

Quickly movable screw jack

The present utility model relates to a lifting implement, i.e. a screw jack with the function of quickly moving up-and-down, which is especially suitable to be used as car's maintaining tool for a sedan. The nucleus of its invention -"automatic opening and closing semi-nuts set" except for the screw jack, can be used on bench vice, machine vice, sliding table of machine tool, architectural scaffold and other means that require using screw and nut as kinematic pair of drive but in need of quickly passing over an idle stroke.

Fig. 1-I is a schematic drawing showing the structural principle of a screw jack used for replacing type of a car which is commonly used in car maintenance at present. The screw jack comprises bottom seat 10.5, top support 10.6, four links with sector gears 10.1-10.4, screw 4, left pivot axle O_2 , right pivot axle O_1 , plane bearing 10.8, safeguard pin 10.10, rope 10.11 and pivot axle nut "k" which is integral with the right pivot axle O_1 . The left end of the screw 4 is connected to the pivot axle O_2 , whereas the threaded part at the right end is fitted into the nut "k" which is integral with the pivot axle O_2 . When operating, the screw 4 is rotated, by means of the nut "k", the distance between the left and right two axles O_2 and O_1 is shortened or enlarged, and the top support 10.6 lifts a car W up or down through the link mechanism. As the nut "k" is an integral nut, it cannot quickly pass over an idle stroke, as the

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device has its drawback of low working efficiency.

The object of the present utility model is to overcome the above-mentioned drawback and provide a screw jack with the function of quickly moving up-and-down.

The technical scheme of the present utility model is to replace the integral nut "k" disposed on the right pivot axle O_1 as shown in fig.1-I by a "quickly movable automatic and synchronous opening and closing semi-nuts set" (brief as "F nut" in the following) as shown in fig.1-II and 1-III, others remain the same. It is characterized in that, the "F nut" can be disposed on one pivot axle such as the right pivot axle O_1 in fig. 1-II, so that the threads of the screw 4 at the outer periphery of its right portion can be engaged with the corresponding semi-nuts in the "F nut", and the left end of the screw 4 passing through the central hole of the left pivot axle O_2 is connected to the transmission means (such as joint of a handle, transmission gear box, electric motor etc.) and receives the rotating torque therefrom; or the "F nuts" can be disposed on both pivot axles O_1 and O_2 of the screw jack respectively, as shown in fig. 1-III. However, as to the two "F nuts" and the left and right portion of the screw 4 correspondingly fitted therewith, their threads must be opposite in spiral direction, for example, if the "F nut" disposed on the left pivot axle O_2 and the left portion of the screw fitted therewith have left handed threads (or right handed threads), then the "F nut" disposed on the right pivot axle O_1 and the right portion



of the screw fitted therewith must have right handed threads (or left handed threads). Further, the transmission means to rotate the screw 4 can be disposed at one end of the screw. The "F nut" comprises: (1) supporting seat, (2) one or more semi-nuts, (3) automatic and synchronous opening and closing mechanism for the semi-nuts. The screw with threads on it passes through the supporting hole of supporting seat in the "F nut" to be fitted with the corresponding semi-nuts and its automatic opening and closing mechanism. The features of these three components are: (1) supporting seat: provided on which are the portion (such as pivot axle) connected with the applied carrier (such as screw jack), the portion connected with the screw (such as supporting hole), the portions fitted with the semi-nuts, besides, there are provided position limiting device, safeguard device, quick and slow speeds changing device; (2) semi-nuts: one or more in number, with internal threads less than a half of the periphery, on the semi-nuts are provided up-and-down sliding guideways, outer peripheral face and actuating member (such as cam profile, guide pin of face cam), sometimes it has further the structural member (such as pivot axle, supporting and positioning surface) connected to the practically applied carrier. (3) "semi nuts automatic and synchronous opening and closing mechanism" comprises: automatic and synchronous overload separating device, relatively opening and closing actuating device" including that of elastically engaging and rigidly self-locking type (all these will be briefed as "opening and closing actuating device" in the following) which makes the screw and the semi-nuts selatively open and closed,



self-locking device to retain the engagement of the semi-nuts and position limiting device to limit the opening and closing stroke, safeguard device to prevent the semi-nuts from suddenly separating out when the screw jack is lifted, and the speed changing control device which makes the screw jack a quick or slow drop.

The advantages of the invention lie in that, owing to the use of "F nut", the screw jack can quickly pass over an idle stroke, thereby the working efficiency is improved. Although the impact is greater with quick drop, but the sedan is designed to have a perfect antishock system of spring and tyre, so its potential can be fully utilized. Furthermore, if an electric motor is equipped and it is desired to drop the lifted car, this can be achieved simply by reversing the rotating of the motor, once it is reversed, the car will quickly drop under gravity, thus electrical energy is saved on dropping.

The following is a brief description of the attached drawings:

Fig.1-I is a schematic drawing showing the structural principle of a screw jack of the prior art which uses integral nut "k" on the right pivot axle O_1 .

Fig.1-II is an electrically operated screw jack with the function of quick and slow moving up-and-down which uses the "F nut" of the present invention and a speed reducing transmission means for



the motor.

Fig 1-III is a schematic drawing showing the jack, in which "F nut" are provided on the left and right pivot axle O_1 and O_2 respectively.

Fig. 2-I is a main view of the embodiment of an "opening and closing actuating device" when it is composed of an internal curved cam pair and a plate spring. In the figure, the screw 4 rotates in "M" direction, and the internal and external threads are in engaging state.

Fig.2-II is one of the A-A sectional view of fig 2-I, showing that the screw 4 rotates in "M" direction, the internal threads of the two semi-nuts are going to engage with the external threads of the screw.

Fig.2-III is the another A-A sectional view of fig.2-I, showing that the screw 4 rotates reversely in "N" direction, the internal and the external threads are separated from each other.

Fig. 3-I is a perspective view of the supporting seat of Fig.2-I.

Fig.3-II is a perspective view of the upper and lower two semi-nuts 2A, 2A'.

Fig 3-III is a perspective view of up-and-down sleeve 3A in fig



2.

Fig.3-IV is a perspective view of the expandable spring 14.

Fig.4-I is a main view of the embodiment of an "opening and closing actuating device" when it is composed of an internal curved cam and an end face cam groove. On the figure, the screw 4 rotates in "M" direction, the internal and external threads are in engaging state.

Fig.4-II is one of G-G sectional view of fig.4-I, the screw 4 rotates in "M" direction, the internal and external threads are in engaging state.

Fig.4-III is another G-G sectional view of fig.4-I, the screw rotates reversely in "N" direction, the internal and external threads are in separating state.

Fig.4-IV is a perspective view of the upper and lower semi-nuts 2B, 2B' of fig.4-I.

Fig. 5-I is a main view of the embodiment of "opening and closing actuating device" when the kidney-like end face cam grooves are disposed on the semi-nuts. In the figure, the screw 4 rotates in "M" direction, the internal and external threads are in engaging state.

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Fig.5-II is one of F-F sectional view of fig.5-I. In the figure, the internal and external threads are in engaging state.

Fig. 5-III is the another F-f sectional view of fig.5-I. In the figure, the internal and external threads are in separating state.

Fig.6-I is a main view of the embodiment of "opening and closing actuating device" when the kidney-like end face cam grooves are disposed on the up-and-down sleeve and the cam guide pins are disposed on the semi-nuts. In the figure, the internal and external threads are in separating state.

Fig.6-II is one of G-G sectional view of fig.6-I.

Fig.6-III is a H-H sectional view of fig.6-I.

Fig.6-IV is the another G-G sectional view of fig.6-I, compression spring 32 is used to replace the "drop portion of cam profile" 3.D.22, and the internal and external threads are in separating state.

Fig.7 is a main view of the embodiment of "opening and closing actuating device" when the cam profile is disposed on the cylinder 3E.1 of the up-and-down sleeve, and the cam guide pin is disposed on the end of the semi-nuts. The screw 4 rotates reversely



in "N" direction, the internal and external threads are in separating state.

Fig.8 is a view of the embodiment of "opening and closing actuating device which is of the link type of "crank-sliding block mechanism". This figure is the third of F-F sectional view of fig.5-I, in which the screw 4 rotates reversely in "N" direction, the internal and external threads are in separating state.

Fig. 9-I is a main view of the embodiment of "opening and closing actuating device" which is a cam pair composed of an outer peripheral radial cam and cam up-and-down plate, and the pivot axles O_1 are disposed on the semi-nut.

Fig.9-II is a perspective view of the semi-nut 2F.

Fig.10-I is a main view of the embodiment of "opening and closing actuating device". It is the same as fig.9-I except the pivot axles O_1 are disposed on a supporting seat 1G.

Fig.10-II is a perspective view of the supporting seat 1G.

Fig.11 is a main view of the embodiment of "opening and closing actuating device". It is the same as Fig.9-I except the supporting frame 1F is eliminated.

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Fig.12-I is a view of the embodiment which is the same as fig.11 except an anti-shift frame is added.

Fig.12-II is a perspective view of the frame.

Fig.13 is a main view of the embodiment of "opening and closing actuating device". It is a cam pair composed of an eccentric cam sleeve 3H conjugating with a frame-like opening.

Fig.14-I is a main view of the embodiment of "opening and closing actuating device" which is the same as fig.13 except that the semi-nut is also disposed in the eccentric cam sleeve.

Fig.14-II is one of A-A sectional view of fig.14-I.

Fig.14-III is the another A-A sectional view of fig.14-I.

Fig.15-I is a partial main view of overload separating device of the semi-nuts opening and closing mechanism wherein the device is of an end face friction cone type.

Fig.15-II is an A-A sectional view of Fig.15-I.

Fig.16-I is a partial main view of overload separating device of the semi-nuts opening and closing mechanism wherein the device is of outward expandable friction ring type.



Fig.16-II is one of the B-B sectional view of Fig.16-I, showing the structure of an outward expandable friction ring.

Fig.16-III is the another B-B sectional view of Fig.16-I, showing structure of an inward expandable friction ring.

Fig.17-I is a partial main view of overload separating device of the semi-nuts opening and closing mechanism wherein the device is of axial guiding pillar (or ball) type.

Fig.17-II is a partial main view of overload separating device of the semi-nuts opening and closing mechanism wherein the device is of radial ball (or pillar) type.

Fig.18-I is a main view of "quick and slow speeds control device" of the semi-nuts opening and closing mechanism wherein the device is a locking device of the pawl and inserting pin type.

Fig.18-II is one of the A-A sectional view of fig.18-I.

Fig.18-III is the another of A-A sectional view of fig.18-II.

Fig.19-I is an alternative of fig.18-I, wherein the device is composed of a spring hoop and a fork type eccentric handle.



Fig.19-II is a k-k sectional view of fig.19-I.

Fig.20 is a main view of the "F nut" of the invention when it is used on the practical carrier of a bench vice.

Fig.21-I is a main view of the embodiment of the screw jack of the invention, wherein its rocking handle is made into foldable type.

Fig.21-II is a main view of the embodiment of the invention, wherein its rocking handle is made into foldable and retractable type.

Fig.2-I is the first embodiment of the invention. It is characterized in that, one or more semi-nuts are used. The screw is supported by the supporting seat. One or more semi-nuts are evenly distributed around the cross-section of the screw. The semi-nuts are disposed between the supporting seat and the up-and-down sleeve. The semi-nuts are provided with opening and closing means which can automatically rise or drop. The up-and-down sleeve is provided with anti-shift means to prevent the shift along the axial direction of the screw. The supporting seat comprises: supporting arms (one or two), supporting hole (one or two correspondingly), supporting body (including means connecting to the carrier such as pivot axle O_1 etc.), the up-and-down guiding member which is fitted with the semi-nuts up-and-down sliding guideway, and the position limiting member. The screw passes through the supporting hole with



movable fit and is fitted with the screw and the up-and-down means (such as the up-and-down sleeve, including the anti-shift means to prevent the axial shift). For two or more semi-nuts, they should be symmetrically arranged about the center of the screw. The semi-nuts have internal threads which extend less than a half of the periphery, sliding guideways for guiding the up-and-down movement, as well as actuating member to transmit the up-and-down force; the "semi-nuts automatic opening and closing mechanism" which is used to control the automatic and synchronous opening and closing motion of the semi-nuts comprises opening and closing actuating device (such as up-and-down sleeve and cam profile), overload separating device (such as pawl, spring hoop etc.) and upward stroke limiting device, safeguard device, self-locking device, and speed changing device which makes the screw to have the function of being capable to advance or retract with either quick or slow speed.

Fig.2-I is a main view of the embodiment of the "F nut" of the invention, wherein two semi-nuts are used, and the opening and closing actuating device for the semi-nuts is composed of inner curved cam and an expandable plate spring.

This embodiment comprises supporting seat 1A, the upper and lower two semi-nuts 2A and 2A', expandable plate spring 14, up-and-down sleeve 3A, pawl 7, spring hoop 6, limiting stop pin 15, clamp plate 17, locking device 5 and the screw 4. As the practical carrier of "F nut" is a screw jack, so the supporting seat is to be



connected to the pivot axle 1A.1 (as fig.3-I). The screw 4 passes through supporting hole 1A.2 and the inner hole 3A.1 of the up-and-down sleeve, and cooperates with the semi-nuts and their opening and closing actuating device. The outer side faces 2A.2 and 2A.3 etc. of the two seminuts 2A and 2A' at its left side with about half of its volume are in movable fit with the inner side guideway faces 1A.3 and 1A.4 of the supporting seat; while the other half at the right end is mounted in a large hole at the left end of the up-and-down sleeve 3A, that hole really is an inner-curved cam, its cam profile is composed of two symmetric segments of rise portions 3A.2, 3A.3 and two segments of inner arcs 3A.4 with minimum radius as R_{min} (this is also the self-locking cam profile of the self-locking device to prevent the separation of the closed semi-nuts), as well as other two segments of inner arcs 3A.5 with maximum radius as R_{max} . The expandable plate spring 14 is mounted in the grooves 2A.4 and 2A'.4 (fig.3-II) of the upper and lower two semi-nuts, alternatively, instead of the expandable plate spring, each of the semi-nut may use its own individual spring, thereby urging the upper and lower seminuts to separate outward, so as the highest points 2A.5 and 2A'.5 of the outer arcs of the semi-nuts can always firmly press against the inner-curved cam face of the up-and-down sleeve, this inner-curved cam profile really is the "opening and closing actuating device" of "F nut", its working principle is easy to understand. Suppose the up-and-down sleeve 3A rotates in "M" direction (clockwise), the inner-curved cam profile which contacts with the highest points 2A.5, 2A'.5 of the outer arc of the semi-nuts



will move from the place of maximum radius 3A.5, through the rise portion of cam profile 3A.2, and to the place of minimum radius 3A.4, thus forcing the two semi-nuts 2A and 2A' to close with each other in the direction toward the center of the screw (brief as centripetal movement in the following), until the internal and external threads are completely engaged and self-locked (fig.2-II). At that time, the position limiting stop pin 15 just touches with the stopper 17. On the contrary, for the same reason, if the up-and-down sleeve rotates in "N" direction (counterclockwise), then the semi-nuts 2A and 2A' will make centrifugal movement, so that the internal and external threads will be separated from each other, as shown in fig.2-III.

The torque to rotate the above up-and-down sleeve 3A either in "M" or in "N" direction comes from the screw 4, it is transmitted to the up-and-down sleeve through an "automatic synchronous overload separating device" mounted on the up-and-down sleeve. The "overload separating device" shown in fig.2-I comprises a pawl 7 which is mounted in a radial hole 3A.7 of the up-and-down sleeve (in sliding fit), a spring hoop 6 and a keyway 4.1 on the screw 4. At the lower end of the pawl there are two ramps 7.1 whose end part could be pushed by the resilience of the spring hoop 6 to press against the outer periphery of the screw 4 or fall into the keyway 4.1 of the screw 4, when the screw 4 rotates in "M" direction, the side edges 4.1.1 of the keyway 4.1 of the screw touch with the ramps 7.1 of pawl, push the pawl 7 and up-and-down 3A and rotate with the



up-and-down sleeve in "M" direction, then the "opening and closing actuating device" on the up-and-down sleeve 3A forces the semi-nuts 2A, 2A' to make "centripetal engaging movement" until the limiting stopper 17 on the up-and-down sleeve touches with the stop pin 15 on the supporting seat 1A and the rotation is stopped. Meanwhile the screw 4 still rotates in "M" direction so as the force exerted by the side edge 4.1.1 of the keyway on the pawl ramp 7.1 is increased till the upward axial component of the force is greater than the downward pressure which is exerted by the spring hoop 6 on the pawl, the ramp 7.1 of the pawl would be squeezed out apart from the keyway 4.1, i.e. separating under overload, and the screw could still rotate in "M" direction to lift the car. On the contrary, when the screw rotates in "N" direction, the torque would be transmitted in the same way to the up-and-down sleeve 3A through the pawl 7, cause the up-and-down sleeve 3A rotate with the screw 4, and through "opening and closing actuating device" cause the semi-nuts make "centrifugal movement" to force the internal and external threads to be separated (see fig.2-III), then the quick drop of the screw jack is realized. If it is desired that the falling speed is to be slowed, a locking device 5 could be mounted on the supporting seat 1, this device comprises an inserting pin 5.1, a spring 5.2, a socket for inserting pin 5.3, a pin axle 5.4 and an eccentric handle 5.5, wherein the front end of the inserting pin 5.1 is an inserting pin tip 5.1.1, which is just aligned with the locking hole 3A.8 in the up-and-down sleeve 3A. The working principle of the locking device is as follows: when it is desired that the screw 4 should have the



functions of slow retract and slow advance (i.e. the screw jack can rise or drop in a slow way); at first, operate the handle, let the screw 4 rotate in "M" direction, which cause the internal and external threads to be in engagement, then let the arrow of the eccentric handle 5.5 be placed in vertical direction (as shown in fig.2-I), meanwhile the eccentric handle 5.5 is at a position of short axis (i.e. the bottom face 5.5.2 of the eccentric handle 5.5 is in contact with the front end face 5.3.1), the inserting pin 5.1 could be inserted in the locking hole 3A.8, and the up-and-down sleeve 3A is fixed to be incapable of rotation, thereby the internal threads of the semi-nuts 2 and the external threads of the screw could be kept in engagement, this is the same as conventional screw drive mechanism, and the original functions of slow advance and slow retract are completely retained. When it is desired that the screw should have the functions of quick advance and quick retract, the eccentric handle 5.5 could be placed with its arrow in horizontal position, whereby the eccentric handle 5.5 is at the position of long axis (i.e. the side face of the eccentric handle 5.5 is in contact with the front end face 5.3.1 of the spring seat 5.3), meanwhile the inserting pin tip 5.1.1 retracts from the locking hole 3A.8 of the up-and-down sleeve 3A and the up-and-down sleeve 3A could be brought by the screw and pawl to rotate in "N" direction, thus the internal threads of the semi-nuts 2A and 2A' could be separated from the external threads of the screw, thereby cause the screw 4 to have the function of speedily passing through an idle stroke. If the carrier to be applied is a screw jack, then the quick rise or drop of that screw jack can be realized.



Fig.4-I is an "opening and closing actuating device" of the "F nut" of the invention, it is divided into two sets of actuating devices, of which the actuating device responsible for automatic closing of the semi-nuts 2B and 2B' is the same as fig.2-I, i.e. the inner-curved cam profiles 3B.2, 3B.4, 3B.5 on the large hole at left end of the up-and-down sleeve 3B, whereas the actuating device responsible for automatic opening of the semi-nuts is undertaken by an end face cam pair which is composed of cam grooves and cam guide pins, the end face cam grooves 2B.2 and 2B'.2 of that cam pair are disposed on the right end face of the semi-nuts 2B and 2B', its up-and-down actuating cam profiles are 2B.3 and 2B'.3, see fig.4-II; and its cam guide pins 16 and 16' are disposed on the left end face 3B.2 of the up-and-down sleeve 3B; alternatively, according to the principle of relative motion, the cam grooves may be disposed on the up-and-down sleeve, while the guide pins may be correspondingly disposed on respective semi-nut. Its working procedure is as follows: when the screw 4 rotates in "M" direction, its torsion moment is transmitted to the up-and-down sleeve 3B through the pawl 7, and the up-and-down sleeve also rotates in "M" direction, as the radians of rise portion 3B.2 of inner-curved cam profile is changed from a large value to a smaller value, the semi-nuts 2B, 2B' are forced to make "centripetal engaging movement" until they are stopped by the limiting stopper 17, meanwhile the screw 4 continues to rotate in "M" direction and the screw jack is raised with a slow speed (see fig.4-II). On the contrary, when the screw 4 rotates in "N" direction



(as fig.4-III), the up-and-down sleeve 3B also rotates in "N" direction, the cam guide pins 16 and 16" mounted on the up-and-down sleeve 3B enter into the cam grooves 2B.2 and 2B'.2 and cooperate with the rise portions 2B.3 and 2B'.3 of cam profiles, causing the semi-nuts 2B and 2B' to make "centrifugal movement", thereby realizing the separation of the internal and external threads, thus permitting quickly moving to and fro between the screw and the nut. Others are the same as fig.2-I.

The "opening and closing actuating device" as shown in fig.5-I is characterized by its fully end face cam pairs. Its kidney-like end face cam grooves 2C.2 and 2C'.2 are disposed on the right end face of the semi-nuts 2C and 2C', and the actuating members for the cam grooves are composed of the rises portion of cam profile 2C.4 and the drop portion of cam profile 2C.3. The cam guide pins 16 and 16' are disposed on the left end face 3C.2 of the up-and-down sleeve 3C. As to the position limiting device for the movement range on opening and closing the semi-nuts and the self-locking device after opening and closing the semi-nuts, their actuating members are the arc type cam profiles 2C.7, 2C'.7, 2C.8, 2C'.8 at the two ends of the kidney-like cam grooves. Its working procedure is as follows: when the screw 4 rotates in "M" direction and brings the up-and-down sleeve 3C and the guide pins 16, 16' provided on it to rotate together in "M" direction, through the action of drop portion cam profile 2C.4 and 2C'.4 on the end face of the semi-nuts, the semi-nuts are forced to make "centripetal engaging movement" until the



guide pins 16 and 16' are stopped by the end 2C.7 of the kidney-like grooves, causing the internal and external threads to be fully engaged and self-locked (such as fig.5-II). On the contrary, when the screw 4 rotates in "N" direction, through the action of rise portions 2C.3 and 2C'.3 of cam profiles, the semi-nuts 2C and 2C' are forced to make centrifugal movement, causing the separation of the internal and external threads. Others are the same as fig.2-I.

Another structural form of the "opening and closing actuating device" as shown in fig.6-I is characterized in that, the kidney-like cam gooves 3D.2 and 3D'.2 are disposed on the cam disc 3D.1 of the up-and-down sleeve 3D, the actuating members of the cam grooves are composed of rise portion cam profile 3D.2.1 and drop portion cam profile 3D.2.2 as well as position limiting (and self-locking) cam profile 3D.2.4 and 3D.2.3; the cam guide pins 16 and 16' are disposed on the semi-nuts 2D and 2D', which are restrained to make up-and-down as well as opening and closing movement in a frame shape (or dovetail shape etc.) up-and-down guideway of the supporting seat 1D. As to the restraint of axial shift of the up-and-down sleeve 3D, it is accomplished by providing bosses 16.1 to the end face of cam guide pins 16, 16' for resisting against the right side face 3D.4 of the cam disc 3D.1. There are many equivalent schemes to restrain the axial shift of the up-and-down sleeve 3D. For example, instead of using the bosses 16.1 which are integral with the cam guide pins, the bosses may be directly mounted on a means connected with the supporting seat 1D. Since both the "opening and



closing actuating devices" of this fig.6-I and fig.5-1 are composed of kidney-like cam groove and cam guide pin (only difference is the relative mounting position of these two, one is on the up-and-down sleeve, and the another is on one of the semi-nuts), so the acting procedure and working principle of these two are completely the same, it needs not to be discussed further.

The "opening and closing actuating device" of fig.6-IV is derived on the basis of fig.6-II: at first, the drop portion cam profile 3D.2.2 of the kidney-like cam grooves 3D.2 and 3D'.2 in fig. 6-II is eliminated (for convenience to discuss, only take one of the cam grooves 3D.2 as example), only the rise portion cam profile 3D.2.1 and the actuating members for the position limiting device and self-locking device i.e. cam profiles 3D. 2.3 and 3D.2.4 are retained, next, it is provided in addition one set of elastically engaging and rigidly self-locking actuating means, which is composed of elastically engaging spring (including the integral retractable spring 32 or individual springs mounted separately on respective semi-nut) and self-locking device. One of the structures of the above self-locking device is to use a cam pair which is composed of cam profile 3D.2.4 and cam guide pin 16, other structures are the same as fig.6-I and fig.6-II. Thus, the "opening and closing actuating device" of fig 6-IV substantially contains two sets of actuating device: of which one set is the "separating actuating device" to accomplish the automatic separation of the semi-nuts 2D and 2D', one of its embodying scheme is realized by a cam pair which is



composed of rise portion cam profile 3D.2.1 on the cam disc 3D.1 and cam guide pin 16 on the semi-nut 2D, or is realized by a cam pair which is composed of guide pin 16 on the cam disc 3D.1 and rise portion 3D.2.1 of cam profile on the semi-nut 2D; the another set is an elastically engaging and rigidly self-locking “engaging actuating device”, one of its embodying scheme is to use the above-mentioned elastically engaging and rigidly self-locking actuating means to realize an engaging rate of 100%.

The “opening and closing actuating device” of fig.7 is achieved by making improvement on the basis of Fig.2-I, it is realized by a radial cam pair which is composed of cam profiles 3E.1.2 and 3E.1.1 on the inner and outer cylindrical body of the up-and-down sleeve 3E and the cam conjugating pins 18, 19, while the conjugating pins 18, 19 are mounted on the transmitting pins 16E and 16E' at the ends 2E.1 and 2E'1 of the semi-nuts, other structures are the same as fig.2-I.

The “opening and closing actuating device” of fig.8 is realized by a crank-slider mechanism. The crank 20 has two pivot axle holes O_2 and O_3 , pivot axle hole O_2 is connected with the semi-nut 2F, while O_3 is connected with the up-and-down sleeve 3F. Other structures are similar as fig 2-I. On operating, when the up-and-down sleeve 3F rotate in “N” direction, the pivot axle O_3 also rotates in “N” direction, then the inclination angle α of the crank becomes larger, so that the pivot axles O_2 and O_2' of the crank make



“centrifugal movement”, causing the semi-nuts 2F and 2F’ to be separated from each other, until the crank touch the position limiting face 2F.1. On the contrary, when the up-and-down sleeve 3F follows the screw 4 to rotate in “M” direction, the pivot axles O_2 and O_2' of the crank will bring the semi-nuts 2F and 2F’ to make “centripedal engaging movement”.

The “opening and closing actuating device” of fig 9-I and 9-II is realized by a cam pair which is composed of the cam profiles (including rise portion profile 2F.2 and drop portion profile 2F.3) on the outer periphery of the semi-nut 2F and the up-and-down plate 3F.1 on the up-and-down sleeve 3F. The semi-nut 2F has its internal threads 2F.6 less than a half of the periphery, a semi-plain-hole 2F.7 with diameter greater than that of the screw 4, two pivot axles 2F.7 at front and rear sides connected with the carrier (the screw jack), and a rise portion of cam profile 2F.2 and a drop portion of cam profile 2F.3 on its outer periphery. The screw 4 passes successively through left end hole 1F.1 of the supporting frame 1F, plain hole 2F.7 of the semi-nut, hole 3F.3 of the up-and-down sleeve, and right end hole 1F.2 of the supporting frame. When the up-and-down plate 3F.1 of the “actuating device” rotates to the upmost position, where it is inserted in a sliding fit between an upper top face 2F.9 on the outer periphery of the semi-nut 2F and an upper bottom face 1F.3 of the inner cavity of the supporting frame 1F. The above “actuating device” also can be made the following three simple equivalent transformation, such as:



(1) The pivot axles 2F.7 connected to the carrier (screw jack) and disposed initially at the front and rear sides on the outer periphery of the semi-nut 2F, can be modified as to be mounted on the front and rear side faces of the left side wall of the supporting frame 1F, thus the supporting frame 1F is changed into a supporting seat 1G with pivot axles, as shown in fig 10-I and fig.10-II, i.e. there mounted pivot axles 1G.7 and 1G'.7 on the front and rear side faces 1G.8, 1G.9 of the left side wall of the supporting seat 1G. The semi-nut after dropping off its pivot axles 2F.7 is changed into a semi-nut 2G without pivot axle. Others such as the up-and-down sleeve 3G are completely the same as 3F etc. including that pawl 7 is mounted on the up-and-down sleeve, locking device 5G is mounted on the supporting frame as 5F etc.

(2) In the fig.9-I, the original supporting frame 1F is eliminated, only the semi-nut 2F with pivot axle O_1 and the up-and-down sleeve 3F are retained, other main structures remain the same, thus it is transformed into another new "actuating device" (as shown in fig.11), i.e. with semi-nut 2G and up-and-down sleeve 3G. To prevent axial shift, a stop pin 12 is provided on the up-and-down plate 3G.1 of the up-and-down sleeve, correspondingly a deep groove 2G.10 is cut on the semi-nut 2G to cooperate with the stop pin 12.

(3) In the same manner, by eliminating the original supporting



frame 1F in fig.9-I (others remain the same), it is transformed into another new “actuating device”, with semi-nut 2F and up-and-down sleeve 3F. To prevent axial shift, an anti-shift frame 33 is added, there are two lug holes 33.1 and 33.2 on the frame which can be put on the pivot axles 2F.7 on the front and rear side faces of the semi-nut 2F.

The working principle of the “opening and closing actuating device” in fig.9-I is as follows: When the screw 4 via the pawl 7 brings the up-and-down sleeve 3F and the up-and-down plate 3F.1 on it together to rotate in “M” direction, the up-and-down plate 3F.1 makes planetary rotation around the rise portion of the cam profile 2F.2 and the drop portion of cam profile 2F.3 on the outer periphery of the semi-nut 2F. Since the distance from these cam profiles to the center of the internal threads is variable, such as the distance from cam profile 2F.2 to the center of the internal threads 2F.6 is a maximum, whereas that from cam profile 2F.3 to the center is a minimum. So the distance from the center of the inner hole 3F.3 of the up-and-down sleeve and the screw 4 in sliding fit with which to the center of the internal threads 2F.6 of the semi-nut 23 will become smaller as the up-and-down plate 3F.1 makes planetary rotation in “M” direction, thus forcing the external threads 4.3 of the screw and the internal threads 2F. 6 of the semi-nut to engage with each other. On the contrary, when the screw 4 brings the up-and-down sleeve 3F to rotate in “N” direction, the internal and external threads will separate from each other. Besides, the width of the



supporting frame 1F from the front to the rear is just equal to the width between the front and rear side face 2F.11 and 2F.12 of the left portion of the semi-nut, the supporting frame 1F serves as up-and-down guideways to hold the semi-nuts between the link plate 10.1, 10.2 of the screw jack, so the screw 4 can only make the up-and-down motion between the link plates.

The "opening and closing actuating devices" as shown in fig.13 is realized by an eccentric cam kinematic pair which is composed of an eccentric cam sleeve 3H and the upper and lower two flat surface 1H.4 and 1H.3 of a frame-like rectangular opening of the semi-nut supporting seat 1H. The semi-nut supporting seat 1H has a shape of frame; in the center of the frame, there is a rectangular opening, the upper and lower plane 1H.4 and 1H.3 of that opening is in sliding fit with the eccentric outer circumferential surface 3H.2; internal threads 1H.6 and 1H.5 which are less than a half of the periphery and semi-plain-holes 1H.1 and 1H.2 with diameter greater than that of the screw 4 are provided separately in the left and right two side walls 1H.7 and 1H.8 of the frame. The screw 4 successively passes through the plain hole 1H.h1 of left wall, the inner hole 3H.1 of eccentric cam and the plain hole 1H.2 of right wall. Besides, at the front and rear sides of the left side-wall of the frame, pivot axles O_1 are provided to be connected with the screw jack body 10.1 and 10.2 of the practical carrier.

As to the wall thickness of the eccentric cam-sleeve 3H, it is



thick on one side and thin on another side due to eccentricity. When the eccentric cam sleeve 3H rotates in "M" direction after the screw 4, the thickest portion just rotates to the lowest position and contacts with the lower plane 1H.3 of the supporting seat, thereby the center of the screw 4 is raised, forcing the internal and external threads to engage with each other. On the contrary, when the screw 4 with the eccentric sleeve 3H rotate in "N" direction, the thickest portion of the eccentric sleeve 3H rotates to the upmost plane 1H.4 of supporting seat 1H, the internal and external threads separate from each other.

The "opening and closing actuating device" as shown in fig.14-I is realized by a cam kinematic pair which is composed of the eccentric cam profile 2J.1 on the outer periphery of the semi-nuts 2J and the upper and lower two planes 1J.1 and 1J. 2 of the frame-like rectangular opening in the supporting frame 1J.

The eccentric cam profile 2J.1 on the outer periphery of the semi-nuts 2J in fact is a cylindrical surface with O_3 as center, there are two eccentric holes in the body of semi-nut 2J, the centers of these holes are O_2 and O_4 , both their eccentric distances from the center O_3 are equal to e (e is slightly greater than the depth of a spiral thread), the eccentric hole with center O_4 is a semi-plain-hole 2J.3 with diameter greater than that of the screw 4, the eccentric hole with center O_2 has its internal threads 2J.4 less than a half of the periphery, on the semi-nut 2J are provided two up-stroke



limiting pins 35, 36 and a radial hole 2J.5, in which is fitted with a pawl 34, and a spring hoop 6 presses against the pawl 34, causing the cone body of pawl tip 34.1 to press against the outer periphery of the screw 4 or be inserted into the keyway 4.1.

The supporting seat has a shape of frame, in the opening of the frame, semi-nut 2J is seated. The screw successively passes through the left frame supporting hole 1J.3 of the supporting seat 1J, the semi-nut hole and the right frame supporting hole 1J.4. At the front and rear sides of the left frame port are mounted pivot axles 1J.5 (with O_1 as center), to be connected to the practical carrier (screw jack).

In order to improve the engaging property, besides the cylindrical body, the shape of cam profile 2J.1 on the outer periphery of the semi-nut 2J can be designed into other cam curves according to the requirement.

The principle of this mechanism is evident that, when the screw 4 bring the semi-nut 2J to rotate in "M" direction, the farthest point on the eccentric outer periphery 2J.1 apart from the center O_2 of internal threads rotates to the lower plane 1J.2 of the internal cavity of the supporting frame so as the center O_2 of internal threads coincides with the center O_3 of the screw 4, causing the internal and external threads coming into engagement, this is stopped by the position limiting pin 35 when it touches with the lower plane 1J.2,



as shown in fig.14-II. On the contrary, when the screw rotates in "N" direction, and brings the semi-nut 2J to rotate in the same direction, as shown in fig.14-III. When the nearest arc part on the eccentric outer periphery 2J.1 apart from the center O_2 of inner threads rotates to contact with the lower plane 1J.2, the center O_2 of internal threads O_2 goes apart from the center O_5 of the screw 4, realizing the separation of the internal and external threads, the rotation is stopped by the position limiting pin when it touches with the lower lane 1J.2.

Summarizing the above, for the "F nut" of the invention, many equivalent mechanisms can be used to replace these embodiments. For instance, the Archimede's spiral end face threads commonly used in the three-jaw automatically centering chuck of a lathe can be used to replace the end face cam mechanism in fig.4-I; again, the number of semi-nut can be one or two, or more than two. All these are within the scope of the invention, so it will not be listed one by one.

With respect to the "automatic and synchronous overload separating device" used in the invention, besides the overload separating device of fig.2-I which is composed of a pawl 7 and a spring hoop 6, there are a great many of other equivalent overload separating devices. As to the form, it may be of single direction or of double direction, as to the drive manner, it may be electro-magnetic, hydraulic or pneumatic, as to the overload separating element,



must be greater than the depth that the teeth would be inserted in.

Fig 16-I and 16-II is an overload separating device of an expandable ring with its outer circumference as friction surface. This embodiment uses an outer circumference friction expandable ring 25 in fig.16-I to replace the friction ring 21 and compression spring 22, the expandable ring 25 is still kept by a check ring 24, and there is an axial open slot 25.1 provided on the cylindrical body of the expandable ring 25. When the expandable ring is in the free state, its outside diameter 25.2 is greater than the inside diameter of inner hole 3A.11 of the up-and-down sleeve 3A. When assembling, the open slot 125.1 is forced to contract, it releases after the expandable ring is inserted into the inner hole 3A.11, thus by resilience the outer circumference 125.2 of the expandable ring 125 expands and sticks on the inner wall of the inner hole 3A.11 of the up-and-down sleeve 3A, and results a certain amount of frictional force. The inside diameter of the expandable ring is slightly greater than the outside diameter of the screw, and the former is connected to the latter through a guide key 23. Its operating process is the same as the type of friction ring in fig.9-I, the only difference is that the friction surface which can slide over at overload is transferred from the end face (or cone face) to the outer circumference of the expandable ring.

Fig.16-III is an overload separating device of the type of an expandable ring with its inner hole as friction surface. Its working



various elements such as pawl (of single or double direction), teeth, ball, guide pillar, friction cone (disc, plate, block, cushion) and various elastic elements (such as spring, elastically expandable loop or ring, expandable sleeve) can be used. In the following, some of the equivalent overload separating devices derived from fig.2-I are listed.

Fig.15-I, 15-II show a friction overload separating device using friction ring(or friction cone). Its working principle is as follows: A friction ring (cone) 21 is mounted in an up-and-down sleeve 3A, and slidably encloses the outer circumference of the screw 4. Friction face (cone) 21.1 tightly presses against the right friction face (cone) 3A.10 of the up-and-down sleeve 3A under the effect of the compression spring 22, friction ring (cone) 21 is connected to the screw 4 through a guide key 23. When the screw 4 rotates, its driving torque is transmitted through keyway 4.1, guide key 23, friction face of friction ring (cone) 21.1 to the up-and-down sleeve 3A which is brought to rotate together, until it stops when colliding with an upward stroke limiting means, but the screw will continue to rotate, meanwhile this friction pair is overloaded and slides over each other without hindering the rotation of the screw, and the screw can achieve its predetermined job. The above stated contact faces 21.1 and 3A.10 of the friction ring (cone) can be replaced by a pair of teeth which can slide over each other under the effect of a compression spring 22 when overload occurs. Of course the amount of compression deformation of the compression spring



principle is essentially the same as fig 16-II. Its expandable ring 26 has also an axial open slot 26.1. When in free state, the inside diameter of its inner hole 26.2 is slightly smaller than the outside diameter 4.9 of the screw 4. After the screw is inserted in the inner hole, by resilience the inner hole embraces around the outer periphery of the cylinder of the screw 4 and results a certain amount of frictional force (there is no keyway on the screw). The outside diameter of the inwardly expandable ring 26 is slightly smaller than the inside diameter of the inner hole of the up-and-down sleeve 3A, the driving torque of the screw is transmitted through a transmitting pin 127 to the up-and-down sleeve 3A. The operating process is the same as fig.16-II, but that the friction surface which can slide at overload is directly undertaken by the friction surface lying between the outer circumference of the screw 4 and the inner hole of the expandable ring.

Fig. 17-I is an overload separating device of the type of axially distributed guide pillar (or steel ball). Its working principle is as follows: On the left end face of a sliding sleeve 28 which encloses around the screw 4, there are radial small holes, small compression springs 29 and guide pillar 30 (or steel ball) are fitted into the small holes, and engage with the resistant small cone pits 3A.12 which are provided on the right end face of the up-and-down sleeve 3A. The operating process is essentially the same as fig.15-1, the only difference is that, the pure end face friction in fig.15-I is changed into small cone pit resisting with guide pillar (or steel ball) in



fig.17-I. The device shown in fig.17-II is the equivalent mechanism of that shown in fig 17-I, the axially arranged holes of guide pillar in fig. 17-I has been changed into radially arranged holes in fig. 17-II where 3A.13 represents an axially resistant groove. In a word, there can be still many kinds of overload separating devices composed by various overload elements but are the equivalent mechanisms of the overload separating device of the invention.

With respect to the structural form of the "quick and slow speed control device" used in the invention, besides the inserting pin locking device 5 of fig.2-I, fig.19-I is another kind of pawl type locking device 5'. Its structure is essentially the same as the inserting pin type locking device 5, except the cylindrical inserting pin 5.1 is replaced by the pawl 7 of fig.2-I, thus the inserting pin tip 5.1.1 of the original cylindrical inserting pin 5.1 is replaced by a pawl type inserting pin tip 5'.1.1 with double conical faces, or replaced by a pawl type inserting pin tip with single conical face, i.e. the pawl pin tip only with ramp on one side while the other side is a right angle, this inserting pin tip can be inserted into the keyway 4.1 of the screw 4 or retracted from it under the control of the eccentric handle 5',5, the socket 5'.2 for the inserting pin is fixed on the up-and-down sleeve 3A. For convenience of operation, the eccentric handle 5',5 with a plate of arrow shape can be replaced by an eccentric handle 36 with a fork of two branches which cooperate with the end tip of the pawl 30. For mounting spring 6, a groove 3A.10 is cut on the up-and-down sleeve 3A, and a groove 30.3 is cut



on the pawl 30 correspondingly.

The working principle of the pawl locking device is as follows: when the eccentric handle 5'.5 is placed in the vertical position, as shown in fig.18-II, the pawl can be inserted into the keyway 4.1 under the action of a compression spring 5'.2, the action is the same as the "locking device" 5 of fig 2-1. At this time, if the screw 4 rotates in "M" direction, it can via keyway 4.1 and conical face 5'.1.2 of the pawl bring the up-and-down sleeve to rotate in "M" direction, and via the opening and closing actuating device to cause the internal threads of semi-nuts 2A, 2A' to engage with the external threads of the screw 4. At this time, if the eccentric handle 5',5 is placed at its horizontal position, as shown in fig.18-III, then the end tip 5.1.1 of the pawl is lifted apart from the keyway 4.1 of the screw 4. In this manner, no matter how the screw 4 rotates either in "M" or in "N" direction, the up-and-down sleeve 3A cannot be brought to rotate with the screw 4, thereby the engaging and self-locking state between the internal and external threads of the semi-nuts and the screw is held, this is the same as conventional screw-and-nut drive mechanism, and the original functions of slow advance and slow retract is retained, if the carrier to be applied is a screw jack, then at this time, the slow rise or drop of that screw jack can be realized.

In the quickly movable screw jack as shown in fig. 1-II, the left end of the screw 4 passes through the central supporting hole of the left pivot axle O_2 and connects with the transmission means



which imports the driving torque. Among these transmission means, besides the "directly manual type" using a handle which manually and directly rotates the screw and the "manual speed reducing type" using a handle which manually rotates a transmission gear box then brings the screw to rotate, it is characterized in that, the electric source on the car itself may be used, it can use a electric motor 10.8 to drive the transmission gear box 10.9 then drive the screw 4, thus forming an "electrically driven type" or a "manual and electric dual use type" which can be operated either manually or electrically.

The handle 10.7 as shown in fig.-I is composed of a handle body 10.7.5 and rocking arms 10.8.1., 10.7.2. In order to reduce the volume so that the handle can be stored conveniently, it can be made foldable or retractable. The features of fig.21-I are: the rocking arms 10.7.1, 10.7.2 of the control handle 10.7. can be folded separately and quickly with pivot axles 10.7.3 and 10.7.4 as axis, using spring 10.7.6 and steel ball 10.7.7 to accomplish positioning. Fig.21-II shows the mechanism which can be retracted by placing the rocking arm 10.7 into the inner hole 10.7.8 of the hollow rocking arm 10.7.1, 10.7.9 is positioning coiled spring, the handle body 10.7.5 can be made foldable or retractable if necessary.

Summarizing the above, although the carrier relaed is screw jack which can quickly or slowly up or down, but the most essential nucleus of the invention is a "F nut". That mechanism has a wide variety of applied carrier. If the applied carrier is a screw jack, then



that screw jack is a "double speed screw jack". If the applied carrier is a bench vice, then the invention is a quickly or slowly, opening or closing bench vice. For instance, fig 20 is the embodiment which uses the "F nut" as shown in fig 2-I, but the carrier is changed from a screw jack to a bence vice. The method of retrofitting really is very simple, it needs only change the connecting part between the respective carrier and the "F nut". e.g. the pivot axle O_1 on the supporting seat 1A in fig 2-I is omitted, and the bottom plane 1A'1 and vertical plane 1A'2 on the supporting seat 1A' are utilized to directly contact with the corresponding positioning planes a_1 and a_2 on the fixed body "a" of the bench vice, and the screws "h" are used for fastening. While the screw 4 needs only to connect with the movable body "c" of the bench vice, others remain unchanged. As summary, for the applied field i.e. the applied carrier of the "F nut" of the invention, besides the screw jack, it can be used further in: bench vice, machine vice, pipe vice, sliding table of machine tool, tailstock of a lathe, architectural scaffold whose height can be adjusted and all others require using screw and nut pair as drive device and consistute new mechanism, all are within the scope of the invention. (It needs only using some common methods to change the connection with the above applied carriers.)





Claims

1. A quickly movable screw jack comprising: screw 4, bottom seat 10.5, top support 10.6, lifting link mechanism 10.1-4, left pivot axle O_1 , right pivot axle O_2 , is characterized in that:

(1) a quickly movable automatic and synchronous opening and closing semi-nuts set (brief as "F nut" in the following) is provided on the left and right pivot axles O_2 and O_1 ;

(2) the left end of the screw 4 passes through the central hole of the left pivot axle O_2 and connects with a manual or machinedriven transmission means which imports driving forque, and the threads of the screw 4 on the outer periphery of its right portion can be engaged with the correspondingly semi-nuts in the "F nut" when it is provided on the right pivot axle O_1 ;

(3) the "F nut" comprises: ①supporting seat, ②one or more semi-nuts, ③automatic and synchronous opening and closing mechanism for the semi-nuts; the screw with threads on it passes through the supporting hole of supporting seat in the "F nut" to be fitted with the semi-nuts and its automatic and synchronous opening and closing mechanism;

the features of these three components are: ①supporting seat: provided on which are the portion connected with the applied carrier,





the portion fitted with the screw for its relative rotation and axial movement, the portion fitted with the semi-nuts for its opening and closing movement; besides, there are provided position limiting device, safeguard device, quick and slow speeds changing device;

②semi-nuts: one or more in number, with internal threads less than a half of the periphery, on the semi-nuts are provided: guiding and sliding fitted face or member for realizing the opening and closing movement, actuating member fitted with position limiting device and self-locking device, outer peripheral face and actuating member including cam profile or cam guide pin or transmitting pin to produce and transmit the opening and closing (up-and-down) force;

③semi-nuts automatic and synchronous opening and closing mechanism, compressing the following components: automatic and synchronous overload separating device, actuating device for relatively opening and closing between the screw and the nuts including that of elastically engaging and rigidly self-locking type (all these will be briefed as "opening and closing actuating device" in the following), self-locking device to retain the engagement of the semi-nuts and position limiting device to limit the opening and closing stroke, safeguard device to prevent the semi-nuts from suddenly separating out when the screw jack is lifted, and the "speed changing device" for the quick and slow speeds makes the screw jack a quick or slow drop.

2. The quickly movable screw jack as claim 1, characterized in that, the structure of the "opening and closing actuating device"





in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is: the screw 4 passes through the supporting hole 1A.2 of the supporting seat 1A and the inner hole 3A.1 of the up-and-down sleeve 3A, and cooperates with two semi-nuts 2A and 2A' which can make relative opening and closing (up and down) movement relative to the screw 4, the outer side faces 2A.2, 2A'.2 and 2A.3, 2A'.3 at its left side with about half of its volume are in movable fit with the sliding guideways 1A.3, 1A.4 of the supporting seat 1A, while the other half at the right end is mounted in a large hole at the left end of the upper-and-down sleeve 3A, its "opening and closing actuating device" is an inner-curved cam means on that large hole, the cam profile is composed of two symmetric segments of rise portions 3A.2, 3A.3 and two segments of inner arcs 3A.4 with minimum radius as R_{min} (this is also the self-locking cam profile of the self-locking device to prevent the separation of the closed semi-nuts), as well as other two segments of inner arcs 3A.5 with maximum radius as R_{max} ; the expandable spring 14 is mounted in the grooves 2A.4 and 2A'.4 of the upper and lower two semi-nuts, alternatively, instead of the expandable spring, each of the semi-nuts may use its own individual spring, thereby urging the upper and lower semi-nuts 2A', 2A to separate outward, so as the highest points 2A.5 and 2A'.5 of the outer arcs of the semi-nuts can always firmly press against the inner-curved cam face of the up-and-down sleeve, its clamp plate 17 and stop pin 15 compose the position limiting device for the opening and closing stroke of the semi-nuts.

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3. The quickly movable screw jack as claim 1, characterized in that, the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is achieved by making improvement on the "opening and closing actuating device" of the above claim 2, i.e. the actions of automatic opening and automatic closing for the semi-nuts are separately accomplished by two sets of "actuating device", others remain the same; of which the "actuating device" responsible for automatic closing and self-locking of the semi-nuts are still the inner-curved cam profiles 3B.2, 3B.4, 3B.5 on the large hole at left end of the up-and-down sleeve 3B, whereas the "actuating device" responsible for automatic opening of the semi-nuts is undertaken by an end face cam pair which is composed of cam grooves and cam guide pins, the end face cam grooves 2B.2 and 2B'.2 of that cam pair are disposed on the right end face of the semi-nuts 2B and 2B', the cam profiles for actuating the separating action are 2B.3 and 2B'.3, and its cam guide pins 16 and 16' are disposed on the left end face 3B.2 of the up-and-down sleeve 3B, or according to the principle of relative motion, the cam grooves may be disposed on the up-and-down sleeve, while the guide pins may be correspondingly disposed on respective semi-nut.

4. The quickly movable screw jack as claim 1, characterized in that, the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism of the "F nut" is a fully end face cam pair which is composed of kidney-like end face cam





grooves and cam guide pins, its kidney-like end face cam grooves 2C.2 and 2C'.2 are disposed separately on the right end face of the semi-nuts 2C and 2C', and the opening and closing actuating members for the kidney-like cam grooves are composed of the rise portion of cam profile 2C.4 and the drop portion of cam profile 2C.3, while the cam guide pins 16 and 16' are disposed on the left end face 3C.2 of the up-and-down sleeve 3C, as to the position limiting device for the movement range on opening and closing the semi-nuts and the self-locking device after opening and closing the semi-nuts, their actuating members are composed of the arc type cam profiles 2C.7, 2C'.7, 2C.8, 2C'.8 at the two ends of the kidney-like cam grooves.

5. The quickly movable screw jack as claim 1, characterized in that, the structure of the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism" in the "F nut" is that, the kidney-like cam grooves 3D.2 and 3D'.2 are disposed on the cam disc 3D.1 of the up-and-down sleeve 3D, the "actuating members" for the opening and closing movement of the semi-nuts are composed of rise portion cam profile 3D.2.1 and drop portion cam profile 3D.2.2, whereas the position limiting device for the movement range on opening and closing the semi-nuts and the self-locking device after opening and closing the semi-nuts, their actuating members are composed of the arc type cam profiles 3D.2.4, 3D.2.3, and its cam guide pins 16, 16' are disposed on the semi-nuts 2D and 2D', which are restrained to make opening and closing (up





and down) movement in a frame shape or dovetail shape guideway of the supporting seat 1D, as to the restraint of axial shift of the up-and-down sleeve 3D, it is accomplished by providing bosses 16.1 to the end face of cam guide pins 16, 16' for resisting against the right side face 3D.4 of the cam disc 3D.1, or the bosses 16.1 on the above cam guide pins may be eliminated, then the loss bodies may be directly mounted on a means connected with the supporting seat 1D.

6. The quickly movable screw jack as claim 1, characterized in that, the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is that of the elastically engaging and rigidly self-locking type, its structural form is derived from the structure described in claim 5, by eliminating the drop portion of cam profile 3D.2.2 of the kidney-like cam grooves 3D.2 and 3D'.2 (for convenience to discuss, only take one of the cam grooves 3D.2 as example), retaining only the rise portion of cam profile 3D.2-1 and the actuating members for the position limiting and self-locking device, i.e. cam profiles 3D.2.3 and 3D.2.4, and providing in addition one set of elastically engaging and rigidly self-locking actuating means, which is composed of elastically engaging spring (including the integral retractable spring 32 or individual springs mounted separately on respective semi-nut) and self-locking device, one of the structures of the above self-locking device is to use a cam pair which is composed of cam profile 3D.2.4 and cam guide pin 16, other structures are the same as that of claim 5; thus, the "opening and closing actuating device"





substantially consists of two sets of actuating device: of which one set is the "separating actuating device" to accomplish the automatic separation of the semi-nuts 2D and 2D', one of its embodying scheme is realized by a cam pair which is composed of rise portion cam profile 3D.2.1 on the cam disc 3D.1 and cam guide pin 16 on the semi-nut 2D, or is realized by a cam pair which is composed of guide pin 16 on the cam disc 3D.1 and rise portion cam profile 3D.2.1 on the semi-nut 2D, the another set is an elastically engaging and rigidly self-locking "engaging actuating device", one of its embodying scheme is to use the above-mentioned elastically engaging and rigidly self-locking actuating means to realize an engaging rate of 100%.

7. The quickly movable screw jack as claim 1, characterized in that, the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is achieved by making improvement on the basis of the "opening and closing actuating device" as described in claim 2, it is realized by a radial cam pair which is composed of cam profiles 3E.1.2 and 3E.1.1 provided on the inner and outer cylindrical body of the up-and-down sleeve 3E and the cam conjugating pins 18, 19 mounted on the transmitting pins 16E and 16E' at the ends 2E.1 and 2E'.1 of the semi-nuts, other structures remain the same.

8. The quickly movable screw jack as claim 1, characterized in that, the "opening and closing actuating device" in the "semi-nuts





automatic opening and closing mechanism” of the “F nut” is achieved by making improvement on the “opening and closing situating device” as described in claim 2, it is realized by a crankslder mechanism, the crank 20 has two pivot axle holes O_2 and O_3 , of which pivot axle hole O_2 is connected with the semi-nut 2F, while O_3 is connected with the up-and-down sleeve 3F, other structures semain the same.

9. The quickly movable screw jack as claim 1, characterized in that, the “opening and closing actuating device” in the “semi-nuts automatic opening and closing mechanism” of the “F nut” is realized by a cam pair which is composed of the profiles (including rise portion profile 2F.2 and drop portion profile 2F.3) on the outer periphery of the semi-nut 2F and the up-and-down plate 3F.1 on the up-and-down sleeve 3F, the semi-nut 2F has its internal threads 2F.6 less than a half of the periphery, a semi-plain-hole 2F.8 with diameter greater than that of the screw, two pivot axles 2F.7 at front rear sides connected with the carrier (screw jack), and a rise portion of cam profile 2F.2 and a drop portion of cam profile 2F.3 on its periphery; the screw 4 passes successively through left end hole 1F.1 of the supporting frame 1F, plain hole 2F.8 of the semi-nut, hole 3F.3 of the up-and-down sleeve, and right and hole 1F.2 of the supporting frame; when the up-and-down plate 3F.1 of the “actuating device” rotates to the upmost position where it is inserted in a sliding fit between an upper top face 2F.9 on the outer periphery of the semi-nut 2F and an upper bottom face 1F.3 of the inner cavity





of the supporting frame 1F; the above "actuating device" can be reformed, such as: (1) the pivot axles 2F.7 connected to the carrier (screw jack) and disposed initially at the front and rear sides on the outer periphery of the semi-nut 2F, can be modified as to be mounted on the front and rear side faces of the left side wall of the supporting frame 1F, thus the supporting frame 1F is changed into a supporting seat 1G with pivot axles, i.e. there mounted pivot axles 1G.7 and 1G'.7 on the front and rear side faces 1G.8, 1G.9 of the side wall of the supporting seat 1G; the semi-nut after dropping off its pivot axles 2F.7 is changed into a semi-nut 2G without pivot axle; others such as the up-and-down sleeve 3G are completely the same as the above up-and-down sleeve 3F; or (2) the original supporting frame 1F is eliminated, only the semi-nut 2F with pivot axle O_1 and the up-and-down sleeve 3F are retained, other main structures remain the same, i.e. with semi-nut 2F and up-and-down sleeve 3F; to prevent axial shift, a stop pin 12 is provided on the up-and-down plate 3F.1 of the up-and-down sleeve, correspondingly a deep groove 2F.10 is cut on the semi-nut 2F to cooperate with the stop pin 12; or (3) the original supporting frame 1F is eliminated, other main structures remain the same, with semi-nut 2F and up-and-down sleeve 3F; to prevent axial shift, an anti-shift frame 33 is added, there are two lug holes 33.1 and 33.2 on the frame which can be put on the pivot axles 2F.7 on the front and rear side faces of the semi-nut 2F.

10. The quickly movable screw jack as claim 1, characterized





in that, the structure of the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is realized by an eccentric cam kinematic pair which is composed of an eccentric cam sleeve 3H and the upper and lower two planes 1H.4 and 1H.3 of a frame-like rectangular opening of the semi-nut supporting seat 1H; the semi-nut supporting seat 1H has a shape of frame, in the center of the frame, there is a rectangular opening, the upper and lower planes 1H.4 and 1H.3 of that opening is in sliding fit with the outer peripheral surface 3H.2 of the eccentric cam 3H, internal threads 1H.6 and 1H.5 which are less than a half of the periphery and semi-plain-holes 1H.1 and 1H.2 with diameter greater than that of the screw 4 are provided separately in the left and right two side walls 1H.7 and 1H.8 of the frame, the screw 4 successively passes through the plain hole 1H.1 of left wall, the inner hole 3H.1 of eccentric cam and the plain hole 1H.2 of right wall, besides, at the front and rear sides of the left side wall of the frame, pivot axles O_1 are provided to be connected with the screw jack body 10.1 and 10.2 of the practical carrier, furthermore, overload separating means 7 is provided on the eccentric cam 3H, speed changing mechanism 5 is provided on the frame 1H.

11. The quickly movable screw jack as claim 1, characterized in that, the "opening and closing actuating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is realized by a cam kinematic pair which is composed of the cam





profile 2J.1 on the outer periphery of the semi-nuts 2J and the upper and lower two planes 1J.1 and 1J.2 of the frame-like rectangular opening in the supporting frame 1J, the eccentric cam profile 2J.1 on the outer periphery of the semi-nuts 2J in fact is a cylindrical surface with O_3 as center, there are two eccentric holes in the body of semi-nut 2J, the centers of these holes are respectively O_2 and O_4 , both their eccentric distances from the center O_3 are equal to e (e is slightly greater than the depth of a spiral thread), the eccentric hole with center O_4 is a semi-plain-hole 2J.3 with diameter greater than that of the screw 4, the eccentric hole with center O_2 has its internal threads 2J.4 less than a half of the periphery, on the semi-nut 2J are further provided two up-stroke limiting pins 35, 36 and a radial hole 2J.5, in which is fitted with a pawl 34, and a spring hoop 6 presses against the pawl 34, causing the cone body of pawl tip 34.1 to press against the outer periphery of the screw 4 or be inserted into the keyway 4.1; the supporting seat 1J has a shape of frame, in the opening of the frame, semi-nut 2J is seated, the screw successively passes through the left frame supporting hole 1J.3 of the supporting seat 1J, the semi-nut hole and the right frame supporting hole 1J.4, at the front and rear sides of the left frame part 1J.6 are mounted pivot axles 1J.5 (with O_1 as center) to be connected to the practical carrier (screw jack);

in order to improve the engaging property, besides the cylindrical body, the shape of cam profile 2J.1 on the outer periphery of the semi-nut 2J can be designed into other cam curves





according to the requirement.

12. The quickly movable screw jack as any one of claims 1-11, characterized in that, the structure of the "automatic and synchronous overload separating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" is:

on the up-and-down sleeve 3A, there is provided a radial pawl hole 3A.7, in which is mounted a pawl 7, a spring hoop 6 is fitted on the pawl 7, while on the screw 4, there is provided one or more axial keyway 4.1 so as to be fitted with the pawl 7, at the lower end of the pawl 7 there are two ramps 7.1, or only one ramp with other plane at right angle to consistute a pawl of single direction as required.

13. The quickly movable screw jack as any one of claims 1-11, characterized in that, the structural form of the "automatic and synchronous overload separating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" comprises an up-and-down sleeve 3A, a friction ring (cone) 21, a guide key 23, a compression spring 23 and a check ring 24, the friction ring (cone) 21 is mounted in the up-and-down sleeve 3A, and is connected to the screw 4 through the guide key 23, while on the said screw 4, there is provided axial keyway 4.1 so as to be fitted with the guide key 23; or the contact faces 21.1 and 3A.10 of the friction ring (cone) can be replaced by a pair of teeth, meanwhile the amount of deformation of the compression spring 22 must be





increased so as to give a space for the left and right movement which is slightly greater than the depth that the teeth would be inserted in.

14. The quickly movable screw jack as any one of claims 1-11, characterized in that, the "automatic and synchronous overload separating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" comprises an elastically expandable ring 26, a transmitting pin 27, an up-and-down sleeve 3A and a check ring 24, there is an open slot 26.1 provided on the elastically expandable ring 26 for producing sufficient frictional force, when the expandable ring is in the free state, its inside-diameter is slightly smaller than the screw 4, the expandable ring 26 is mounted between the screw and the up-and-down sleeve and is connected with the up-and-down 3A sleeve through the transmitting pin 27.

15. The quickly movable screw jack as any one of claims 1-11, characterized in that, the "automatic and synchronous overload separating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" comprises an elastically expandable ring 25 with an opening 25.1, a guide key 23 and a check ring 24, when in free state, the outside diameter 25.2 of the expandable ring 25 is slightly greater than the inside diameter of inner hole 3A.11 of the up-and-down sleeve, the expandable ring is mounted between the screw and the up-and-down sleeve, and is connected to the screw provided with axial keyway 4.1 through the guide key 23.





16. The quickly movable screw jack as any one of claims 1-11, characterized in that, the "automatic and synchronous overload separating device" in the "semi-nuts automatic opening the closing mechanism" of the "F nut" comprises a sliding sleeve 28, a guide key 23, many spaings 29, many guide pillars 30 and an up-and-down sleeve 3A, small compression springs 29 and guide pillar 30 are fitted into some axial small hole on left end face of sliding sleeve 28 and engage with the resistant small cone pits 3A.12 which are provided on the right end-face of the up-and-down sleeve 3A, the sliding sleeve 28 in connected with the screw 4 through the guide key 23, axial keyway 4.1 is provided on the screw 4 so as to fit with the guide key 23, guide pillar 30 can be replaced by steel ball.

17. The quickly movable screw jack as any one of claims 1-11, characterized in that, the "automatic and synchronous overload separating device" in the "semi-nuts automatic opening and closing mechanism" of the "F nut" comprises a sliding sleeve 28, a guide key 23, many springs 29, many steel balls 30, an up-and-down sleeve 3A and many resistant small slots 3A.13, steel balls 30 and springs 29 are mounted in radial small holes of the up-and-down sleeve 28, steel balls 30 are fitted with the resistant slots or pits 3A.13, the sliding sleeve 28 is connected with the screw through the guide key 23, axial keyway 4.1 is provided on the screw 4 to fit with the guide-key 23, steel ball 30 can be replaced by guide pillar.





18. The quickly movable screw jack as any one of claims 1-11, characterized in that, the "quick and slow speeds control device" in the "semi-nuts automatic and synchronous opening and closing mechanism" of the "F nut" employs an inserting pin type locking device which is composed of an inserting pin 5.1, a socket for inserting pin 5.3, an axial pin 5.4 and an eccentric handle 5.5, the front end of the inserting pin 5.1 is a cylindrical inserting pin tip 5.1.1, it can be inserted into the locking hole 3A.8 on the up-and-down sleeve 3A, the inserting pin tip 5.11 can be inserted into the locking hole 3A.8 or be withdrawn from it if the arrow direction of the operating eccentric handled be controlled to be vertical (or horizontal), the socket 5 for the inserting pin is mounted on the supporting seat 1A.

19. The quickly movable screw jack as any one of claims 1-11, characterized in that, the "quick and slow speed control device" in the "semi-nuts automatic and synchronous opening and closing mechanism" of the "F nut" employs pawl type locking device 5', its structure is essentially the same as the inserting pin type locking device 5, except the cylindrical inserting pin 5.1 is replaced by the pawl 7, thus the inserting pin tip 5.1.1 of the original cylindrical inserting pin 5.1 is replaced by a pawl type inserting pin tip 5'.1.1 with double conical faces, or with single conical face, i.e. the pawl pin tip only with ramp on one side while the other side is a right angle, this inserting pin tip can be inserted into the keyway 4.1 of the screw 4 or retracted from it under the control of the eccentric





handle 5'.5, the socket 5'.2 for the inserting pin is fixed on the up-and-down sleeve 3A, for convenience of operation, the eccentric handle 5'.5 with a plate of arrow shape can be replaced by an eccentric handle 36 with a fork of two branches which cooperate with the end tip of the pawl 30, for mounting spring 6, a groove 3A.10 is cut on the up-and-down sleeve 3A, and a groove 30.3 is cut on the pawl 30 correspondingly, in the same manner, it needs only to operate the handle 36 to a correct direction, such as vertical or horizontal, the end tip 30.2 of the pawl can be retracted from the keyway 4.1 of the screw 4 or inserted into it.

20. The quickly movable screw jack as claim 1, characterized in that, left (or right) handed threads are provided on the outer periphery of the left portion of the screw 4 so as to be fitted with the corresponding semi-nuts in the "F nut" provided on the left pivot axle O_2 , whereas right (or left) handed threads are provided on the outer periphery of the right portion of the screw 4 so as to be fitted with the corresponding semi-nuts in the "F nut" provided on the right pivot axle O_1 , further, the transmission means to rotate the screw 4 may be disposed at any end of the screw.

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Abstract

This utility model relates to a conventional lifting implement, it is screw jack with the function of quickly moving up-and-down. It is characterized in that, it has a set of "automatic and synchronous opening and closing semi-nuts means which is composed of supporting seat, semi-nuts and its automatic opening and closing actuating device, by adding locking device, its function of slow up and slow down can be restored. When an electric motor is added, it becomes a new type electrically driven screw jack which can move up-and-down quickly. This utility model of semi-nuts opening and closing means can be used adversely on all the cases that require using screw drive mechanism but in need of quickly moving.

Quickly movable elastically engaging screw-and-nut mechanism

1. Field of technique

The invention relates to a quickly movable elastically and automatically engaging screw-and-nut mechanism (brief as "F nut pair" in the following) which is a new type of screw-and-nut mechanism and can be used on the carriers such as car screw jack, bench vice, architectural scaffold, sliding table of machine tool and the like, and other means that require using screw-and-nut as kinematic pair of drive but in need of quickly passing over an idle stroke. Also it can be used as a "means for speedily adjusting distance and locating a positions" which allows arbitrary adjustment and positioning. The key technique used is a mechanically program-controlled, elastically engaging, automatically opening and closing screw-and-nut pair of the invention, which allows the semi-nuts under the effect of the mechanically programmed automatically controlled system, auto-matically and successively perform the following five predetermined mechanically program-controlled actions (brief as "5 steps for automatically opening and closing" in the following): (1) The thread peak elastically and automatically aligning with the thread valley; (2) the thread peak and the thread valley automatically and elastically engage with each other in "full thread depth"; (3) rigidly selflocking the completely engaged semi-nuts and screw; (4) releasing selflocking to wait for seperating; (5) rigidly seperating the semi-nuts and the screw.

2. Back ground of prior art

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In the past the applicant had applied many invention patents relating to quickly opening and closing screw-and-nut mechanism with either the screw or the nut up-and-down in many countries such as U.S. patents no.4,834,355, 4,923,185, 5,282,392 and other related patents such as CN 2078210U, CN 1047466A, CN2065969U, CN2057131U, CN1065514A. In these patents, the engagement of thread peak and thread valley of the screw and nut is essentially achieved by means of such rigid operation actuating device as a variety of cams, links etc. to directly and rigidly make forced engagement. There exist frequently the problems of fail in engagement of the threads and being incapable to work normally. Thus there are two drawbacks: one of the drawbacks is a low percentage of the number of threads engaged in their total number of threads. The reason is evident. Since the thread peak of either triangular thread or trapezoid thread both has a certain width, therefore these thread peaks are likely to collide with each other and not to be engaged when they are engaged in a rigid manner. And the probability of happening this phenomena increases as the width of thread peak increases. The other drawback is a low percentage of the number of threads engaged in "full thread depth" in their total number of threads. The full thread depth is the depth between the thread peak and thread valley of the semi-nut and screw which should be and can be engaged. By the rigid manner, a complete engagement in "full thread depth" can be attained only when the center of thread peak and the center of thread valley of the semi-nuts and screw are just aligned with each other, it is evident that the probability is also certainly very low, so the most engagements of the threads are not engagement in "full thread depth". Although they are engaged, but the engaging depth at every time is not as ideal, sometimes it begins to work when the engaging of the internal and external

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threads has not yet reached the specified depth, thus loading capacity and reliability of the screw threads are lowered. Also in the prior arts, there is a pateht CN 2139872Y, the engaging means for its semi-nuts although employs spring for elastically engaging, but the disengaging of its semi-nuts is accomplished by another manual operating lever. This patented technique belongs to a technical field of rather primitive, manually operating opening and closing screw-and-nut pair without any mechanically programmed, automatically controlled system. It does not belong to the same technical field of the present invention and has not the function of performing "5 steps for automatically opening and closing" while the present invention has that function. In summary, by using the key technique "mechanically program-controlled, elastically engaging, automatically opening and closing screw-and-nut pair", the present inventin can perform "5 steps for automatically opening and closing", thereby overcome the various drawbacks existed in the abovementioned reference documents and bring forth new ideas.

3. Summary of the invention

The invention provides a quickly movable elastically engaging screw-and-nut mechanism (brief as "F nut pair" in the following) comprising screw, semi-nuts, supporting seat, opening and closing device. There provide one or more semi-nuts uniformly distributed around the cross-section of a screw which is supported by a supporting seat. The semi-nuts are located between the supporting seat and the up-and-down sleeve and are provided with an opening and closing means which can automatically rise or drop. The up-and-down sleeve is provided with an antishift means to prevent shift along the axial directin of the screw. The supporting seat comprising supporting arms (one or

two), supporting hole (one or two correspondingly), supporting body (including means connected to the carrier such as pivot axle O_1), up-and-down guide member which is fitted with up-and-down sliding guideways of the semi-nuts, and position limiting member. The screw passes through the supporting hole, the semi-nuts and the up-and-down means (such as up-and-down sleeve, including axially antishift means) in a movable fit. For two or more semi-nuts, they should be arranged around the center of the screw. The semi-nuts have internal threads which extend less than a half of the periphery, sliding guideways for guiding the up-and-down movement, as well as actuative member to transmit the up-and-down force. It is characterized in that, the "mechanically program-controlled, automatically opening and closing device for the semi-nuts" (brief as "automatic opening and closing device" in the following) which is used to control the automatic and synchronous opening and closing motion of the semi-nuts comprises "elastically engaging actuating element" (such as spring) acting on the semi-nuts, "rigid selflocking actuating element" for rigidly selflocking the semi-nuts, and "seperating actuating device (such as cam profile, link mechanism) for rigidly seperating the semi-nuts. Said "automatic opening and closing device" further comprises mechanically program-controlled motion assigning actuating element (such as up-and-down sleeve), autometric, synchronous overload seperating device (such as pawl, spring hoop etc.) and upward stroke limiting device, safeguard device, and speed changing device which makes the screw to have the function of being capable to advance or retract with either quick or slow speed.

By using "mechanically program-controlled, elastically engaging, automatically opening and closing screw-and-nut pair", the invention has found a reliable, simple and practical embodiment scheme of a mechanically

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programmed, automatically controlled system. Said scheme can make the semi-nuts successively perform the "5 steps for automatically opening and closing" according to the predetermined motion procedure in an operating cycle period of one turn of the positive or inverse revolution of the screw. The concrete technical scheme of the invention is to use an elastic means to engage the internal threads of the nut and the external threads of the screw in a manner like soft landing. While a rigid selflocking actuating device is used for selflocking the nut after it has been engaged. When it is desired to operate in the inverse way to realize the separation between the internal and external threads, also a rigid automatic separating device is used, thus the rigid and elastic technique are used in a combined manner, which ensures not only the % of threads engaged reaching 100%, but also the % of threads engaged in full standard depth reaching 100%. At the same time, the said screw-and-nut pair which is in engagement and under heavy load can 100% ensure its reliability on selflocking.

4. Brief description of the drawings

Fig. 1 is a schematic view illustrating the work principle of a car screw jack which employs the "F nut pair" of the invention and has the function to rise or drop with two speeds (quick and slow).

Fig.2 is a main view of the first embodiment of the "F nut pair", it has two semi-nuts, wherein "elastically engaging actuating element" is a "retractable plate spring", "rigid self-locking element" is an internal curved cam, "separating actuating device" is an end face cam pair which is provided on the end faces of the semi-nuts. In the figure, the screw 4 rotates clockwise

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(brief as M direction in the following), the internal and external threads are in engaging state.

Fig.3 is a similar main view as fig.2 but the screw 4 rotates counterclockwise (brief as N direction in the following), the internal and external threads are in separating state.

Fig.4-I is the A-A sectional view of fig.2, showing that the screw 4 rotates in M direction, the two semi-nuts make centripetal movement under the effect of retractable plate spring, the internal and external threads are in engaging state.

Fig.4-II is the B-B sectional view of fig.2, showing that after the semi-nuts have been engaged with the screw, the semi-nuts are self-locked by the internal curved cam profile.

Fig 5-I is the D-D sectional view of fig.3, showing that the screw 4 rotates in N direction, the internal and external threads are in separating state.

Fig.5-II is the E-E sectional view of fig.3, showing that the semi-nuts have been released from self-locking and it makes centrifugal separating movement under the effect of end face cam pair.

Fig.6-I is a perspective view of the supporting seat of Fig.2-I.

Fig.6-II is a perspective view of the up-and-down sleeve of fig 2-I.

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Fig.6-III is a perspective view of the upper and lower two semi-nuts of fig.2-I.

Fig 6-IV is a perspective view of the retractable plate spring of fig.2-I.

Fig 7-I is a main view of the second embodiment of the "F nut pair", wherein "elastically engaging actuating element" is a spring steel wire, "rigid self-locking element" and "seperating actuating element" are disc-shape cam profile provided on the up-and-down sleeve. In this figure, the screw 4 rotates in M direction, the internal and external threads are in engaging state.

Fig. 7-II is the F-F sectional view of fig 7-I.

Fig.7-III is the G-G sectional view of fig.7-I.

Fig.8-I is a main view of the third embodiment of the "F nut pair", wherein "elastically engaging actuating element" is a compression spring, self-locking and seperating device are the same as fig.7-I, but in this figure, the double speeds changing device is integral with the pawl, now the screw is in the slow speed state, i.e. it can rotate arbitrailly in M or N direction, but it is in the self-locking state that the internal and external threads can not be seperated from each other.

Fig 8-II is and of the J-J sectional views of fig 8-I, showing that the pawl is lifted away from the screw.

Fig 8-III is the another J-J sectional view of fig 8-I, showing that the pawl

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is lowered to be inserted into the keyway of the screw 4.

Fig 8-IV is the partial H-H sectional view of fig. 8-I.

Fig 9-I is a main view of the fourth embodiment of the "F nut pair", wherein "elastically engaging element" is a compression spring, "rigid self-locking element" is an internal curved cam pair, "seperating actuating device" is an external curved cam pair. In this figure, the screw 4 rotates in N direction, the internal and external threads are in seperating state.

Fig.9-II is the K-K sectional view of fig.9-I.

Fig.10 is a main view of the fifth embodiment of the "F nut pair", this figure is all the same as fig. 9-II except using link machanism as "seperating actuating device" which is different from fig.9-II. In this figure, the screw 4 rotates in N direction, the internal and external threads are in seperating state.

Fig.11-I is a main view of the sixth embodiment of the "F nut pair", it has only one semi-nut. Wherein "elastically actuating element" is a compression spring, "rigid self-locking element" is an up-and-down plate, "seperating actuating device" is a radial cam pair provided on the outer periphery of the semi-nut. In this figure, the screw rotates in M direction, the internal and external threads are in engaging state.

Fig.11-II is one of the P-P sectional views of fig.11-I, showing that when the screw 4 rotates in M disection, the internal and external threads, being engaged elastically with each other, are self-locked by the up-and-down plate.

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Fig 11-III is the another P-P sectional view of Fig.11-I, showing that when the screw 4 rotates in N direction, the internal and external threads separate from each other under the effect of the up-and-down plats of the cam pair.

Fig.12-I is a perspective view of the supporting seat of Fig.11-I.

Fig.12-II is a perspective view of the semi-nut of fig.11-I.

Fig 12-III is a perspective view of the up-and-down sleeve of Fig.11-I.

Fig.12-IV is a perspective view of a semi-nut with a pivot axle O_1) that pivot axle in fig.11-I is connected with the carrier (screw jack), now is modified to be provided on the semi-nut through an equivalent transformation.

Fig.13-I is the seventh embodiment of the "F nut pair", which is on the basis of fig.11-I, let the internal threads be provided in the supporting seat, "elastically engaging element" is a compression spring, self-locking and seperating device is an eccentric cam.

Fig.13-II is the Q-Q sectional view of fig.13-I.

Fig.14-I is the eighth embodiment of the "F nut pair", which is on the basis of fig.13-I, let the internal threads be provided in te eccentric cam, "elastically engaging element is a torsion spring."

Fig.14-II is the S-S sectional view of figy.14-I.

Fig.15-I is a partial main view of overload seperating device of the semi-nut opening and closing mechanism wherein the device is of an end face friction cone type.

Fig.15-II is the A-A sectional view of fig.15-I.

Fig.16-I is a partial main view of overload seperating device of the semi-nut opening and closing mechanism wherein the device is of outward expandable friction ring type.

Fig.16-II is one of the B-B sectional views of fig.16-I, showing the structure of an outerward expandable friction ring.

Fig.16-III is the another B-B sectional view of fig.11-I, showing the structure of an inward expandable friction ring.

Fig.17-I is a partial main view of overload seperating device of the semi-nut open and closing mechanism wherein the device is of axial guiding pillar (or ball) type.

Fig.17-II is a partial main view of overload seperating device of the semi-nut opening and closing mechanism wherein the device is of radial ball (or pillar) type.

Fig.18 is a main view of the "F nut pair" of the invention when it is used

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on the practical carrier of a bench vice.

Fig.19-I is a schematic view of the embodiment of a "quick distance adjusting and positioning means" which employs the "F nut pair" of the invention and can be used for when arbitrary distance adjusting and setting is required.

Preferred embodiments of the invention

Fig.2 is the first embodiment (embodiment A) of the invention, the carrier for use of the key part "F nut pair" is a screw jack used for replacing tyre of a car as shown in fig.1. The "F nut pair" is mounted on the pivot axle O_1 at right side of the screw jack.

The screw jack comprises bottom seat 6, top support 2, four links with sector gears, left pivot axle O_2 , right pivot axle O_1 , plane bearing, screw 4 with handle 1, and "F nut pair" of the invention which is integral with the right pivot axle O_1 . The left end of the screw 4 is connected with the pivot axle O_2 and its right end threaded part is matched with the "F nut pair". When operating, the screw 4 is rotated, by means of the "F nut pair", the distance between the left and right two pivot axles O_2 and O_1 is shortened or enlarged, and the top support lifts a car up or down through the link mechanism.

Fig.2 is the main view of "F nut pair" of the invention, wherein the screw 4 is rotated in the M direction, the internal and external threads being in the normal state of engagement. This embodiment has two semi-nuts. The features

of its opening and closing actuating mechanism are: ① the elastically engaging actuating element of the semi-nut is a retractable type plate spring 12; ② the rigid self-locking element is an internal-curved type cam pair; ③ separating actuating device is an end face cam pair provided at the end face of the semi-nut.

The concrete structure of this embodiment comprises supporting seat 13, two upper and lower semi-nuts 7 and 8, retractable plate spring 12, up-and-down sleeve 11, cam guide pin 16, pawl 10, spring hoop 9, limiting stop pin 14, clamp plate 15, speed changing device 17 and the screw 4. As the carrier of "F nut pair" is a screw jack, so the supporting seat is to be connected to the pivot axle 13.1 (as Fig.6-I). The screw 4 passes through supporting hole 13.2 and the inner hole 11.1 of the up-and-down sleeve, and cooperates with the semi-nuts and their "automatically opening and closing device." The front and rear two outer side faces 7.1, 7.2, 8.1, 8.2 of the two semi-nuts 7 and 8 are in movable fit with the inner side guideway faces 13.4, 13.5 of the supporting seat; and the left and right two end faces 7.3, 8.3 and 7.8, 8.8 are in movable fit with the right and guideway face 13.3 of the supporting seat and the left end guideway face 11.4 of the up-and-down sleeve respectively. As to the "separating actuating device" of the semi-nuts, this embodiment provides end face cam grooves 7.10 and 8.10 on the right end face of the semi-nuts 7 and 8, which engage respectively with cam guide pins 16A and 16B on the left end face 11.4 of the up-and-down sleeve 11 to form the end face cam pair, i.e. the separating actuating device. The design features of cam profile of the above cam pair are as follows (take the upper semi-nut 7 as example, see fig.4-II and fig.5-II): Let the radii of the internal curved profile of the cam be maximum (R_{II}) at the right

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conner (at position II) of the cam profile, and be minimum (RI) at the left corner (at position I), the difference of the two radii is the amount to be moved outward by the semi-nut 7 when it is seperated, as shown in fig.5-II. When the cam guide pin 16A rotates with the screw 4 and the up-and-down sleeve together in the N direction from position III, throught position II to position I, the internal threads 7.9 and 8.9 of the semi-nuts 7 and 8 seperate from the external threads 4.1 of the screw 4 at once. Of course, as the up-and-down sleeve 11 rotates in N direction, its self-locking internal curved cam profile also rotates in N direction from position I to position III for awaiting orders (see fig.5-II). As to the elastically engaging actuating element of this embodiment, it is the retractable plate spring 12 rendering its slow and uniform centripedally retracting resilience to the semi-nuts softly through the curved faces 7.4 and 8.4 on the groove bottom of the semi-nuts. As to the rigid self-lacking actuating element, it is the internal curved cam profiles 11.2 and 11.3 provided on the up-and-down sleeve 11. Its working principle can be discussed as follows (take the upper semi-nut 7 as example): When the up-and-down sleeve rotates in M direction, the cam guide pin 16A will move from position I→position II→position III, thus in the up-and-down guideway, the semi-nut 7 makes centripedal elastically engaging movement in a soft landing manner under the effect of plate spring until reaching the standard engaging depth which is specified by the thread form as shown in fig.4-I. Meanwhile, the curved face 7.7 of the upper cam of the upper semi-nut 7 locates also at its lowest position, and the internal curved profile 11.2 of the cam on the up-and-down sleeve 11 has just rotated to the position I, as it makes engagement rigidly with the external curved cam profile 7.7 of the semi-nut, whereby allowing the semi-nut 7 hold with the screw without seperation even when the semi-nut 7 is subjected to heavy load during operation, and the aim of self-locking attained.

The torque to rotate the above up-and-down sleeve either in M or in N direction comes from the screw 4, it is transmitted to the up-and-down sleeve through an "automatic synchronous overload separating device" mounted on the up-and-down sleeve. The "overload separating device" comprises a pawl 10 which is mounted in a radial hole 11.6 of the up-and-down sleeve (in sliding fit), a spring hoop 9 and a keyway 4.2 on the screw 4. At the lower end of the pawl there are two ramps 10.1 whose end part could be pushed by the resilience of the spring hoop to press against the "outer periphery of the screw 4 or fall into the keyway of the screw. When the screw rotates in M direction, the side edges 4.3 of the keyway 4.2 of the screw touch with the ramps of pawl 10.1, push the pawl and up-and-down sleeve and rotate synchronously with the up-and-down sleeve in M direction, then each actuating device on the up-and-down sleeve forces the semi-nuts 7 and 8 to make "centripetal engaging movement" until the limiting stopper 15 on the up-and-down sleeve touches with the stop pin 14 on the supporting seat 13 and the rotation is stopped. Meanwhile the screw 4 still rotates in M direction so as the force exerted by the side edge 4.3 of the keyway on the pawl ramp 10.1 is increased till the upward axial component of the force is greater than the downward pressure which is exerted by the spring hoop 9 on the pawl, the ramp of pawl would be squeezed out apart from the keyway 4.3, i.e. separating under overload, and the screw could still rotate in M direction to lift the car. On the contrary, when the screw rotates in N direction, the torque would be transmitted in the same way to the up-and-down sleeve 11 through the pawl 10, cause the up-and-down sleeve rotate with the screw 4, and through each actuating device cause the semi-nut make "centrifugal movement" to force the internal and external threads to the separated (see fig.3), then the quick drop of the screw jack is realized. If it is

desired that the falling speed is to be slowed, a locking device 17 could be mounted on the supporting seat 13, this device comprises an inserting pin 17.5, a spring 17.4, a socket for inserting pin 17.3, a pin axle 17.2 and an eccentric handle 17.1, wherein the front end of the inserting pin 17 is an inserting pin tip 17.5, which is just aligned with the locking hole 11.5 in the up-and-down sleeve 11. The working principle of the locking device is as follows: when it is desired that the screw should have the functions of slow retract and slow advance (i.e. the screw jack can rise or drop in a slow way); at first, operate the handle, let the screw 4 rotate in M direction, which causes the internal and external threads to be in engagement, then let the arrow of the eccentric handle be placed in vertical direction (as shown in fig.2), meanwhile the eccentric handle 17.1 is at the position of short axis (i.e. the bottom face 17.7 of the eccentric handle 17.1 is in contact with the upper end face 17.6 of the spring seat 17.3), the inserting pin 17 could be inserted in the locking hole 11.5, and the up-and-down sleeve 11 is fixed to be incapable of rotation, thereby the internal threads of the semi-nuts 7, 8 and the external threads of the screw could be kept in engagement, this is the same as conventional screw drive mechanism, and the original functions of slow advance and slow retract are completely retained. When it is desired that the screw should have the functions of quick advance and quick retract, the eccentric handle 17.1 could be placed with its arrow in horizontal position, whereby the eccentric handle 17.1 is at the position of long axis (i.e. the side face of the eccentric handle 17.1 is in contact with the upper end face 17.6 of the spring seat 17.3), meanwhile the inserting pin tip 17.5 retracts from the locking hole 11.5 of the up-and-down sleeve 11 and the up-and-down sleeve 11 could be brought by the screw and pawl to rotate in N direction, thus the internal threads of the semi-nuts could be separated from the external threads of the screw, thereby cause

the screw to have the function of speedily passing through an idle stroke. If the carrier to be applied is a screw jack, then the quick rise or drop of that screw jack can be realized.

Fig 7-I shows the main view of the second embodiment of the "F nut pair". In this embodiment, the equivalent transformation theorem M of relative motion is applied, only the cam profiles of self-locking and separating actuating elements in fig.2 of the first embodiment are transferred to the same cam on the up-and-down sleeve, others being the same. The concrete structure is as follows: The cam guide pins 19 and 20 are mounted respectively on the right side end face of the semi-nuts 21 and 22, which are restrained to make up-and-down as well as opening and closing movements in a frame shape up-and-down guideway (such as that composed of 4 faces 23.1-23.4, see fig.7-II, or other shapes as dovetail, cylinder etc.) of the supporting seat 23. The elastically engaging actuating element of the two semi-nuts is a spring hoop 24. The post-engagement "rigid self-locking elements" are the internal curved faces 18.4 and 18.5 on the up-and-down sleeve 18 which hook up the cam guide pins 19, 20 to selflock (see fig. 7-III), the "separating actuating device" is undertaken also by an up-and-down cam profile 18.1 provided on the same up-and-down sleeve, the cam profile 18.1 with its minimum radius R_1 at 18.2 and maximum radius R_2 at 18.3 cooperates with the cam guide pins 19, 20 to form cam pairs for making the separating motion. As to the restraint of axial shift of the up-and-down sleeve 18, it is accomplished by providing bosses 19.1 and 20.1 to the end face of cam guide pins 19, 20 for resisting against the right side face 18.6 of the cam 18. Alternatively, it can be accomplished by mounting a large washer with cylindrically protruded edge or a housing to the right side end face 18.6 of the up-and-down cam 18 and securing to the supporting seat 23

(such as by welding or connecting with screw etc.) as shown in fig.8-I. As to the working procedure of engaging, self-locking and separating, since it is completely the same as the first embodiment both in operating process and in working principle, so it will not be further discussed.

Fig. 8-I is the main view of the third embodiment of the "F nut pair". The structural form of some mechanism elements of the above second embodiment in fig.7-I has only made some equivalent transformation according to the equivalent transformation theorem, such as elastically engaging element is replaced by two compression springs 25, 26, the axially anti-shift means of the up-and-down sleeve is replaced by a closed dustproof housing 28 which is connected to the supporting seat 30 by screw 29. Besides, the inserting pin tip 17.5 and the pawl 10 of speed changing means in fig.2 has combined into a new pawl rod 31. Others being the same as the second embodiment, so it will not be discussed further. But one point may be mentioned that these equivalent transformation of the third embodiment not only improve manufacturability but also also enhance its reliability, especially the new speed changing means 31 facilitates speed changing operation. The speed changing process is as follows: (1) changing into slow speed: let the screw 4 rotate in M direction, and the two semi-nuts 36, 37 are in engagement with the screw 4. Meanwhile, rotate the eccentric handle 32 to the horizontal position, and insert it into a positioning slot 33.1 of the positioning plate 33, as shown in fig. 8-II and 8-IV, whereby the lower pawl working part 31.1 of the pawl rod 31 has been lifted apart from the keyway 14.2 of the screw 4 by the eccentric handle 32, and the up-and-down sleeve 27 is also fixed by the handle 32 such that the former cannot rotate further, so the two semi-nuts and the screw are always forced into mesh, this is the same as conventional nut-screw pair, so it can only work at slow speed, (2)

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changing into quick speed: the only thing to do is to lift the handle 32 (apart from the positioning slot) as shown in fig. 8-III, whereby the pawl is released, the pawl part 31.1 can enter into the keyway 4.2 of the screw, at the time the working condition is the same as fig.3, it requires only to rotate the screw 4 in N direction, the two semi-nuts 36, 37 will soon be separated from each other.

Fig.9-1 is the fourth embodiment of the invention, whose "opening and closing actuating device" is derived on the basis of fig.2-I. The endface cam profiles 7.6 and 8.6 (see fig.4-II) which undertake the semi-nuts separating actuating device have been transferred to the outer cylindrical surface of the up-and-down sleeve 38 in fig.9-I as shown at 38.1 and 38.2, and the cam guide pins 39 which match with the cam profiles are connected with the semi-nuts 34 through link rods 40. While the ends of curved grooves 38.3 and 38.4 provided on the up-and-down sleeve 38 are used as a position limiting means for the rotation of the up-and-down sleeve. When said ends collide with the link rods 40, the rotation is limited. Others such as self locking element, elastically engaging element and their operating process, all is the same as fig.2, it needs not be further discussed.

Fig. 10 is the fifth embodiment of the invention which is derived on the basis of fig.2 only by changing the two cam profiles 8.5, 8.6, 7.5, 7.6 into two link plates 41 and 42 as in fig. 10 for the use of separating actuating element, and eliminates the cam guide pin 16A, 16B on the up-and-down sleeve 13 in fig 2. The other such as "elastically engaging actuating element" and "rigid self-locking element" are essentially identical. As to how the two link plates 41 and 42 cause the semi-nut rigidly separating, its separating mechanism is as follows: take the opening and closing of the upper semi-nut 43 as example,

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there are two pivot pins 47 and 46 inserted into the link plate 41, wherein 47 is provided on the up-and down sleeve 45, 46 is provided on the semi-nut 43, and the pivot pin hole of the link plate 41 which matches with the pivot pin 46 is an oblong groove hold 41.1. The operating process is as follows: when the up-and-down sleeve 45 rotates with the pivot pin 47 in N direction, owing to the fact that the lower end arc 41.2 of the oblong groove hole 41.4 of the link plate 41 comes into contact with the pivot pin 46, which will bring the semi-nut 43 move along the axis 43.1 to separate away. When the up-and-down sleeve rotates in M direction, owing to the fact there is a corresponding space in the upper part of the oblong groove hole 41.1 of the link plate, so that the elastically engaging movement of the semi-nut 43 caused by the spring 48 and the selflocking of the semi-nut 43 caused by the selflocking cam profile 45.1 both are not kindered. By utilizing the principle of selflocking at dead angle, i.e. the link 47 can be selflocked when the transmitting angle $\alpha=0^\circ$, the semi-nuts also can be selflocked and the selflocking cam profile can be eliminated, thus on designing, when $\alpha=0^\circ$, the upper end arc 41.3 of the elongated groove hole 41.1 is made to just contact with the pivot pin 46 of the engaged semi-nuts and the position is present by stop block.

Fig.11 is the sixth embodiment of the invention which is characterized in that there is only one semi-nut 50. In this embodiment, the "elastically engaging actuating element" is a compression spring 49, the "rigid selflocking actuating element" is an up-and-down plate 51.1 on the up-and-down sleeve 51, and the separating actuating device is a radial cam profile face 50.1 provided on the outer periphery of the semi-nut 50. When the screw rotates in M direction, the internal and external threads are in mesh. The concrete structure

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is as follows: The semi-nut 50 has its internal threads 50.2 less than a half of the periphery, a plain hole 50.3 with diameter greater than that of the screw 4, and a drop portion of cam profile 50.1 on its outer periphery. The screw 4 passes successively through left end hole 52.1 of the supporting frame 52, plain hole 50.3 of the semi-nut, hole 51.2 of the up-and-down sleeve, and right end hole 52.2 of the supporting frame. The "elastically engaging actuating element" for the semi-nut 50 is a compression spring 49. When the internal and external threads are brought in engagement, the up-and-down plate 51.1 on the up-and-down sleeve 51 rotates after the screw 4 and the up-and-down sleeve 51 and comes to the upmost position, where it is inserted in a sliding fit between an upper top face 50.4 on the outer periphery of the semi-nut 50 and an upper bottom face 52.3 of the inner cavity of the supporting frame 52, thereby achieving rigid selflocking. When the screw 4 rotates in N direction (see fig 11-III), the up-and-down sleeve 51 is brought to rotate together through the pawl 10, and the cam pair composed by the inner side face 51.3 of the up-and-down plate and the cam profile 50.1 on the outer periphery of the semi-nut 50 forces the semi-nut 50 upward, thus to separate the internal and external threads 50.3 and 4.1, until the inner side face 51.3 of the up-and-down plate collides with the lower plane 50.6 of the semi-nut 50. The above device has many ways to carry on equivalent transformation, such as the cam profile can be provided on the inner side face 51.3 of the up-and-down plate 51.1 of the up-and-down sleeve; again, the pivot axle O_1 joined with the carrier (screw jack) can be transferred to the semi-nut, as shown in fig 12-IV. In a word, there are still many variations which will not be listed up.

Fig.13-I is the seventh embodiment of the invention, which is derived on the basis of fig. 11-I by transferring the internal threads into the supporting seat.

It is characterized in that the supporting seat is a frame with a rectangular opening at its center. Internal threads 55.3, 55.4 which are less than a half of the periphery and plain holes 55.1, 55.2 with diameter greater than that of the screw 4 are provided in the left and right two side walls of the frame of supporting seat 55. There further mounted guide groove means 59, 60 (it can be mounted also on the carrier) which allow the screw 4 to move in up-and-down direction only. And an eccentric cam sleeve is mounted in movable fit between the upper and lower faces of the rectangular opening of supporting seat 55. On the eccentric cam sleeve, there retains only the drop portion of cam profile (rise portion of cam profile is omitted to avoid interfering with the engaging action of the compression spring 56). The screw 4 successively passes through the respective holes according to fig. 13-I. In this embodiment, the "elastically engaging/actuating element" is composed of a guided positioning rod 57, a compression spring 56 and a half circular curved cushion which has a half circular arc 61.1 conforming to the outer circumference of the screw, whose function is to transmit the compression force of the spring to the up-and-down moving screw 4. While the selflocking and separating actuating devices are realized by an overload separating means (as pawl 10) and a cam pair which is composed of an eccentric cam sleeve and the upper and lower parallel planes 55.5 and 55.6 of the rectangular opening of supporting seat 55.

Fig. 14-I is the eighth embodiment of the invention which is a combination of fig.11-I and fig.13-I. The internal threads are directly provided in the curved face of inner cavity of the eccentric cam sleeve 63, the structure of said inner cavity 63.1 is the same as the inner cavity of the semi-nut 50 in fig.11-I. The outer structure of the eccentric cam sleeve 63 and the rectangular opening of the supporting seat 62 are also essentially the same as fig.13-I. This

embodiment is characterized in that, the internal threads 63.2 of the eccentric cam sleeve 63 and the external threads 4.1 of the screw 4 are engaged along a direction tangent to the outer circumference of the screw (while in all the previous embodiments, the engagement proceeds along a radial direction), so the "elastically engaging actuating element" used is a torsion spring, whose one end 65.1 is connected with the eccentric cam sleeve 63 and the other end 65.2 is connected with the supporting seat 62. Pawl 67 used as overload separating means is directly provided on the eccentric cam sleeve 63.

Summarizing the above, for the "F nut pair" of the invention, many equivalent mechanisms can be used to replace these embodiments. For instance, the Archimede's spiral and face threads commonly used in the three-jaw automatically centering chuck of a lathe can be used to replace the end face cam mechanism in fig.2; again, the number of semi-nut can be one or two, or more than two. All these are within the scope of the invention, so it will not be listed one by one.

With respect to the "automatic, synchronous overload separating device" used in the invention, besides the overload separating device of fig.2 which is composed of a pawl 10 and a spring hoop 9, there are a great many of other equivalent overload separating devices. As to the form, it may be of single direction or of double direction, as to the drive manner, it may be electromagnetic, hydraulic or pneumatic, as to the overload separating element, various elements such as pawl (of single or double direction), teeth, ball, guide pillar, friction cone (disc, plate, block, cushion) and various elastic elements (such as spring, elastically expandable loop or ring, expandable sleeve) can be used. In the following, some of the equivalent overload separating devices

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derived from fig.2 are listed.

Fig.15-I, 15-II show a friction overload separating device using friction ring(or friction cone). Its working principle is as follows: A friction ring (cone) 121 is mounted in an up-and-down sleeve 3A, and slidably encloses the outer circumference of the screw 4. Friction face (cone) 121 tightly presses against the right friction face (cone) 3A.10 of the up-and-down sleeve 3A under the effect of the compression spring 122, friction ring (cone) 121 is connected to the screw 4 through a guide key 123. When the screw 4 rotates, its driving torque is transmitted through keyway 4.1, guide key 123, friction face of friction ring (cone) 121.1 to the up-and-down sleeve 3A which is brought to rotate together, until it stops when colliding with an upward stroke limiting means, but the screw will continue to rotate, meanwhile this friction pair is overloaded and slides over each other without hindering the rotation of the screw, and the screw can achieve its predetermined job. The above stated contact faces 121.1 and 3A.10 of the friction ring (cone) can be replaced by a pair of teeth which can slide over each other under the effect of a compression spring 122 when overload occurs. Of course the amount of compression deformation of the compression spring must be greater than the depth that the teeth would be inserted in.

Fig 16-I and 16-II is an overload separating device of an expandable ring with its outer circumference as friction surface. This embodiment uses an outer circumference friction expandable ring 125 in fig.16-I to replace the friction ring 121 and compression spring 122, the expandable ring is still kept by a check ring 124, and there is an axial open slot 125.1 provided on the cylindrical body of the expandable ring 125. When the expandable ring is in

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the free state, its outside diameter 125.2 is greater than the inside diameter of inner hole 3A.11 of the up-and-down sleeve 3A. When assembling, the open slot 125.1 is forced to contract, it releases after the expandable ring is inserted into the inner hole 3A.11, thus by resilience the outer circumference 125.2 of the expandable ring 125 expands and sticks on the inner wall of the inner hole 3A.11 of the up-and-down sleeve, and results a certain amount of frictional force. The inside diameter of the expandable ring is slightly greater than the outside diameter of the screw, and the former is connected to the latter through a guide key 123. Its operating process is the same as the type of friction ring in fig.15-I, the only difference is that the friction surface which can slide over at overload is transferred from the end face (or cone face) to the outer circumference of the expandable ring.

Fig.16-III is an overload separating device of the type of an expandable ring with its inner hole as friction surface. Its working principle is essentially the same as fig 16-II. Its expandable ring 126 has also an axial open slot 126.1. When in free state, the inside diameter of its inner hole is slightly smaller than the outside diameter 4.9 of the screw 4. After the screw is inserted in the inner hole, by resilience the inner hole embraces around the outer periphery of the cylinder of the screw 4 and results a certain amount of frictional force (there is no keyway on the screw). The outside diameter of the inwardly expandable ring 126 is slightly smaller than the inside diameter of the inner hole of the up-and-down sleeve 3A, the driving torque of the screw is transmitted through a transmitting pin 127 to the up-and-down sleeve 3A. The operating process is the same as fig.16-II, but that the friction surface which can slide at overload is directly undertaken by the friction surface lying between the outer circumference of the screw 4 and the inner hole of the expandable ring.

Fig. 17-I is an overload separating device of the type of axially distributed guide pillar (or steel bar). Its working principle is as follows: On the left end face of a sliding sleeve 128 which encloses around the screw 4, there are radial small holes, small compression springs 129 and guide pillar 130 (or steel ball) are fitted into the small holes, and engages with the resistant small cone pits 3A.12 which are provided on the right end face of the up-and-down sleeve 3A. The operating process is essentially the same as fig.15-1, the only difference is that, the pure end face friction in fig.15-I is changed into small cone pit resisting with guide pillar (or steel ball) in fig.17-I. The device shown in fig.17-II is the equivalent mechanism of that shown in fig 17-I, the axially arranged holes of guide pillar in fig. 17-I has been changed into radially arranged holes in fig. 17-II where 3A.13 represents an axially resistant groove.

Summarizing the above, although the carrier related is a screw jack which can quickly or slowly up or down, but the most essential nucleus of the invention is a "F nut pair". That mechanism has a wide variety of applied carrier. If the applied carrier is a screw jack, then that screw jack is a "double speed screw jack". If the applied carrier is a bench vice, then the invention is a quickly or slowly, opening or closing bench vice. For instance, fig 18 is the embodiment which uses the "F nut pair" as shown in fig 2, but the carrier is changed from a screw jack to a bench vice. The method of retrofitting really is very simple, it needs only change the connecting part between the respective carrier and the "F nut pair". e.g. the pivot axle O_1 on the supporting seat 1A in fig 2 is omitted, and the bottom plane 1A'1 and vertical plane 1A'2 on the supporting seat 1A' are utilized to directly contact with the corresponding positioning planes a_1 and a_2 on the fixed body "a" of the bench vice, and the

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screws "h" are used for fastening. While the screw 4 needs only to connect with the movable body of the bench vice, others remain unchanged. Furthermore, it is possible to derive many other devices which may be used for other purposes, e.g. fig. 19-I is derived from fig.11-1 by changing pawl 10 into a guide key 70, the speed-changing device 17 is omitted and adding a stop block 74.1 on the left outer periphery of the up-and-down sleeve, adding a positioning block 71 on the supporting seat 72, and changing over the connecting manner between the supporting seat and the carrier, while others remain the same as fig.2. Thus fig.19-I becomes a quick positioning device which employs the "F nut pair". The positioning device can be at least two methods of application: One of which is to fix the supporting seat, let the screw move in axial direction at will, once when it is positioned, rotate the screw 73 in M direction about one turn, the position can be locked soon. This can be used in a quick bench vice, it needs only adding a drive screw at the rear end of the screw to apply a clamping force; the other method is to fix the screw, in that case, the supporting seat must rotate inversely in N direction about one turn, then it can move at will, when it reaches the desired position, further rotates in M direction about one turn, the supporting seat can be locked at a certain position on the screw 73. This can be used in rigid stroke stop block where the axial force is considerably large and the axial position are frequently required to adjust.

As a summary, the applied filed i.e. the applied carrier of the "F nut pair" of the invention, besides the screw jack, it can be used further in: bench vice, machine vice, pipe vice, sliding table of machine tool, tailstock of a lathe, architectural scaffold whose height can be adjusted and all others require using screw and nut pair as drive device and constitute new mechanism, all are

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within the scope of the invention. It needs only using some common methods to change the connection with the above applied carries.



Claims

1. A quickly movable elastically engaging screw-and-nut mechanism (brief as "F nut pair" in the following) comprising screw, semi-nuts, supporting seat, opening and closing device; there provide one or more semi-nuts uniformly distributed around the cross-section of a screw which is supported by a supporting seat; the semi-nuts are located between the supporting seat and the up-and-down sleeve and are provided with an opening and closing means which can automatically rise or drop; the up-and-down sleeve is provided with an antishift means to prevent shift along the axial direction of the screw; the supporting seat comprises supporting arm (one or two), supporting hole (one or two correspondingly), supporting body (including means connected to the carrier such as pivot axle O_1), up-and-down guide member which is fitted with up-and-down sliding guideways of the semi-nuts, and position limiting member; the screw passes through the supporting hole, the semi-nuts and the up-and-down means (such as up-and-down sleeve, including axially antishift means) in a movable fit; for two or more semi-nuts, they should be arranged around the center of the screw; the semi-nuts have internal threads which extend less than a half of the periphery, sliding guideways for guiding the up-and-down movement, as well as actuating member to transmit the up-and-down force, it is characterized in that,

the "mechanically program-controlled, automatically opening and closing device for the semi-nuts" which is used to control the automatic and synchronous opening and closing motion of the semi-nuts comprises "elastically engaging actuating element" (such as spring) acting on the semi-nuts, "rigid selflocking actuating element" for rigidly selflocking the semi-nuts,

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and "seperating actuating device" (such as cam profile, link mechanism) for rigidily seperating the semi-nuts, said "automatic opening and closing device" further comrises mechanically program-controlled motion assigning actuating element (such as up-and-down sleeve), automatic, synchronous overload seperating device (such as pawl, spring hoop etc.) and upward stroke limiting device, safeguard device, and speed changing device which makes the screw to have the function of being capable to advance or retract with either quick or slow speed.

2. The screw-and-nut mechanism of claim 1, characterized in that, its "mechanically program-controlled opening and closing device for the semi-nuts" (brief as "opening and closing device" herein) has the structure as follows: the screw 4 passes through the supporting hole 13.2 and the inner hole 11.1 of the up-and-down sleeve, and cooperates with the semi-nuts and their opening and closing device, the front and rear two outer side faces 7.1, 7.2, 8.1, 8.2 of the two semi-nuts 7 and 8 are in movable fit with the inner side guideway faces 13.4 and 13.5 of the supporting seat; and the left and right two end faces 7.3, 8.3 and 7.8, 8.8 are in movable fit with the right end guideway face 13.3 of the supporting seat and the left end guideway face 11.4 of the up-and-down sleeve respectively; as to the seperating device of the semi-nuts, it provides end face cam grooves 7.10 and 8.10 on the right end faces of the semi-nuts 7 and 8, which engage respectively with cam guide pins 16A and 16B on the left end face 11.4 of the up-and-down sleeve 11 to form the end face cam pair; as to the elastically engaging actuating element, it is the retractable plate spring acting on the curved face 7.4 and 8.4 on the groove bottom of the semi-nuts and rendering its slow and uniform centripedally retracting resilience softly to the semi-nuts; as to the rigid selflocking actuating element, it is the

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internal curved cam profiles 11.2 and 11.3 provided on the up-and-down sleeve 11; when the semi-nut 7 makes centripetal elastically engaging movement in a soft landing manner under the effect of the plate spring 12 until reaching the standard engaging depth which is specified by the thread shape, the curved face 7.7 of the upper cam of the upper semi-nut 7 locates also at its lowest position, and the internal curved profile 11.2 of the cam on the up-and-down sleeve 11 has just rotated to the position I, so it makes engagement rigidly with the external curved cam profile 7.7 of the semi-nut, thus realizing the selflocking.

3. The screw-and -nut mechanism of claim 1 and 2, characterized in that, its "opening and closing device" has the structure as follows: the screw passes through the supporting hole and the inner hole of the up-and-down sleeve, and cooperates with the semi-nuts and their opening and closing device, the cam guide pins 19 and 20 are mounted respectively on the right side end face of the semi-nuts 21 and 22, which are restrained to make up-and-down as well as opening and closing movements in a frame shape up-and-down guideway (such as that composed of four faces 23.1-23.4, or other shapes as dovetail, cylinder etc.) of the supporting seat 23; the "elastically engaging actuating element" of the two semi-nuts is a spring hoop 24; the post-engagement "rigid selflocking actuating element" are the internal curved faces 18.4 and 18.5 on the up-and-down sleeve 18 which hook up the cam guide pins 19, 20; the "seperating actuating element" is undertaken also by an up-and-down cam profile 18.1 provided on the same up-and-down sleeve 18, the cam profile 18.1 with its minimum radius R_1 at 18.2 and maximum radius R_2 at 18.3 cooperates with the cam guide pins 19, 20 to form cam pairs for making the rigid seperating motion of the semi-nuts; as to the restraint of axial shift of the up-and-down sleeve 18,

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it is accomplished by providing bosses 19.1 and 20.1 to the end face of cam guide pins 19, 20 for resisting against the right side face 18.6 of the cam 18, alternatively, it can be accomplished by mounting a large washer with cylindrically protruded edge or a housing to the right side end face 18.6 of the up-and-down cam 18 and securing to the supporting seat 23 (such as by welding or connecting with screw etc.).

4. The screw-and-nut mechanism of claim 1 or 3, characterized in that, its "opening and closing device" has the structure as follows: the cam guide pins 19 and 20 are mounted respectively on the right side and face of the semi-nuts 36 and 37, but the cylindrical length of the cam guide pins is somewhat shorter than the thickness of the up-and-down sleeve 27, the semi-nuts 36 and 37 can make up-and-down sliding movement in the guideways of supporting seat 30, the elastically engaging actuating elements are two compression springs 25, 26, acting on the end parts of the semi-nuts 36, 37 respectively, the antishift means of the up-and-down sleeve is a closed dustproof housing which is connected with the supporting seat 30 by screw 29 (or by welding), the post-engagement "rigid selflocking elements" for the semi-nuts 36,37 are the internal curved faces on the up-and-down sleeve 27 which hook up the cam guide pins, the motion of the "seperating actuating device" for the semi-nuts is also accomplished by an up-and-down cam profile provided on the same up-and-down sleeve 27.

5. The screw-and-nut mechanism of claim 1 or 2, characterized in that, the elastically engaging element of the semi-nuts 43,44 is a retractable plate spring 48, the "seperating actuating device" is a link mechanism composed of two link plates 41, 42, semi-nuts, up-and-down sleeve, and link pivot pins 46,

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47, there are two pivot pins 47 and 46 on the link plate 41, wherein 47 is provided on the up-and-down sleeve 45, 46 is provided on the semi-nut 43, and the pivot pin hole of the connecting rod plate 41 which matches with the pivot pin 46 is an elongated groove hole 41.1; the operating process is as follows: when the up-and-down sleeve 45 rotates with the pivot pin 47 in N direction, owing to the fact that the lower end arc 41.2 of the elongated groove hole 41.1 of the link plate 41 comes into contact with the pivot pin 46, which will bring the semi-nut 43 move along the axis 43.1 to separate away, when the up-and-down sleeve rotates in M direction, owing to the fact that there is a corresponding space in the upper part of the elongated groove hole 41.1 of the link plate, so that the elastically engaging movement of the semi-nut 43 caused by the spring 48 and the rigid selflocking of the semi-nut 43 caused by the selflocking cam profile 45.1 both are not hindered; by utilizing the principle of selflocking at dead angle, i.e. the link 47 can be selflocked when the transmitting angle $\alpha=0^\circ$, the semi-nuts also can be selflocked and the selflocking cam profile can be eliminated, thus on designing, when $\alpha=0^\circ$, the upper end arc 41.3 of the elongated groove hole 41.1 is made to just contact with the pivot pin 46 of the engaged semi-nuts and the position is present by stop block.

6. The screw-and-nut mechanism of claim 1, characterized in that its "opening and closing device" has a structure of only one semi-nut 50, the "elastically engaging actuating element" is a compression spring 49, the "rigid selflocking element" is an up-and-down plate 51.1 on the up-and-down sleeve 51, and the "seperating actuating device" is a radial cam profile face 50.1 provided on the outer periphery of the semi-nut 50; when the screw rotates in

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M direction, the internal and external threads are in mesh, the semi-nut 50 has its internal threads 50.2 less than a half of the periphery, a plain hole 50.3 with diameter greater than that of the screw 4, and a drop portion of cam profile 50.1 on its outer periphery; the screw 4 passes successively through left end hole 52.1 of the supporting frame 52, plain hole 50.3 of the semi-nut, hole 51.2 of the up-and-down sleeve, and right end hole 50.2 of the supporting frame; the elastically engaging actuating element for the semi-nut 50 is a compression spring 49; when the internal and the external threads are brought in engagement, the up-and-down plate 51.1 on the up-and-down sleeve 51 rotates after the screw 4 and the up-and-down sleeve 51, comes to the upmost position, where it is inserted in a sliding fit between an upper top face 50.4 on the outer periphery of the semi-nut 50 and an upper bottom face 52.3 of the inner cavity of the supporting frame 52, thereby achieving rigid selflocking; when the screw 4 rotates in N direction, the up-and-down sleeve 51 is brought to rotate together through the pawl 10, and the cam pair composed by the inner side face 51.3 of the up-and-down plate and the cam profile 50.1 on the outer periphery of the semi-nut 50 forces the semi-nut 50 upward, thus to separate the internal and external threads 50.2 and 4.1, until the inner side face 51.3 of the up-and-down plate collides with the lower plain 50.6 of the semi-nut 50; the above device has many ways to carry an equivalent transformation such as the cam profile can be provided on the inner side face 51.3 of the up-and-down plate 51.1 of the up-and-down sleeve, again, the pivot axle O_1 joined with the carrier (screw jack) can be transferred to the semi-nut.

7. The screw-and-nut mechanism of claims 1 and 2, characterized in that, its "opening and closing device" has a speed changing device which can make the screw to have the function of being capable to advance or retract either in

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quick or in slow speed; the structure is as follows (take screw jack as example); there mounted on the supporting seat 13 a locking device 17 which comprises an inserting pin 17.5, a spring 17.4, a socket for inserting pin 17.3, a pin axle 17.2 and an eccentric handle 17.1, wherein the front end of the inserting pin 17 is an inserting pin tip 17.5, which is just aligned with the locking hole 11.5 in the up-and-down sleeve 11, the eccentric handle 17.1 has its short axis position and long axis position.

8. The screw-and-nut mechanism of claims 1 and 4, characterized in that, its "opening and closing device" has a speed changing device which can make the screw to have the function of being capable to advance or retract in either quick or slow speed, the structure is as follows, the inserting pin tip 17.5 of the speed changing device 17 has combined with the pawl 10 into a new pawl rod 31, (1) when changing into slow speed, let the screw 4 rotate in M direction, and the two semi-nuts 36, 37 are in engagement with the screw 4, meanwhile rotate the eccentric handle 32 to the horizontal position and insert it into a positioning slot 33.1 of the positioning plate 33, such that the two semi-nuts are always forced into mesh without separation, this is the same as conventional nut, so it can only work at slow speed, (2) when changing into quick speed, the only thing to do is to lift the handle 32 (apart from the positioning slot), whereby the pawl 10 is released, the pawl past 31.1 can enter into the keyway 4.2 of the screw, it requires only to rotate the screw 4 in N direction, the two semi-nuts will soon be separated from each other.

9. The screw-and-nut mechanism of claims 1 and 6, characterized in that, it can be used as a "quick positioning means", the up-and-down sleeve 74 is connected to the screw 73 by a guide key 70, a stop block 74.1 is added on the

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inner outer periphery of the up-and-down sleeve 74 and a positioning block 71 is added on the supporting seat 72, said positioning means has at least two methods of application, one of which is to fix the supporting seat, let the screw move in axial direction at will, once when it is positioned, rotate the screw 73 in M direction about one turn, the screw can be locked soon, this can be used in a quick bench vice, but it needs adding a drive screw at the rear end of the screw to apply clamping force; the other method is to fix the screw 73, the supporting seat 72 must rotate inversely in N direction about one turn, then it can move at will, when it reaches the desired position, further rotates in M direction about one turn, the supporting seat can be locked at a certain position on the screw 73, this can be used in rigid stroke stop block where the axial force is considerably large and the axial position are frequently required to adjust.