

July 19, 1949.

R. LARAQUE
SCREW JACK WITH A REVERSIBLE MOTOR AND
SAFETY EJECTION MEANS

2,476,376

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4 Sheets-Sheet 1

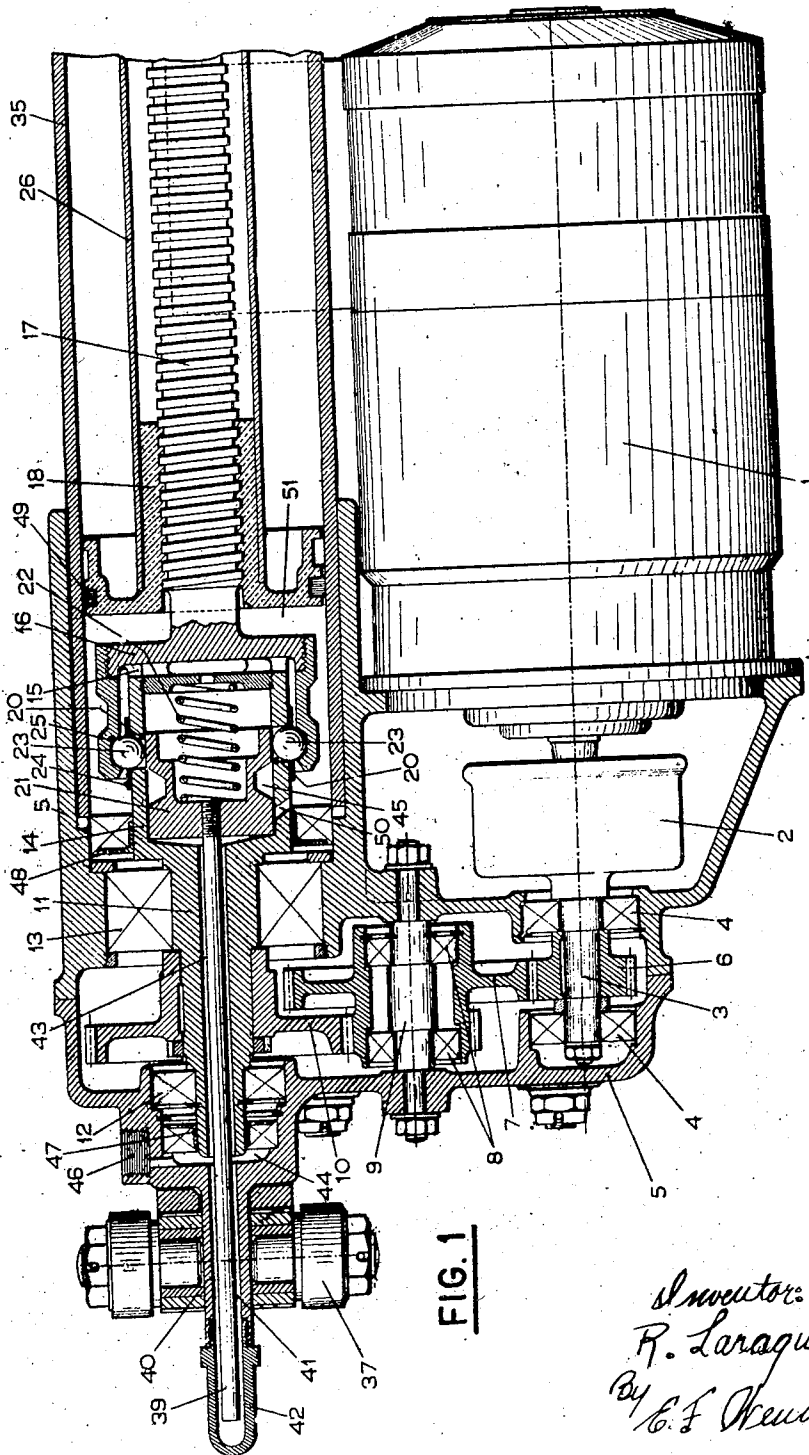


FIG. 1

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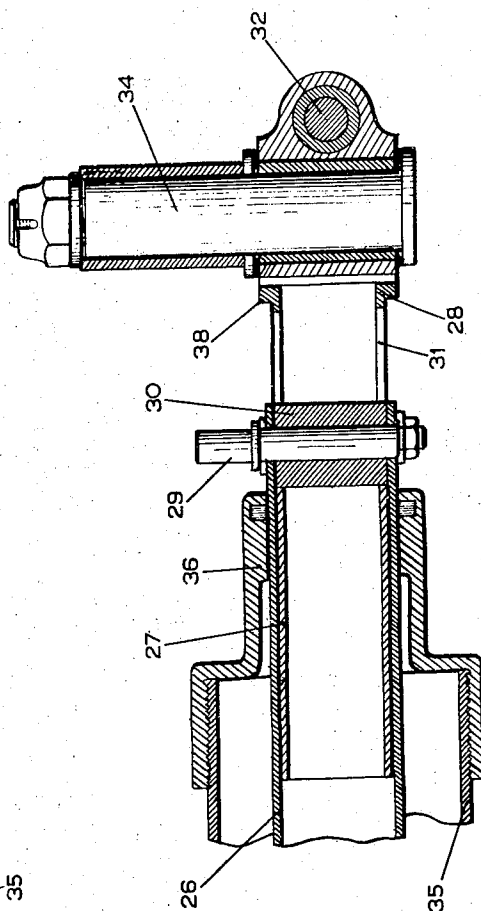
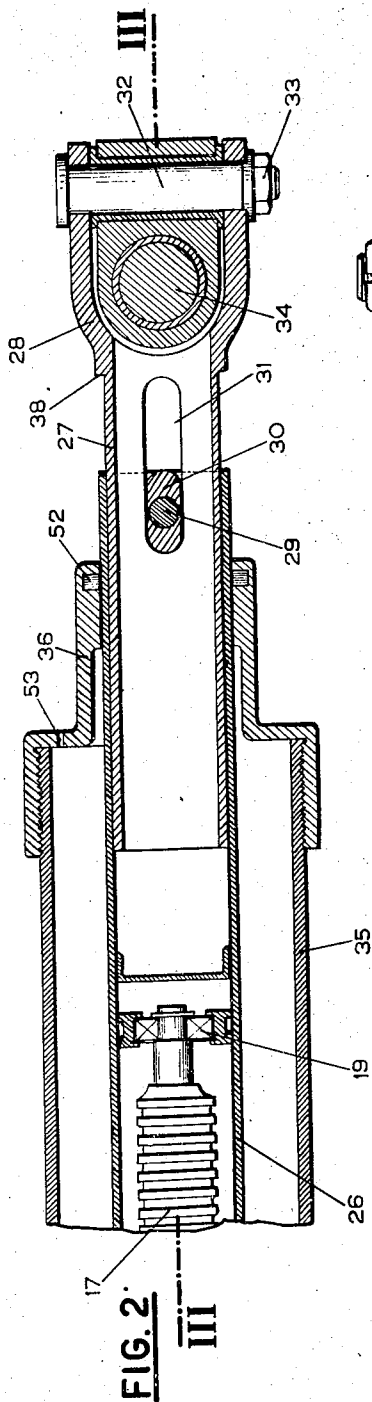
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FIG. 4

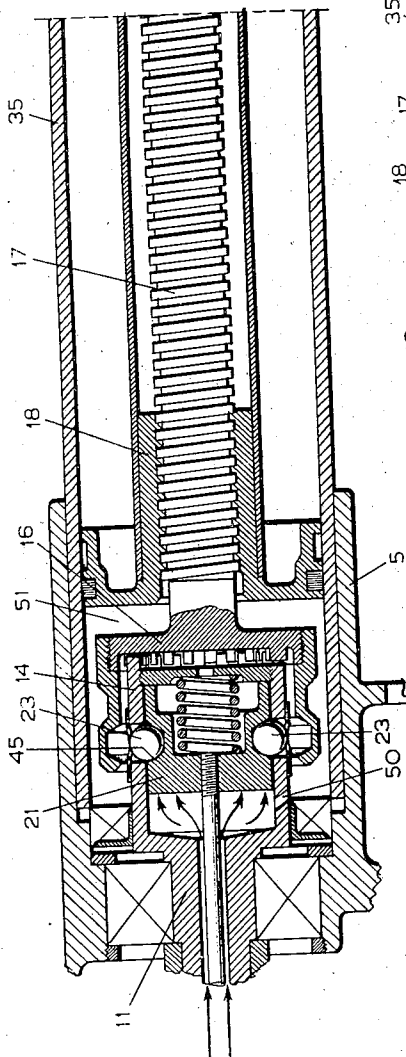
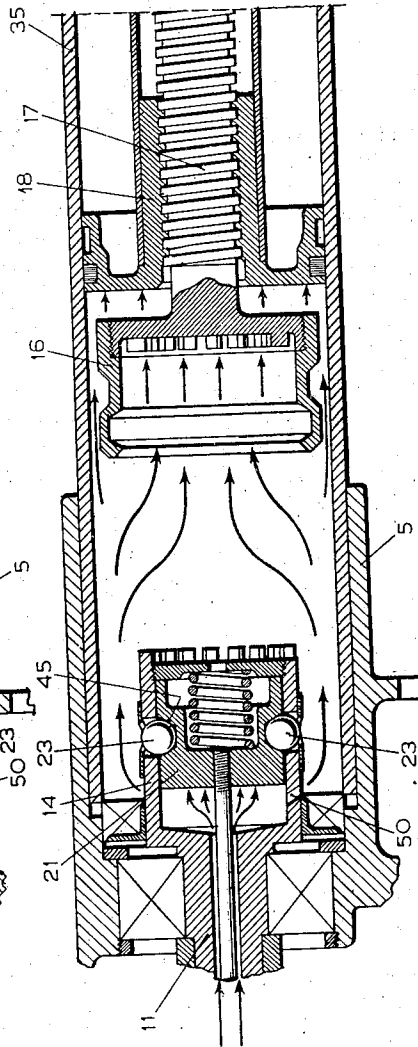


FIG. 5



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FIG. 6

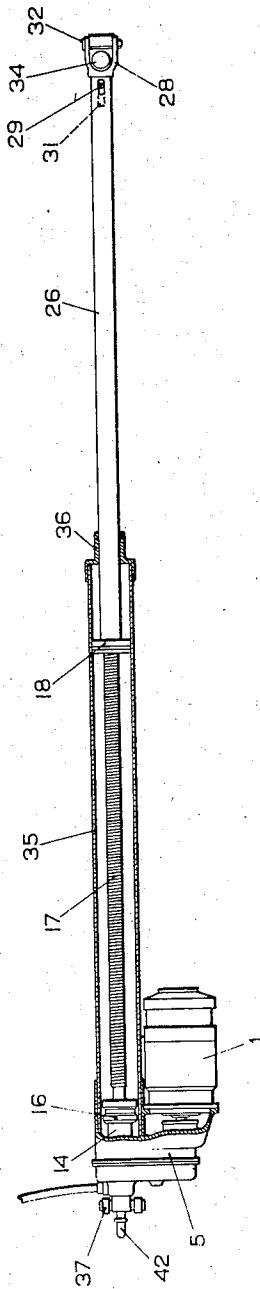
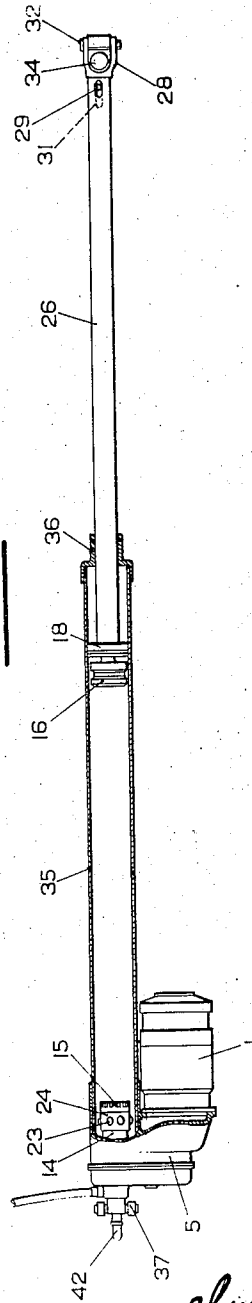


FIG. 7



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UNITED STATES PATENT OFFICE

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SCREW JACK WITH A REVERSIBLE MOTOR
AND SAFETY EJECTION MEANS

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Application January 5, 1948, Serial No. 636
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8 Claims. (Cl. 60—6)

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The present invention has for its object to provide the new article of manufacture formed by a screw jack controlled by a reversible motor and provided with a safety device acting in a given direction of actuation (ejection of the jack-rod), said device being adapted to be actuated through a simple and fast actuating operation, in the event of non-operation or a check in the operation occurring for any reason and at any point of the stroke in said direction, of the motor which normally provides for such operation (such as an electric motor).

A jack of the above character is applicable, by way of example and not of limitation, in connection with the retracting operation of an aircraft-undercarriage or landing gear which is normally effected, both for retracting and projecting the undercarriage, through the rotation of a reversible motor, and for which it is desired to avert the consequences arising from an impossibility of projecting the undercarriage in a normal manner at a desired time.

To actuate said safety device, it is simply necessary to release, under the action of a very slight actuating stress, a detent percussion member, having a spring normally retained under tension, and the release of which is operative to open the check valve of a tank containing a pressure fluid. This fluid, through a conduct connecting it with the jack, then penetrates into the safety device, first uncouples the rigid connection between the control screw and the drive system connected with the motor, then directly acts upon the screw-and-nut assembly of the jack causing this assembly to move in the manner of a piston within its cylinder and causing accordingly an ejection of the rod and also, in the exemplary application mentioned above, the ejection of the undercarriage rigidly coupled with the end of said assembly.

Further characteristics and features of the invention will appear from the ensuing disclosure relating to a preferred embodiment of the reversible motor and safety ejection jack, illustrated by way of indication and not of limitation in the accompanying drawing wherein:

Fig. 1 is a fragmentary longitudinal cross-section showing the drive portion and the safety ejection device for the rod of the jack forming the subject of this invention.

Fig. 2 shows in fragmentary longitudinal cross-section the portion of the jack to which is attached the retractable undercarriage.

Fig. 3 is a fragmentary longitudinal cross-section on line III—III of Fig. 2.

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Fig. 4 is a cross-section showing the position occupied by certain elements of the jack after admission of the pressure fluid into the safety device.

Fig. 5 shows the position occupied by said elements after the screw-and-nut assembly has been released from rigid connection with the engine controlled drive device.

Fig. 6 diagrammatically illustrates the jack in ejected position when the normal control device is being used.

Fig. 7 is a diagram illustrating the jack in ejected position when the safety device is being used.

In Fig. 1 there has been illustrated the means used to drive the jack in its normal operation. In this case, the drive is transmitted from a reversible motor 1 through a couple-limiting clutch means 2 (diagrammatically indicated in the drawing) to a speed reducing gearing controlled as follows: the drive portion of the clutch 2 is rigid with the shaft 3 journaled in appropriate anti-friction bearings 4 mounted in the casing 5. Said shaft has secured thereon a pinion 6 meshing with the larger diameter portion of a gear 7 provided with two sets of teeth, said gear being fitted with appropriate anti-friction bearings 8 supported on the fixed shaft 9 rigid with the casing 5. The smaller diameter portion of the dual-toothed gear 7 meshes with a toothed gear 10 secured on a bushing 11 which rotates in appropriate anti-friction bearings 12 and 13 supported in the casing 5.

The bushing 11 terminates in a cylindrical portion 14 of enlarged diameter, the end face of which is adapted to engage through a claw-clutch means 15 the head 16 of the jack-screw 17 which is supported at one of its ends by its nut 18 and at the opposite end in a suitable bearing 19 (see Fig. 2).

In order to prevent the head 16 of the jack screw 17 from becoming uncoupled from the cylindrical portion 14 of the bushing 11, said cylindrical portion is formed with one or more recesses 20 the bottom or end-wall of which is formed by the periphery of a hollow piston 21 axially slidable within the cylindrical portion 14 of the bushing 11 but maintained in normal operative position of the device by means of a biasing spring 22; said spring engages at one end the end wall of the hollow piston 21 and at its other end the end wall of the cylindrical portion 14 of the bushing 11.

In each of said recesses 20 is arranged a ball 23 engaging said recess so as to be more than

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half embedded therein and which rests against the peripheral surface of the hollow piston 21 (Fig. 1). The ball is retained in its recess (irrespective of the attitude of the aircraft in flight) by means of a retaining socket 24. The other portion of the ball 23 engages the bottom of an annular groove 25 of trapezoidal cross-section formed in the head 16 of the screw 17. The above-described ball-and-groove locking device acts to prevent any lateral displacement of the screw 17 together with the interiorly threaded member 18 which controls the helical movement of the screw 17 through the agency of the clutch claws 15, the head 16 of the screw 17 with the end face of the cylindrical portion 14 of the bushing 11.

The nut 18 is blocked against rotation through a telescopic tube 26 with which it is rigidly connected, said tube in turn being made rigid with the tubular extension 27 (see Figs. 2 and 3) of a fork member 28 through a pin 29 on which is mounted a key 30 for sliding displacement in a slot 31 formed in said tubular extension 27. The fork 28 carries a pin 32 (a screw-threaded end of which is provided with a nut 33) which makes it possible to immobilize the pin 34 to which is attached the retractable undercarriage, not shown. The just described assembly thus provides a universal or Cardan joint. On the other hand the casing 5 is extended on the side of the telescopic tube 26 by a guiding tube 35 terminating in a bearing or journal housing 36. The casing 5 is at its opposite end pivoted through a universal joint to the body of the aircraft through the use of a pivotal fork 37.

In normal operation of the screw jack forming the subject of this invention, the reversible motor 1 transmits its drive through a reducing gearing and through the bushing 11—14 to the screw 17 which then shifts its nut 18 along the tube 25. Said nut in its displacement carries with it in either one or the other direction the telescopic tube 26 with which it is rigid. The relative movement between the telescopic tube 26 and the slotted fork element 27 gives rise at the start of each stroke in either direction, to an initial lost motion phase for the tube 26 and the pin 29 rigid therewith, prior to exerting any action upon the undercarriage itself. This lost motion serves to control the levers (not shown herein) which cause the unlatching of the undercarriage when in projected position or the release of the undercarriage when in retracted condition.

After the key 30 has engaged either one of the end walls of the slot 31, the telescopic tube 26 causes the retractable undercarriage attached to the jack shaft 34 (see Fig. 6), respectively to be raised when moving in one direction and to be lowered when moving in the opposite direction. In the accompanying drawing the raising of the undercarriage is shown to be effected upon contraction of the jack and the lowering of the undercarriage upon expansion of the jack.

Within the jack driving device which has just been described is accommodated the safety lowering device. As may be ascertained from Fig. 1 this device is of highly simple construction and operation and offers a minimum overall size or bulk, since it occupies the central portion of the jack according to the invention. Said safety lowering device is controlled by the hollow piston 21 mentioned above and on the face of which initially acts the pressure medium. Said hollow piston carries a push rod 39 which at its opposite end extends through an extension 40 of the fac-

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ing 5, slightly projecting outwardly thereof. The push-rod 39 is separated from the extension 40 of the casing 5 by an annular duct or channel 41. A cap 42 threadedly engaging the extension 40 of the casing 5 protects from any extraneous action the end of the push-rod 39 (projecting out of the casing 5) and seals the end of the annular duct 41. A certain amount of clearance is provided between the central portion of the push-rod 39 and the internal portion of the bush 11, so as thereby to define a sort of annular channel 43. There is similarly provided at 44 a certain spacing between the end face of the bush 11 and the casing 5, for purposes to be described later. The hollow piston 21 is peripherally formed with an annular groove 45 of trapezoidal cross-section.

There is formed in the casing 5 a screw-threaded aperture 46 adapted to receive for instance the threaded connection of the flexible pipe communicating with the above-mentioned pressure fluid tank.

Rotary joints 47 and 48 mounted on the bushing 11 and the cylindrical portion 14 as well as the slidable joint 49 provided on the nut 18 ensure fluid-tightness of the device.

Finally, the chamber of variable volume defined by the tube 26 and the nut 18, the tube 35 and the bearing 36, serves as a pneumatic damper for the safety ejection of the tube, through the provision of the tight seals 49 (on the nut 18) and 52 (on the bearing 26), as well as the vent outlets 53 formed in the bearing 36 and which if desired may be provided adjustable through screws or loaded by an adjustable spring-biased check-valve, not shown herein.

Should for any reason and at any point of its downward (jack expanding) stroke, the motor 1 break down, or should for any accidental cause such as an abnormally "tough" area, the reaction be greater than the maximum permissible sliding value for the stress-limiting clutch 2, the pilot would then release the percussion member of the safety tank. The pressure medium flows into the safety device, the result of this being to displace the hollow piston 21 until it engages the end face of the cylindrical portion 14 (Fig. 4) while compressing its spring 22, blocking it by pressure action in its new position and uncovering the port 50 formed in the cylindrical portion 14 of enlarged diameter in the bushing 11, and through which the pressure fluid penetrates into the expansion chamber 51. Under the effect of the pressure exerted by the nut 18, the balls 23 are projected into the annular groove 45 and release the head 16 of the screw 17, which is thus disconnected from the cylindrical portion 14 of the bush 11. The fluid pressure continuing to further act upon the surface of the nut 18, pushes the nut 18 and the screw 17 through the tube 35, after the manner of a piston in its cylinder (see Figs. 5 and 7). The nut and its screw in turn carry with them in their displacement, through the agency of the telescopic tube, the fork member 28 (see Figs. 2 and 3) with which the retractable undercarriage (not shown) is rigid, thus enabling the latter to be lowered.

After landing has been effected, in order to recondition or recock the safety device of the jack according to the invention, the percussion member of the safety tank is first cocked, the effect of this being to allow the check valve of the tank to drop back upon its seating and to vent the jack to atmosphere. Then the undercarriage and the jack are disconnected. For

this purpose it is simply necessary to extract the pin 32 from the fork 28 by loosening the nut 33 (see Figs. 2 and 3); then the cap 42 is unscrewed (Fig. 1). Since pressure is relieved from the face of the hollow piston 21 the latter will have been restored to its initial position (as shown in Fig. 1) by the action of the biasing spring 22. The telescopic tube 26 is then reinserted into the tube 35; after having pressed the push-rod 39; in the first place so as to uncover the port 50 and thus to allow escape of the fluid from tube 35; and in the second place to allow the balls 23 to be retracted so as to enable the head 16 of the screw 17 to return to its place. After the annular groove 25 of the head 16 comes into register with the recesses 20 for the balls 23, the application of pressure is discontinued on the push-rod 39; the balls 23 then ride up along the cam-surface of the annular groove 45, and, while thus returning to their place, they latchingly connect the head 16 of the screw 17 with the engine controlled driving device. The safety device is then cocked and in a condition to resume its function.

It will of course be understood that the exemplary embodiment described above and illustrated in the accompanying drawings is given merely by way of indication and not of limitation, and it may be possible to provide any modifications in the jack with a safety rod-ejecting device according to the invention, and to replace therein certain elements by equivalent ones without departing from the spirit of the invention.

Thus for example the jack according to the invention could be applied to the control of a device other than a retractable aircraft undercarriage.

What is claimed is:

1. A screw-jack device comprising in combination a casing having an elongated tubular portion, a tube telescopable within said tubular portion in coaxial spaced relation therewith slidable in the outer end of said tubular portion; a structure to be operated by said device attached to the outer end of said tube, a nut member at the inner end of said tube non-rotatably sealingly slidable in said tubular portion, a screw-rod engaging said nut and extending in coaxial relation with both said tubular portion and said tube, said screw-rod when rotated causing said nut-and-tube assembly to move axially between a retracted and a projected position with respect to said casing, a reversible power-means outside said tubular casing, a drive connection extending from said power-means to a drive member in said casing opposite the inner end of said screw-rod, co-operating clutch means in said drive member and in said inner end of said rod adapted to drivingly couple said rod and said member in rotation when said rod is in said retracted condition, means to latch and unlatch said member and said inner end of said rod with respect to each other when so coupled, pressure-fluid actuated means in said tubular casing, means to admit pressure fluid from an external source to one side of said last-mentioned means, said means being operative, when so actuated, to first unlatch said drive-coupling between said rod and said member and then to cause said fluid pressure to act upon said nut to impart a bodily axial displacement to said nut-and-tube assembly together with said screw-rod from said retracted to said projected position thereof, thereby operating said structure accordingly.

2. A screw-jack device as claimed in claim 1

wherein said latching means comprises in combination a head at the inner end of said screw, a pair of complementary generally intersecting cylindrical surfaces in said drive member and said head respectively, circumferentially spaced recesses in the outer one of said surfaces and correspondingly disposed apertures through the inner one of said surfaces, and a latching ball adapted to be housed partly in each one of said recesses and partly in the related aperture, said pressure-actuated means being operative, when unactuated, to retain said balls in such position and when actuated, to allow said balls to drop through said apertures completely out of the related recesses.

3. A screw-jack device as claimed in claim 1 wherein said drive-member has a cavity with cylindrical walls directed towards said screw-rod, said screw-rod has a cavity with cylindrical walls directed towards said member adapted to surround said first-mentioned cylindrical walls; annularly arranged clutch teeth at the end of said walls of said member and complementary clutch-teeth in the bottom of said cavity in said head, adapted to co-operate in rotational driving engagement with each other when said screw-rod is in said normal retracted position; circumferentially-spaced recesses in the inner peripheral surface of said cylindrical walls of said screw-head and correspondingly-arranged apertures through said cylindrical walls of said member, a latching ball adapted to be seated partly in each of said recesses and partly in the related aperture in said normal retracted position of said screw-rod; a piston sealingly slidable in said cavity of said member between a retracted latching position and a projected unlatching position with respect thereto, and having a peripheral annular groove arranged to register with said annular apertures only for said projected position of said piston to then allow said balls to drop into said groove, spring means urging said piston to said retracted position thereof, and said pressure-fluid when admitted urging said piston towards said projected unlatching position thereof.

4. In a screw-jack device as claimed in claim 1 wherein the inner surface of said nut defines a fluid-tight enclosure with said casing, a hollow cylindrical portion on said member and a hollow cylindrical portion on the inner end of said screw-rod surrounding said first-mentioned portion, complementary pairs of annularly arranged recesses in the cylindrical walls of said portions respectively and a set of balls each movable between a latching position wherein said ball partly engages each one of said complementary pair of recesses in said cylindrical walls respectively and an unlatching position wherein said ball is retracted out of the recess in said cylindrical wall of said screw-rod cavity, a piston formed with a peripheral groove sealingly slidable in said member cavity, spring means urging said piston to a position wherein said periphery thereof retains said balls in said latching position thereof, means to admit said pressure fluid into the chamber defined between the inner walls of said member cavity and the adjacent side of said piston to thereby urge said piston to an unlatching position wherein said groove therein allows said balls to drop to said retracted condition thereof, a port through the cylindrical wall of said member cavity arranged to be uncovered by said piston when urged to said unlatching position, said port providing communication from

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said chamber to said enclosure to thereby cause said pressure-fluid to first positively force said balls to said retracted position thereof, and then to drive said nut together with said screw and said tube to said projected position thereof out of said tubular casing.

5. A screw-jack device as in claim 1 wherein said power-means comprises a reversible electric motor secured outside of said tubular casing and said drive connection includes a torque-limiting device on the shaft of said motor and a reducing gearing from said device to said drive-member.

6. A screw-jack device as in claim 1 wherein said tubular casing portion, said nut, said tube and said slidable seal between said tube and said portion define a substantially air-tight enclosure forming a pneumatic damping means for the emergency-projecting movement of said assembly, and an adjustable vent aperture is provided for said enclosure to adjust the damping action thereof.

7. A screw-jack device comprising in combination a casing having an elongated tubular portion, a tube telescopable within said portion in coaxial spaced relationship therewith slidably sealed in the outer end of said portion, a structure to be operated by said device attached to the outer end of said tube, a nut member at the inner end of said tube sealingly non-rotatably slidable in said tubular portion, and defining with the inner end of said casing a sealed enclosure, a screw-rod engaging said nut and extending coaxially to said tubular portion and said tube, a reversible power-means outside said casing, a drive member in said casing opposite the inner end of said rod and a drive connection extending from said power-means to said drive-member, a cavity with a cylindrical wall extending from said member towards said rod and a cavity with a cylindrical wall extending from the inner end of said rod towards said member surrounding said first cavity-wall, clutch-teeth on the end of said first cavity-wall and clutch-teeth in the end-wall of said second cavity drivingly cooperating therewith when said rod is retracted within said casing for normal operation, annularly-spaced recesses in the inner-cylindrical

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surface of said second cavity-wall and complementary apertures through said first cavity wall, a ball each adapted when in a latching position, to be partly seated in each of said recesses and partly seated in a related one of said apertures, a piston sealingly slidable in said first cavity defining a chamber with the end-wall thereof, a peripheral groove around said piston, spring means urging said piston to a position wherein the periphery thereof retains said balls in said latching position thereof, a supply of pressure fluid outside said casing, means to admit pressure fluid in an emergency from said supply to said chamber to thereby urge said piston to an unlatching position wherein said groove allows said balls to be retracted from out of said respective recesses, a port through the cylindrical wall of said first cavity arranged to be uncovered by said piston only as said piston is urged to said unlatching position to provide communication from said chamber through said port to said enclosure, whereby said fluid acts in said enclosure first to force said balls to said retracted position thereof and then to drive said nut, tube and screw assembly outwardly of said casing.

8. In a screw-jack as claimed in claim 7, a push-rod extending from said piston axially and projecting from out of said casing to allow said piston to be manually actuated after said piston has operated in an emergency, both to uncover said port and thus allow the fluid in said enclosure to be vented, and to allow retraction of said balls to thus enable said screw to return to the normal retracted position thereof.

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