May 22, 1934. J. F. SUMMERS 1,959,990

CALCULATING DEVICE

Filed Jan. 11, 1933 2 Sheets-Sheet 1

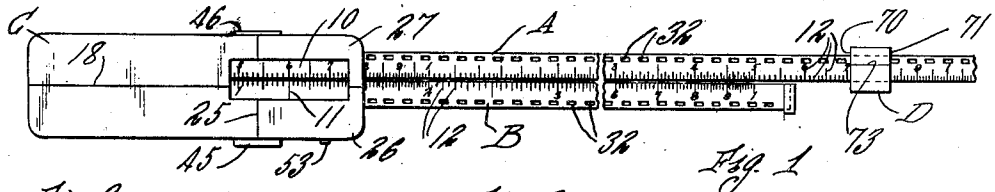


Fig. 1

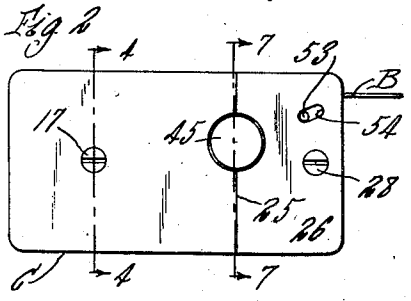


Fig. 2

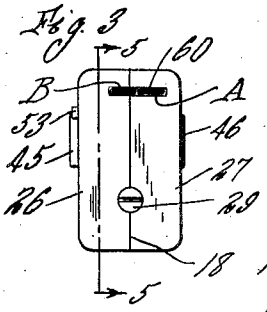


Fig. 3

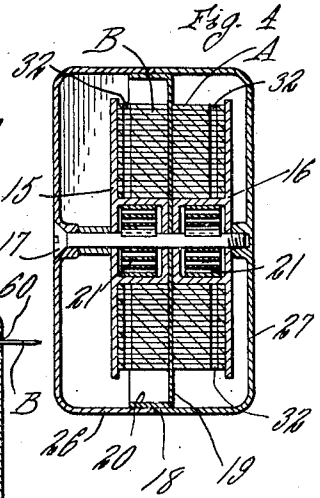


Fig. 4

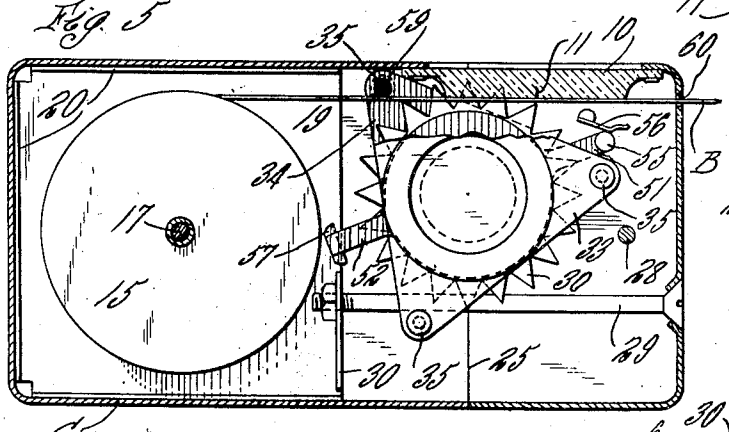


Fig. 5

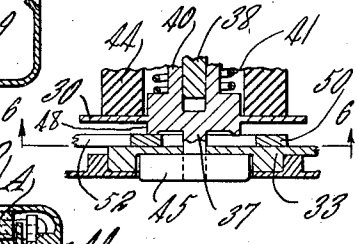


Fig. 8

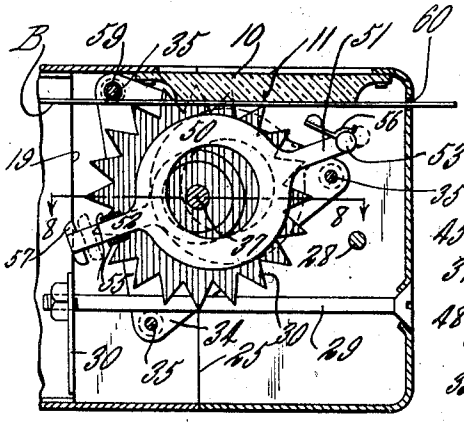


Fig. 6

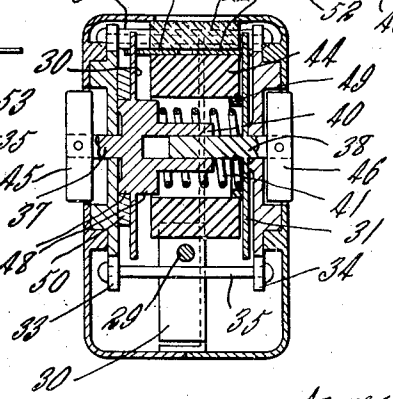


Fig. 7

INVENTOR
James F. Summers
by Parker, Prochnow & Turner
ATTORNEYS

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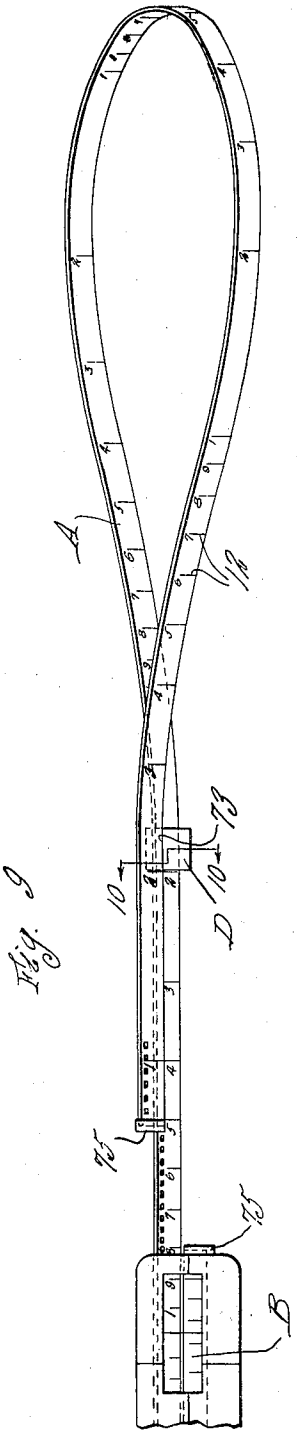


Fig. 9

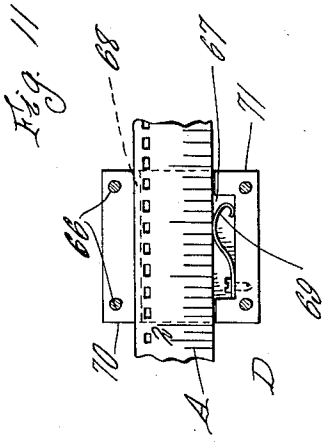


Fig. 11

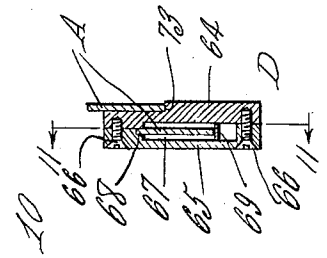


Fig. 10

INVENTOR
James F. Summers
by Parker, Prochnow & Farmer
ATTORNEYS.

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CALCULATING DEVICE

James F. Summers, Snyder, N. Y.

Application January 11, 1933, Serial No. 651,109

4 Claims. (Cl. 235—70)

This invention relates to portable calculating devices by means of which various mathematical calculations can be made, and which occupy a small space when not in use.

Heretofore portable or pocket calculating devices have been mainly in the form of slide rules, in which cases, however, the length of the slide rules must be limited in order to make it possible to carry the same in a pocket, and the accuracy of a slide rule depends to a large extent upon its length.

The objects of this invention are to provide flexible tape with graduations suitable for making calculations of various kinds and arranged so that two tapes or two lengths or stretches of a single tape may be placed adjacent to each other and shifted lengthwise of each other to make the desired calculations; also to provide a tape of this kind with means for facilitating the placing of graduations on one tape or part of a tape in the desired relation to another tape or part of the tape; also to provide a device of this kind having a pair of tapes arranged side by side with graduations on adjacent portions thereof and arranged to coil up within a suitable housing or container, so that the tapes occupy very little space; also to provide a calculating device of this kind in which the tapes are mounted on separate reels arranged side by side to permit each tape to move lengthwise independently of the other for placing the tapes into the desired registration with each other; also to provide means, in a calculating device of this kind, for preventing lengthwise movements of the tapes relative to each other; also to provide a construction of this kind in which two reels are used which normally operate independently of each other to wind the tapes on the same and to provide other means for coupling the tapes to prevent relative lengthwise movement of one tape to the other and to permit simultaneous lengthwise movement of the tapes; also to provide a device of this kind with means for locking both tapes against movement; also to improve the construction of calculating devices of this kind in other respects hereinafter specified.

In the accompanying drawings:

Fig. 1 is a top plan view of a calculating device embodying this invention.

Figs. 2 and 3 are respectively side and end views thereof.

Fig. 4 is a sectional view thereof, on line 4—4, Fig. 2, and on an enlarged scale.

Fig. 5 is a longitudinal sectional elevation, on line 5—5, Fig. 3.

Fig. 6 is a fragmentary sectional elevation thereof, on line 6—6, Fig. 8.

Fig. 7 is a transverse sectional elevation thereof, on line 7—7, Fig. 2.

Fig. 8 is a fragmentary transverse sectional elevation thereof, on line 8—8, Fig. 6.

Fig. 9 is a top plan view of the calculating device showing a single tape used for making calculations with the aid of a device for use in placing graduations of one part of the tape into the desired relation to graduations of another part thereof.

Fig. 10 is a transverse sectional elevation thereof, on line 10—10, Fig. 9.

Fig. 11 is a longitudinal sectional elevation thereof, on line 11—11, Fig. 10.

A and B represent two tapes or stretches of tapes, since obviously the two tapes could be connected at their outer ends and be parts of a single tape and the word "tapes" as herein used is intended to include two stretches or parts of a single tape. C represents a housing provided with suitable means for enabling the tapes to be coiled up within the same, and the top face of the housing is preferably provided with an opening, which may have a glass window 10 having a hair line or index 11 thereon, so that graduations 12 on the two tapes can be clearly seen. These graduations may be of any suitable or desired form, logarithmic graduations being used where multiplication, division and similar calculations are to be made and graduations according to logarithms of logarithms are being used for finding roots and powers, while simple arithmetic graduations may, of course, be used for other calculations. These tapes are preferably made of relatively thin material, so that they can be of considerable length without occupying much space when coiled, and consequently, certain portions of these tapes may carry one set of graduations, while other portions carry other sets of graduations. In the construction shown, only one edge portion of the top face of each tape is provided with graduations, and the other faces of the tapes may also be graduated, as clearly shown in Fig. 9, but the graduations may be placed on the tapes in any other suitable or desired manner. It is not intended to limit this invention to any particular type of graduations for use in making calculations. Preferably, the two tapes are made of relatively thin metal such as steel, although nonmetallic materials of suitable strength and flexibility may be employed, if desired.

Any suitable means may be employed for coil-

ing or winding up the tapes within the housing. In the particular construction shown, two reels 15 and 16 are provided, which are journalled on a pin or bolt 17 which, in the construction illustrated, has a threaded engagement at one end with a lug or projection of a side wall of the housing, and the pin may also be used for securing together two sections of the housing which may, for example, be split or separated along a longitudinal line 18. In order to keep the two tapes on their own reels, a relatively thin partition plate or wall 19 is preferably provided between the two reels, the ends of the partition wall being flanged over at 20 and secured to one of the two parts of the housing and forming a lip or flange for holding the adjacent edges of the two parts of the housing in correct alinement. The reels are preferably provided with springs 21 which normally tend to turn the reels in a direction to wind the tapes thereon. Any other means for winding or coiling the tapes within the housing may be employed and a housing of other construction may also be employed, if desired.

In order to facilitate the assembly and mounting of the parts in the housing, the housing may be split transversely thereof along the line 25, Figs. 1, 2 and 6, thus resulting in a housing which is formed of four parts, two front parts 26 and 27 thereof being secured together by means of a transverse screw or bolt 28, and these two parts are secured to the other portion of the housing by means of a bolt 29 engaging a flange 30 of the transverse partition 19.

In addition to providing means for winding up or reeling the tapes within the housing, it is also desirable to provide means whereby the two tapes may be held against relative movement to each other. For example, in making a calculation, it is generally necessary to adjust the tapes lengthwise of each other until two graduations thereon are in registration. It may then be desirable to hold the two tapes in such relative positions but at the same time to permit the tapes to be moved into or out of the housing, to read the answer or answers. Means of this kind are provided in the housing, and in the particular construction illustrated, include two gear or sprocket wheels 30 and 31 having teeth adapted to engage in slits or perforations 32 formed in the tapes A and B. These gears are rotatably mounted in a frame arranged within the housing and which includes two side frame members 33 and 34, which in the particular construction are substantially triangular in shape and are connected near their apices by means of transverse rods or bars 35, the ends of which are suitably secured to the frame members. The frame members in turn may be secured against movement relatively to the housing of the device in any suitable manner. Each frame member is provided with a central aperture in which a hub portion of one of the gears 30 and 31 is journalled, the gear 30 being provided with a hub or axle 37 extending into an aperture in the frame member 33 and the gear 31 is provided with a hub or axle 38 bearing in the aperture in the frame member 34. The two axles 37 and 38 are mounted to rotate independently of each other, but are held in concentric relation to each other, for example, by means of an extension 40 on the hub member or axle 37 which is provided with a bearing recess or aperture to receive the axle member 38. Yielding means, such as a spring 41, may be interposed between the two gears to normally hold the same in the positions shown in Fig. 7, in which each gear may rotate freely independently of the other.

When it is desired to prevent relative lengthwise movement of the two tapes with reference to each other, the two gear members may be coupled or connected in such a manner that neither can turn without a corresponding turning movement of the other. A clutch of any suitable or desired construction may be employed for this purpose, and in the construction shown, an annular clutch, coupling, or friction member 44 is provided between the two gears, and the gears are constructed to shift toward and from each other into and out of engagement with the clutch member 44. In the particular construction shown, this clutch member is arranged between the two gears and each gear axle or hub is provided at the outer end thereof and beyond the outer wall of the housing with a knob or projection so that the gears may be moved toward each other and into engagement with the clutch member 44, the sprocket wheels 30 and 31 being provided respectively with knobs or projections 45 and 46. When it is desired to couple the gears to prevent relative movement of the same, it is merely necessary to push the two knobs or buttons 45 and 46 toward each other. The clutch or friction member 44 may be made of any suitable or desired friction material for the purpose of frictionally engaging the inner faces of the two gears 30 and 31 at opposite sides of the friction member, or if desired, a positive coupling member may be employed to form a connection between the two gears or sprocket wheels 30 and 31. The coupling member may be held in place when the parts are in the position as shown in Fig. 7, by means of an annular portion 48 on the gear 30, and by means of an inwardly projecting sleeve portion 49 which may extend inwardly from the inner face of the gear 31. Other means may, of course, be employed for holding this coupling member in position to engage the gears. The inwardly extending annular shoulder 49 also serves to confine the adjacent end of the spring 41 in its operative position.

As a result of the construction shown, after the two tapes have been set in a desired relation to each other, the two knobs 45 and 46 may be pressed inwardly toward the housing, which results in a coupling of the two gears through the medium of the coupling member 44. It is then possible to move the two tapes in or out of the housing C so that the answer or answers to the calculations can be read on any part of the tapes on which it may occur.

In the case of some calculations, it is necessary to hold the two tapes against movement relatively to each other for a considerable period of time. In a case of this kind, suitable means are provided for holding the two gears in their connected or coupled positions against the action of the coil spring 41 without the continued application of pressure to the two disks or knobs 45 and 46. This can be accomplished by means of a number of different structures and by way of example, a holding member is shown in the accompanying drawings which is in the form of an annular member 50 having arms 51 and 52 extending outwardly therefrom in opposite directions. The annular member during the ordinary use of the calculating device surrounds the hub portion 48 of the gear 30 between this gear and the adjacent frame member 33. When this gear is moved toward the gear 31 into the position

shown in Fig. 8, the annular member 50 may be shifted in such a manner as to be interposed between the hub portion 48 of the gear 30 and the adjacent side frame member 33, whereupon the two gears 30 and 31 will be held in engagement with the coupling member 44. In order to make this movement possible, the end of the arm 51 is provided with a laterally extending knob or projection 53 extending out through a slot 54 in the wall of the housing into a position to permit shifting of the knob lengthwise of the slot 54, and preferably the frame member 33 is provided with inwardly extending guide projections 55 arranged at opposite sides of the extension or arm 52 to guide the annular member 50 in its movement. A spring detent 56 of any suitable or desired form may be employed within the housing to engage with the knob or projection 53 to hold this knob in different positions.

It may also be desirable at times to lock the gears so that neither of them can be moved in either direction. In order to accomplish this, the arm 52 of the annular member is preferably provided with a resilient pad or shoe 57 which may engage with one or more of the teeth of the gear or sprocket member 30 to prevent rotation of the same. This pad may be made of any suitable material, such for example as soft rubber, or the like, and is clearly shown in Figs. 5 and 6. When the knob or projection 53 is moved to the opposite end of the slot 54 from that occupied by the knob in Fig. 2, the pad or shoe will be moved to the dotted line position shown in Fig. 6, to engage one or more teeth of the sprocket wheel, thus positively holding the gear 30, as well as the gear 31 coupled thereto, against rotation.

The resilient detent 56 would, of course, hold the knob or projection 53 in any of the three positions. The locking of the gear wheel 30 can, of course, only be effected when the annular member 50 is in a position in which the two gear wheels are in engagement with the friction or clutch member 44, and consequently, the locking of one gear wheel also results in the locking of the other one. This locking arrrangement may, for example, be used when the two tapes have been placed in a definite relation relatively to each other, and when it is desired to prevent the springs 31 of the rolls from drawing the tapes into the housing C.

In order to insure an engagement of the tapes with the gear wheels which will be free from lost motion, the teeth of the gear wheels are preferably pointed or wedge-shaped as shown, and the glass window 10 is preferably of sufficient thickness to extend inwardly to engage with the upper surface of the tapes, and thus hold the tapes in correct engagement with the teeth. This guiding action of the window may be supplemented by a roller 59, pivoted on a cross member 35 of the frame on which the gears are journalled. A slot 60 in the housing, through which the tapes pass into and out of the housing, also helps to guide the two tapes into and out of the housing and into correct relation to the gear wheels. This will eliminate any movement of either tape with reference to its gear wheel without corresponding movement of its gear wheel.

In addition to using the two tapes jointly for making calculations thereon, it is also possible to make calculations with the use of one tape only, and in some cases, it may be desirable to make certain calculations on one tape only and then employ the results thus obtained in connection with the other tape for further calculations. When this is desirable, a single tape may be looped or bent backward on itself, as clearly shown in Fig. 9, and the graduations on the two superimposed portions of the tape will then run in opposite directions. When logarithmic graduations are used on tapes of this kind, multiplication or division can be effected by placing graduations representing multiplier and multiplicand opposite to each other, whereupon the product will be read opposite a graduation representing the number 1 on either stretch of the tape. From this explanation, it will be obvious that division may be accomplished in a corresponding manner by placing a graduation representing the numeral 1 on one stretch of tape opposite the graduation representing the dividend on another stretch of tape, whereupon the divisor and quotient will be in registration on opposite stretches of tape. Other calculations can be made as will be obvious from the foregoing explanation. In Fig. 9, the tape A has been looped back and the graduations corresponding to the numbers 2 have been placed in alinement, and the product of these two numbers appears opposite the 1 of either stretch of tape, or in division, graduation 1 is in registration with the dividend 4 and in registration with the divisor 2 is the quotient 2.

The tape may, of course, be used in this manner by hand, but preferably, a suitable guide device is employed for placing a graduation on one stretch of tape into accurate registration with the desired graduation on the other stretch of tape. A guide device of this kind is shown in Figs. 1, and 9 to 11 inclusive, and includes a slide member arranged on the tape and held thereon in such a manner that one or both ends thereof lie perpendicularly to the length of the tape, and so that two stretches of tape can be alined with reference to this guide member. In the particular construction shown, the guide member D is made up of two substantially square or rectangular parts 64 and 65 secured together, for example, by screws 66, and both of these parts are recessed to form between them a channel 67 extending lengthwise through the guide member D. A part of this channel is preferably reduced in thickness as indicated at 68 to receive an edge of the tape A, and a spring 69 normally urges the tape into the reduced channel portion 68. One or both of the opposite edges 70 and 71 of the guide member are formed to extend at right angles to the inner edge or surface of the reduced slot 68, and an outer face of the guide member, such for example as the front or top face of the same, is preferably also provided on the outer surface thereof with a ledge or shoulder 73 upon which an edge of another portion of the tape may rest, the shoulder 73 also being formed to be at right angles to the edges 70 and 71 of the guide device.

The ends of the two tapes are provided with enlarged ends or parts 75 which prevent the outer ends of these tapes from being drawn inwardly through the slot 60 in the housing and this enlargement on the tape A preferably also prevents the end of this tape from passing through the guide D, so that this member is held in place on the tape. The tape may be drawn freely through the guide member in either direction, but the spring 69 provides sufficient friction between the guide member and the tape to enable the guide member to remain in any position in which it is set on the tape. Consequently,

in making a calculation, the guide member is first placed into correct relation to a graduation on the tape A, and the tape is then looped so that a portion thereof rests against the guide member and upon the shoulder 73 thereof, on which the looped-over portion of the tape may be moved lengthwise until a desired graduation thereon is also placed into registration with an edge of the guide member. The answer can then be read on some other part of the tape, and calculations from this answer can, if desired, then be continued by the use of the other tape B. It will, of course, be understood, however, that the guide member D may be used on the other tape B, or if desired, each of these tapes may be provided with a guide device of this kind. A guide device of any other construction may also be employed in connection with either or both of these tapes, or the guide member may be omitted, if desired, since calculations can be made on a single tape without the use of this guide member.

The use of a single tape for making calculations is facilitated by having graduations on the same scale on opposite faces of the tape, but it will be understood that it is not necessary that the tape be graduated on opposite faces, for the reason that with freely flexible tape, it is possible to twist the tape so that the graduated face of the looped-over portion of the tape can be brought into registration with the graduations on the other portion of the tape.

As illustrated in Fig. 9, the free end of the tape is turned through approximately half a circle before placing a stretch thereof into parallel relation to another stretch of tape, but it is also possible, in cases where the tape is long enough and sufficiently flexible, to turn the free end of the tape through a complete circle before placing this stretch of the tape into registration with another portion thereof. When this is done, the two adjacent stretches of tape have the graduations on one face of the tape extending in the same directions, and calculations can then be made in the same manner as with an ordinary slide rule. The guide member may also be used with the tape when bent in this manner.

In view of the fact that it is now possible to obtain flexible metal tapes which are very thin, it will be obvious that by means of the construction shown, tapes of considerable length may be wound on the reels, and the graduations on the tapes may, consequently, be made on a much larger scale than is possible on an ordinary slide rule, and furthermore, a series of different graduations may be provided on different portions lengthwise of the tapes. A very complete and accurate calculating device can, therefore, be produced in accordance with my invention which may be contained in a very small case that can be readily carried in a pocket.

I claim as my invention:

1. A calculating device including a pair of tapes of freely flexible material and arranged with an edge of one tape adjacent to an edge of the other tape, said adjacent edges being provided with graduations arranged to cooperate for making calculations, means for coiling said tapes independently of each other, means for yieldingly drawing said tapes into a housing, and means for locking said tapes against movement into and out of said housing.

2. A calculating device including a pair of tapes of flexible material, a housing, means within said housing for coiling said tapes within said housing independently of each other, means operable at will for connecting said tapes to cause the same to be coiled within said housing without lengthwise movement of one tape relatively to the other, and means for locking said tapes to prevent movement of the same into or out of said housing.

3. A calculating device including a pair of tapes of flexible material, a housing, means within said housing for coiling said tapes within said housing independently of each other, a sprocket wheel for each tape, said tapes having slots adapted to cooperate with the teeth of the sprocket wheels, said sprocket wheels normally rotating independently of each other to permit each tape to be moved into and out of said housing independently of the other tape, and means for locking said sprocket wheels against rotation to prevent movement of said tapes into and out of said housing.

4. A calculating device including a pair of tapes of flexible material and provided with graduations arranged lengthwise thereof, a housing, means for winding said tapes independently of each other within said housing, sprocket wheels journalled in said housing to rotate independently of each other, said tapes having slots adapted to engage with the teeth of said sprocket wheels, means for connecting said sprocket wheels to cause the same to rotate without movement relatively to each other to cause said tapes to move into and out of said housing without relative lengthwise movement, and means for locking said sprocket wheels against rotation to hold said tapes against movement into and out of said housing.

JAMES F. SUMMERS.