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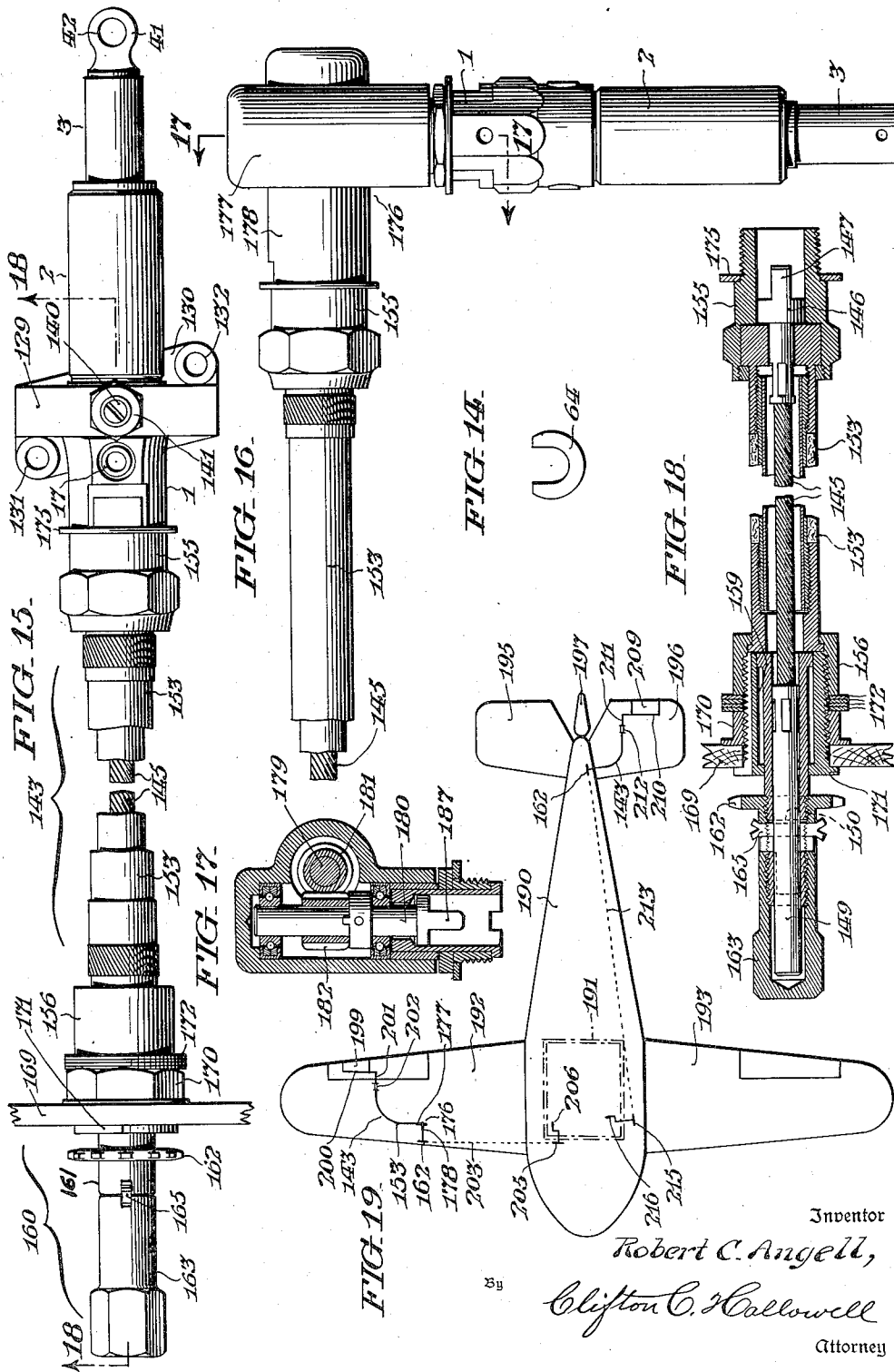
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TAB ACTUATOR

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5 Claims. (Cl. 74-424.8)

My invention relates particularly to an assembly adapted to be employed in aircraft, whereby the pivoted flaps, sometimes called tabs and serving as an auxiliary to the wings, rudder and fins of an airplane, may be controlled, and is especially directed to that part of such an assembly that is commonly termed the tab actuator.

It is well known to those familiar with airplane construction and maintenance that the tabs should be so stabilized as to prevent fluttering due to looseness or play of the controlling or actuating assembly which connects them with the primary controlling mechanism at the operator's station.

The principal objects of my invention are to provide a tab actuator having its relatively adjustable parts so correlated that they are capable of such minute calibration as to prevent axial play and consequently to insure against any possible fluttering or vibration of the tab which it is designed to actuate, and to provide means arranged to insure substantial maintenance of the adjusted parts relatively immobile.

Other objects of my invention are to provide a tab actuator that is so constructed and arranged that its relatively adjustable parts are conveniently accessible for assembly and adjustment, but which are absolutely inaccessible when assembled, both from vision or tampering, by those unauthorized to make adjustments.

My invention includes a tab actuator having a threaded stem by which the length of said tab actuator is arranged to be varied by rotation through relatively rotatable abutted internally threaded members which may be rotatably adjusted to vary the surface tension on the threads of said threaded stem, and provides normally inaccessible means to maintain said abutted members thus rotatably adjusted.

My invention comprehends relatively rotatable adjustable threaded collars respectively having relatively opposed annular bands of serrations which may be engaged by open retaining rings of relatively soft metal or other suitable material interposed to prevent accidental relative rotation of said collars when thus adjusted to the desired extent, which retaining rings are normally inaccessible in the assembled tab actuating structure.

My invention also includes all of the various novel features of construction and arrangement as hereinafter more definitely specified.

In the accompanying drawings, Figure 1 is a plan view of a tab actuator mounted to swing in a convenient form of pivotal mounting; Fig. 2 is a front elevational view of the tab actuator and its pivotal support illustrated in Fig. 1; Fig. 3 is a front elevational view of said tab actuator mounted to swing in another form of pivotal mounting; Fig. 4 is a fragmentary side elevational view of the forward end region of the tab actuator shown in Fig. 1, and suspended in the pivotal mounting shown in Fig. 3, said pivotal mounting being shown in section for convenience of illustration; Fig. 5 is a plan view of the pivotal mounting illustrated in Figs. 3 and 4; Fig. 6 is a vertical longitudinal sectional view of the tab actuator and its mounting shown in Fig. 1 taken axially on the line 6-6 in said figure; Fig. 7 is a fragmentary horizontal sectional view of the forward end of the tab actuator shown in Figs. 1 and 6, taken on the line 7-7 in said Fig. 6; Fig. 8 is a transverse vertical sectional view of the tab actuator taken on the line 8-8 in Fig. 7; Fig. 9 is a transverse vertical sectional view of the tab actuator taken on the line 9-9 in Fig. 6; Fig. 10 is a transverse vertical sectional view taken on the line 10-10 in Fig. 6; Fig. 11 is a front elevational view of the ball spacer guide for spacing the balls of the ball thrust bearing disposed in the forward end of the tab actuator; Fig. 12 is a front elevational view of the adjusting nut wire lock shown at the medial region of Fig. 6; Fig. 13 is a front elevational view of the jam nut wire lock shown at the medial region of Fig. 6; Fig. 14 is a front elevational view of the C-shaped washer which embraces the screw stem at its headed end, as shown in Fig. 6; Fig. 15 is a plan view of the flexible tab actuator assembly embodying the extensible and retractable tab actuator illustrated in Figs. 1, 4, 6 and 7, and including the pivotal mounting illustrated in Figs. 3 and 4; Fig. 16 is a fragmentary plan view of the flexible tab actuator assembly including a right angular fitting and embodying the extensible and retractable tab actuator unit illustrated in Figs. 1, 4, 6, 7 and 15; Fig. 17 is a central vertical sectional view of the right angular fitting illustrated in Fig. 16, taken axially on the line 17-17 in said Fig. 16; Fig. 18 is a central longitudinal sectional view of the driven end of the flexible tab actuator assembly illustrated in Fig. 15, taken axially on the line 18-18 in Fig. 15; and Fig. 19 is a plan view of an airplane illustrating diagrammatically possible means of incorporation of the tab actuator assembly including the extensible and retractable tab actuator unit.

2 is a front elevational view of the tab actuator and its pivotal support illustrated in Fig. 1; Fig. 3 is a front elevational view of said tab actuator mounted to swing in another form of pivotal mounting; Fig. 4 is a fragmentary side elevational view of the forward end region of the tab actuator shown in Fig. 1, and suspended in the pivotal mounting shown in Fig. 3, said pivotal mounting being shown in section for convenience of illustration; Fig. 5 is a plan view of the pivotal mounting illustrated in Figs. 3 and 4; Fig. 6 is a vertical longitudinal sectional view of the tab actuator and its mounting shown in Fig. 1 taken axially on the line 6-6 in said figure; Fig. 7 is a fragmentary horizontal sectional view of the forward end of the tab actuator shown in Figs. 1 and 6, taken on the line 7-7 in said Fig. 6; Fig. 8 is a transverse vertical sectional view of the tab actuator taken on the line 8-8 in Fig. 7; Fig. 9 is a transverse vertical sectional view of the tab actuator taken on the line 9-9 in Fig. 6; Fig. 10 is a transverse vertical sectional view taken on the line 10-10 in Fig. 6; Fig. 11 is a front elevational view of the ball spacer guide for spacing the balls of the ball thrust bearing disposed in the forward end of the tab actuator; Fig. 12 is a front elevational view of the adjusting nut wire lock shown at the medial region of Fig. 6; Fig. 13 is a front elevational view of the jam nut wire lock shown at the medial region of Fig. 6; Fig. 14 is a front elevational view of the C-shaped washer which embraces the screw stem at its headed end, as shown in Fig. 6; Fig. 15 is a plan view of the flexible tab actuator assembly embodying the extensible and retractable tab actuator illustrated in Figs. 1, 4, 6 and 7, and including the pivotal mounting illustrated in Figs. 3 and 4; Fig. 16 is a fragmentary plan view of the flexible tab actuator assembly including a right angular fitting and embodying the extensible and retractable tab actuator unit illustrated in Figs. 1, 4, 6, 7 and 15; Fig. 17 is a central vertical sectional view of the right angular fitting illustrated in Fig. 16, taken axially on the line 17-17 in said Fig. 16; Fig. 18 is a central longitudinal sectional view of the driven end of the flexible tab actuator assembly illustrated in Fig. 15, taken axially on the line 18-18 in Fig. 15; and Fig. 19 is a plan view of an airplane illustrating diagrammatically possible means of incorporation of the tab actuator assembly including the extensible and retractable tab actuator unit.

In said figures, the tab actuator unit, best il-

illustrated in Figs. 1, 6, 7, 8, 9 and 10, may, for convenience, be described as having the head section 1, the body section 2 and the tail section 3. Said head section 1 is relatively short and tubular, having the forward reduced region of its bore provided with the internal screw threads 6, and having the inturned flange 7 and the relatively enlarged bore 9.

Said tubular head section 1 is provided with the oppositely disposed axially aligned apertures 10 and 11 which are encircled by the outwardly extended flanges 12 and 13 arranged, as shown, to be bent inwardly to embrace the medially disposed peripheral flanges 15 and 16 on the respective bearing cups 17 and 18 which are respectively inserted in said apertures 10 and 11 and which have the conical bearings 19 and 20, the purpose of which will be hereinafter described in detail.

As shown in Figs. 6 and 7, the body section 2 comprises the elongated tubular barrel 21 having its forward reduced end region 22 telescoped within the tubular head section 1 and retained therein by the transversely disposed retaining pins 23 and 24 which extend through the inturned flange 25, as shown in Figs. 7 and 8.

Said barrel 21 is provided in its reduced telescopic region 22 with the axially aligned apertures 26 and 27 relatively registered with the apertures 29 and 30 respectively which extend through the walls of the rear end region of the tubular head section 1, and said apertures 26 and 27 are encircled by the outwardly extended flanges 31 and 32 arranged, as shown, to be bent inwardly to embrace the medially disposed peripheral flanges 33 and 34 on the respective bearing cups 35 and 36 which are respectively inserted in said apertures 26 and 27 and extend through the apertures 29 and 30 and which provide the conical bearings 37 and 38, the function of which will be hereinafter described in detail.

The barrel 21 of the body section 2, provides a smooth cylindrical bore 39 in which the enlarged forward half 40 of the tubular tail section 3 is arranged to slide in its reciprocation when retracted or extended to the positions shown in Figs. 15 and 6 respectively, or to any intermediate position. The free end half of said tail section 3 is relatively reduced in diameter and is provided with the attaching eye fitting 41 having the aperture 42 and is provided with the cylindrical extension 43 projecting into the bore 45 of the tail section 3 with which it is engaged by the pin 46 extended transversely through said tail section 3 and extension 43, as shown best in Fig. 6.

The forward end region of the bore 45 is enlarged and provides the counterbore 47 which is provided forwardly with the internal screw threads 49 and which affords a pocket 50 providing a shoulder 51 against which the internally threaded sleeve bushing 52 bears when disposed in said pocket 50, said sleeve bushing 52 being conveniently retained in position in said pocket by the transversely extended retaining pins 53 and 54 which may be driven into the relatively parallel apertures 55 and 56 in the tail section 3 and the relatively aligned apertures 57 and 58 in the sleeve bushing 52, as illustrated in Figs. 6 and 10.

The relative axial movement of the body section 2 and tail section 3 to vary the length of the tab actuator unit is arranged to be effected by the actuating screw 60 which extends through said body section in threaded engagement with the sleeve bushing 52 and terminates in the

flange 61 formed by the interposed neck 62, the outward or extensible movement of the tail section 3 being limited by the yoke-shaped washer 64, which is best illustrated in Fig. 14 and which is arranged to embrace the neck 62 of the actuating screw 60, as shown in Fig. 6.

In order to prevent possible fluttering of the tab which the tab actuator unit is designed to actuate, it is highly essential that there be substantially no axial play between the parts of the actuator unit that operate to effect the varying of its length.

For the purpose of insuring the proper surface tension between the threads of the screw 60 and sleeve bushing 52 and thereby preventing lost motion, there is provided the threaded tension adjusting nut 65 which is threadedly disposed on the adjusting screw 60 and having its flange 66 abutted against the sleeve bushing 52 and having in its forward periphery the notches 67 and 68 which may be engaged by a suitable tool with which it may be rotated on said shaft to the desired extent to produce the required tension and consequent absence of longitudinal play or lost motion between the tab to be actuated and the means for initiating such actuation.

The tension adjusting nut 65 is encircled by the annular jam nut 70 which is in threaded engagement with the internal screw threads 49 in the forward end region of the counterbore 47 of the tail section 3 and which bears against the forward surface of the flange 66 to hold it firmly in its abutted engagement with said bushing 52, and said jam nut 70 has its forward edge provided with the notches 71 and 72 by which it may be engaged for rotatable adjustment.

As illustrated in Figs. 6 and 9, the forward end region of the tail sections 3 and the jam nut 70 are respectively provided with opposed relatively spaced knurled bands affording inwardly directed serrations 75 in the tail section 3 and opposed outwardly directed serrations 76 on the jam nut 70. These opposed serrations are arranged to be engaged, as shown, by the open ring 77 formed of relatively soft metal, such as illustrated in Fig. 13, which is forced longitudinally between the knurled members 3 and 70 so that the teeth formed by said serrations bite into said ring 77 and thereby prevent relative rotation of said members 3 and 70.

Similarly, the inner and outer surfaces respectively of the jam nut 70 and adjusting nut 65 are provided with opposed knurled bands affording inwardly directed serrations 79 on the jam nut 70 and the opposed outwardly directed serrations 80 on the adjusting nut 65. Said serrations are arranged to be engaged, as shown, by the open ring 81 formed of relatively soft metal such as illustrated in Fig. 12, which is forced longitudinally between the knurled members 65 and 70 so that the teeth formed by said serrations bite into said ring 81 and thereby tend to lock said members 65 and 70 against relative rotation.

The forward end of the actuating screw 60 terminates in the cylindrical extension shaft 63 upon the end of which the bifurcated drive coupling 82 is secured by the transversely extended retaining pin 83. Said drive coupling 82 has the forwardly extending prongs 85 and 86 and the rearwardly extending hub 87 against which the annular ball bearing thrust washer 89 bears. Said thrust washer 89 is directly mounted on the screw shaft 63 and is arranged to rotate therewith, being provided with the incurved slot 90

which is engaged by the forwardly extending prongs 91 and 92 projecting from the thrust washer drive collar 93 which is secured to the screw shaft 63 by the retaining pin 95.

The ball bearing thrust washer 89 is included in the ball bearing unit which comprises the forward annular ball race disk 96 which bears against the inturned flange 7 and between which and said thrust washer 89 is disposed a circular series of bearing balls 97 which are equally spaced by the annular ball spacing cage 99 having the circular series of ball retaining apertures 100.

Said ball bearing unit also comprises the rearward annular ball race disk 101 which bears against the inturned flange 25 and between which and said thrust washer 89 is disposed a circular series of bearing balls 102 which are equally spaced by the annular ball spacing cage 103.

As best shown in Fig. 7, the drive coupling 82, which is arranged to be operatively connected with the driving elements illustrated in Figs. 15 and 16, has its retaining pin 83 so disposed as to be capable of insertion or removal through the aligned apertures 105 and 106, and to be rendered integral with said drive coupling 82 by forming the V-shaped slots 109 and 110 in its opposite ends, as shown in Fig. 7, by a suitably provided tool that may be extended through said apertures 105 and 106 to spread the ends of said retaining pin 83, as shown.

Referring particularly to Figs. 1, 2 and 6, the actuator structure thus described may be pivotally supported for actuation in the mounting 112 which is provided with the apertures 113, 114, 115 and 116 through which screws or bolts may be extended and by means of which it may be secured to a panel or other suitable form of attachment.

Said mounting 112 has the central preferably circular walled opening 119 through which the head section 1 of the actuator structure is extended, being supported therein for swinging movement by the relatively opposed conical pivots or trunnions 120 and 121 respectively engaged in the bearing cups 17 and 18 and having their respective screw threaded shanks 122 and 123, which are provided with the slotted heads 125 and 126, adjustably engaged in said mounting 112 and arranged to be secured in adjusted position by the jam nuts 127 and 128.

The actuator structure comprising the head section 1, body section 2 and tail section 3, may be pivotally supported in the mounting 129, as illustrated in Figs. 3, 4, 5 and 15, said mounting 129 having the base 130 provided with the screw or bolt or screw holes 131 and 132 and also having the preferably circular walled opening 133 through which the head section 1 of the actuator structure is extended, being supported therein for swinging movement by the relatively opposed conical trunnions 135 and 136.

As best illustrated in Figs. 3 and 4, the trunnion 135 is engaged in the bearing cup 35 and has its cylindrical shank 137 engaged in the base 130 while the trunnion 136 is engaged in the bearing cup 36 and has its screw threaded shank 139, which is provided with the slotted head 140, adjustably engaged in said mounting 129 and maintained thus adjusted by the jam nut 141.

As shown in Fig. 15, the tab actuator structure illustrated in Fig. 6 may be operatively connected with the operator's station, which may be conveniently located, as in the cockpit of an

airplane such as illustrated in Fig. 19, through means of a flexible shaft assembly 143 of well known construction, and, as shown in Fig. 18 comprises the flexible shaft 145 having the rearwardly extending terminal fitting 146 providing the projecting fin 147 and the forwardly extending terminal fitting 149 having the longitudinally extending slot 150. Said flexible shaft 145 extends for free rotation through the flexible sheath 153 which is provided with the externally screw threaded coupling 155 and the internally screw threaded coupling 156.

The coupling 155 is threadedly engaged with the forward end of the head section 1 so that the projecting fin 147 of the terminal fitting 146 engages between the prongs 85 and 86 whereby rotation of the flexible shaft 145 effects rotation of the actuating screw 60 and produces a consequent longitudinal movement of the tail section 3 with respect to the body section 2 of the tab actuator, as best illustrated in Fig. 6, to vary the length of the tab actuator in accordance with the direction of rotation of said actuating screw 60.

The coupling 156 is threadedly engaged with the threaded bushing 159 which provides a nipple for the shaft driving unit 160 comprising the sleeve 161 on which the sprocket wheel 162 is mounted, and the terminal thimble 163, said sprocket wheel having the transversely extending pin 165. As illustrated in Figs. 15 and 18, the shaft driving unit 160 is arranged to be attached to a stationary support such as the wall or panel 169, and may be rigidly engaged therewith by the nut 170 which bears against one side of the panel 169 and the flange 171 on the bushing 159 against the opposite side of said panel. As illustrated, washers 172 may be conveniently interposed between the nut 170 and the coupling 156, and one or more washers 175 may be included between the head section 1 and the coupling 155.

It has been found in practice that it is desirable to connect the tab actuator structure including the head, body and tail sections 1, 2 and 3 respectively with the terminal coupling 155 of the flexible shaft assembly 143 on relatively angular axes and therefore the right angular unit 176 may be interposed, as illustrated in Fig. 16 and shown in section in Fig. 17, and comprising the relatively angular offset cylindrical casing barrels 177 and 178 formed in unitary relation and housing relative transverse offset shafts 179 and 180 respectively having the relatively cooperative spiral toothed gears 181 and 182. The shaft 179 is arranged to be driven by connection with the flexible shaft 145 and the shaft 180 has the projecting fin 187 corresponding to the fin 147 and arranged to engage the prongs 85 and 86 of the driving coupling in the head section 1 of the tab actuator, as illustrated in Figs. 6 and 16. Said shafts 179 and 180 may be conveniently mounted to rotate on bearings, as illustrated in Fig. 17.

The illustration included in Fig. 19 indicates diagrammatically various means by which the tab actuator herein described may be employed. In said figure the airplane shown includes the fuselage 190 having the cockpit 191, the wings 192 and 193, the stabilizer fins 195 and 196 and rudder 197.

The wing 192 is provided with the tab 199 mounted to be turned up or down on the hinge 200 and having the lever 201 to which is connected the tab actuator 202, such as illustrated

in Fig. 6, and including the head, body and tail sections 1, 2 and 3. Said tab actuator is connected by the flexible shaft assembly 143, as shown in Fig. 15, and includes the sprocket wheel 162, which is connected by the sprocket chain 203 with the sprocket wheel 205 having the operating handle 206 by which it may be rotated in either direction by the operator or pilot.

Similarly, the tab 209 is hinged at 210 and has the lever 211 which is connected through the tab actuator 212 including the head, body and tail sections 1, 2 and 3, shown in Fig. 6, flexible shaft assembly 143, as shown in Fig. 15, and includes the sprocket wheel 162, which is connected by the sprocket chain 213 with the sprocket wheel 215 having the operating handle 216 by which it may be rotated in either direction by the operator or pilot.

My invention is advantageous in that it serves to produce extremely delicate movements of adjustments, to insure that such movements be made with a minimum of lost motion and to maintain the adjusted elements in a stabilized relation when thus adjusted.

Although I have shown and described the tab actuator and associated assemblage as particularly applicable to use in aircraft practice, it may be employed with facility and efficiency in connection with the actuation of other devices or accessories used in either aircraft or other assemblages, and therefore I do not desire to limit my invention to the precise details of construction and arrangement as herein set forth, as it is obvious that various modifications may be made therein without departing from the essential features of my invention as defined in the appended claims.

Having thus described my invention, I claim:

1. A device of the class described comprising a pivoted body section having thrust and pull bearings mounted therein, a relatively movable section carried thereby in telescopic relation therewith, provided with a bore and having a screw threaded bushing retained therein, a screw threaded shaft having a bearing washer mounted thereon arranged to cooperate with said thrust and pull bearings to prevent its axial movement, and having a neck forming a flange, said shaft being extended through said body and into said movable section in threaded engagement with said bushing, means wholly inclosed within said device arranged to vary the surface tension between the threads of said screw threaded shaft and the threads of said bushing, and an open sided yoke-shaped washer embracing said neck and being retained by the wall of said bore and serving to limit the outward movement of said movable section with respect to said body section.

2. The combination with a screw shaft, of relatively rotatable members mounted thereon and respectively having relatively opposed serrations,

and an open-sided ring of relatively soft material engaging said serrations to prevent their relative rotation.

3. A device of the class described, comprising a head section having aligned pivot bearings, a ball bearing unit mounted in said head section, a body section having its forward reduced end region extended into said head section and secured thereto and having aligned pivot bearings, a tail section arranged to telescopically slide in said body section, being provided with an attaching eye, and having a screw threaded bushing secured therein, a screw shaft extended through said body section in threaded engagement with said bushing and having a bearing washer cooperative with said ball bearing unit to prevent its longitudinal movement in said head and body section, and having a neck forming a terminal flange, a yoke collar embracing said neck and cooperative with said flange to limit the relative movement of said tail section on said screw shaft, a coupling on the forward end of said shaft, a collar threadedly engaged on said collar and arranged to bear with varying degrees of pressure against said bushing, a jam nut in threaded engagement with said tail section in engagement with said collar, means tending to prevent relative rotation of said jam nut and tail section, and means tending to prevent relative rotation of said jam nut and collar, said collar and jam nut being prevented from unauthorized adjustment by being inclosed in said body section irrespective of the relative positions of said body section and its cooperative tail section.

4. The combination with a screw shaft, of relatively rotatable members mounted thereon and respectively having relatively opposed serrations, and an open-sided ring of relatively pliant material engaging said serrations independently of said shaft and arranged to prevent their relative rotation.

5. A device of the class described comprising a pivoted body section having thrust and pull bearings mounted therein, a relatively movable section carried thereby in telescopic relation therewith, provided with a bore and having a screw threaded bushing retained therein, a screw threaded shaft having means arranged to cooperate with said thrust and pull bearings to prevent its axial movement, and having a neck forming a flange, said shaft being extended through said body into said movable section in threaded engagement with said bushing, means wholly inclosed within said device arranged to vary the surface tension between the threads of said screw threaded shaft and the threads of said bushing, and means cooperative with said neck and being retained by the wall of said bore serving to limit the outward movement of said movable section with respect to said body section.

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