

[54] **EXTRACTOR HOLDDOWN APPARATUS**

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[51] Int. Cl. F16h 27/02
[58] Field of Search 74/89.15; 64/29; 339/113, 268, 339/263, 172; 279/1, 30; 269/218; 254/31, 69, 70, 73, 86, 106, 107; 192/56, 148; 81/52.4

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[57] **ABSTRACT**

An extractor holddown apparatus is disclosed for displacing and securing a unit of electronic equipment onto a rack or shelf. The apparatus includes a spindle pivotally connected to the shelf. A carriage is threadedly mounted on the spindle and is adapted to be rigidly secured to the unit of electronic equipment. The carriage is driven along the spindle to apply a translational force on the unit to move the unit rearwardly into engagement with a rear connector, and to maintain the unit in a secured position with a desired amount of force. The carriage is also forwardly driven to function as an extractor. A drive assembly for driving the carriage along the spindle includes a knob shell having a drive nut located therein. The drive nut is threadedly mounted on the spindle and is resiliently coupled to the carriage for applying an axial force thereto. Spring biased drive pins interconnect the knob shell with the drive nut and are disengageable on a given amount of force. An indicator plate is also located within the knob shell to provide a visual inspection aid to indicate whether or not the apparatus is applying the desired amount of force on the carriage. Spring-biased self-locking means also interconnect the drive nut and the spindle to prevent antirotation therebetween.

44 Claims, 5 Drawing Figures

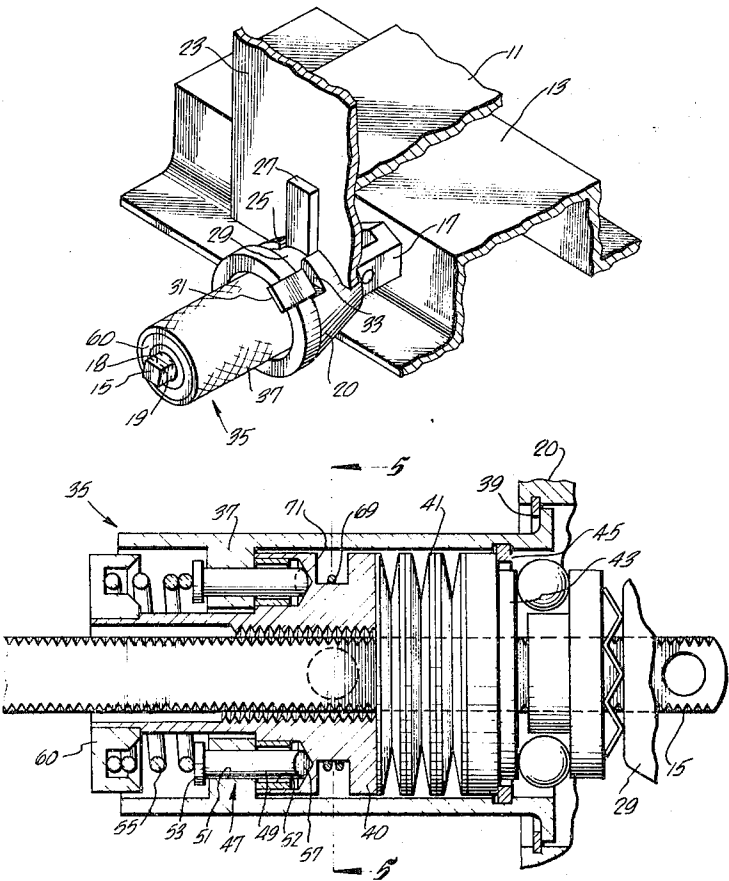


FIG 1

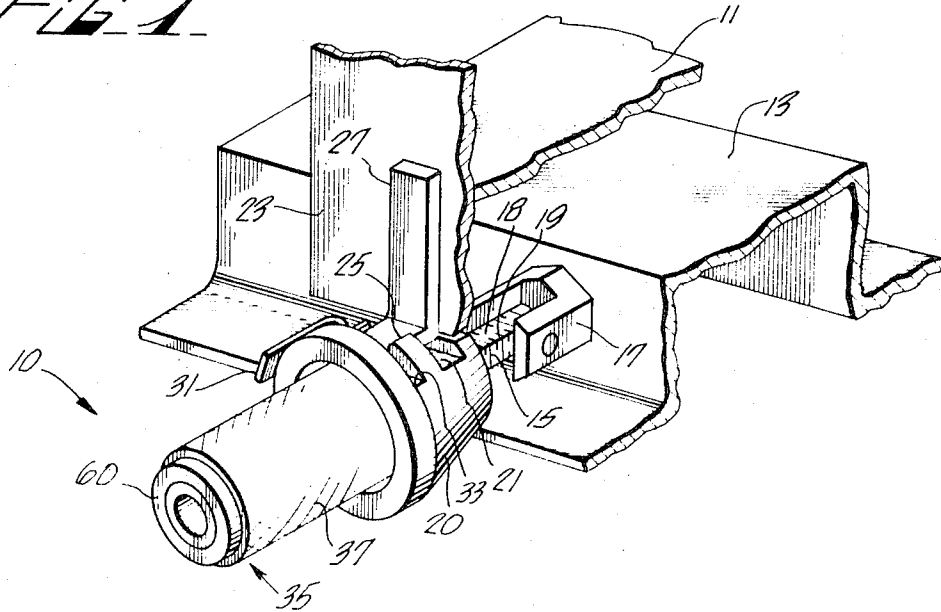
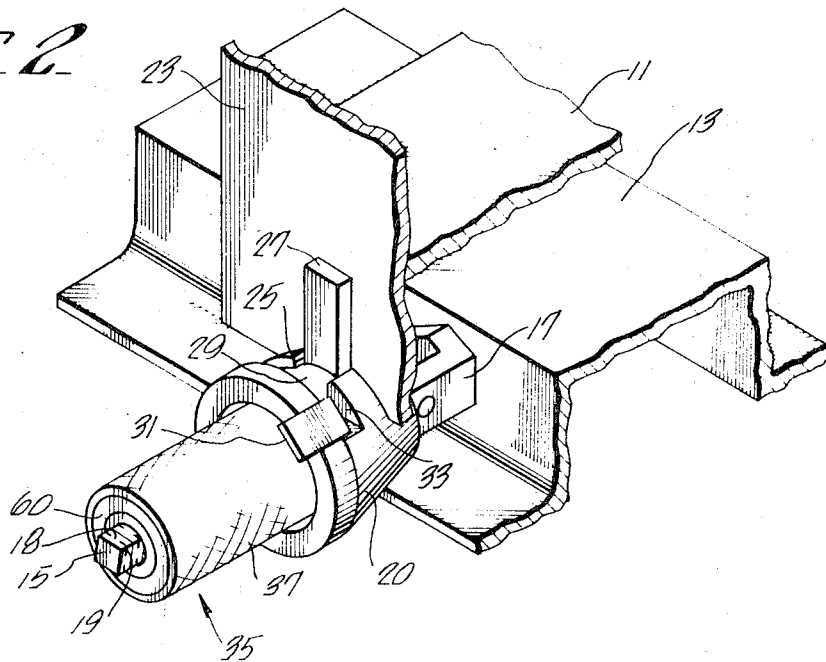
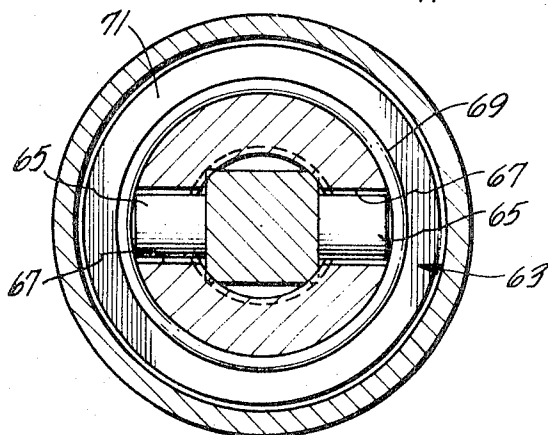
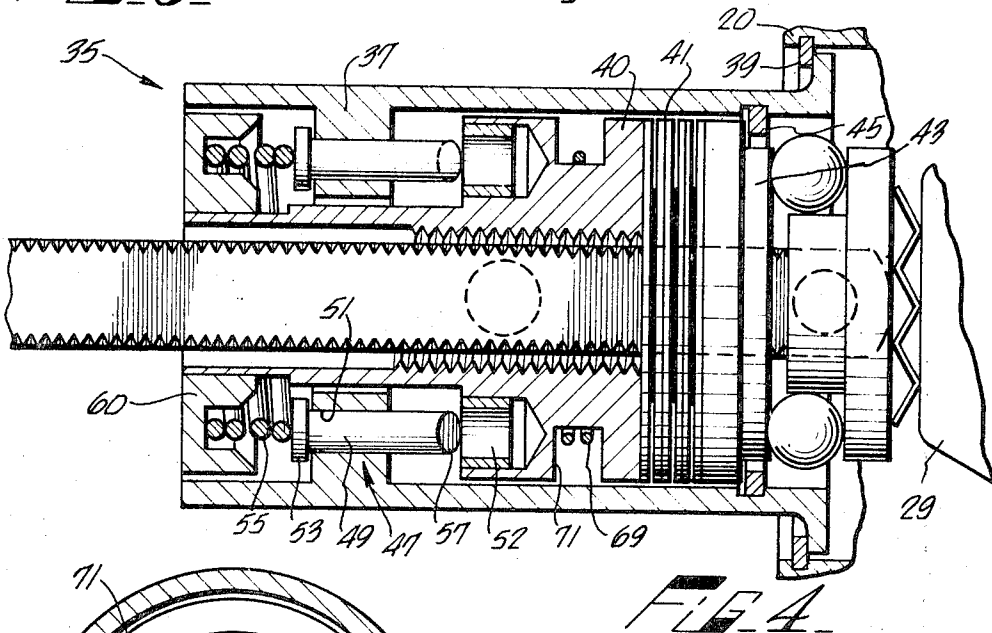
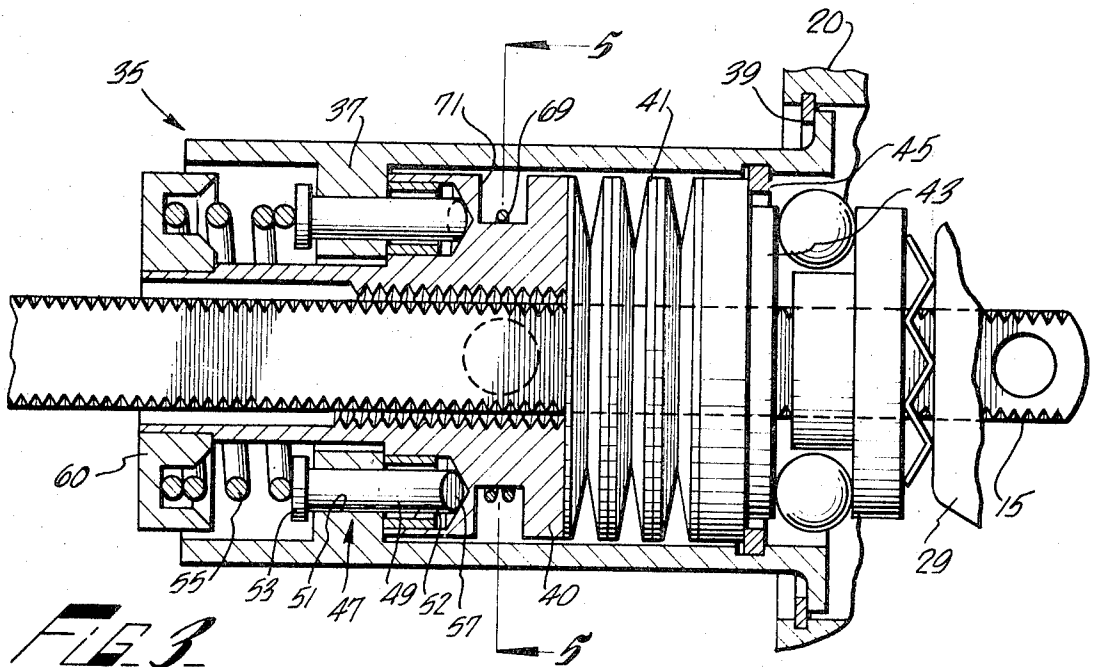


FIG 2



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EXTRACTOR HOLDDOWN APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the mounting of electronic equipment, and more particularly to means for extracting and securing units of electronic equipment onto a rack or shelf.

2. Description of the Prior Art

The development of electronic equipment support structure is vitally important for two reasons. Firstly, electronic equipment is generally very expensive and secure support means are necessary to safeguard against the destruction of such equipment. Secondly, because of the electrical connections involved in introducing the units of electronic equipment into the system, the mounting structure must be precise to insure proper alignment between the units and the connectors and to maintain the units in a secured position with the proper amount of force.

The problems involved in the utilization of support equipment become much more acute when the electronic equipment is transported on aircraft. In a typical flight, the electronic equipment is subjected to many vibratory forces which can have a deleterious effect thereon. As a result, various support structures have been developed to combat against these forces.

As a general rule, in transporting electronic equipment, the various units are supported on racks or shelves. In mounting the equipment, the units are placed on channels or rails. Each unit is electrically connected to the system at the rear thereof with an extractor being provided at the front of the unit to displace the item rearwardly with a sufficient amount of force to enable the unit to become engaged with the connectors. The unit is then secured in that position by a holddown mechanism that is rigidly attached to the shelf and is connected to the unit (usually a toe at the base thereof) to maintain a desired amount of force thereon. A conventional holddown mechanism usually includes a spindle pivotally mounted on a hinge which, in turn, is integrally connected to the shelf. A movable carriage is threadedly mounted on the spindle and is axially movable therewith. The carriage includes a bearing surface which engages the toe. The carriage is then locked in the engaged position by various means, such as setscrews, locking wires, etc.

To remove the unit from the rack the holddown mechanism is disengaged and the extractor is then operated to displace the item forwardly, out of engagement with the connector.

Although such mechanisms are used quite extensively in the aircraft industry, they still suffer from various shortcomings and problems that severely hamper their utilization. One problem encountered is that two mechanisms are required on each unit to extract and hold down the item. Since a great number of these mechanisms are required for each aircraft, a large amount of weight is involved which is undesirable.

Moreover, conventional extractors and holddown mechanisms can apply an amount of force to the units greater than desired if improperly utilized. Such a force can easily damage the units and/or their connections.

Another difficulty encountered is that there are no means on these extractors and holddown mechanisms to visually indicate whether or not the mechanisms are applying the desired amount of force on the units. Conventional mechanisms must be checked by torque indicators or other complex means which are cumbersome and impractical to use.

Another shortcoming involved with the utilization of conventional mechanisms lies with the locking means. The setscrews and locking wires are difficult to use and often work loose during the flight.

SUMMARY OF THE INVENTION

The present invention obviates the above-mentioned shortcomings by providing a novel apparatus that combines the functions of extracting and holding down in a unitary mechanism. The apparatus includes a spindle pivotally con-

nected to the shelf. A carriage is threadedly mounted on the spindle and is axially movable thereon. The carriage is adapted to be rigidly secured to a toe provided on a unit of electronic equipment to apply a translational force on the unit to move the unit rearwardly into engagement with a rear connector and to maintain the unit in a secured position with a desired amount of force. The carriage is also forwardly driven to function as an extractor. A drive assembly for rotatably driving the carriage along the spindle includes a knob shell having a drive nut located therein. The drive nut is threadedly mounted on the spindle and is resiliently coupled to the carriage by means of a plurality of bellville washers for applying an axial force thereto. Spring-biased drive pins interconnect the knob shell with the drive nut and are disengageable upon a given amount of force to prevent overloading the apparatus. A toroidal indicator plate is integrally connected to the drive nut and is axially movable therewith. The indicator includes an annular surface that extends partially out of the knob shell when no forces are applied by the drive nut. The indicator is further dimensioned to extend entirely within the knob shell when the drive nut is applying the desired amount of force on the carriage. Self-locking means are also provided to prevent antirotation of the drive nut on the spindle. The spindle has planar surfaces and the locking means includes pin means biasly connected to the drive nut which are adapted to ride over and engage the planar surfaces of the spindle to enable the drive nut to remain in the locked position at any angular position.

A primary object of the invention is to provide a novel extractor holddown apparatus that combines the functions of extracting and holding down a unit of electronic equipment in a single apparatus. Such a combination results in a great saving of weight when utilized in aircraft.

Another object of the invention is to provide a drive assembly for an extractor holddown apparatus having visual inspection means for indicating whether or not the apparatus is applying the desired amount of force on the unit.

A further object of the invention is to provide a drive assembly that is self clutching to insure against the apparatus applying too much force to the unit.

Still another object of the invention is to provide a drive assembly having self-locking means to insure against antirotation of the apparatus from the spindle.

The features of the present invention which are believed to be novel are set forth with particularly in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an extractor holddown apparatus of the present invention showing the apparatus in its open position;

FIG. 2 is a perspective view of the extractor holddown apparatus showing the apparatus in its closed or secured position;

FIG. 3 is a cross-sectional view of the drive assembly again showing the apparatus in its open position;

FIG. 4 is a cross-sectional view of the drive assembly again showing the apparatus in its closed or secured position; and

FIG. 5 is a cross-sectional view of the drive assembly taken along lines 5—5 of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, FIGS. 1 and 2 illustrate an extractor holddown apparatus, generally indicated by arrow 10, utilized for displacing and securing a unit 11 of electronic equipment onto a rack or shelf 13. Both the unit 11 and the shelf 13 are illustrated fragmentally and in no way form part of the invention.

The apparatus 10 includes a spindle 15 pivotally connected to a hinge 17 which, in turn, is integrally connected to the shelf 13. The spindle 15 is square-shaped having four intersecting planar surfaces 18 with the spindle 15 being threaded along the edges 19 formed by the intersections of these surfaces. The utilization of these planar surfaces 18 will be described more fully hereinafter with respect to FIG. 5.

The apparatus 10 further includes a carriage 20 which is adapted for engagement with the unit 11. The carriage 20 includes a transverse groove 21 formed therein for receiving the lower edge of a front wall 23 of the shelf 13. The carriage 20 also includes an axial slot 25 for receiving a toe 27 conventionally provided on units such as the one illustrated. A cup portion 29 is adapted to be pivotally mounted within the carriage 20 and includes a handle 31 integrally formed therewith extending outwardly through a transverse groove 33 formed in the carriage 20. FIG. 1 shows the cup portion 29 and the handle 31 in its open position, whereas in FIG. 2 the cup portion 29 and handle 31 are pivoted clockwise across the carriage to enable the cup portion 29 to extend over the lower extremity of the toe 27, thereby retaining the toe 27 and front wall 23 in a secured position.

The carriage 20 is adapted to be driven by a drive assembly along the spindle 15 to apply a translational force on the unit 11 to move the unit 11 rearwardly into engagement with a rear connector (not shown) and to maintain the unit in a secured position with a desired amount of force. The carriage 20 is also forwardly driven to function as an extractor.

The drive assembly, generally indicated by arrow 35, is adapted to drive the carriage 20 along the spindle 15 and includes a knob shell 37 adapted to extend into one end of the carriage 20 and is retained therein by means of a snap ring 39 (see FIGS. 3 and 4).

Referring now to FIGS. 3 and 4, the drive assembly 35 further includes a drive nut 40 threadably mounted on the spindle 15 and axially movable thereon. (It should be noted that spindle 15 is shown in elevation with its threads engaging the threads of the drive nut 40 as shown in FIG. 5.) The drive nut 40 is resiliently coupled to the carriage 20 by means of a plurality of bellville washers 41 which are located within the knob shell 37 at the rearward end of the drive nut 40. The rearward end of the bellville washers 41 is biased engaged to a bearing assembly 43 which in turn biases the cup portion 29 of the carriage 20. The bearing assembly 43 enables the bellville washers 41 to rotate with respect to the carriage 20 while still enabling the drive nut 40 to transmit a translational force therethrough to the carriage 20.

The drive nut 40 is rotatably driven by the knob shell 37 by interconnecting means, generally indicated by arrow 47. The interconnecting means 47 includes a plurality of drive pins 49 extending through a plurality of registering bores 51 and 52 formed in the knob shell 37 and drive nut 40, respectively. The forward end of the drive pins 49 is flanged at 53 with a coil spring 55 engaging the flanged ends to apply a rearward force thereto. The inner extremities of drive pins 49 are beveled at 57 in the clockwise direction of rotation of the drive nut 40 to provide automatic disengaging. The operation means will be described in greater detail hereinafter.

The apparatus 10 is also provided with a toroidal indicator plate 60 which extends over the forward end of the drive nut 40 and is integrally connected thereto. The rearward face of the plate 60 includes an annular groove formed therein to receive the forward end of the coil spring 55. The indicator plate 60 provides a visual inspection aid to indicate whether or not the desired amount of force is being applied by the drive nut 40. The operation of the indicating means will be described in detail hereinafter.

The apparatus 10 is also provided with self-locking means, generally indicated by arrow 63, and is more fully illustrated with respect to FIG. 5. The self-locking means 63 includes a plurality of pins 65 extending through a plurality of radial bores 67 formed in the drive nut 40. A coil spring 69 is located within an annular groove 71 formed in the drive nut 40 and is

adapted to engage the pins 65 to provide an inward force thereto to force the pins 65 into engagement with the planar surfaces 18 of the spindle 15.

OPERATION

The operation of the apparatus 10 will be described with respect to two positions; the open position shown in FIGS. 1 and 3, and the closed or secured position shown in FIGS. 2 and 4.

With respect to the open position, the drive nut 40 and the indicator plate 60 are positioned in such a manner that the indicator plate 60 extends out of the forward end of the knob shell 37. (See FIG. 1.) When it is desired to apply a translational force to the carriage 20, the knob shell is rotated manually in the clockwise direction. The interconnecting drive pins 49 transfer the rotational force of the knob shell 37 to the drive nut 40. During such rotation the drive nut 40 is threadably driven along the spindle 15 rearwardly in axial direction. During the initial axial movement thereof, the drive nut 40 applies a force through the bellville washers 41 to the carriage 20. During this movement, both the knob shell 37 and the drive nut 40 move rearwardly together, with the drive nut 40 driving the carriage 20 along with the unit 11 rearwardly into engagement with the rear connector. Upon engagement with the rear connector, the carriage 20 and the knob shell 37 cease to move rearwardly. However, the knob shell 37 is still rotated manually to rotatably drive the drive nut in a rearward axial direction along the spindle 15. Because of such movement, the drive nut 40 continues to apply a progressively greater force through the bellville washers 41 to the carriage 20.

As shown in FIG. 4, the drive nut continues to move rearwardly along the spindle until the drive pins approach the forward ends of the bores 52 of the drive nut 40. In this position the desired amount of translational force is applied by the apparatus 10 onto the carriage 20. It should be noted that any desired force can be applied for the same displacement of the drive nut 40 by changing the number of bellville washers 41. In the position shown in FIG. 4 a reactionary force is applied to the drive nut 40 which the drive pins 49 must overcome while driving the drive nut. However, the beveled ends 57 are dimensioned to barely contact the edges of the bores 52 and the spring 69 is calibrated to permit the pins 49, at a predetermined amount of reactive force, to slip out of the bores 52 to enable the knob shell 37 to rotate freely and to become disengaged with the drive nut 40. Any further rotation in the clockwise direction will still cause the knob shell 37 and drive nut 40 to be disengaged. In the position shown in FIGS. 2 and 4 the drive nut 40 applies a desired amount of force to the carriage 20 which, in turn, secures the unit 11 with the transmitted force, while any greater amount of applied force to the unit 11 is prevented by the clutching action of the drive pins 49.

When it is desired to extract the carriage 20 and the unit 11, the knob shell 37 is rotated in the counterclockwise direction. In this direction of rotation, the straight edges of the drive pins 49 engage the bores 52 to rotatably drive the drive nut 40 in the same direction. It should be noted a positive connection is effected, since the drive pins 49 are not beveled in the counterclockwise direction of rotation, and are driven into engagement with the bores 52 by the spring 55.

During such an operation, the indicator plate 60 moves in the axial direction, along with the drive nut 40. As a result, in the open position the plate 60 extends out of the knob shell 37 during the initial movement of both the knob shell 37 and the drive nut 40. (See FIG. 1.) However, after engagement, the drive nut 40 and the indicator plate 60 continue to move rearwardly with respect to the knob shell 37, and the indicator plate 60 is dimensioned to extend entirely within the knob shell 37 at the moment the drive pins disengage the drive nut 40 and the desired amount of translational force is applied thereby. As can be seen, such a means provides a visual in-

spection aid to the operator and at any time can indicate whether or not the apparatus is applying the desired amount of force. Such a visual inspection is conducted without the use of any tools or gauges.

The self-locking means 63 operates in such a manner that upon rotation of the drive nut 40 around the spindle 15, the pins 65 continuously engage one of the planar surfaces 18 of the spindle 15 and is held in such engagement by the spring 69. Therefore, upon rotation of the drive nut 40 the pins continuously ride over the intersecting edges 19 of the spindle 15 to engage the planar surfaces 18 thereof. The spring 69 enables the pins 65 to engage the planar surfaces 18 with sufficient force to prevent antirotation of the drive nut 40 while still permitting a greater amount of force by the operator to rotate the drive nut in the desired direction.

As can be seen, the apparatus 10 combines the functions of extracting and holding down a unit 11 in a single apparatus, which results in a great saving of weight when utilized in an aircraft. Furthermore, the clutching means of the interconnecting means 47 prevents any overloading of the unit 11 which could damage the unit 11 or its connection. The indicator means which is built into the unit is also quite advantageous in visually indicating whether or not the desired amount of applied force is exerted by the apparatus. Finally, the self-locking means does away with the cumbersome lock wiring and other means for locking the apparatus in the secured position.

It should be noted that various modifications can be made to the apparatus while still remaining within the purview of the following claims.

It should also be noted that the drive assembly 35 can be utilized to apply a translational force to any member with all of the features described therein still functioning in the same manner.

What is claimed is:

1. In an extractor-front holddown apparatus for displacing and securing a component chassis onto a rack, said rack having a spindle attached to the front end thereof, the apparatus having a carriage movable along the axis of the spindle, said carriage having means for receiving a portion of the component chassis, the improvement comprising:

drive means movably mounted on the spindle and connected to said carriage for applying a translational force to said carriage in both directions of axial movement; and means movably mounted on said carriage for securing the portion of the component chassis with said receiving means, free of any additional translational forces to said carriage.

2. The invention of claim 1 further comprising means for visually indicating that a predetermined amount of translational force is applied to said carriage.

3. The invention of claim 1 further comprising clutch means for uncoupling said drive means from said carriage upon a predetermined amount of applied translational force acting on said carriage.

4. The invention of claim 3 wherein said drive means includes a drive nut threadedly mounted on said spindle.

5. The invention of claim 4 wherein said drive means further comprises a knob shell extending over said drive nut and said clutch means comprises means for interconnecting said knob shell to said drive nut to enable said knob shell to rotatably drive said drive nut.

6. The invention of claim 5 wherein said interconnecting means further comprises spring-biased means for releasing said interconnecting means in one direction of rotation.

7. The invention of claim 6 wherein said interconnecting means includes drive pin axially positioned within axial bore means formed within said knob shell and drive nut.

8. The invention of claim 7 wherein said drive pin means are adapted to recede from the axial bores of said drive nut upon further translational movement of the drive nut with respect to said knob shell.

9. The invention of claim 8 wherein said drive pin means are resiliently mounted within said axial bores.

10. The invention of claim 9 wherein the extremities of said drive pin means located within the axial bores of said drive nuts are beveled in the direction of rotation of said drive nut.

11. The invention of claim 7 further comprising means for visually indicating that a predetermined amount of translational force is applied to said carriage.

12. The invention of claim 11 wherein said indicator means comprises an indicator plate integrally connected to said drive nut, and axially movable therewith, said plate being dimensioned to extend out of one end of said knob shell when said drive nut is applying a force on said carriage below said predetermined amount of translational force, and to extend entirely within said knob shell when the drive nut is applying a force on said carriage equal to said predetermined amount of translational force.

13. The invention of claim 3 wherein said receiving means comprises a transverse recess formed on the upper portion of said carriage.

14. The invention of claim 13 wherein said securing means comprises a cup-shaped latch pivotally mounted on said carriage and adapted to extend over the unit portion received in said recess.

15. The invention of claim 7 further comprising resilient coupling means for interconnecting said carriage and said drive nut.

16. The invention of claim 15 wherein said resilient means comprises a plurality of bellville washers located within said knob shell.

17. The invention of claim 16 further including bearing means extending between said one end of said bellville washers and said carriage to permit relative angular rotation therebetween.

18. The invention of claim 4 further including self-locking means for preventing antirotation of said drive nut with respect to said spindle.

19. The invention of claim 18 wherein said self-locking means includes:

said spindle having a plurality of intersecting planar surfaces with said spindle being threaded at said intersections; and spring-biased means connected to said drive nut and engaging said planar surfaces for applying a holding force on said planar surfaces at any angular position of said drive nut.

20. The invention of claim 19 wherein said spring-biased means includes:

a plurality of pins extending through a plurality of radial bores formed within said drive nut and engaging the planar surfaces of said spindle; and a coil spring extending around said drive nut and biasly engaging said pins to urge them into engagement with said planar surfaces.

21. In a drive assembly for an extractor-front holddown apparatus, said apparatus adapted to displace and secure a component chassis onto a rack, said rack having a spindle attached to the front end thereof, the improvement comprising:

drive means movably mounted on said spindle and connected to a driven member for applying a translational force to the driven member;

clutching means for disengaging said drive means to limit the amount of translational force that the drive means can apply to the driven member; and

indicator means coupled to said drive means for visually indicating that a predetermined amount of translational force is applied by said drive means to the driven member.

22. The invention of claim 21 further including self-locking means for preventing antirotation of said drive means with respect to said spindle.

23. The invention of claim 21 wherein said drive means includes a drive nut threadedly mounted on said spindle.

24. The invention of claim 23 wherein said drive means further includes knob shell extending over said drive nut.

25. The invention of claim 22 wherein said indicator means comprises an indicator plate integrally connected to said drive

nut and axially movable therewith, said plate being dimensioned to extend out of one end of said knob shell when said drive nut is applying a force on said carriage below said predetermined amount of translational force, and to extend entirely within said knob shell when the drive nut is applying a force on said carriage equal to said predetermined amount of translational force.

26. The invention of claim 23 wherein said resilient means includes a plurality of bellville washers located within said knob shell.

27. The invention of claim 26 further including bearing means extending between said one end of said bellville washers and said driven member to permit relative angular rotation therebetween.

29. The invention of claim 28 wherein said drive means includes a drive nut threadedly mounted on said spindle.

28. The invention of claim 21 further including clutch means for uncoupling said drive means from said driven member upon a predetermined amount of applied translational force acting on said driven member.

30. The invention of claim 29 wherein said drive means further includes:

a knob shell extending over said drive nut;
resilient coupling means interconnecting said driven member and said drive nut to provide a translational force on said driven member upon axial movement of said drive nut.

31. The invention of claim 30 wherein said clutching means includes means interconnecting said knob shell to said drive nut to enable the rotation of said knob shell to rotatably drive said drive nut.

32. The invention of claim 31 wherein said interconnecting means includes spring-biased means for enabling said interconnecting means to be releasable in one direction of rotation thereby insuring against the drive nut applying too much force to said driven member.

33. The invention of claim 32 wherein said interconnecting means includes drive pin means axially positioned within axial bore means formed within said knob shell and drive nut.

34. The invention of claim 33 wherein said drive pin means are adapted to recede from the axial bores of said drive nut upon further translational movement of the drive nut with respect to said knob shell.

35. The invention of claim 34 wherein said drive pin means are resiliently mounted within said axial bores.

36. The invention of claim 35 wherein the extremities of said drive pin means located within the axial bores of said drive nuts are beveled in the direction of rotation of said drive nut.

37. The invention in accordance with claim 22 wherein said

drive means includes a drive nut threadedly mounted on said spindle.

38. The invention of claim 37 wherein:

the spindle is adapted to have a plurality of intersecting planar surfaces with said spindle being threaded at said intersections;

said self-locking means comprising spring-biased means connected to said drive nut and engaging said planar surfaces for applying a holding force on said planar surfaces at any angular position of said drive nut.

39. The invention of claim 37 wherein said spring-biased means includes:

a plurality of pins extending through a plurality of radial bores formed within said drive nut and engaging the planar surfaces of said spindle; and

a coil spring extending around said drive nut and biasly engaging said pins to urge them into engagement with said planar surfaces.

40. In an extractor-front holddown apparatus for displacing a component chassis onto a rack, said rack having a spindle attached to the front end thereof, the apparatus having a carriage, movable along the axis of the spindle, having means for receiving a portion of the component chassis, the improvement comprising:

drive means movably mounted on said spindle and connected to said carriage for applying a translational force to said carriage in both directions of axial movement; and means for visually indicating that a predetermined amount of translational force is applied by said drive means to the driven member.

41. The invention of claim 40 further comprising clutch means for uncoupling said drive means from said carriage upon said predetermined amount of applied translational force acting on said carriage.

42. The invention of claim 14 wherein said drive means includes a drive nut threadedly mounted on said spindle.

43. The invention of claim 42 wherein said drive means further comprises a knob shell extending over said drive nut and said clutch means comprises means for interconnecting said knob shell to said drive nut to enable said knob shell to rotatably drive said drive nut.

44. The invention of claim 43 wherein said indicator means comprises an indicator plate integrally connected to said drive nut, and axially movable therewith, said plate being dimensioned to extend out of one end of said knob shell when said drive nut is applying a force on said carriage below said predetermined amount of translational force, and to extend entirely within said knob shell when the drive nut is applying a force on said carriage equal to said predetermined amount of translational force.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,640,141 Dated February 8, 1972

Inventor(s) Robert A. Hollingsead, Abraham Kuchler and Clyde Robert Pryor

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

<u>Column</u>	<u>Line</u>	
6	74	"22" should be "24"
7	8	"23" should be "25"
8	11	"37" should be "38"

Signed and sealed this 29th day of August 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Office

ROBERT GOTTSCHALK
Commissioner of Patents