CALCULATING DEVICE

James F. Summers, Snyder, N. Y.

Application April 16, 1932. Serial No. 605,723

14 Claims. (Cl. 235--71)

This invention relates to calculating devices of a portable type by means of which various mathematical calculations can be made.

The objects of this invention are to provide a calculating device by means of which greater accuracy can be obtained by means of a calculating device occupying materially less space than is required for slide rules and other calculating devices of corresponding accuracy; also to provide a device of this kind which can be easily manipulated to make calculations which when not in use can be confined in a small case; also to provide a calculating device in which the graduations by means of which calculations are made are formed on a flexible tape which, when not in use, may be arranged in a coil; also to improve calculating devices of this kind in the other respects hereinafter specified.

This invention is based on the fact that the sum of any two numbers is equal to twice their average and, consequently, if two sets of graduations are arranged side by side and coextensive, one set of graduations being of half of the scale of the other, then the average of two numbers on the first set of graduations will be found at a point midway between these numbers, and twice this average can be found on the other set of graduations at a point directly opposite the average. This principle may be carried out in higher mathematics by using other ratios between the two sets of graduations than the 2:1 ratio above referred to.

In the accompanying drawing:

Fig. 1 is a side elevation, partly in section, of a calculating device embodying this invention.

Fig. 2 is a fragmentary face view of a portion of the tape;

Fig. 3 is a perspective view of another portion of the tape;

Fig. 4 is a fragmentary perspective view of two portions of tape with a slide member arranged on one of the portions;

Fig. 5 is a side elevation of the calculating device when not in use;

Fig. 6 is a sectional view of line 6—6, Fig. 2;

Fig. 7 is a sectional view on line 7—7, Fig. 5.

The invention is shown in the accompanying drawing as applied to a flexible tape which cooperates with means for finding a midway point between two other points on the tape, but it will be understood that it is not intended to limit the invention to the particular device shown, since obviously the invention may be carried out by other means than those illustrated.

A represents a strip or flexible tape which may,

for example, be made of steel or other material, and which when not in use may be wound by means of a coil spring 10 upon a drum or spool 11, the spool and spring being arranged within a case 12. All of these parts may be of any suitable construction, such for example as heretofore used in connection with measuring tapes.

The tape is provided with a plurality of sets of graduations which, for sake of convenience may be arranged at the opposite edges of the tape, and these sets of graduations are coextensive lengthwise of the tape. One of these sets of graduations is two or more times the scale of the other set and the smaller set of graduations may therefore be repeated so that two or more successive sets of graduations are arranged opposite to the larger scale set of graduations.

Referring first to the lower portion of Fig. 3, which shows in its simplest form the principle upon which my invention is based, the edge portion 15 of the lower portion of the scale shown in this figure is provided with a set of graduations spaced equally from each other and provided with numbers arithmetically arranged. Subdivisions of the graduations are preferably also provided, such subdivisions being only partly shown in Figs. 2 and 3 for the sake of clearness. On the other edge portion 16 of the same part of the tape is arranged another set of graduations, the graduations in this case being half the scale of the other graduations, or in other words, the graduations on the edge 16 are twice the number of the graduations on the edge portion 15 and are spaced half as far apart. This portion of the tape is intended to be used for addition and subtraction, and it will be noted that the numbers on the graduations of the edge portion 16 are double those on corresponding graduations on the edge portion 15, so that if any number on the edge portion 15 is added to itself, or doubled, the answer can be read on the directly opposite side of the tape, to wit, on the edge portion 16. If two numbers are to be added, these numbers are located on the edge portion 15 of the tape and a point midway between these two numbers is then found on the edge portion 16 so that by means of the graduations on this edge of the tape the answer can be read off. For example, if the tape is made of material that is sufficiently flexible to permit creasing of the same, any two numbers on the scale at the edge portion 15 can be added by doubling the tape upon itself to place these

two numbers directly opposite each other and then bisecting the portion of the tape between these two numbers in the usual way by creasing the tape. At the crease and on the edge portion 16 will be found the answer. For example, if 3 and 9 are to be added, the tape is flexed so that the graduations 3 and 9 on the edge portion 15 of the tape are in registration, and by finding the half-way position between these two numbers on the opposite edge portion of the tape, the answer 12 can be read. Subtraction is, of course done in a similar manner. If 3 is to be subtracted from 12, the flexible tape could be creased at 12, so that the portions of the tape toward opposite ends from the crease will lie in contact. In registration with 3 will be 9. When the tape is made of metal or other less flexible material, suitable means for finding the half-way position may be employed instead of creasing the tape. In order to facilitate the use of the tape, identical graduations are preferably formed on both faces of the tape so that, for example, the same graduations will be formed on both faces of the edge portions of the tape.

In order to effect multiplication and division, the same principle can be employed on a different tape or on a different portion of the same tape, if the opposite edge portions of the tape are provided with logarithmic graduations. In this case again, the graduations on the edge portion 17 of the tape are on a larger scale than the graduations on the edge portion 18, being twice the scale for ordinary multiplication and division, although different ratios may be used for other mathematical calculations. The smaller scale graduations are repeated so that when the scale of one set of graduations is twice that of the other, two complete sets of graduations will be placed opposite a single set of graduations, or if desired, the numbers on the smaller scale graduations may run from 1 to 100 while those on the larger scale graduations run from 1 to 10. The logarithmic graduations may be formed in the same manner as is customary on slide rules, the numbers opposite the graduations being natural numbers. Consequently, in order to multiply two numbers, it is necessary to find these two numbers on the graduations on the edge portion 17 of the tape and then find a point half way between these two numbers. This may be done by bending the tape so that these two numbers are in registration. The product is found on the opposite scale at a point half-way between these two numbers. By reversing this procedure, division may, of course, be done. Numbers may be squared or square roots taken by reading directly across the tape from one scale to the other.

Still another tape may be graduated in such a way that logarithmic graduations are on one edge portion while the logarithms of logarithms are used as a basis of graduation of the opposite edge portion of the scale, and by a similar manipulation of the tape, as already described, other calculations can be made which will be obvious to those skilled in mathematics, such as raising numbers to different powers, and finding roots.

Since the tape may be of thin material, it may also be made long enough to have different sets of graduations for adding, multiplying and raising of numbers to different powers, on different portions of the length of the tape, or if desired, the entire length of the scale may be used for only one

of these operations, in which case the accuracy of the device is correspondingly increased.

Any suitable means may be provided on the tape for facilitating the use of the same. For example, for placing two graduations on the tape into registration, a slide member 20 may be provided on the tape, this slide, as shown, being in the form of a block of metal or other material having a slot 21 extending through the same through which the tape A may slide. The front face of the block at one side of the slide may be recessed or cut out as indicated at 22 in Figs. 2 and 4, to facilitate reading the graduations on the tape, and the rear face of the block may be provided with a step or ledge 24a on which the edge of another portion of the tape A may be placed, as indicated in Fig. 6. In this way, two graduations on the edge portion 17 of the tape may be placed into registration, as indicated in Fig. 2. During the time that the answer is being read, the two portions of the tape adjacent to the slide 20 can be held in correct relation to each other by two fingers of one hand. Any other device may be used for this purpose, or, if desired, which device may be entirely omitted, since two graduations can be placed into registration without the aid of any slide or similar device.

The device shown in the drawing for use in finding the answer may be of any suitable or desired form for the purpose of determining the half-way position on the tape between the two parts in registration on the slide, 20. In the particular construction shown for this purpose a cylinder or partly cylindrical member 25 is provided which may either be rotatably or rigidly secured by means of a pin 24 to two side plates 26 and 27. The cylinder 25 is preferably of such radius that the tape A can be bent around the same without creasing or otherwise damaging the tape. These side plates may be held in correct relation to each other and to the cylinder 25 by any suitable means such, for example, by riveting or upsetting the ends of the pin 24 against the outer faces of the side plates, and if desired, also by a pair of posts or spacing members 28. Preferably these posts are rigidly secured to one of the plates and extend slidably through apertures in the other plate, so that the outer ends of the plates connected by the posts may be moved toward and from each other. These posts serve to confine the tape between the cylinder 25 and the posts so that the finder is permanently but movably arranged on the tape. The plate 26 is provided in the middle portion thereof with an arrow 30 or other indicator pointing toward the edges 18 or 16 of the tape, this arrow or indicator being located in the longitudinal central line of the finder. Consequently, when the two graduations on the edge portion 17 or 15 of the tape are placed into registration and the finder is pulled away from this point of registration to bisect the portion of the tape lying between these two points, as shown in Fig. 1, the arrow 30 will point to the correct answer on the edge portion 18 of the tape. In order to facilitate reading of the answer, the outer ends of the plates 26 and 27 may be pressed toward each other, as shown in Fig. 2, in which case these plates will engage the opposite edges of the tape and will hold the same against displacement relatively to the arrow or indicator 30 so that the answer may be read at the convenience of the person using the calculating device.

In order to make this possible, the cylinder 25 is notched or recessed at opposite sides, as indi-

cated at 31 in Figs. 2 and 7, or if the cylinder is rotatable about its axis, this can be made possible by having the recesses extend completely around the ends of the cylinder so that the tape extends slightly beyond the ends of the peripheral portion of the cylinder.

In order to avoid error in the answer resulting from the improper holding of the finder relatively to the tape, the plates 26 and 27 have extensions 32 which are provided near their edge portions with graduations 33 spaced equally from the center lines of the plates. The finder will be in correct position with reference to the tape when the central plane of the finder lies midway between the two parts of the tape extending to the finder, and consequently the finder will be in this correct position when the two parts of the tape adjacent to the graduations 33 are spaced at equal distances from the central line of these graduations, and this spacing of the tape relatively to the finder can easily be determined by means of the graduations 33.

When it is necessary to use the device for multiplying two numbers, the graduations of which are so close together that the slide 20 cannot be used, the two plates 26 and 27 may be provided adjacent to the portion of the tape at the finder with another series of graduations 35 which extend from the longitudinal central plane of the finder, or from the arrow 30 to opposite sides of the plates and to the inner edges 32 thereof, these graduations 35 thereof extending around the position occupied by the tape, as clearly shown in Fig. 1. These graduations are all equally spaced from the central plate of the finder and, consequently, when it is desired to multiply two numbers which are close together on the tape, instead of bringing these numbers into registration with each other, the two numbers are placed at equal distances from the indicator 30, such distances being readily determinable by the aid of the graduations 35. In this way, the middle point between the two graduations can be quickly found. The necessity of working with two graduations spaced closely together can, of course, be avoided by repeating at least portions of the sets of graduations at opposite ends of the main set of graduations on the tape. By extending the length of the extensions 32 of the side plates 26 and 27, this method of finding the half-way point could be carried on to a greater extent than shown in the drawing. Other means than the two shown for finding the midway point between two points on the tape can be employed if desired.

Preferably, the case 12 is made to receive at least a part of the finder to hold the same when not in use, and for this purpose, in the particular construction illustrated, the winding drum or spool 11 is spaced from the opposite side walls of the case 12 to a sufficient extent to permit parts of the plates 26 and 27 to enter into the case and straddle the drum or spool, as shown in Fig. 7. A retaining spring 37 may be arranged on a side of the case in such a way as to releasably engage with an end of the central pin 24 extending through the cylinder 25, and thus hold the finder in place on the case. The end of the tape may be provided with an enlarged outer end 38 which will not pass through the slot 21 in the slide 20 so that when the device is not in use the parts may be mounted thereon, as shown in Fig. 5. The tension of the spring 10 in this case also tends to hold the finder on the case. Any other means may be employed for detachably

holding the parts of the device together when not in use.

The device described has the advantage that the tape can be made of thin material, such as metal, so that a considerable length can be wound upon a relatively small spool or pulley. This permits the graduations to be made on a large enough scale to provide for accuracy equivalent to that of a slide rule of substantially the same length. When the device is not in use, the tape occupies very little space so that the entire calculating device occupies only a very small fraction of the space which would be occupied by a slide rule of corresponding accuracy.

I claim as my invention:

1. A calculating device having two sets of parallel, coextensive graduations, one set of graduations being twice the number of and proportionally spaced with respect to the graduations of the other set, the graduations being given the same value designations and arranged in the same order in both sets of graduations, and mechanical means associated with said sets and operable for directly indicating the midpoint between any two points on one set.

2. A calculating device having a plurality of sets of proximate parallel, coextensive unit graduations, the number of graduations of each set being a multiple of the number of graduations in another of said sets, the unit graduations of all sets being proportionately spaced with respect to those of the other sets, given the same value designation, and arranged in the same order, and mechanical means operable endwise with respect to said sets and cooperating therewith for directly indicating a selected, multiple division point between any two points on one set.

3. A calculating device having a flexible tape provided on a lengthwise portion thereof with a set of graduations and having on a coextensive portion thereof a second set of graduations formed on a smaller scale such that a definite number of said second sets of graduations occupy a length of said tape coextensive with the length of said first set, and means associated with said tape to find on said second set of graduations a point half way between two points on said first set of graduations.

4. A calculating device, including a graduated strip provided on a lengthwise portion thereof with a set of graduations and having on a coextensive parallel lengthwise portion thereof a second set of graduations formed on half of the scale of said first set of graduations, and means associated with said strip for finding on said second set of graduations a point half-way between two points on said first set of graduations.

5. A calculating device, including a graduated flexible tape provided on a lengthwise portion thereof with a set of graduations and having on a co-extensive parallel lengthwise portion thereof a second set of graduations formed on a smaller scale than the first set of graduations, said tape being adapted to be bent to place two graduations on the first mentioned set of graduations into registration, and means cooperating with said tape to find a point on said other set of graduations midway between said registering graduations.

6. A calculating device including a graduated flexible tape provided on a lengthwise portion thereof with a set of graduations and having on a coextensive lengthwise portion thereof a second set of graduations formed on half of the scale of the first set of graduations, said tape being

adapted to be bent to place two graduations of said first set into registration, a device having a curved surface over which a portion of the tape intermediate of said graduations extends, and means on said device to indicate a point on the tape which is midway between said registering graduations.

7. A calculating device including a flexible tape and having graduations thereon and adapted to be bent to place two graduations on different parts of the tape into registration, and a device cooperating with said tape for finding a point thereon midway between said registering graduations, said device including an indicator, which, when the portion of the tape between said registering graduations is pulled taut, will be at said midway point.

8. A calculating device including a flexible tape and having graduations thereon and adapted to be bent to place two graduations on different parts of the tape into registration, and a device cooperating with said tape for finding a point thereon midway between said registering graduations, said device including a curved part against which said tape bears when the portion of the tape between said registering graduations is pulled taut, and side members arranged to engage the opposite side edges of the tape to hold the same in correct relation to said curved part, and a graduation on said device indicating the midway point of said portion of tape between said registering graduations.

9. A calculating device including a flexible tape having graduations lengthwise thereof and adapted to be bent to place two registrations on different parts of said tape into registration, and a device for finding the midway point between said registering graduations, said device including a curved part against which a portion of the tape bears when the part of the tape between said registering graduations is pulled taut, side members connected with said curved part and arranged to engage the edges of said tape and having a part extending towards said registering graduations, said part having graduations for indicating when said side members are in correct relation to said registering graduations, and means on one of said side members for indicating the point on said tape located midway between said registering graduations.

10. A calculating device including a strip having graduations arranged lengthwise thereon, and a device arranged to cooperate with said strip

for finding a point thereon midway between two graduations of said strip, including an indicator arranged to point to said midway point on the strip, and graduations on said device, equally spaced from said indicator, with reference to which graduations on said strip may be spaced at equal distances from said indicator.

11. A calculating device including a flexible strip provided with graduations arranged lengthwise thereon, and a device for use in finding a point midway between two graduations on said strip, said device including a curved surface over which a part of said strip may be bent, an indicator on said device for indicating a point halfway between two graduations on said strip, and graduations on said device extending toward opposite sides of said indicator for use in connection with the spacing of two graduations on said strip at equal distances from said indicator.

12. A calculating device including a graduated strip of flexible material, said strip being adapted to be bent to place two graduations on different parts of the strip into registration, means for determining the point on said strip midway between said registering graduations, and a member slidably arranged on said strip and movable into registration with one of said registering graduations and having a part adapted to receive the portion of the strip carrying the other registering graduation to facilitate the placing of said graduations into registration.

13. A calculating device including a graduated flexible tape, a spool on which the same may be wound, a case in which said spool is contained and open at an edge portion to permit the tape to be drawn out of said case, a device adjustable lengthwise of said tape for use in determining a point midway between two graduations on said tape, and means on said case for receiving a portion of said device to hold the same in connected relation to said case.

14. A calculating device including a graduated flexible tape, a spool on which the same may be wound, a spring for turning said spool in a direction to wind the tape thereon, a device movable lengthwise of said tape for determining a point midway between two graduations on said tape and having parts adapted to enter into said case, said spring serving to yieldingly hold said device in operative relation to said case when said device is not in use.

JAMES F. SUMMERS.

55

130

60

135

65

140

70

145

75

150