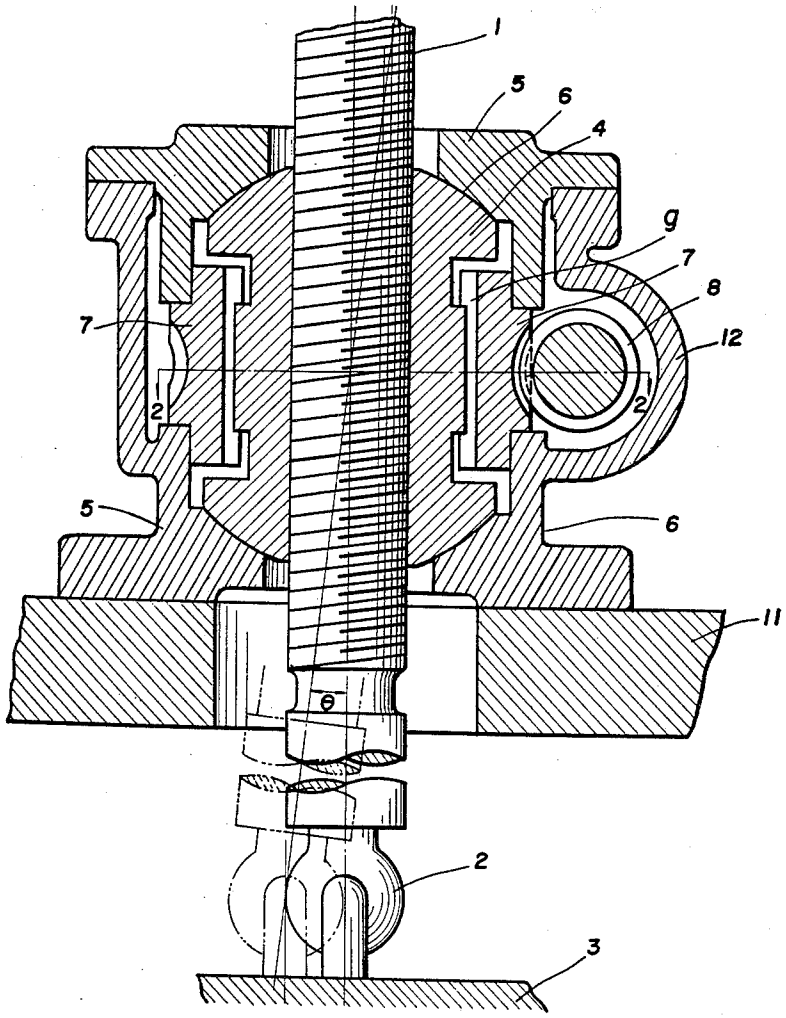
Dec. 25, 1962 KOICHI WATANABE ETAL 3,069,924

SCREW JACK

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Fig. 1



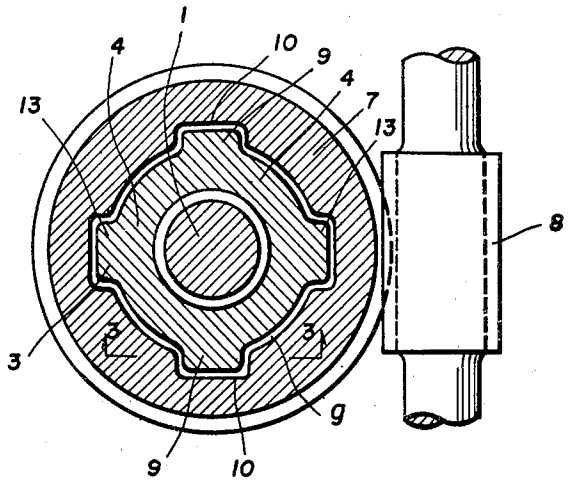
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Fig. 2



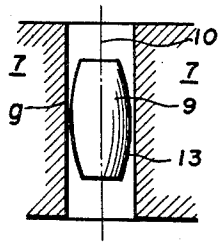


Fig. 3

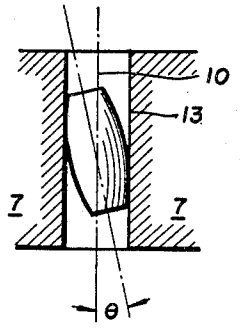


Fig. 4

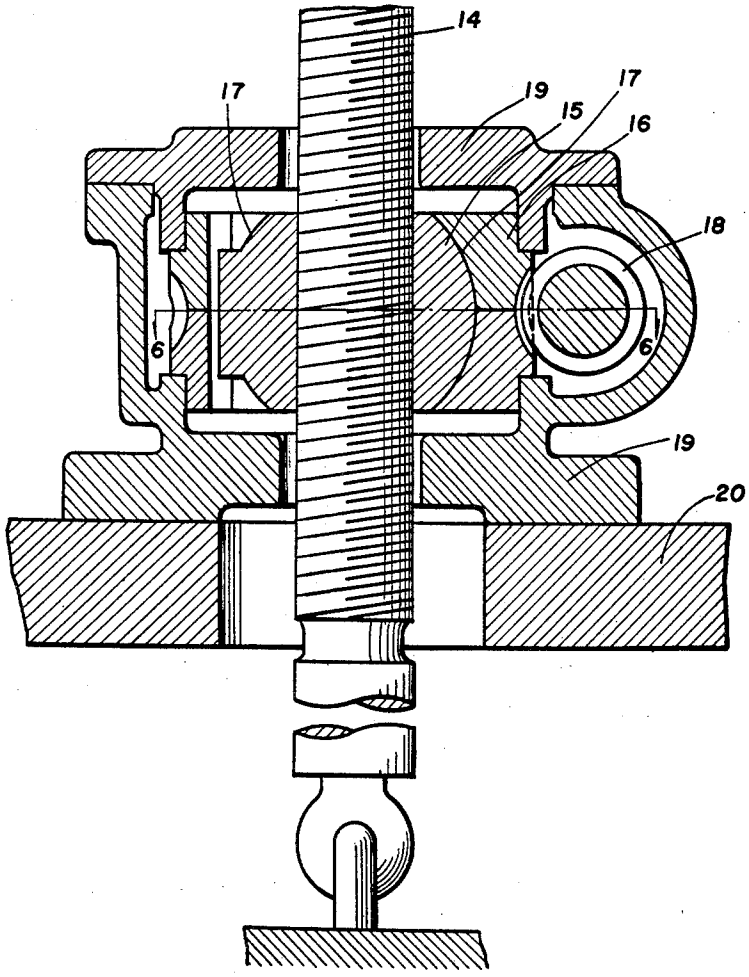
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Fig. 5



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Fig. 6

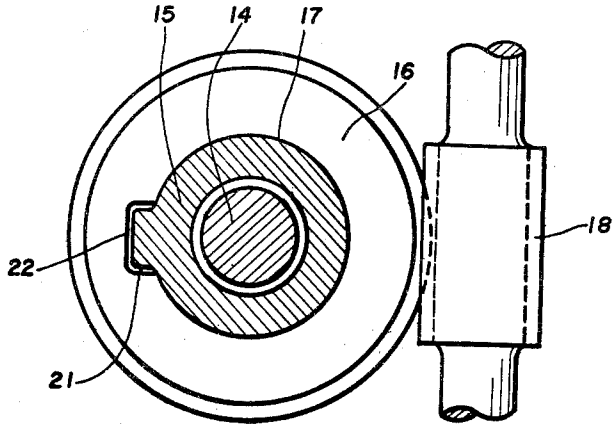
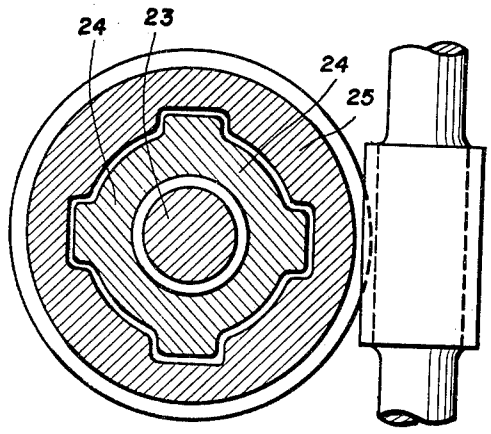


Fig. 8



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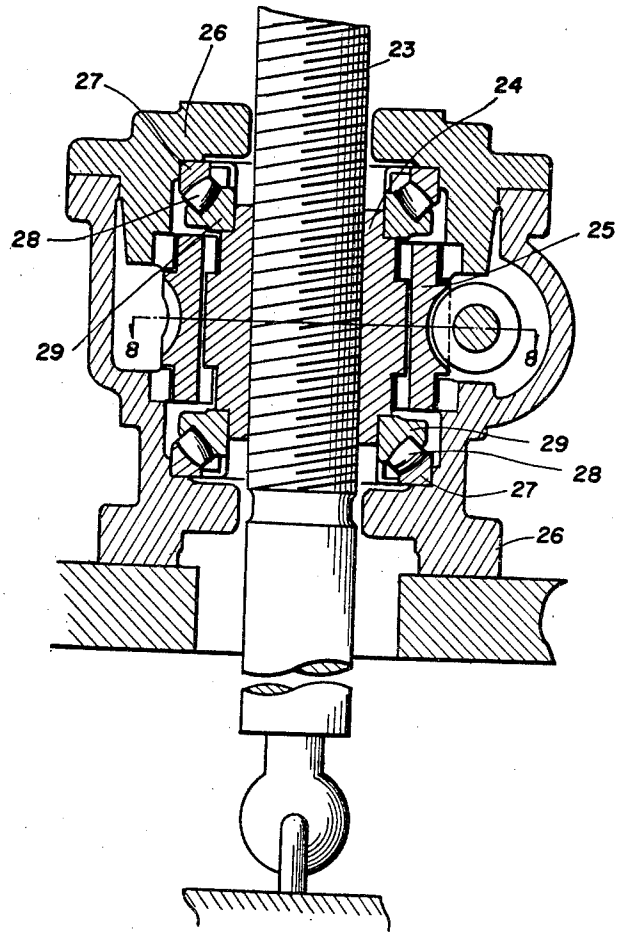
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Fig. 7



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3,069,924

SCREW JACK

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Filed Aug. 18, 1959, Ser. No. 834,598
8 Claims. (Cl. 74—424.8)

This invention relates generally to a screw jack for raising, lowering and suspending a heavy load for a long period of time, and more particularly, to a screw jack in which the screw is raised and lowered by rotating a worm wheel and nut mechanism held against vertical movement.

A screw jack operated by a worm wheel and nut mechanism is generally used for raising and lowering a heavy load that is suspended for long periods of time. However, the bending force acts on the screw rod when the load is not truly vertical, and the screw rod becomes deflected due to the weight of the suspended load. Strains in the screw rod may be accentuated by the temperature variations, or there may be errors in setting up the jack. When a common screw jack is used, it will not operate smoothly owing to the improper application of forces applied to the screw thread, in case the load is raised or lowered. The bending forces on the screw are accentuated when the suspended load swings owing to vibrations or earthquakes and the like. In a commonly used screw jack, the screw rod is liable to be bent or partially broken.

The object of the present invention is to eliminate such difficulties. In a screw jack in accordance with the present invention, the inclination of the screw rod has no influence on the torque transmission of the worm, and the suspended load can be raised and lowered smoothly even when the screw rod is inclined to the vertical, and further, the tolerable inclination angle of the screw rod can be made large without hindering its operation.

In accordance with the present invention, the part rotated by the worm is divided into two. One is the nut body part to fit the screw rod, and the other is the worm wheel part to gear into worm. The nut body part is freely rotatably held by the spherical bearing mechanism, and is also coupled with the worm wheel part with a certain clearance.

Other objects and advantages appear hereinafter in the following description and claims.

The accompanying drawings show, for the purpose of exemplification without limiting the invention or the claims thereto, certain practical embodiments illustrating the principles of the invention wherein:

FIG. 1 is a view in vertical section of one embodiment of this invention.

FIG. 2 is a view in section taken on line 2—2 of FIG. 1.

FIG. 3 is a view in section taken on line 3—3 of FIG. 2.

FIG. 4 is a view in section taken on line 3—3 when the nut is askew.

FIG. 5 is a view in vertical section of another embodiment of this invention.

FIG. 6 is a view in section taken on line 6—6 of FIG. 5.

FIG. 7 is a view in vertical section of still another embodiment of the invention.

FIG. 8 is a view in section taken on line 8—8 of FIG. 7.

Referring to the drawings, in FIG. 1, 1 is a screw rod which is the principal element of the jack and is a non-rotary axially movable threaded traveling screw provided with the eye 2 at the lower end of the screw rod 1. The eye 2 embraces a complementary eye extending from

the suspended load 3. 4 is an internally threaded rotary nut body to fit the screw rod 1. 5 is a jack housing or casing member having a removable cap and which surrounds the nut for supporting the same. A spherical bearing which effectively encircles the nut 4 and has an outer bearing portion and an inner bearing portion rotatable and tiltable to the outer bearing portion which bearing portions are complementary contact faces 6 of the nut body 4 and the jack casing are spherical and therefore, the nut body 4 is supported so as to rotate freely on the spherical casing 5. 7 is a worm wheel or annular rotary driving means rotatably supported by the housing and connected to operate the nut body 4 through an interlocking tooth means in the form of a gear tooth arrangement with a clearance g. The worm wheel is interengaged with a worm 8, and is provided with at least one cavity 10 in which protruded a toothed part 9 on the nut body 4 in which it can freely fit, as shown in FIG. 2. The rotation is transmitted by means of the connection of the protruded tooth parts 9 within the cavity or recesses 10. This connection forms a coupling for rotation that allows the nut angular tilting movement. 11 is a stationary table on which the jack casing 5 is mounted. 12 is a part of the casing for housing the worm 8.

In the above embodiment, the worm 8 is rotatable manually or electrically as hitherto practised, for raising and lowering the screw rod.

When the worm 8 is rotated, the worm wheel 7 is rotated also, by the worm wheel mechanism, and the nut body 4 which is coupled with the worm wheel 7, by the recessed cavities 10 and the protruded tooth parts 9, rotate together. The screw rod 1 does not rotate, but it moves axially up and down.

If the axis of the screw 1 tends to incline due to a certain cause, it can be inclined freely up to the angle θ as shown with the dotted line at a tolerable range of clearance g with the worm wheel 7 along the spherical surface 4 of the nut body.

FIGS. 3 and 4 show the connecting function of the protruded tooth parts 9 of the nut body 4 with the recess cavities 10 of the worm wheel. FIG. 3 shows the normal condition of the rod 1 which is not inclined, on both sides of which there is clearance g. FIG. 4 shows the state of the rod inclined up to the maximum tolerable angle θ. The contact surface 13 of the protruded tooth parts 9 is formed as arc so as to make the tolerable inclination larger. As a result of such construction, even when the rod inclines slightly, the nut body 4 would follow and be freely inclined, and no influence would be given on the engaging teeth faces between the worm 8 and the worm wheel 7. Thus, while the normal engaging condition is kept, the engaging action and the power transmission in the worm mechanism can be performed smoothly as usual. The rotating action is transmitted to the nut body 4 without any trouble through the contact face 13 of the protruded tooth parts 9 and the recess cavities 10 when the axis of the rod 1 is at an angle less than θ.

FIG. 5 shows another embodiment of this invention. The bearing having its outer and inner bearing portions which are indicated by the spherical mating bearing surfaces 17 formed between the nut body 15 and the drive means or worm wheel 16, whereby the transmission of rotating power is effected at one place, namely between the protruded tooth part and the recess cavity. In FIGS. 5 and 6, 14 is a screw rod, 15 a nut body, 16 a worm wheel, or rotary member, 17 a spherical surface, 18 a worm, 19 a jack casing member, 20 a stationary table, 21 a protruded tooth part and 22 a recess cavity. The function of this embodiment is similar to that of FIG. 1,

but the worm wheel carries the weight of the screw rod 14 and transfers the same to the casing 19.

FIG. 7 shows another embodiment of this invention. Instead of providing a spherical surface between the contact surface of the nut body and the casing cover, as in FIG. 1 or the worm wheel as in FIG. 4, the spherical bearing is a spherical roller bearing unit inserted between the nut body and the casing cover or rotary member. In FIGS. 7 and 8, 23 is a screw rod, 24 a nut body, 25 a worm wheel or drive means, 26 a housing, casing member or cover, 27 the outer bearing portion or with the outer race for a spherical roller bearing unit, 28 a spherical roller and 29 the inner bearing portion or inner-race of the spherical roller bearing unit. In this embodiment, the inner-race contacts with the nut body 24, and the outer-race contacts with the casing cover, and the inner race 29 and the spherical roller bearing mechanism 28 is tiltable relative to the axis of and can be rotated freely along the spherical bearing surface of the outer-race 27.

Hereinabove, the invention has been explained with reference to three embodiments. In the case of separating the rotating part into two members, it is essential that the clearance size on the rating connection thereof should be designed by taking into consideration the required inclination range of the screw rod and the gap allowance of the screw rod with the frame. Needless to say, the larger the gap is the more the inclination.

As described above, the jack of the invention eliminates any fear of the screw rod being bent or teeth broken due to an external force or vibration unforseen, such as earthquake, and the jack freely inclines relatively largely in response to such external power. Since such external force does not give any effect on the thread engaging part, the action of raising and lowering can be performed smoothly even when the screw rod is inclined. And, this feature is extremely effective for industrial use.

We claim:

1. In a screw jack, an axially movable threaded traveling screw, an internally threaded rotary nut in mating engagement with said traveling screw for raising and lowering the same, means for rotatably and tiltably supporting said nut on a fixed common center and including a housing, an annular rotary driving means supported by said housing and concentrically encircling said nut on said fixed common center, interlocking tooth means on said driving means and on said nut to rotate the latter, and means defining clearance between said interlocking tooth means to allow said nut to tilt on said fixed common center in said means for rotatably and tiltably supporting said nut.

2. The screw jack of claim 1 characterized in that said said nut and said means for rotatably and tiltably supporting said nut and said annular driving means are mounted on a horizontal plane passing through said fixed common center.

3. The screw jack of claim 2 characterized in that said interlocking tooth means is also centered relative to said horizontal plane.

4. The screw jack of claim 1 characterized in that said means for rotatably and tiltably supporting said nut includes an inner spherical bearing portion on said nut and a mating outer spherical bearing portion on said housing.

5. The screw jack of claim 1 characterized in that said means for rotatably and tiltably supporting said nut includes an inner spherical bearing portion on said nut and a mating outer spherical bearing portion on said drive means supported by said housing.

6. The screw jack of claim 1 characterized in that said means for rotatably and tiltably supporting said nut includes an antifrictional bearing having inner spherical bearing races on said nut and outer spherical bearing races on said housing with mating rollers therebetween.

7. The screw jack of claim 1 characterized in that said driving means is provided with an annular toothed periphery, and means engaging said toothed periphery to rotate said driving means.

8. The screw jack of claim 7 characterized in that said annular toothed periphery and said means engaging said toothed periphery is a driven worm gear and worm respectively and journaled in said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

107,891	Ferguson	Oct. 4, 1870
130,542	Shumusk	Aug. 13, 1872
426,822	Krueger	Apr. 29, 1890
467,515	McArthur et al.	Jan. 26, 1892
572,598	Dean	Dec. 8, 1896
2,819,979	Dean	Dec. 31, 1957

FOREIGN PATENTS

2,101	Great Britain	Jan. 25, 1884