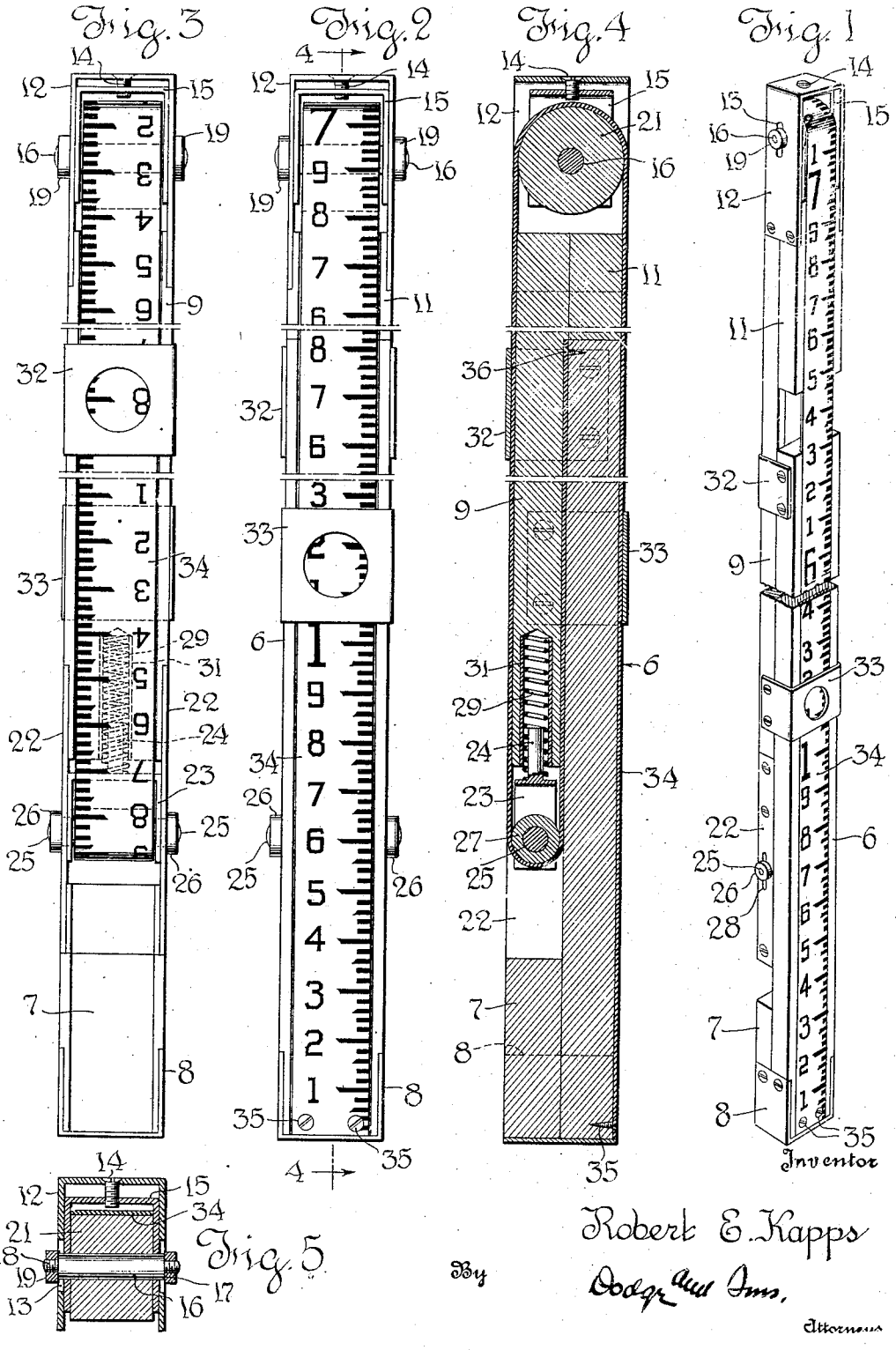
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SURVEYOR'S ROD

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SURVEYOR'S ROD

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This invention relates to surveyors' rods of the extensible type, and the purpose of the invention is to produce a precise direct reading rod.

The conventional extensible rod consists of two telescoping wooden sections upon which the graduations are directly placed. When fully extended the rod is direct reading throughout its entire length, but is characterized by certain serious disadvantages for precise work. In the first place, the wood contracts and expands longitudinally with changes in atmospheric conditions, and this introduces errors which are more or less indeterminate. Attempts to position the parts relatively to each other in their extended relation by means of stops, have proved unsuccessful, and the best practice heretofore has been to use a vernier, by means of which the adjustment of the two parts of the rod in extended position is accurately determined. This method, however, is not free of objection, one source of trouble being that after the two sections are clamped together they slip, and unless the fact is immediately detected, errors are introduced. Unless such a rod is fully extended the upper portion is not direct reading.

The present invention produces a rod in which the extensible frame is of wood but in which the graduations are not placed upon the wood, but, on the contrary, are placed upon a flexible tape, preferably a metal tape formed of a material having approximately a zero coefficient of thermal expansion. As an example of such a material, may be mentioned an alloy of nickel and steel containing 36% nickel. The use of a metal tape of known coefficient of expansion will however permit accurate correction for thermal expansion. The tape is fastened to the rod only at its ends so that the expansion and contraction of the rod do not affect the accuracy of the tape.

Generally speaking, in the preferred form, the frame work is made of two telescoping sections, one guided on the other, the lower section, sometimes called the front section, supporting the upper or rear section. The tape is fastened at its lower end to the lower end of the front section, passes thence upward over the front face of both sections to a pulley which is mounted at or near the upper end of the rear section. After passing 180° around this pulley, the tape extends downward along the rear face of the rear section. At or near the lower end of the rear section is a second pulley, and the tape passes 180° around this pulley and extends thence upward in an interval between the two sections of the rod to a point at or near the upper end of the front section, to the rear face of which it is attached.

In order to keep the tape under a substantially uniform tension so that no error will be introduced by variations in tension, one of the two pulleys, preferably the second one above mentioned, is yieldingly mounted in guides, a take-up spring being provided to afford the desired tension. It is desirable to provide means for adjusting the tension, and this is conveniently provided by making the upper pulley positively adjustable by means of a screw or equivalent device.

There is a substantial advantage in applying the positive adjustment to the first pulley, that is, the one at the top of the rear section, because the position of this pulley determines the position of the active run of the tape. However, this upper pulley might be made fixed, if desired, and other means might be provided for adjusting the tension on the tape, as obviously the tension is affected by the stress on the take-up spring which is susceptible of adjustment in various ways.

The rod constructed as above outlined, is direct reading throughout its length, whether fully or partially extended. This feature is of particular importance in work in mines, tunnels, and the like.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which,—

Fig. 1 is a perspective view of the complete rod with the middle portion broken away to reduce the length of the figure.

Fig. 2 is a front elevation of the rod on a somewhat larger scale, with portions broken away to reduce the length of the figure.

Fig. 3 is a rear elevation of the rod.

Fig. 4 is a vertical axial section on the line 4—4 of Fig. 2.

Fig. 5 is a section through the upper roller and its adjusting means on the axis of the roller.

The lower or front section of the rod is indicated at 6. The face is formed with a shallow channel to receive and protect the steel tape hereinafter described. At its lower end it has at the rear a filler piece or block 7 for the full depth of the complete rod and the lower end is reinforced by a U-shaped metal shoe 8 which is held in place by screws, as indicated in the drawings. The upper or rear section of the rod is indicated at 9, and carries at its upper end a forwardly extending block or filler piece 11.

Extending above the upper end of the portion 9 and filler piece 11 is a U-shaped fitting or stirrup 12 which is formed with elongated slots 13. Suspended within the stirrup 12, by means of an adjusting screw 14, is a second and smaller U-shaped stirrup 15.

Mounted in bearing openings in the stirrup 15 is a cross shaft 16 which also extends through the slots 13. The ends of the journal pin 16 are reduced to provide shoulders 17, and are threaded, as indicated at 18, to receive the retaining nuts 19. The shoulders are so spaced that the nuts 19 do not clamp against the stirrup 12 but permit shifting of the journal pin 16 as the stirrup 15 is adjusted by turning the screw 14.

Journaled on the pin 16 is a pulley or guide roller 21, whose front face is approximately tangent to the base of the channel in the front face of the rod sections. The lower end of the rear section of the rod is provided with two metal extensions 22, one on each of its sides, and between these two extensions is mounted a U-shaped stirrup or fork 23 having a guiding stem 24 projecting upward therefrom. The fork 23 is provided with confining openings for a journal pin 25, essentially similar to the pin 16, and the ends of this shaft are shouldered and threaded, as are those of the pin 16, to receive nuts 26, similar in form and function to the nuts 19, already described. The journal pin 25 carries a roller 27, something less than half the diameter of the roller 16. The ends of the pin 25 extend through guiding slots 28 in the extension pieces 22, thus allowing the guide roller or pulley 27 to move longitudinally relatively to the rear section 9.

In order to urge the fork 23 and its roller 27 downward, a coil thrust spring 29 is used, and this is enclosed in a metal bushing 31 forced into a hole bored in the lower end of the section 9. The two sections 6 and 9 are guided in their longitudinal sliding movements by two stirrups, one of which, 32, is fixed to the front section and encircles the rear section, and the other of which, 33, is connected to the rear section and encircles the front section. These stirrups are of usual construction.

A tape 34 bearing suitable graduations, is connected at its lower end, as indicated, at 35, to the lower end of the front face of the front section 6, and lies in the channel or recess formed to receive it. This channel is extended in the front face of the block 11 forming a portion of the rear section so that the tape is guided and protected throughout its entire run over the front faces of the supporting frame. The tape then passes to the rear around the roller 21, being in contact with the roller through 180°. Thence it extends downward and passes around the roller 27 with which it contacts through 180°. Thence it passes upward to a point near the upper end of the rear face of the front section to which it is connected by screws or other suitable means, as indicated at 36.

The tape 34 may be made of steel or other suitable material, but for best effect I propose to make it of a metal or alloy characterized by a zero or substantially zero coefficient of thermal expansion. If such a metal be used it is unnecessary to introduce any correction factor for temperature, but in any case the tape is wholly free from the rod and the expansion and contraction of the rod, which is the result of various atmospheric conditions in addition to temperature, does not affect the length of the tape. It thus follows that even where a thermally expansible tape is used the only error is that due to temperature and the correction is determinate.

In use the tension screw 14 is set up to place the tape under a definite and substantially uniform tension, and this is made sufficient to insure the retention of the rod in its various adjusted settings without the use of any clamping means though a clamping means might be provided if desired. The important point is that the use of a clamping means is not essential to accuracy, because even if the two sections of the rod should slip one relatively to the other, the accuracy of position of the tape on the front or reading face of the rod would not be affected.

It will be observed that the rod is direct reading throughout its length regardless of its degree of extension, that the tape is in a fixed and definite relation to the position of the rod and in all adjusted positions of the rod is under a substantially uniform tension. The rod is thus precise under all conditions, may be lengthened or shortened at will, and is subject only to those determinate errors which are occasioned by changes of temperature, and those errors may be eliminated by the proper selection of material where circumstances justify the extra expense.

Important considerations contributing to accuracy are the facts that the tape is connected with the rod only at its ends, that it is per-

manently connected to the face of the rod at all times, that it is subject to substantially uniform tension at all times, and that it is free to expand and contract independently of the rod just as the rod is free to expand and contract independently of the tape.

The mechanical structure adopted to accomplish these results is subject to variation, as will be obvious to skilled mechanics.

What is claimed is,—

1. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including two members, one longitudinally slidable on the other; a pair of guide pulleys mounted on one of said members adjacent the ends thereof; a tape connected at its ends with the other member and free of connection with said frame structure intermediate said points of connection, said tape extending from one point of connection over the entire length of the front face of said frame structure, thence around one pulley, thence along the back of the frame structure to and around the other pulley to the other point of connection; and means for placing said tape under substantially constant tensile stress.

2. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including two members, one longitudinally slidable on the other; a pair of guide pulleys mounted on one of said members adjacent the ends thereof; a tape connected at its ends with the other member and free of connection with said frame structure intermediate said points of connection, said tape extending from one point of connection over the entire length of the front face of said frame structure, thence around one pulley, thence along the back of the frame structure to and around the other pulley to the other point of connection; and a resilient mounting for one of said pulleys.

3. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including two members, one longitudinally slidable on the other; a pair of guide pulleys mounted on one of said members adjacent the ends thereof; a tape connected at its ends with the other member and free of connection with said frame structure intermediate said points of connection, said tape extending from one point of connection over the entire length of the front face of said frame structure, thence around one pulley, thence along the back of the frame structure to and around the other pulley to the other point of connection; a resilient mounting for one of said pulleys; and a positively adjustable take-up mounting for the other pulley.

4. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including two members, one longitudinally slidable on the other; a pair of guide pulleys mounted on one of said members adjacent the ends thereof; a tape connected at its ends with the other member and free of connection with said frame structure intermediate said points of connection, said tape extending from one point of connection over the entire length of the front face of said frame structure, thence around one pulley, thence along the back of the frame structure to and around the other pulley to the other point of connection; spring actuated means for placing said tape under tensile stress; and means for adjusting the stress exerted by the last named means.

5. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including a lower section provided at its lower end with means for positioning the rod, and an upper section longitudinally slidable on the lower section; a pair of guide pulleys mounted on the upper section adjacent the extremities thereof; a tape connected to the front face of the lower section adjacent the lower end thereof and extending thence free of said frame structure upward over the entire length of the front faces of both sections, thence to the rear over one of said pulleys, down the rear face of the upper section to the second pulley, around the second pulley and thence to a point adjacent the upper end of the lower section to which it is connected; and means for placing said tape under substantially constant tensile stress.

6. A rod of the type defined in claim 1, in which said tape is of metal characterized by a substantially zero coefficient of thermal expansion.

7. A rod of the type defined in claim 5, in which the tape is of a metal having a substantially zero coefficient of thermal expansion.

8. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including two members, one longitudinally slidable on the other; a pair of guide pulleys mounted on one of said members adjacent the ends thereof; a tape connected at its ends with the other member and free of connection with said frame structure intermediate said points of connection, said tape extending from one point of connection on the front face of the frame structure, around one pulley, thence along the back of the frame structure to and around the other pulley to the other point of connection; and means for placing said tape under substantially constant tensile stress.

9. A surveyor's rod of the extensible type, comprising in combination, an extensible frame structure including a lower section provided at its lower end with means for positioning the rod, and an upper section longitudinally slidable on the lower section; a pair of guide pulleys mounted on the upper section adjacent the extremities thereof; a tape

of material having a substantially zero coefficient of thermal expansion connected to the front face of the lower section in fixed dimensional relation to said positioning means, and extending thence upward and then to the rear over one of said pulleys, down the rear face of the upper section to the second pulley, around the second pulley and thence to a point adjacent the upper end of the lower section to which it is connected; and means for placing said tape under substantially constant tensile stress.

In testimony whereof I have signed my name to this specification.

ROBERT E. KAPPS.