Aug. 21, 1923. 1,465,570

E. E. ARNOLD

LIFTING JACK

Filed May 29, 1920 2 Sheets-Sheet 1

FIG. 2.

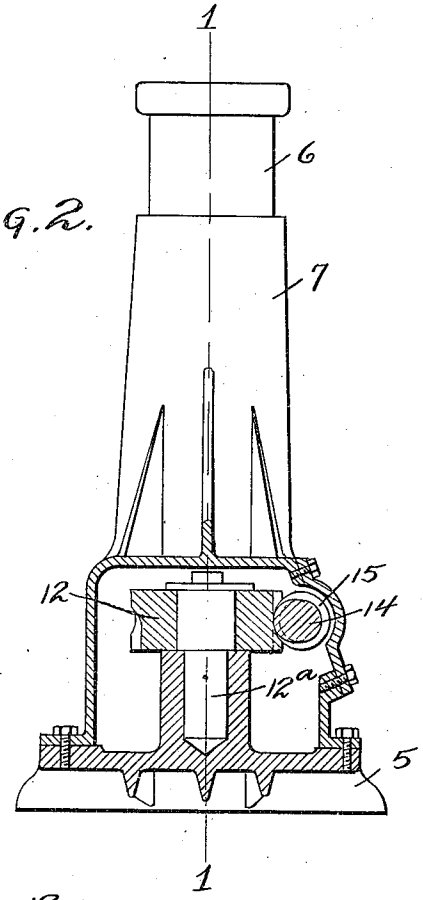
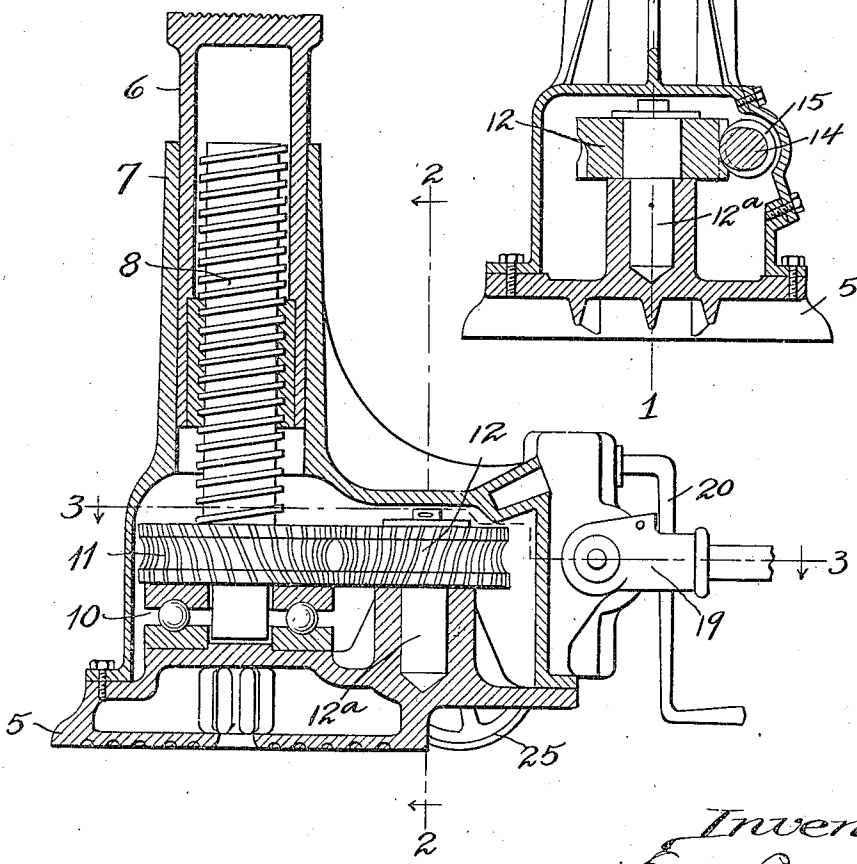


FIG. 1.



Inventor.
Edwin E. Arnold
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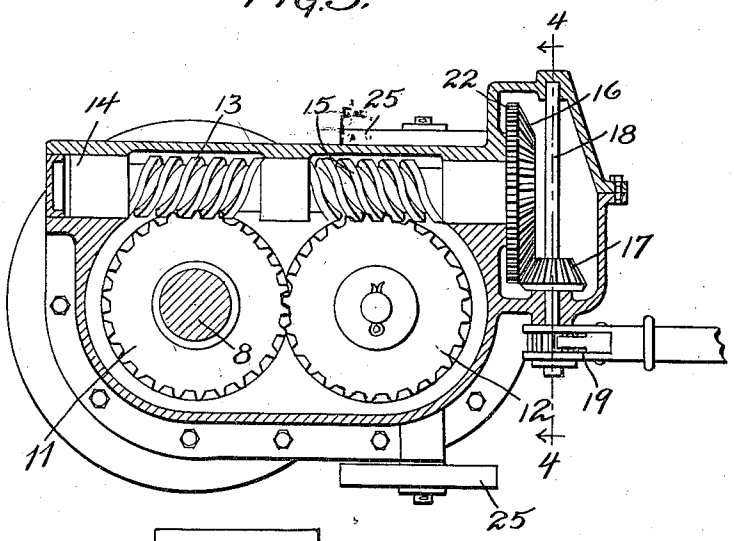
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FIG. 3.



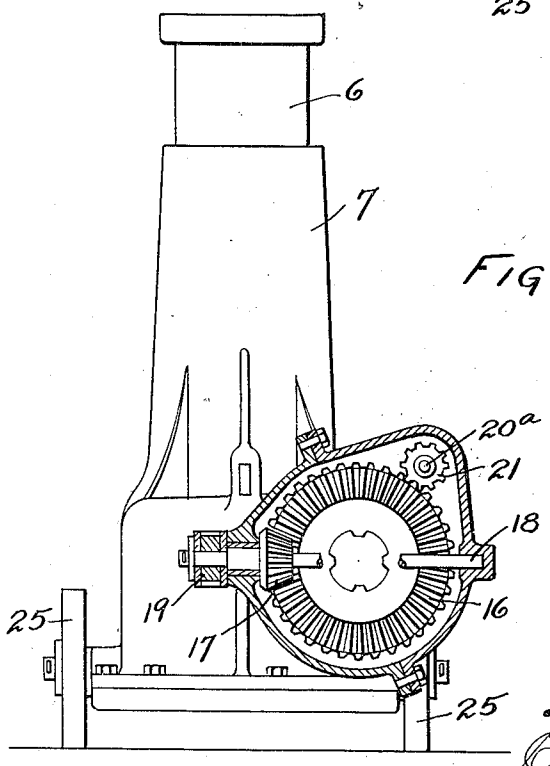


FIG. 4.

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Patented Aug. 21, 1923. 1,465,570

UNITED STATES PATENT OFFICE.

EDWIN E. ARNOLD, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO IRON CITY PRODUCTS COMPANY, A CORPORATION OF PENNSYLVANIA.

LIFTING JACK.

Application filed May 29, 1920. Serial No. 385,302.

To all whom it may concern:

Be it known that I, EDWIN E. ARNOLD, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Lifting Jacks, of which the following is a specification.

This invention relates to lifting jacks and has for an object to produce a heavy duty jack which is compact, relatively light, simple to manufacture and simple and effective in operation and which includes a double worm drive as a part of the operating mechanism.

A further object is to produce a worm actuated jack of large capacity in which the load to which the lifting mechanism is subjected is distributed between two worm gear trains which form a part of the operating mechanism.

These and other objects which will be made more apparent throughout the further description of the invention are attained by means of a jack embodying the features herein described and illustrated in the drawings accompanying and forming a part hereof. In the drawings Figure 1 is a sectional view taken along the line 1—1 of Figure 2 and illustrates a jack embodying my invention. Figure 2 is a sectional view taken along the line 2—2 of Figure 1. Figure 3 is a sectional view taken along the line 3—3 of Figure 1 and Figure 4 is a sectional view taken along the line 4—4 of Figure 3.

Lifting jacks employing double worm gear operating mechanisms have many advantages over ordinary jacks, primarily because the load to which the lifting ram and the operating mechanism is subjected is distributed over two sets of operating gears. Double worm jacks as ordinarily constructed are, however, not well adapted for large capacities since there are a number of features in such jacks that are controlling, in so far as the capacity of the jack is concerned, unless the size and weight of the jack is of no importance. The present invention produces a jack having all the advantages of a double worm jack but which is relatively light and relatively small in size, particularly where it is designed for high capacities. In the ilustrated embodiment this is accomplished by employing a screw actuated ram and an operating mechanism for the screw including two intermeshing spiral gears which are actuated by means of a right and left hand worm, through the agency of worm engaging teeth formed on each gear. Inasmuch as the spiral gears intermesh and are also driven by worms formed on the same worm shaft, it is essential to so construct the worm path or worm engaging teeth co-operating with each gear that each worm will take its proportion of the load and will transmit its proportion of the power to the lifting ram. It will be apparent that this would ordinarily be a difficult problem, unless precision instruments were employed and a high grade of workmanship attained, since it is necessary to maintain a three point contact, and to maintain it in such a way that each contact transmits its proportion of the power applied to the ram or takes its proportion of the load. This is easily and simply accomplished in the illustrated embodiment by forming a worm path on the spiral gears in such a way that the worm engaging teeth of each gear have the same nominal pitch and spiral angularity as the teeth of the spiral gears, and by so mounting the right and left hand worm that it is free to move axially, to automatically equalize the power transmitted by the right and left hand portions of the worm. With such an arrangement it is a relatively simple problem to manufacture a power transmitting gear train in which the proper gear contact between the teeth of the spiral gears and between each worm and the teeth of its co-operating worm path are maintained during all operating conditions of the jack.

Referring to the drawings; the jack illustrated is provided with a base 5 which supports the operating mechanism and the weight of the lifting ram 6, and which also supports the housing and ram guide 7. The ram 6 may be tubular in form and as shown is provided with internal threads meshing with the threads of a steep pitch screw 8 which extends into the ram and is preferably supported by a thrust collar 9. The thrust collar 9 is in turn supported by a thrust bearing 10 mounted on the base 5. The thrust bearing illustrated is of the ball type, but obviously any type of thrust bearing may be employed.

As shown, a combination worm wheel and spiral gear 11 is keyed or otherwise rigidly

mounted on the screw 8 and is located adjacent to the thrust collar 9. The gear 11 meshes with a similar but complementary gear 12 and also with a left hand worm 13 formed on a worm shaft 14. A right hand worm 15 also formed on the shaft 14 meshes with the worm engaging teeth formed on the combination spiral gear and worm wheel 12. The combination spiral gear and worm wheel 12 is journaled on a vertical shaft 12ª which is suitably mounted on the base 5. The axis of the gear 12 is parallel to the axis of the gear 11, and the axes of both these gears extend at right angles to the axis of the worm shaft 14.

The worm shaft 14 is journaled in suitable bearings formed in the jack housing and is so arranged that it is free to move axially an amount sufficient to insure automatic equalization of the load on the two parts of the worm. A bevel gear 16 is so mounted on the shaft 14 that it accommodates the longitudinal motion of the shaft but at the same time is capable of transmitting rotary motion to it. This may be accomplished by splining the gear to the shaft. The gear 16 meshes with a bevel gear 17, mounted on a shaft 18, which is suitably journaled in the jack housing. In the illustrated embodiment, a ratchet mechanism 19 is mounted on the projecting end of the shaft 18 and is adapted to impart rotation to the worm 14 in a direction to lift the ram 6. The ratchet mechanism is preferably adapted to impart motion in one direction only to the shaft 18 and consequently the jack is provided with a lowering crank 20 which is operatively connected to a shaft 20ª, suitably journaled in the housing 7 and carrying a gear 21. As shown, this gear meshes with crown teeth 22 formed on the bevel gear 16.

As has been stated the worm path on each gear 11 and 12 is formed integrally with the gear. As illustrated each worm path is located midway between the ends of its associated gear, and each worm engaging tooth, forming a part of the path, is, in effect, a continuation of one of the spiral teeth of the gear. Each gear is so proportioned that ample normal tooth surface is provided on either side of the worm path to insure proper operation of the gears.

In manufacturing these combination gear and worm wheels the spiral teeth are formed in the usual manner. The worm path is then preferably so formed on each gear that the nominal pitch and spiral angularity of the worm engaging teeth are the same as the spiral teeth of the gear. Each worm path is, however, formed by a hob capable of cutting a replica of the path engaging worm. It is necessary or at least desirable to cut the worm path to a sub-pitch diameter with relation to the pitch diameter of the gear teeth so as to give sufficient surface contact for good working conditions and adequate lubrication of the worm. This may be accomplished by allowing the worm path hob to run in slightly beyond the normal pitch diameter of the spiral teeth so as to produce the desired sub-pitch diameter. The pitch and helix angle of the worms 13—15 are preferably identical but complementary to the pitch and helix angles of the worm engaging teeth and of the spiral teeth of the gears 11 and 12.

The pitch of the screw 8 is preferably of such angularity as to allow it to be revolved by the pressure of the load upon the ram. The operating gear train is, however, preferably so designed, that it is not reversible under load, but the angle of the worm teeth is preferably such that a relatively small turning force applied, for example, to the crank 20, will overcome the friction between the worm and worm engaging teeth and permit the load to be lowered quickly or the jack to be quickly adjusted by the crank 20. The operation of the jack is as follows:

The jack is placed in position and the crank 20 is employed to adjust the ram to a lifting position with relation to the load to be lifted. The ratchet is then employed in the ordinary manner and during the operation of the jack both worms 13—15 are effective in transmitting power to the ram, because of the floating of the worm and the consequent automatic adjustment for the purpose of equalizing the work done by each worm. The worm shaft 14 transmits equal operating forces to the worm paths formed on the gears 11 and 12 and the force transmitted to the gear 12 is transmitted by means of the intermeshing gear 11 to the screw 8. Substantially all the power applied to the worm shaft is employed in doing effective work in raising the ram, since there are no unbalanced axial thrusts occasioned within the operating mechanism, and consequently the tooth pressure is relatively low, with reference to the load encountered by the ram and there is no necessity for employing restraining or counter-balancing thrust bearings in the operating mechanism. The thrust imparted by the load is borne entirely by the thrust bearing 10. In addition to the automatic equalization of the load on, or the delivery of power by the two worms 13 and 15, the longitudinally floating worm shaft, is capable of compensating for slight inaccuracies in the formation of the teeth and will continually adjust itself to equalize the load under all varying operating conditions encountered.

As has been described, the angular pitch of the screw 8 is such that it is reversible under load, whereas the angular pitch of the worms is such as to just prevent such a reversal under normal load conditions. For

this reason the crank 20 may be readily employed in lowering the load and in moving the ram into or out of contact with the load.

In the drawings I have shown the jack provided with side wheels 25 suitably journaled on the base 5, which may be employed in moving the jack from place to place.

The jack housing is so constructed that it may be filled with lubricant to any level. I preferably fill it to the level defined by the axis of the worm shaft 14, since under such conditions the operation of the operating mechanism will distribute the lubricant so that the operating parts will be effectively lubricated. Where it is desired to employ lubricant, such as oil, the shaft 18 will preferably be provided with a packing at the joint between it and the housing. If the lubricant level is located above the axis of the worm shaft it will also be desirable to pack the joint between the housing and the shaft 20^a or the appurtenant crank 20.

It will be apparent that the combination gear and worm wheel members 11 and 12 may be of different pitch diameters and that various changes, additions and omissions may be made in the details of construction of the jack illustrated without departing from the spirit and scope of my invention as set forth by the appended claims.

What I claim is:

1. In a jack, a ram, in combination with an operating mechanism therefore, comprising two intermeshing spiral gears, worm engaging teeth formed on each gear of substantially the same nominal pitch and spiral angularity as the spiral teeth of the gear, and a right and left hand worm meshing with the worm engaging teeth of both gears.

2. In a jack, a ram, in combination with an operating mechanism therefore, comprising two intermeshing spiral gears, worm engaging teeth formed on each gear of substantially the same nominal pitch and spiral angularity as the spiral teeth of the gear but to a sub-pitch relation to the spiral teeth, and a right and left hand worm meshing with the worm engaging teeth of each gear.

3. In combination in a jack, a ram, and an operating mechanism therefore, comprising two intermeshing spiral gears, a worm path of substantially the same nominal pitch and spiral angularity as the teeth of said gears hobbed to a sub-pitch diameter on each gear, a right and left hand worm engaging the worm path of both gears, and means secured to one of said gears for actuating said ram.

4. In combination in a jack, a ram, and an operating mechanism therefore, comprising a right and left hand worm, intermeshing gears, a worm path hobbed in each gear and co-operating with said worm, a screw secured to one of said gears for actuating said ram, a thrust bearing for the gear to which said screw is secured and means for rotating said worm.

5. In combination in a screw jack, a ram, a screw for actuating said ram, a worm wheel for actuating the screw, a worm for actuating the worm wheel, a ratchet, bevel gears for imparting motion of the ratchet to the worm, a crown gear formed on one of said bevel gears and meshing therewith for actuating said worm independently of said ratchet.

6. In a jack, a lifting ram, in combination with a ram actuating mechanism therefore, including two worm wheels, means for gearing said worm wheels together, a compound worm meshing with both worm wheels and movable axially to equalize tooth pressures between the worm and each worm wheel, and means for transmitting power from said worm wheels to said lifting rams.

7. In a jack, a lifting ram, in combination with a ram actuating mechanism therefore, including two worm wheels, means for gearing said wheels together, a right and left hand worm meshing with said worm wheels and movable relatively to the axis of one worm wheel to automatically equalize the power transmitted by the worm to each wheel and means for transmitting power from the worm wheels to the ram.

8. In a jack, a lifting ram and an operating mechanism therefore, including two intermeshing spiral gears, a worm path of substantially the same nominal pitch and spiral angularity hobbed to a sub-pitch diameter on each gear, a right and left hand self adjusting worm engaging the worm path of both gears, means for transmitting power to said worm and means for transmitting power from said gears to said ram.

9. In combination in a lifting jack, a ram, an operating mechanism therefor comprising two intermeshing gears, a worm path formed on each gear, a right and left hand worm meshing with both worm paths and movable axially to equalize tooth pressure between the worm and each worm path, a ratchet mechanism and means including a gear mounted on said worm and movable longitudinally with relation thereto for imparting motion from the ratchet to said worm, a ram-engaging screw mounted on one of the first-mentioned gears, and a thrust bearing for said gear.

In testimony whereof, I have hereunto subscribed my name this 28th day of May, 1920.

EDWIN E. ARNOLD.