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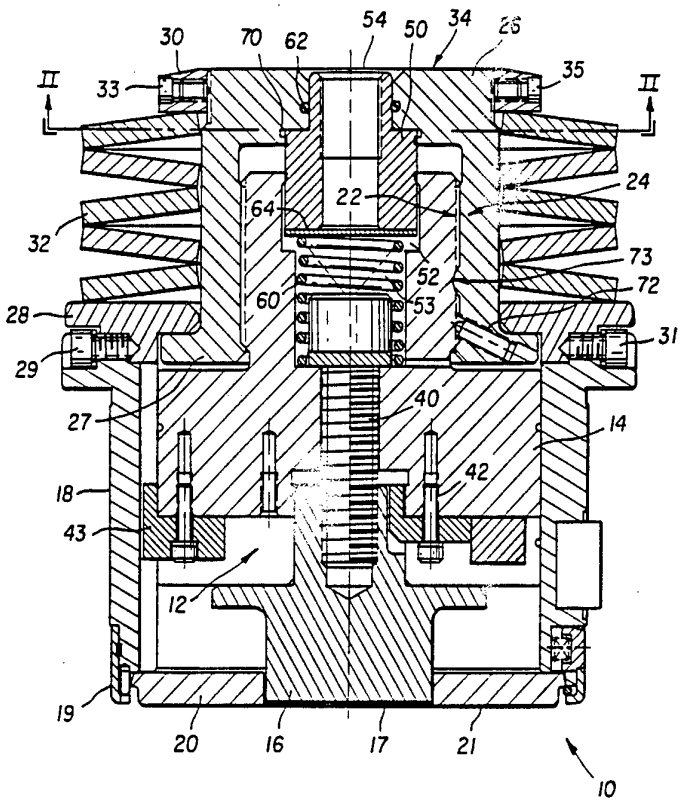
(54) Title: ADJUSTABLE LENGTH PUNCH SET ASSEMBLY

(57) Abstract

An adjustable length punch assembly for adjusting the overall length of a punch having an axial adjustable punch driver and punch holder (14) retained at least in part within a punch guide sleeve (18) and biased axially with respect thereto by a biasing spring (32), of the type including means operable in a locking position for locking the punch driver with respect to the punch holder and for preventing length adjustment. The locking means is formed and operates by a locking component having at least n locking detents (55, 57, 59, 61) formed thereon that are retained in engagement with a corresponding set of N first detent stops (55′, 57′, 59′, 61′) formed in the punch holder in both the locking and release positions and a plurality of m x n second detent stops (70) formed in the axially adjustable punch driver for providing m x n possible engageable orientations of the at least n detents (55, 57, 59, 61) with respect to the axially adjustable punch driver.



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ADJUSTABLE LENGTH PUNCH SET ASSEMBLY

BACKGROUND OF THE INVENTION

Technical Field--The invention relates generally to punch set assemblies used in punch presses, and particularly to adjustable length punch set assemblies wherein the punch may be adjusted to compensate for punch blade length reduction due to sharpening.

Description of the Prior Art--Repeated use of a punch assembly in a punch press operation results in the natural dulling and wear of the punch blade or tip. Once the tip has become dull, the effectiveness of the punch assembly is reduced and the punch tip must be sharpened. Sharpening may be accomplished by grinding the end of the punch tip, and this results in shortening the length of the blade and, consequently, the punch. The length of the punch then must be adjusted to compensate for the ground-off portion of the punch blade.

A first type of punch set assemblies that allow for length corrections are exemplified in U.S. Pat. Nos. 4,031,787 and 4,141,264. These patents disclose punch sets that compensate for the shortened punch blade length by adding shims, washers or other similar objects to the punch. The problem with this method is that the added washers or the like are usually weak and cannot withstand the constant cyclical forces placed upon a punch. Also, the length of the punch tip can only be adjusted within certain limits before it becomes too short for effective operation, thereby limiting the number of times the punch tip can be sharpened. In addition, most such methods that allow for the adjustment of the length of the punch tip require dismantling of the entire punch in order to access the punch tip for adjustment; this obviously can be a rather time-consuming process. Additionally, once the punch has been reassembled, further effort is frequently expended in determining how much the sharpening and adjusting steps have affected the axial position of the tip with reference to the plane of the stripper plate opening that it extends through in use.

Improvements on these known methods are described in commonly assigned U.S. Pat. No. 4,375,774 and in co-pending U.S. Pat. Appln. Serial No. 743,689 filed August 12, 1992. In the '774 patent and the '689 application, the punch driver and punch holder or body components of the punch are attached by mutually engageable threaded portions so that overall punch length adjustment may be accomplished by rotation of the threaded portions so that the punch tip may be properly aligned with the opening in the stripper plate. Locking mechanisms are provided in each case. In the '774 patent, an expandable locking pin is inserted into aligned locking pin holes wherein it interferes with and prevents rotation of the threaded portions. While simplifying the axial length adjustment process, this approach requires removal and re-insertion of the locking pin.

In the '689 application, the assembled punch is axially slidably received within a bore provided in a punch guide. A releasable lock for locking the threaded ends against relative rotation is provided by an arcuate wire clip having a radially inwardly extending cam pin. The arcuate clip is retained in an annular groove and radially inwardly extending bore in the punch holder so that the cam pin extends inwardly and into engagement with a set of circumferentially distributed grooves in the male threaded end of the punch body. Length adjustment in either direction is provided by rotating the punch body with respect to the punch holder so that the cam tip is released from one groove and engages a further groove. Such adjustable length punch sets are useful for relatively small diameter punch sets.

An adjustable length forming tool head is disclosed in U.S. Pat. No. 5,020,407 which discloses a length adjustment in the threaded connection between the punch driver and the punch head base which in turn is attached to a form tool body. A length control ring member is spring biased away from and between the driver and the base and is formed with a central opening for engaging the shaft of the driver to prevent their relative rotation and a set of circumferentially spaced apertures for engaging a pair of pins extending from the base. Adjustment is accomplished by grasping the ring member and driver to withdraw the ring member from engagement with the pins and to rotate them

until the next desired set of diametrically opposed apertures is aligned with the pins.

Since the form tool does not have a punch set spring encircling the punch head, it is possible to grasp the ring member and make the length adjustment. Such an arrangement would not be useable in punch sets having a punch spring encircling the punch head, driver and holder components of the type disclosed in the above referenced patents and application.

A need exists, therefore, for an accurate means of adjusting the length of the punch in a manner that is not overly time consuming or difficult.

SUMMARY OF THE INVENTION

It is thus an object of the present invention to provide a readily adjustable punch set assembly for use in a punch press that may be manipulated manually without the use of tools and provide a fine, high resolution, reliable length adjustment particularly for use in heavy duty wide body punch sets.

In accordance with one aspect of the present invention, an adjustable length punch set assembly is provided for adjusting the overall length of a punch having first and second axially adjustable punch components and retained at least in part within a punch guide sleeve and biased axially with respect thereto by a biasing spring of the type including means for locking said first punch component with respect to said second punch component and for preventing length adjustment by relative movement of said first and second punch components in a locking position thereof and for allowing relative movement of said first and second punch component in a release position thereof, said locking means further comprising a locking component having at least one locking detent formed thereon; means for retaining said at least one detent in engagement with a corresponding first detent stop means formed in said first punch component in both said locking and release positions of said locking component; a plurality of second detent stop means in said second axially adjustable punch component for providing a plurality of possible engageable orientations of said at least one detent with respect to said second axially adjustable component; biasing means for biasing said at least one detent of said locking component in locking engagement with one of said second detent stop means formed in said second component; and means for applying force against said biasing means for releasing said at least one detent of said locking component from engagement with said selected second detent stop means

formed in said second component and allowing movement of said locking component to the release position and allowing relative axially adjustment of said first and second punch components to thereby adjust the length thereof.

In the preferred embodiment of the present invention, the length control mechanism comprises an adjustable push button and a biasing spring mounted within a cavity formed within the threaded portions of the punch driver and punch holder, a thumb access hole formed axially within the capped head of the punch driver and extending into the cavity and formed with a plurality **m** *x* **n** detent stops equally spaced in a circle around the periphery of the through-hole, the adjustable push button block having a circular portion adapted to extend into the through-hole to allow relative rotation of the adjusting push button and the punch driver and a block-shaped portion having a plurality of edges and shoulders forming **n** detents configured to engage with a set **N'** of the **m** *x* **n**

detent stops of the punch driver under the force applied by the biasing spring. In use, the locking mechanism prevents the relative rotation of the threaded portions of the punch driver and punch holder unless the operator manually depresses the circular portion to depress the adjusting push button block-shaped portion and release its shoulders from engagement with the detent stops formed within the punch driver, whereupon the punch driver may be rotated to thread it further onto or off from the threaded portion of the punch holder thereby decreasing or increasing the overall length of the punch.

The punch blade attached to the punch holder extends through a stripper plate attached to the punch sleeve (which in turn typically, slidably engages with the punch holder and the punch driver against the biasing force of a punch spring), so that the operator may observe the distance by which the punch blade extends through an opening in the stripper plate and thereby adjust the punch length until the punch blade is properly axially aligned with the plane of the opening in the stripper plate that the punch blade or tip extends through.

In accordance with the present invention, the length adjusting mechanism is readily accessed directly through the punch driver capped head so that it is unnecessary to remove the punch spring or any other components of a heavy duty, wide body punch set in order to make the length adjustment.

The present invention thus provides such a readily adjustable, reliable punch set assembly for use in a punch press.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects advantages and features of the present invention will become apparent from the following detailed description of the preferred embodiments thereof taken in conjunction with the drawings in which:

FIGURE 1 is an axial, partial cross-sectional view of a punch set assembly of the present invention;

FIGURE 2 is an exploded, perspective view of the adjustable length mechanism of the present invention implemented in a preferred embodiment thereof;

FIGURES 3A-3C are top plan, side cross-section, and bottom plan views of the adjusting length push button lock employed in the punch set assembly of the preferred embodiment of the present invention;

FIGURE 4 is a top plan view of the punch holder of the punch set assembly of FIGURE 1; and

FIGURE 5 is a cross-section view taken along lines II-II of the punch driver depicted in FIGURE 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The principles of this invention relate to the workings of a punch set that comprises a punch sleeve, an internally disposed punch body having a punch blade or tip, a punch holder attached to or formed integrally with the punch body, a stripper plate having an opening for the punch blade or tip formed integrally with the punch sleeve or attached thereto, a punch driver attached to the punch holder and a punch spring for biasing the punch driver away from the punch sleeve and attendant and related parts which form the punch set assembly. Accordingly, the invention is appropriate for the numerous applications concerning punch presses, including, but not limited to, single station and turret presses.

A preferred embodiment of a punch set assembly 10 of the present invention is exemplified in the drawings as comprising a punch holder 14 and a replaceable punch blade 16 (together referenced as punch 12) disposed centrally within a punch

sleeve 18, wherein the punch blade 16 extends through an opening 17 in a stripper plate 20. The punch holder 14 has a threaded male portion 22 extending upward and screwed into engagement with a threaded female portion 24 of punch driver 26. A spring support ring 28 and an annular spring retaining nut 30 retain the spring 32 encircling the punch driver 26. The spring support ring 28 is attached by cap screws 29 and 31 to the punch sleeve 18 and bears against the flange 27 of the punch driver 26 to retain it and the spring 32 in the position depicted in FIGURE 1. The threaded retaining nut 30 is locked from rotating about punch driver 26 by a further pair of cap screws 33 and 35.

As can be seen in FIGURE 1, the punch blade 16 is attached to the punch holder 14 by a relatively large hex head cap screw 40 threaded axially into a threaded bore of punch blade 16. A keyway and guide assembly 42 is provided to lock the punch blade 16 from rotating on the cap screw 40 as is conventional in the art. A further conventional elongated slot and keyway assembly 43 guides the assembled punch's reciprocal movement within the sleeve 18. The stripper plate 20 is removably attached to the sleeve 18 by a retaining cap assembly 19 in a manner described more completely in the above-referenced Serial No. (Atty. Docket No. 1650-67). The female and male threaded portions 24 and 22 of the punch driver 26 and punch holder 14 may be unlocked and rotated with respect to one another to lengthen or shorten the axial punch 12 length in a manner to be described.

In a punching operation, a ram (not shown) strikes downwardly on the capped head 34 of the punch driver 26, compressing the compression spring 32 and urging the punch 12 components downwardly until the punch blade 16 protrudes below the lower face 21 of the stripper plate 20. The protruding punch blade 16 passes through a workpiece (not shown) of a sheet material and into a die casting (not shown) to punch an item out of the workpiece having the desired shape. The punch assembly is adaptable to a variety of punch blade shapes attached by cap screw 40 and matching stripper plates 20 depending upon the shape desired to be removed from the workpiece.

The ram is then retracted, releasing the compressive force on the spring 32. The spring 32 then acts against the retaining nut 30, which it abuts, to draw the punch driver 26 and attached punch 12 upward. When the punch blade 16 is retracted

upwardly through the aperture 17 in the stripper plate 20, it engages the workpiece, which often sticks to the retreating punch blade 16, and separates it from the punch blade 16.

In particular regard to the length adjustment mechanism of the present invention, the male threaded portion 22 is sized to be matingly received within the female threaded portion 24, and the threads on the male and female portions are adapted to matingly engage one another. As the punch driver 26 and spring 32 are rotated with respect to the punch holder 14, the punch 12 will move axially with respect to the punch driver 26 as long as the length adjustment mechanism does not lock the punch driver 26 to the punch holder 14. If the pitch of the mating threads is known, the relationship between the degree of relative rotation of these members and the resultant axial movement can be readily determined. Thus, the overall length of the punch can be precisely adjusted by axially rotating the punch driver 26 and spring 32 with respect to the punch holder 14 through a known angle, depending on the resolution of the locking mechanism.

In the preferred embodiment of the present invention, the mating threads of the male and female portions 22 and 24 are cut at a 1/10th inch pitch which translates axially to a lengthening or shortening of 0.100 inches per complete 360° revolution

The length adjustment mechanism of the present invention comprises the adjusting length push button 50 that is fitted into an axially elongated cavity 52 extending from a through-hole 54 in the cap surface 34 of the punch driver 26 into the interior of the threaded portion 22 of the punch holder 14, a biasing spring 60 and retaining washer 61 fitted into an extension 53' of the cavity 52, and an O-ring 62 in a groove in the through-hole 54, all as shown and described in relation to the remaining figures. Generally, the adjusting length push button 50 is seated in the extension 53' of cavity 52 such that it cannot be rotated with respect to the punch holder 14 and biased by the spring 60 into engagement with a set of detent stops 70 formed in the interior surface of the punch driver 26 to lock the punch driver 26 to the punch holder 14 to prevent the relative rotation of the threaded portions 22 and 24.

Generally, when it is desired to rotate portions 22 and 24 to adjust the length of the punch 12, the operator removes the sleeve 18 and attached stripper plate 20 by unscrewing cap screws 29 and 31. Usually then the punch 16 is either replaced

or is dressed to resharpen or shape the blade. Then, the operator depresses the adjusting length push button 50 extending through the hole 54 to release it from engagement with the detent stops formed in the punch driver 26 while simultaneously rotating the punch driver 26 and the spring 32 with respect to the punch holder 14. The specific elements of the locking mechanism that enable the adjustment are as follows.

Turning now to FIGURE 2, it depicts in an exploded perspective view the relation of the component parts of the length adjustment mechanism of the present invention depicted in FIGURE 1. In FIGURE 2, it may be seen that the adjusting length push button element 50 comprises a circular button portion 51 that extends through the circular hole 54 in the punch driver 26 and a square block 53 having four corners 55, 57, 59 and 61. The circular button portion 51 slides axially under thumb pressure against an O-ring 62 fitted into groove 63 in the hole 54 and encircling the button portion 51.

The four corners 55, 57, 59, 61 of the push button 50 act as detents that are adapted to engage with a set of four of the twenty-four detent stops 70 in the top interior surface 27 adjacent to the hole 54 of the punch driver 26 (also shown in FIGURE 5) and engage the four detent stops 55', 57', 59', and 61' formed within the extension 53' of the cavity 52 formed axially in the punch holder 14. The bottom surface of the square block 53 bears against a retaining washer 61 and the biasing spring 60 which in turn bears against an interior surface of the extension 53' of the cavity 52. The washer 61, when fitted into the extension 53' against spring 60, retains spring 60 partially compressed.

Referring now to FIGURES 3A-3C, they depict in top, side cross-section, and bottom views the shape of the push button 50. The corners 55, 57, 59, and 61 are slightly squared as depicted in FIGURE 3C in order to deburr the sharp edges to avoid catching on the detent stops.

Turning now to FIGURE 4, it depicts a top view of the punch holder 14 particularly showing the squared corners or detent stops 55', 57', 59', and 61' of the interior surface adapted to engage with and receive the detents 55, 57, 59 and 61 of the adjusting length push button 50. Thus, when the push button 50 is seated in the

extension 53 of the cavity 52 as shown in FIGURE 1, it cannot rotate with respect to the punch holder 14.

Referring now to FIGURE 5, it depicts, in a cross-section view taken long lines II-II in FIGURE 1, the interior surface of the punch driver 26 and particularly the plurality of detent stops 70 arranged circumferentially around the hole 24 and against which the corners 55, 57, 59 and 61 rest in the position depicted in FIGURE 1. In this embodiment, twenty-four (**m** x **n**) detent stops 70 are shown which provide **m** x **n** possible positions in which the four (N) corner detents of the adjusting length push button 50 may reside in a single complete 360 ° rotation of the punch driver 26 with respect to the punch holder 14. In other words, the punch driver may be rotated in 360°/ (**n** x **m**) or, in this example, 15° increments by the provision of the twenty-four separate positions afforded by the twenty-four detent stops 70. With the 1/10th inch pitch, this works out to an axial incremental length resolution of 0.100 inches/24 or about 0.004 inches per 15° rotation from one set to the next adjacent set of four (N') detent stops 70.

In practice, the punch set assembly 10 is used to punch items having a desired shape from a larger workpiece in a manner well known in the art. After the punch blade has worn and become dull due to repeatedly striking a workpiece, the punch assembly is removed from its turret or machine for sharpening and the sleeve 18 is removed as described above. After sharpening, the length of the punch is shortened by whatever length was ground off. To compensate for this lost length, the push button 50 is depressed and the punch driver 26 is rotated with respect to the punch holder 14. The proper axial spacing of the punch blade 16 to the plane of the opening 17 in the stripper plate 20 can be counted off is 0.004 inch increments, and the push button released so that it is again locked as described above. The actual resulting length may be measured before re-assembly of the sleeve 18.

Referring back to FIGURE 1, a spring loaded detent button 72 is provided in the flange 27 of the punch driver 26 that locks into a notch cut in the male threaded portion 22 of the punch holder 14 after the punch has been shortened severely in order to prevent the continued use of a completely worn down punch 16.

While a preferred embodiment of the present invention has been described, it should be understood that various changes, adaptation and modifications may be

made therein without departing from the spirit of the invention and the scope of the appended claims.

WHAT IS CLAIMED IS:

1. An adjustable length punch set assembly for adjusting the overall length of a punch having first and second axially adjustable punch components and retained at least in part within a punch guide sleeve and biased axially with respect thereto by a biasing spring of the type including means for locking said first punch component with respect to said second punch component and for preventing length adjustment by relative movement of said first and second punch components in a locking position thereof and for allowing relative movement of said first and second punch component in a release position thereof, said locking means further comprising:

a locking component having at least one locking detent formed thereon;

means for retaining said at least one detent in engagement with a corresponding first detent stop means formed in said first punch component in both said locking and release positions of said locking component;

a plurality of second detent stop means in said second axially adjustable punch component for providing a plurality of possible engageable orientations of said at least one detent with respect to said second axially adjustable component;

biasing means for biasing said at least one detent of said locking component in locking engagement with one of said second detent stop means formed in said second component; and

means for applying force against said biasing means for releasing said at least one detent of said locking component from engagement with said selected second detent stop means formed in said second component and allowing movement of said locking component to the release position and allowing relative axially adjustment of said first and second punch components to thereby adjust the length thereof.

2. The adjustable length punch set assembly of Claim 1 wherein:

the first and second axially adjustable punch components comprise a punch holder and a punch driver, respectively, each having mutually engageable threaded portions allowing length adjustment of said punch by rotation of the threaded portions with respect to one another; and

the locking means is retained in a cavity formed axially within the threaded portions of the punch driver and punch holder and is movable axially within the cavity between the locking position and the release position by the application of force to a portion of the locking component.

3. The adjustable length punch set assembly of Claim 2 wherein:

the cavity is formed in the punch driver with a through-hole extending through the punch driver to allow access for the application of force to the locking component and with a plurality of second detent stops formed circumferentially around said through-hole in an evenly spaced circular pattern.

4. The adjustable length punch set assembly of Claim 3 wherein:

the cavity formed in the punch holder comprises a lesser plurality of first detent stops arranged circumferentially around the periphery of the cavity in a circular pattern whereby the lesser plurality of first detent stops may be aligned with a selected subset of the greater plurality of second detent stops formed in the punch driver by relative rotation of the threaded portions of the punch driver and punch holder.

5. The adjustable length punch set assembly of Claim 4 wherein:

the locking component has a plurality of detents corresponding in number and position to the plurality of first detent stops formed in the punch holder and is adapted to be fit with its detents engaging the detent stops in the cavity in the punch driver while in the locking position thereof.

6. The adjustable length punch set assembly of Claim 5 wherein:

the biasing means comprises a spring element fitted within the cavity formed within the threaded portion of the punch driver for applying biasing force against the locking component fitted therein and directing the detents of the locking component into engagement with a selected set of the plurality of second detent stops formed in the punch driver.

7. The adjustable length punch set assembly of Claim 6 wherein:

the portion of the locking component extending through the through-hole of said punch driver is manually engageable for moving said blocking component detents out of engagement with the selected set of detent stops of the punch driver and into the release position for allowing relative rotation of the threaded portion of the punch driver with respect to the threaded portion of the punch holder.

8. The adjustable length punch assembly of Claim 7 wherein:

the locking component is formed of a first section shaped to fit through the through-hole in the punch driver and a second section formed with **n** detents on its periphery;

the cavity of the punch holder is formed in a shape with **N** detent stops formed therein for slidably retaining the biasing spring element and the second portion of the locking component; and

the cavity of the punch driver is formed with the plurality **m x n** of second detent stops arranged circumferentially around the through-hole and shaped to receive the **n** detents of the second portion of the locking component in a number of radial positions thereof.

9. The adjustable length punch assembly of Claim 3 wherein:

the locking component is formed of a first section shaped to fit through the through-hole in the punch driver and a second section formed with **n** detents on its periphery;

the cavity of the punch holder is formed in a shape with **N** detent stops formed therein for slidably retaining the biasing spring element and the second portion of the locking component; and

the cavity of the punch driver is formed with the plurality **m x n** of second detent stops arranged circumferentially around the through-hole and shaped to receive the **n** detents of the second portion of the locking component in a number of radial positions thereof.

10. The adjustable length punch set assembly of Claim 9 wherein:

the locking component is adapted to be fit with its **n** detents engaging the **N** detent stops in the cavity in the punch holder while in both the locking position and the release position thereof.

11. The adjustable length punch set assembly of Claim 10 wherein:

the biasing means comprises a spring element fitted within the cavity formed within the threaded portion of the punch holder for applying biasing force against the locking component fitted therein and directing the **n** detents of the locking component into engagement with a selected set **N'** of the plurality of **m** *x* **n** second detent stops formed in the punch driver.

12. The adjustable length punch set assembly of Claim 11 wherein:

the portion of the locking component extending through the through-hole of said punch driver is manually engageable for moving the **n** locking component detents out of engagement with the selected set **N'** of the plurality of **m** *x* **n** second detent stops of the punch driver and into the release position for allowing relative rotation of the threaded portion of the punch driver with respect to the threaded portion of the punch holder.

13. The adjustable length punch set assembly of Claim 1 wherein:

the first and second axially adjustable punch components comprise an axially disposed cavity formed therein; and

the locking means is retained in the cavity and is movable axially within the cavity between the locking position and the release position by the application of force to a portion of the locking component.

14. The adjustable length punch set assembly of Claim 13 wherein:

the cavity is formed in the second component with a through-hole to allow access for the application of force to the locking component and with a plurality of second detent stops formed circumferentially around the through-hole in an evenly spaced circular pattern.

15. The adjustable length punch set assembly of Claim 14 wherein:

the cavity formed in the punch holder comprises a lesser plurality of first detent stops arranged circumferentially around the periphery of the cavity in a circular pattern whereby the lesser plurality of first detent stops may be aligned with a selected subset of the greater plurality of second detent stops formed in the punch driver by relative rotation of the threaded portions of the punch driver and punch holder.

16. The adjustable length punch set assembly of Claim 15 wherein:

the locking component has a plurality of detents corresponding in number and position to the plurality of first detent stops formed in the first component and is adapted to be fit with its detents engaging the detent stops in the cavity in the first component while in both the locking position and the release position thereof.

17. The adjustable length punch set assembly of Claim 16 wherein:

the biasing means comprises a spring element fitted within the cavity formed within the first component for applying biasing force against the locking component fitted therein and directing the detents of the locking component into engagement with a selected set of the plurality of second detent stops formed in the second component.

18. The adjustable length punch set assembly of Claim 17 wherein:

the portion of the locking component extending through the through-hole of the second component is manually engageable for moving the blocking component detents out of engagement with the selected set of detent stops of the second punch component and into the release position for allowing relative rotation of the first punch component with respect to the second punch component.

19. The adjustable length punch assembly of Claim 18 wherein:

the locking component is formed of a first section shaped to fit through the through-hole in the second punch component and a second section formed with **n** detents on its periphery;

the cavity of the first punch component is formed in a shape with **N** detent stops formed therein for slidably retaining the biasing spring element and the second portion of the locking component; and

the cavity of the second punch component is formed with the plurality **m** *x* **n** second detent stops arranged circumferentially around the through-hole and shaped to receive the **n** detents of the second portion of the locking component in a number of radial positions thereof.

20. The adjustable length punch assembly of Claim 14 wherein:

the locking component is formed of a first section shaped to fit through the through-hole in the second punch component and a second section formed with **n** detents on its periphery;

the cavity of the first punch component is formed in a shape with **N** detent stops formed therein for slidably retaining the biasing spring element and the second portion of the locking component; and

the cavity of the second punch component is formed with the plurality **m** *x* **n** second detent stops arranged circumferentially around the through-hole and shaped to receive the **n** detents of the second portion of the locking component in a number of radial positions thereof.

21. The adjustable length punch set assembly of Claim 20 wherein:

the manually engageable locking component is adapted to be fit with its **n** detents engaging the **N** detent stops in the cavity in the second punch component while in both the locking and the release positions thereof;

the biasing means comprises a spring element fitted within the cavity formed within the first punch portion for applying biasing force against the locking component fitted therein and directing the **n** detents of the locking component into engagement with a selected set **N'** of the plurality of **m** *x* **n** second detent stops formed in the second punch component; and

the portion of the locking component extending through the through-hole of the second punch component is manually engageable for moving the **n** blocking component detents out of engagement with the selected set **N'** of the plurality of **m x n** second detent stops and into the release position for allowing relative axial lengthening or shortening of the punch by movement of the first and second punch components with respect to one another.

AMENDED CLAIMS

[received by the International Bureau on 15 February 1994 (15.02.94); original claims 1-21 replaced by amended claims 1-10 (4 pages)]

1. An adjustable length punch assembly permitting length adjustment without disassembly thereof, the punch assembly comprising:

(a) a punch driver having a hole formed axially therein and containing at least one detent stop;

(b) a punch holder carried by the punch driver and axially adjustable with respect to the punch driver, the punch holder having at least one detent stop;

(c) push button locking means having at least one detent, the push button locking means being positioned axially within and for access through the hole of the punch driver with the at least one detent being engageable with the detent stops of the punch driver and punch holder, the push button locking means being axially movable between a first position in which the at least one detent engages the detent stops of both the punch driver and punch holder to prevent axial movement therebetween, and a second position in which the at least one detent disengages one or the other of said detent stops to enable axial movement of the punch holder with respect to the punch driver; and

(d) biasing means for biasing the push button locking means into the first position.

2. An adjustable length punch assembly permitting the adjustment of its overall length without disassembly, the punch assembly comprising:

(a) a punch driver having a hole formed axially therein, and containing at least one first detent stop;

(b) a punch holder carried by the punch driver, the punch holder and punch driver each having mutually engageable threaded portions thereon permitting axial adjustment therebetween of one of the threaded portions with respect to the other, the punch holder having a cavity formed axially therein and aligned with the hole in the punch driver and having at least one second detent stop;

(c) push button locking means having at least one detent, the push button locking means being positioned axially within the cavity in the punch holder and accessible through the hole in the punch driver with the at least one detent being engageable with the detent stops of the punch driver and punch holder, the push button locking means being axially movable between a first position in which the at least one detent engages the detent stops of both the punch driver and punch holder to prevent relative rotation therebetween, and a second position in which the at least one detent disengages one or the other of said detent stops to enable relative rotation of the punch holder with respect to the punch driver; and

(d) biasing means for biasing the push button locking means into the first position.

3. The adjustable length punch assembly of Claim 2, wherein the punch driver includes a plurality of first detent stops formed circumferentially around the hole formed axially therein.

4. The adjustable length punch assembly of Claim 2, wherein the punch holder includes a plurality of second detent stops formed circumferentially around the cavity formed axially therein.

5. The adjustable length punch assembly of Claim 2, wherein the punch driver and punch holder each include a plurality of detent stops formed circumferentially about the hole and cavity respectively.

6. The adjustable length punch assembly of Claim 5, wherein the number of the plurality of second detent stops is less than the number of the plurality of first detent stops, the number of the first detent stops being an integer multiple of the second detent stops, and the number of second detent stops being alignable with a like number of first detent stops by rotating the punch driver and punch holder with respect to each other.

7. The adjustable length punch assembly of Claim 6, wherein the push button locking means comprises a plurality of detents corresponding in number and position to the plurality of second detent stops formed in the punch holder, the

plurality of detents of the push button means being engageable with a like number of first detents formed in the punch driver while in the said first position.

8. The adjustable length punch assembly of Claim 2, wherein the biasing means comprises a spring positioned within the cavity formed axially in the punch holder, the spring urging the push button locking means into the first said position.

9. The adjustable length punch assembly of Claim 2, wherein a portion of the push button locking means extends through the hole of the punch driver allowing an external force to depress the spring moving the push button locking means into the second said position.

10. An adjustable length punch assembly permitting length adjustment without disassembly thereof, the punch assembly comprising:

(a) a punch driver having a hole formed axially therein and containing a plurality of first detent stops formed circumferentially about the hole;

(b) a punch holder carried by the punch driver, the punch holder and punch driver each having mutually engageable threaded portions thereon permitting axial length adjustment by rotating the threaded portions with respect to each other, the punch holder having a cavity formed axially therein and aligned with the hole in the punch driver and having a plurality of second detent stops formed circumferentially about the cavity, wherein the number of the plurality of second detent stops is less than the number of the plurality of first detent stops, the number of the first detent stops being an integer multiple of the number of second detent stops, and the number of second detent stops being alignable with a like number of first detent stops by rotating the punch driver and punch holder;

(c) a push button locking means having a plurality of detents corresponding in number and position to the plurality of second detent stops formed in the punch holder, the push button means being positioned axially within the cavity of the punch holder and accessible through the hole of the punch driver with the plurality of detents being engageable with a like number of detent stops of the punch driver and punch holder, the push button locking means being axially moveable

between a first position in which the plurality of detents engages a like number of detent stops of both the punch driver and the punch holder to prevent axial movement therebetween, and a second position in which the plurality of detents disengages one or the other of said detent stops to enable axial movement of the punch holder with respect to the punch driver;

(d) a spring positioned with the cavity formed axially in the punch holder, the spring urging the push button locking means into the first said position, and being depressible by an external force applied through the hole in the punch driver to the push button locking means thereby moving the push button means into the said second position.

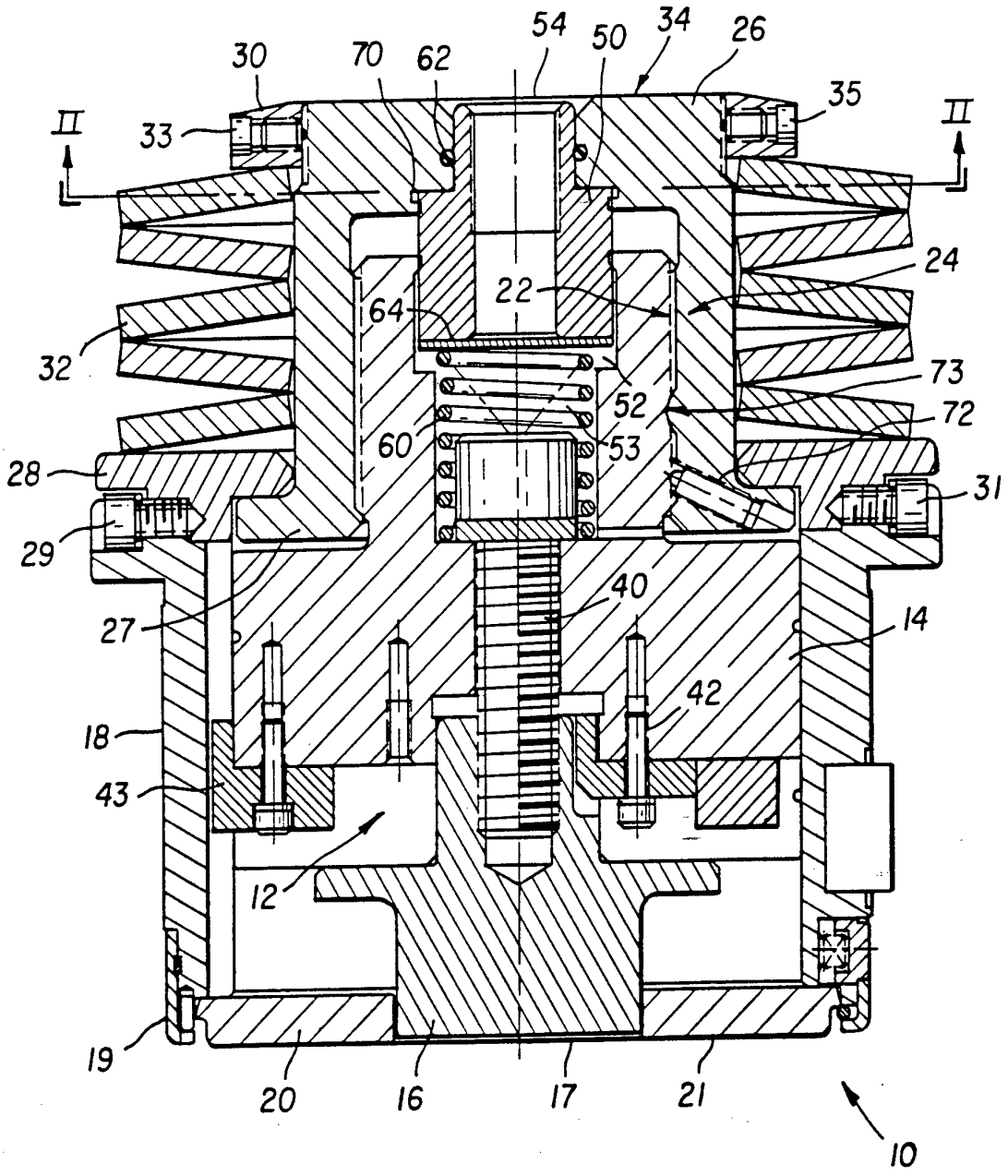
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FIG. 1

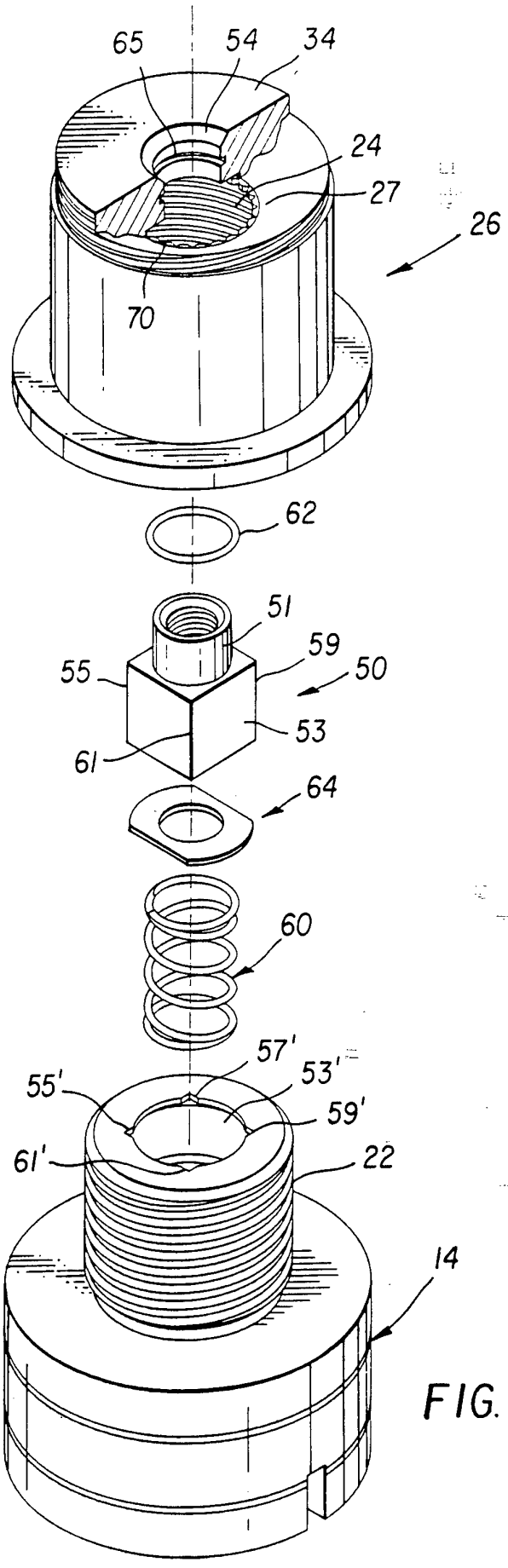

FIG. 2

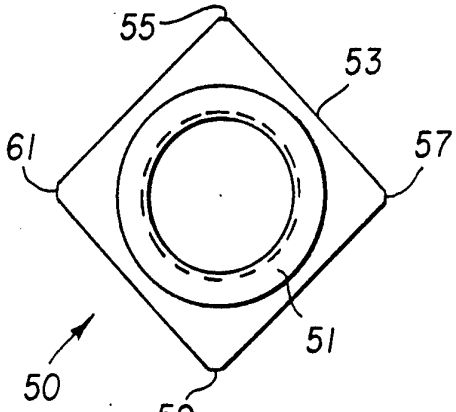

FIG. 3A

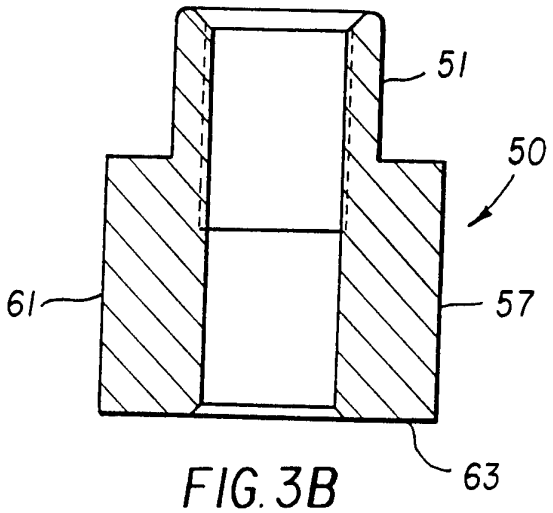

FIG. 3B

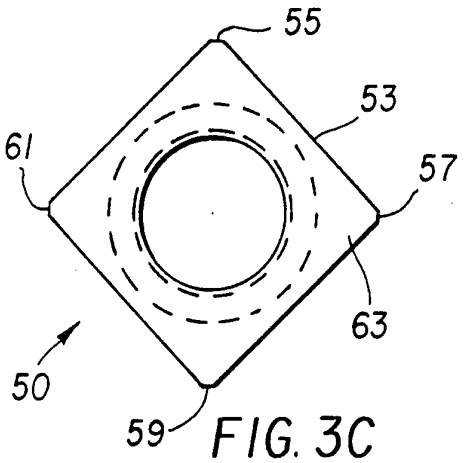

FIG. 3C

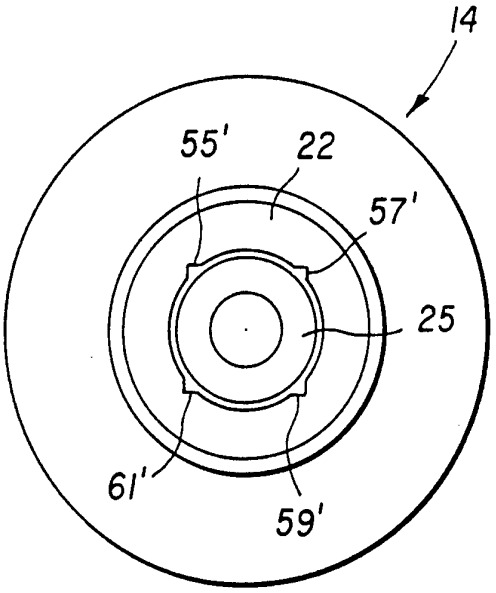

FIG. 4

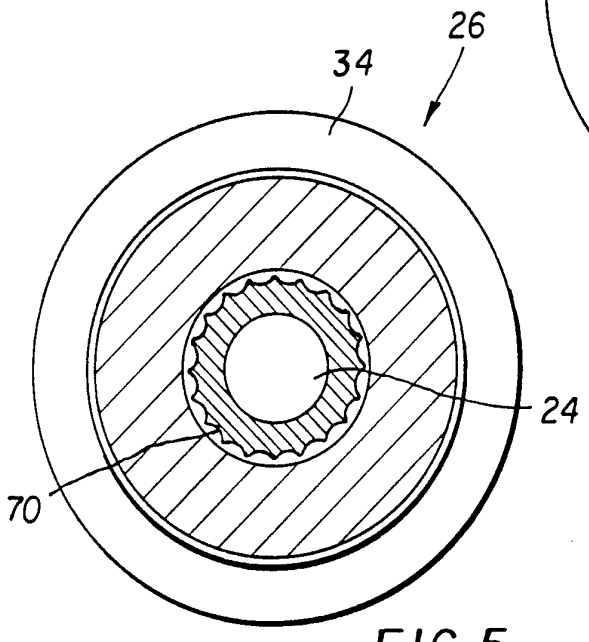

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/09551

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B26F 1/14
US CL :83/686, 700

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 83/684, 699

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5020407 (BRINLEE) 04 June 1991, entire document.	1
Y	US, A, 4375774 (WILSON ET AL) 08 Mar. 1983, figure 1	1
A	US, A, 3848496 (STEVENS ET AL) 19 Nov. 1974	
A	U , A, 3926082 (VON LANGEDORFF) 16 Dec. 1975	
A	US, A, 4012975 (LALONE) 22 Mar. 1977	
A	US, A, 4031787 (CADY) 28 Jun. 1977	
A	US, A, 4141264 (WEISBECK) 27 Feb 1979	
A	US, A, 4440052 (WEISBECK) 03 April 1984	

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 09 November 1993	Date of mailing of the international search report 21 DEC 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer Laura Dorsey for KENNETH E. PETERSON Telephone No. (703) 308-2186

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/09551

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5054347 (JOHNSON et al.) 08 October 1991	