Dec. 1, 1925. 1,563,484

J. M. GUNN

SOLAR ATTACHMENT FOR TRANSITS

Filed May 5, 1923 5 Sheets-Sheet 1

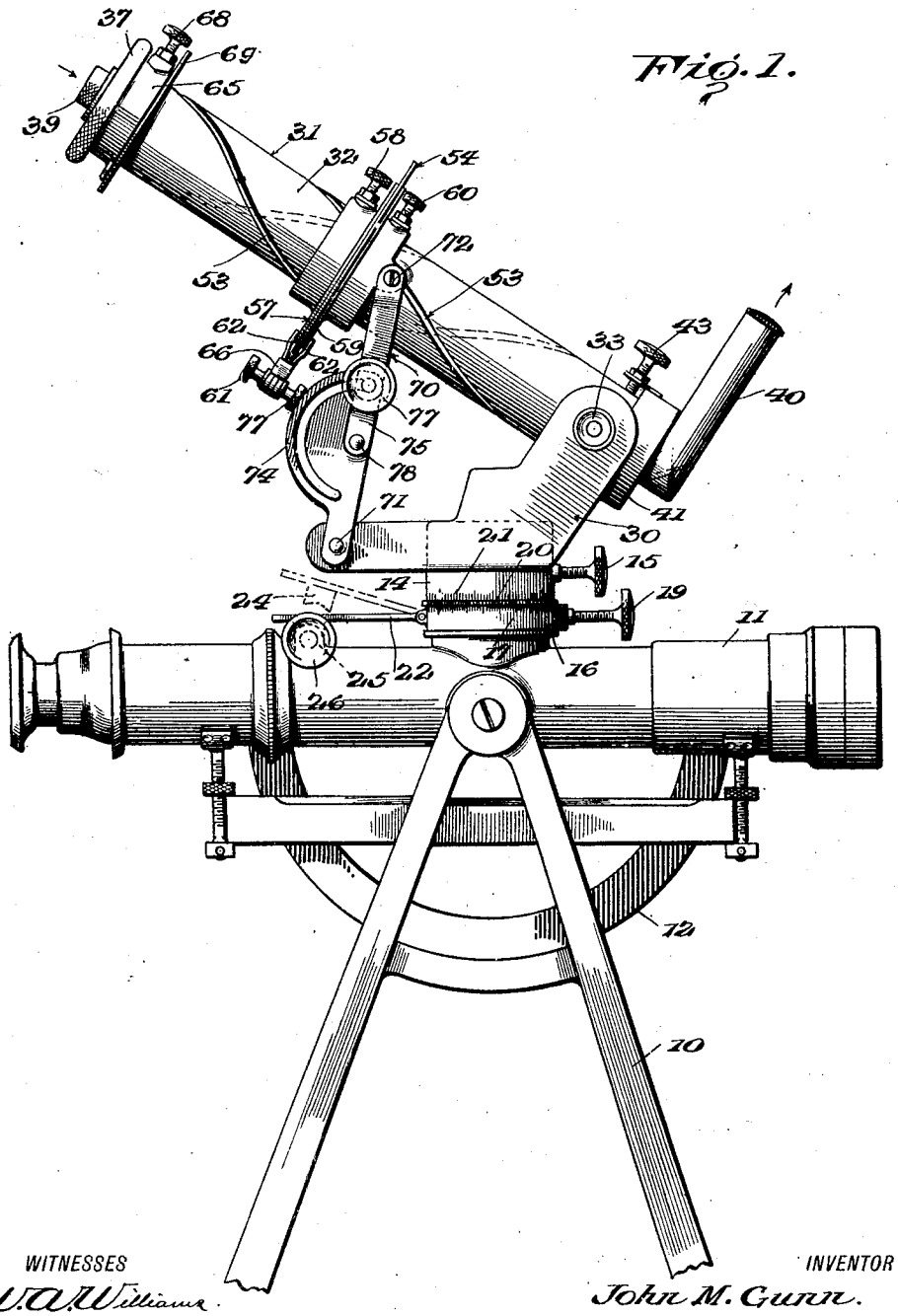


FIG. 1.

WITNESSES

W. A. Williams.

W. F. Buckley.

INVENTOR

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Dec. 1, 1925. 1,563,484

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SOLAR ATTACHMENT FOR TRANSITS

Filed May 5, 1923 5 Sheets-Sheet 2

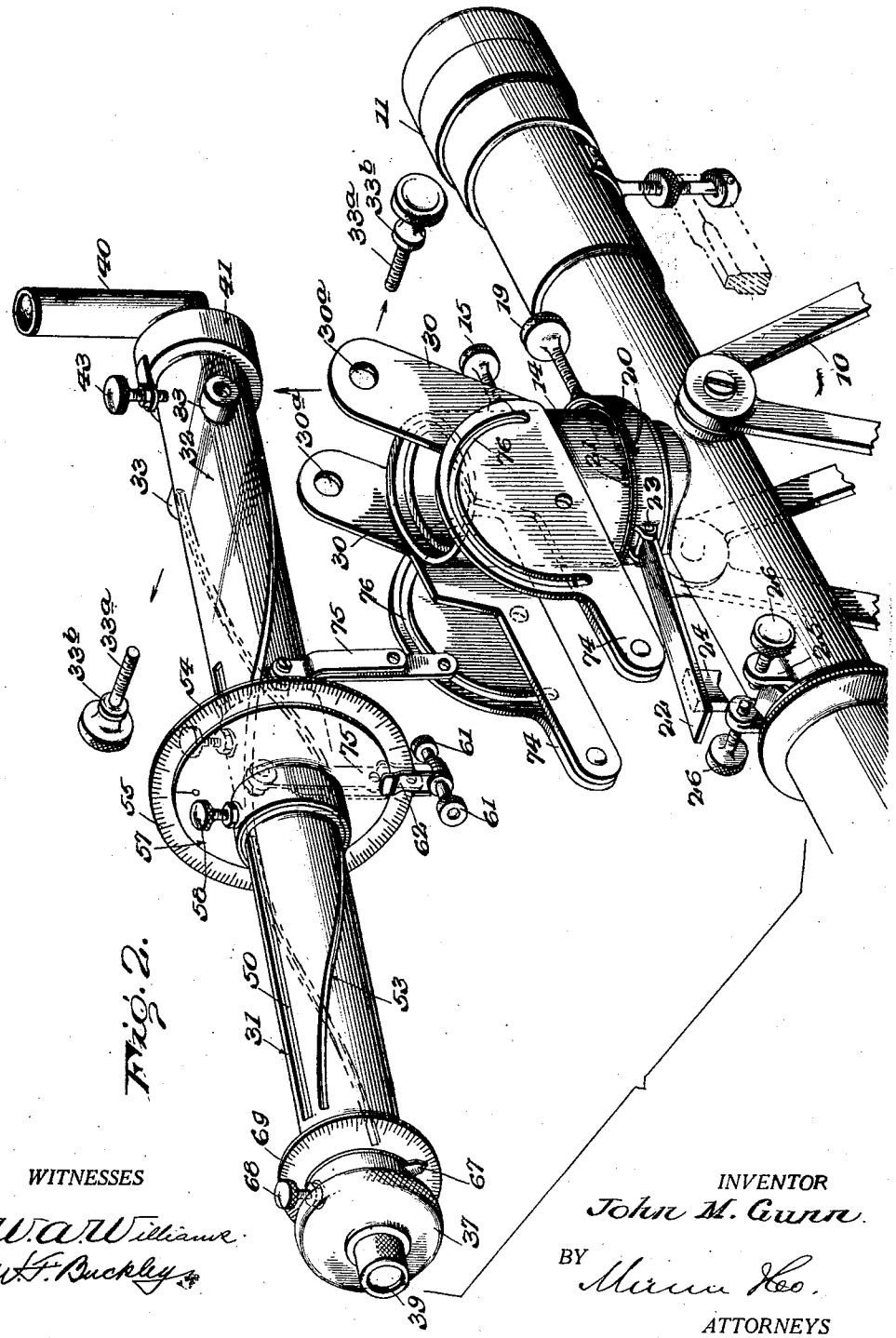


Fig. 2.

WITNESSES

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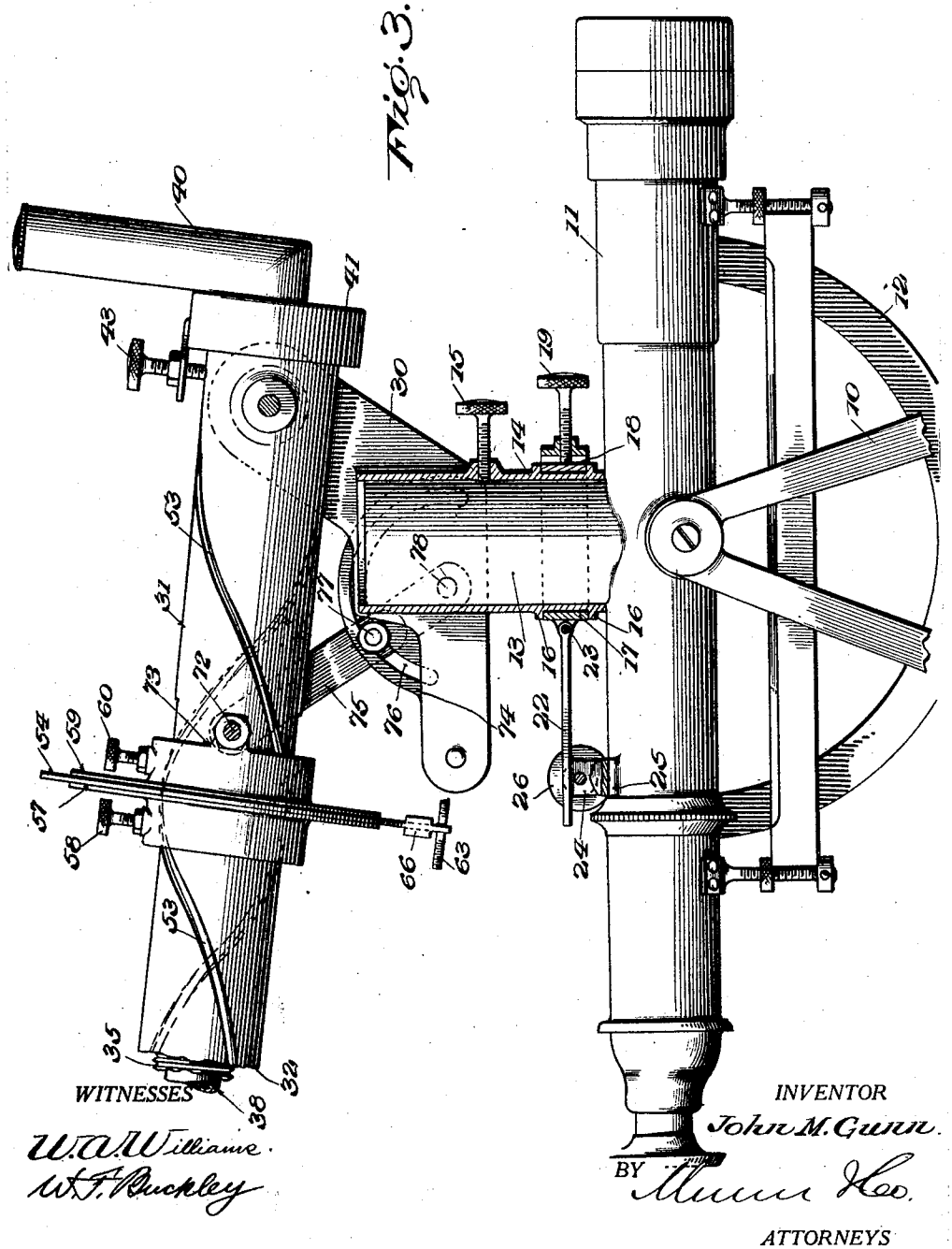
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SOLAR ATTACHMENT FOR TRANSITS

Filed May 5, 1923 5 Sheets-Sheet 3

Fig. 3.



WITNESSES

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SOLAR ATTACHMENT FOR TRANSITS

Filed May 5, 1923 5 Sheets-Sheet 4

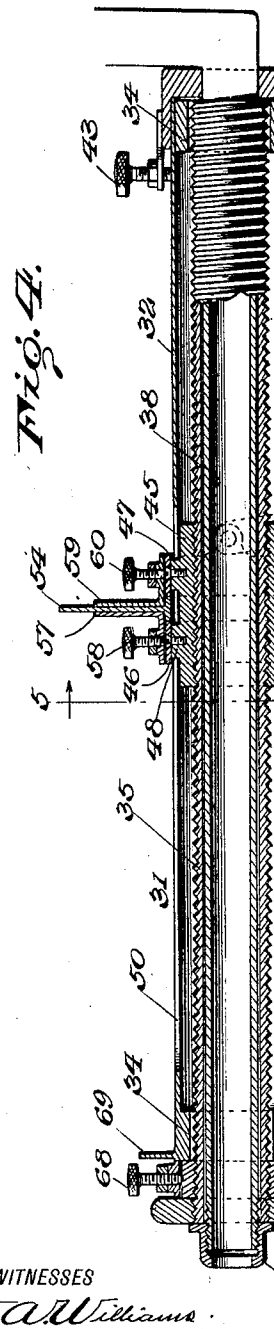


Fig. 4.

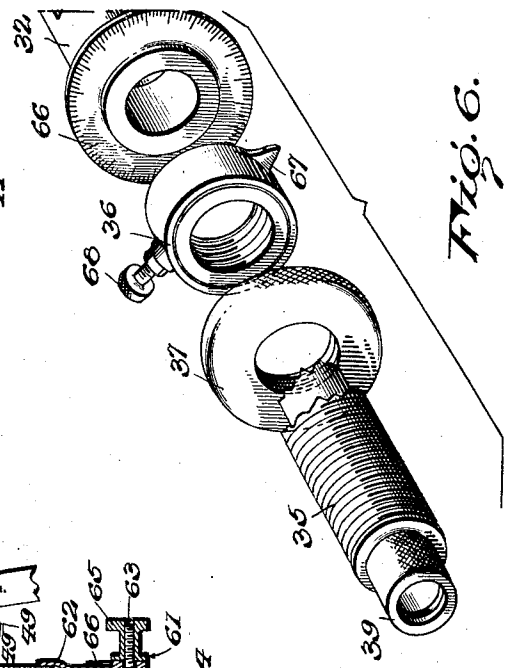


Fig. 6.

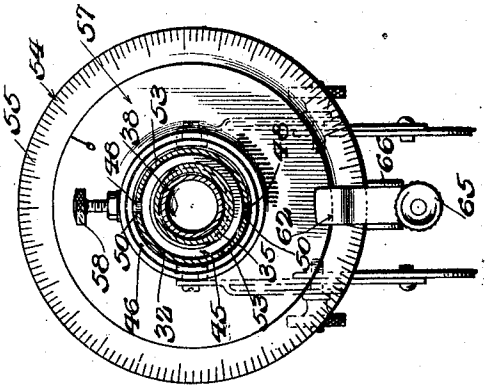


Fig. 5.

WITNESSES

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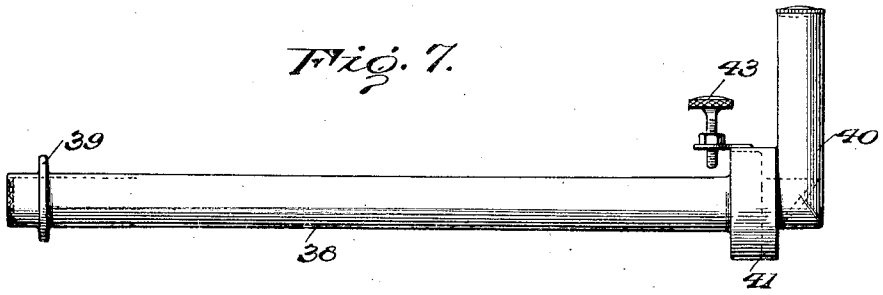
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J. M. GUNN

SOLAR ATTACHMENT FOR TRANSITS

Filed May 5, 1923 5 Sheets-Sheet 5

Fig. 7.



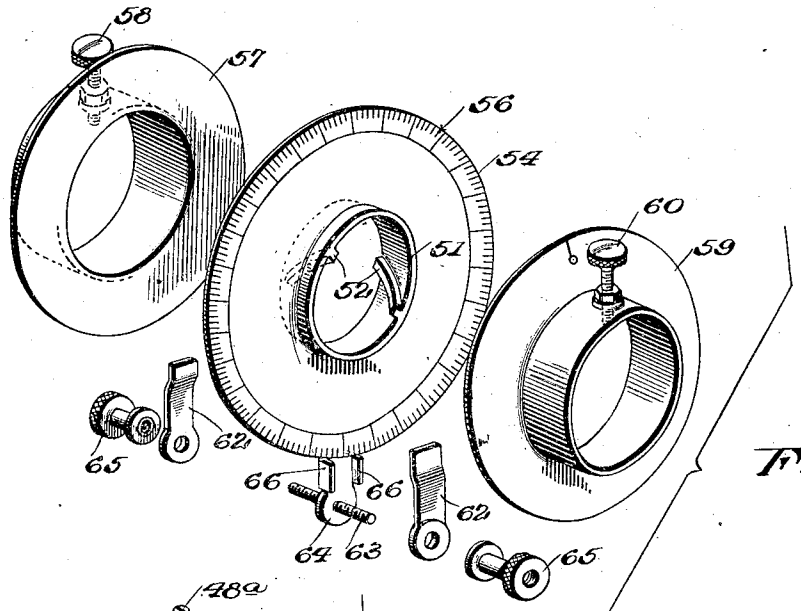


Fig. 8.

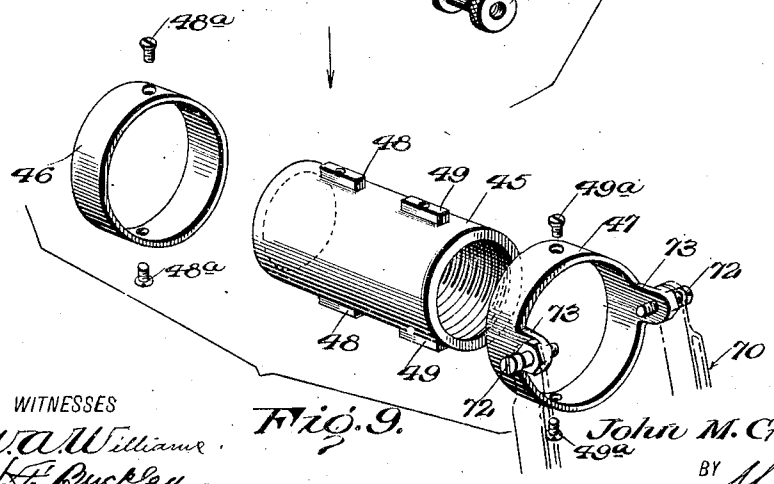


Fig. 9.

WITNESSES

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Patented Dec. 1, 1925. 1,563,484

UNITED STATES PATENT OFFICE.

JOHN MALCOLM GUNN, OF LAGUNA, NEW MEXICO.

SOLAR ATTACHMENT FOR TRANSITS.

Application filed May 5, 1923. Serial No. 636,881.

To all whom it may concern:

Be it known that I, JOHN MALCOLM GUNN, a citizen of the United States, and a resident of Laguna, in the county of Valencia and State of New Mexico, have invented certain new and useful Improvements in Solar Attachments for Transits, of which the following is a specification.

This invention relates to an improvement in solar attachments for transits, and has for its object to provide an instrument of this character capable of carrying out all of the operations and observations which may be achieved by solar attachments now in use without necessitating the series of delicate adjustments required by such attachments and without being exposed to the liability of having the adjustments of its elements accidentally disturbed and which speedily and accurately accomplishes the desired observations and operations.

Another object is to provide an instrument of this character which is of simple and durable construction, and reliable, efficient and accurate in operation.

Other objects and advantages of the invention reside in certain novel features of the construction, combination and arrangement of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming part of this specification, and in which:

Figure 1 is a view in side elevation, showing the solar attachment assembled with a conventional transit;

Figure 2 is a group view in perspective showing certain parts of the solar attachment prior to assembly;

Figure 3 is a fragmentary view, partly in side elevation and partly in vertical section;

Figure 4 is a detail view of the solar tubes showing the same in longitudinal vertical section, parts being shown in elevation for the sake of illustration;

Figure 5 is a view in transverse section on line 5—5 of Figure 4;

Figure 6 is a fragmentary view in perspective showing the parts at the forward end of the solar tubes prior to assembly;

Figure 7 is a detail view in elevation of the image tube;

Figure 8 is a group view in perspective showing the latitude and declination disk and associated parts, and

Figure 9 is a similar view of the means for mounting the latitude and declination disk on the solar tubes.

Referring to the drawings, the numeral 10, designates generally a transit which may be of any conventional or known type and which includes a telescope 11 supported in the usual manner and a vertical arc 12 for measuring or laying off vertical angles.

As shown in Figure 3 a stud 13 is mounted upon the telescope 11 and a sleeve or socket 14 is fitted on the stud 13 and constitutes therewith the axis of the solar attachment. A clamping screw 15 is carried by the sleeve 14 and is engageable with the stud 13 to releasably clamp the sleeve in any desired angular position on the stud. Spaced annular ribs 16 are formed on the sleeve 14 adjacent the lower end thereof and define an annular channel in which a clamping ring 17 operates. The clamping ring 17 is loosely fitted on the sleeve and in the channel and a clamping shoe 18 of arcuate form is arranged in between the clamping ring 17 and the opposed portion of the channel, a clamping screw 19 being carried by the clamping ring and being engaged with the clamping shoe for releasably clamping the ring 17 in desired position on the sleeve. In order to accurately determine the position of the clamping ring 17 with respect to the sleeve 13 graduations 20 are formed on the clamping ring and coact with indicia or graduations 21 formed on one of the ribs 16 or other convenient part of the sleeve 13, this indicia cooperating to determine the angular relation of the clamping ring with respect to the sleeve or socket 14. A guide or setting arm 22 is hingedly connected, as at 23, to the clamping ring 17, and has integrally formed with or suitably secured to its outer end a depending lug 24, the outer end of the arm being adapted to be received in a rack 25 mounted upon the telescope 11, the lug 24 being adapted to cooperate with a tangent screw attachment 26. Preferably the arrangement is such that when the setting or guide arm 22 is positioned in the rack 25, the solar attachment will be in colimation with the telescope of the transit.

The frame of the solar attachment is mounted on the sleeve or socket 14 and

comprises a pair of plates 30 suitably secured to the sleeve 14. A solar tube assembly designated generally at 31, is supported on this frame as will presently be described. This solar tube assembly includes an outer cylindrical tube or casing 32, the lower end of which is provided with trunnions 33 mounted in bearings 30[a] provided therefor in the side plates 30. Clamping screws 33[a] may be provided if found desirable and if provided are threaded into sockets provided therefor in the trunnions 33 and have flanges 33[b] engageable with the plates 30. Spaced bearings 34 are provided within the outer casing or tube 32 (see Figure 4) and these spaced bearings rotatably support an externally threaded sleeve 35 which extends through the casing 32. The ends of the externally threaded sleeve 35 project beyond the casing 32 and one of the projecting ends of this sleeve 35 has fixed thereon a nut 36 and a collar 37 for preventing longitudinal movement of the sleeve 35 in one direction. The nut 36 also serves as a carrier for a pointer as will hereinafter be fully described and the collar is extended to such size as to provide a thumb screw or operating means whereby the sleeve 35 may be turned. Within the sleeve 35 an optical tube or inner tube 38 is arranged, this tube 38 containing the optical system of the solar tube assembly including lens and reflector or prism at the right angle and small bull's eye and two concentric circles on glass screen to receive the sun's image at the top end or may embody any conventional or standard optical system adapted for this use. The optical tube 38 projects at its ends beyond the sleeve 35 and at one end has fixed thereto a flanged nut 39 which rotatably abuts the annular shoulder presented by the adjacent face of the collar 37. The opposite end of the image tube or optical tube has a right angle extension 40 in which the prism of the optical system is arranged and this right angled end carries a cap 41 which rotatably embraces the adjacent end of the casing 32 and which presents a shoulder or collar 42 against which the lower end of the sleeve 35 as well as the casing 32 rotatably abuts. This shoulder 42 together with the collar 37 and flanged nut serves to hold the casing 32, sleeve 35 and image tube 38 against relative longitudinal or rectilinear movement although leaving them free to partake of relative rotary movement. A clamping screw 43 carried by the cap 41 and engageable with the casing 32 provides for the holding of the image tube 38 in adjusted angular position with respect to the casing 32. It is to be understood that the term "solar tube assembly" is employed to characterize broadly the structure made up of the tube 38 containing the optical system, its casing 32, the sleeve 35, its bearings 34, the nut 36, collar 37 and the cap 41.

A nut or traveller 45 is threaded on the sleeve 35, the traveller operating in the space between the sleeve 35 and the inner wall or periphery of the outer casing 32. Spaced rings 46 and 47 constituting a pair are slidably fitted on the outer periphery of the tube or casing 32 and are connected to the traveller 45 through keys designated at 48 and 49 respectively, the keys being suitably connected to the traveller and to their respective rings, screws 48[a] and 49[a] being shown as the connecting means for the sake of illustration although these parts may be welded, soldered, shrunk or otherwise connected. The keys operate in diametrically opposite longitudinal slots 50 cut in the casing 32 whereby the keys serve not only to connect the rings 46 and 47 with the traveller but also to constrain the traveller and the rings to rectilinear motion longitudinally of the tube 32. Thus when the thumb screw 37 is turned to rotate the externally threaded sleeve 35 rectilinear motion will be imparted to the traveller 45 and the rings 46 and 47 connected therewith. A ring 51 is fitted in between the rings 46 and 47 so as to be constrained to partake of longitudinal movement of the rings 46 and 47 while free to rotate relative thereto. This ring 51 carries a pair of spiral driving lugs, designated at 52 which operate in spiral grooves 53 formed in the outer periphery of the tube 32, these spiral grooves being cut into the metal of the tube for a distance approximately two-thirds of the thickness thereof. It is obvious that when the thumb screw 37 is turned to rotate the sleeve 35 and consequently to move the traveller and rings 46 and 47 longitudinally of the casing 32 that the ring 51 will be caused to move longitudinally of and turned about the tube 32 due to the combined action of the rings 46 and 47 and to the cooperation of the driving lugs 52 and spiral slots 53 of the casing 32. The degree of turning movement of the ring 51 is dependent upon the pitch or curvature of the slots 53. A disk 54 is integrally formed or rigidly connected to the ring 51 and partakes of the motion thereof. One face of the disk 54 is provided with graduations, designated at 55 and representing the latitude and the opposite face of the disk is provided with graduations, designated at 56, and representing the declination. Of course the graduations representing the latitude progress from zero to 90° and the graduations representing the declination of the sun progress from each side of the zero mark to 23½° accordingly as the sun is north or south. A flanged indexing device 57 is mounted on the ring 46 and coacts with the face of the disk 54 which bears the graduations 55 representing the latitude,

the indexing device being provided with a clamp screw 58 whereby it may be clamped to the ring 46. Similarly a flanged indexing device 59 is mounted on the ring 47 and coacts with the face 54 bearing the graduations 56 representing the declination, the indexing device 59 having a clamping screw 60 whereby it may be clamped in the desired position on the ring 47. The disk 54 carries two independently operable clamping means 61 adapted to independently clamp the indexing devices 57 and 59 to the disk 54 when desired. The clamping devices 61 are of identical construction and each includes a resilient clamping finger 62 engageable with its disk 57 or 59 as the case may be, the clamping fingers being apertured and fitted on the opposite ends of a screw 63 carried by a lug 64 integral with or suitably connected to the disk 54. Nuts 65 coact with the opposite ends of the screw 63 and engage the clamping fingers to urge them into clamping engagement with their respective discs. The lug 64 is formed with guide wings 66 engageable with the edges of the clamping finger 62 to prevent angular movement thereof.

The graduations 55 and 56 represent the latitude and the declination in degrees and in order to provide for the indication or representation of intermediate values of these quantities an index pointer 67 is adjustably fixed on the nut 36 of the sleeve 35 by means of a screw 68 and coacts with a disk 69 secured to the adjacent end of the casing 32 and upon which disk 69 are graduations representing minutes.

A pair of brace arms, designated at 70 are provided one end of each brace arm being pivotally connected, as at 71, to its side plate 30 and the opposite end of the brace arm being pivotally connected at 72 with ears or lugs 73 provided on the ring 47. The brace arms 70 are of identical construction and each comprises a pair of links 74 and 75, each link 74 having a curved slot 76 therein in which a pin 77 carried by the link 75 operates, the pin 77 having a head at one end and clamping nut threaded on its opposite end whereby it may be clamped in position to hold the links 74 and 75 in adjusted position. The links 74 and 75 are pivotally connected to each other, as at 78 and if desired the pivots 71, 72 and 78 are all provided with clamping nuts or other clamping means so that the brace arms may be releasably held in adjusted position with respect to each other.

In setting up the solar attachment the transit is first carefully clamped. The thumb screw 37 is then turned until the solar tube assembly comes into its seat on the frame, thereby bringing the solar tube assembly into parallel relation with the telescope of the transit. The solar tube assembly is then adjusted about its vertical axis, bringing it into collimation with the telescope of the transit, this being accomplished by first attaining the proper adjustment between the clamping rings 17 and the sleeve 14, clamping the clamp ring in this adjustment and then associating the guide arm 22 connected with the clamp ring with the rack 25.

The indexing device 57 is then adjusted on the ring 46 until it corresponds with the zero of the graduations 55 representing the latitudes, the indexing device being clamped in this position on the ring 46 by the screw 58. The thumb screw 37 is then turned until the disk 54 is moved an angular distance corresponding to the latitude and then the index device is unclamped from the ring 46 and is clamped to the disk 54 by its clamping device 61. Following this the index device 59 is adjusted on the ring 47 until it is coincident with zero of the graduations 56, the indexing device 59 being then clamped in this position by its clamp screw 60. The declination is then set off by turning the thumb screw 37 until the disk 54 has moved a distance corresponding to the declination, this distance of course being determined by observing the relation between the indexing device 59 and the graduations 56. After proper adjustment is had the indexing device 59 is unclamped from the ring 47 and is clamped to the disk 54 by its clamping device 61. The instrument is now ready for a determination of the meridian and when the solar tubes are turned on their polar axis toward the sun the sun's image should be seen in the field of the optical system. The large telescope is now on the meridian because it is only in this position that the sun is disposed in the field.

If it is desired to run on a different course, clamp the solar attachment on its polar axis by means of the clamp screw 15, turn off the desired angle on the plates of the transit, loosen the clamp 15 on the solar attachment and bring the solar attachment back on the meridian and then set the clamp again. If it is desired to reverse the telescope, lift the setting arm 22 out of the rack 25 and bring the solar tube assembly into parallel with the telescope of the transit by manipulating the links of the brace arms 70 and turn telescope. To recover latitude, declination and meridian, reverse the telescope to the opposite position, release the clamp screws of the hinged braces, raise the solar tube assembly in place, and then move the solar attachment around until the guide arm comes into the rack 25. The same principle may be applied on the zenith telescope.

I claim:

1. In a solar attachment for transits, a frame, a solar tube assembly swingably supported on said frame, said solar tube assem-

bly including a tube containing an optical system adapted to construct and present to view an image of the sun and brace rods connecting the solar tube assembly and the frame, said brace rods comprising links pivotally connected to each other.

2. In a solar attachment for transits, a frame, a solar tube assembly swingably mounted on said frame, a ring movable longitudinally of the solar tube assembly, a brace rod pivotally connected to said ring and to the frame whereby the inclination of the solar tube assembly is varied by longitudinal adjustment of said ring, said brace rod comprising links pivotally connected to each other, and means controlled by the ring for indicating the latitude and declination.

3. A solar attachment for transits comprising a frame, a cylindrical casing swingably supported on said frame and having a longitudinal slot and a spiral groove therein, an image tube arranged within said casing and having an optical system for receiving the sun's image, an externally threaded sleeve rotatably mounted within said casing and embracing the image tube, said sleeve being free to rotate but held against longitudinal movement, a traveller having threaded engagement with the sleeve and having keys operating in a longitudinal slot of the casing to constrain the traveller to rectilinear motion, a pair of spaced rings slidably fitted on the casing and rigidly connected to said keys whereby they are constrained to partake of the motion of the traveller, a ring fitted between the spaced rings so as to be constrained to partake of the longitudinal movement thereof while free to rotate relative thereto, said latter ring having spiral driving lugs operatively engaged in the spiral groove of the casing, a disk rigidly connected to the latter ring and having its opposite faces graduated to represent latitude and declination and brace rods pivotally connected to one of the pair of rings and to the frame of the solar attachment.

4. In a solar attachment for transits, a solar tube assembly comprising a casing having a longitudinal slot and a spiral groove, an image tube arranged within said casing and having an optical system for receiving the sun's image, an externally threaded sleeve rotatably mounted within said casing and embracing the image tube, said sleeve being free to rotate but being held against longitudinal movement, a traveller having threaded engagement with the sleeve and having a key operating in the longitudinal slot of the casing to constrain the traveller to rectilinear motion, a ring rigidly connected to said key and fitted on the casing whereby it partakes of the longitudinal movement of the traveller, a second ring fitted on the casing and associated with the first mentioned ring to be constrained to partake of the longitudinal movement thereof while free to rotate relatively thereto, said second ring having a spiral lug fitted in the spiral slot of the casing and a graduated disk carried by said second ring.

5. In a solar attachment for transits, a frame, a solar tube assembly swingably mounted on said frame, an element mounted upon and constrained to move back and forth along the solar tube assembly, bracing means pivotally connected to the element and to the frame whereby the inclination of the solar tube assembly is varied by longitudinal adjustment of said element, and means controlled by said element for indicating the latitude and declination.

6. In a solar attachment for transits, a stud upstanding from the transits, a sleeve rotatably fitted on the stud, a clamping screw carried by the sleeve and engageable with the stud, said sleeve having spaced flanges defining an annular channel, a clamping ring loosely fitted in said channel, means for clamping said ring in adjusted position in the channel, arm hingedly connected to said ring, a rack carried by the transit and adapted to cooperate with said arm, said arm having a lug, a tangent screw carried by the rack and cooperable with the lug of the arm, a frame carried by the sleeve and comprising spaced side plates, a solar tube assembly swingably supported on said frame, a ring movable longitudinally of the solar tube assembly, hinged brace rods pivotally connected to said ring and to the side plates of the frame whereby the inclination of the solar tube assembly is varied by the longitudinal adjustment of said ring, and means controlled by said ring for indicating the latitude and declination.

7. In a solar attachment for transits, a stud upstanding from the transit, a sleeve rotatably fitted on the stud, said stud and sleeve comprising the polar axis of the transit, an arm connected to the sleeve, a rack carried by the transit and cooperable with the arm, a frame carried by the sleeve, a solar tube assembly swingably mounted on the frame, a ring movable longitudinally of the solar tube assembly, a hinged brace rod pivotally connected to the ring and to the frame whereby the inclination of the solar tube assembly is varied by longitudinal adjustment of said ring, and means controlled by the ring for indicating the latitude and declination.

8. In a solar attachment for transits, a frame, a solar tube assembly swingably mounted on said frame, a ring movable longitudinally of the solar tube assembly and organized therewith, a brace rod pivotally connected to said ring and to the frame whereby as the inclination of the solar tube assembly varies the longitudinal adjustment of the ring with respect to said assembly

varies, and means controlled by the longitudinal adjustment of the ring for indicating latitude or declination.

9. In a solar attachment for transits, a solar tube assembly comprising a casing having a longitudinal slot and a spiral tube, an image tube arranged within said casing and having an optical system for receiving the sun's image, an exteriorly threaded sleeve mounted within said casing and embracing the image tube, said sleeve being free to rotate and being held against longitudinal movement, a traveller having threaded engagement with the sleeve and having a key operating in the longitudinal slot of the casing and constraining the traveller to rectilinear motion, a ring rigidly connected to said key and fitted on the casing, a second ring fitted on the casing and arranged with the first mentioned ring to be constrained to partake of the longitudinal movement thereof while free to rotate relative thereto, said second ring having a spiral driving lug fitted in the spiral slot of the casing, a disk carried by said second ring and having graduations thereon representing degrees of latitude and declination, a disk carried by one end of the casing and having indicia thereon indicating minutes of latitude and declination, and a pointer carred by the end of the externally threaded sleeve and cooperable with said last mentioned disk.

10. In a solar attachment for transits, a frame, a solar tube assembly swingably mounted on said frame, an element mounted upon and constrained to move back and forth along the solar tube assembly, bracing means pivotally connected to the element and to the frame whereby the inclination of the solar tube assembly is varied by longitudinal adjustment of said element, means controlled by said element for indicating the latitude and declination; and means for adjusting said element longitudinally.

11. In a solar attachment for transits, a frame, a solar tube assembly swingably mounted on said frame, an element mounted upon and constrained to move back and forth along the solar tube assembly, bracing means pivotally connected to the element and to the frame whereby the inclination of the solar tube assembly is varied by longitudinal adjustment of said element, means controlled by said element for indicating the latitude and declination, said last mentioned means including a disk constrained to rotate around the solar tube assembly as it moves therealong, said disk being constrained to partake of the longitudinal adjustment of said element while free to rotate relative thereto.

12. In a solar attachment for transits, a stud upstanding from the transits, a sleeve rotatably fitted on the stud, a clamping screw carried by the sleeve and engageable with the stud, said sleeve having spaced flanges defining an annular channel, a clamping ring loosely fitted in said channel, means for clamping said ring in adjusted position in the channel, an arm hingedly connected to said ring, a rack carried by the transit and adapted to cooperate with said arm, said arm having a lug, a tangent screw carried by the rack and cooperable with the lug of the arm, a frame carried by the sleeve, and a solar tube assembly mounted on said frame.

13. In a solar attachment for transits, a solar tube assembly, a pair of spaced rings mounted on the solar tube assembly for longitudinal adjustment, said spaced rings being constrained to move together, a third ring arranged between the spaced rings and engaged by the spaced rings so as to be constrained to partake of the longitudinal adjustment of said spaced rings, said third ring being constrained to rotate relative to the solar tube assembly when moved longitudinally thereof, a disk carried by said third ring and having its faces graduated to represent latitude and declination, and indexing devices mounted on the spaced rings and cooperable with the graduations of the disk, and clamping devices for releasably and selectively securing the indexing devices to the spaced rings or to the disk.

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