Oct. 29, 1968 A. F. WEISS 3,407,710

STROKE ADJUSTMENT MEANS FOR CYLINDER AND PISTON ASSEMBLY

Filed Dec. 14, 1966

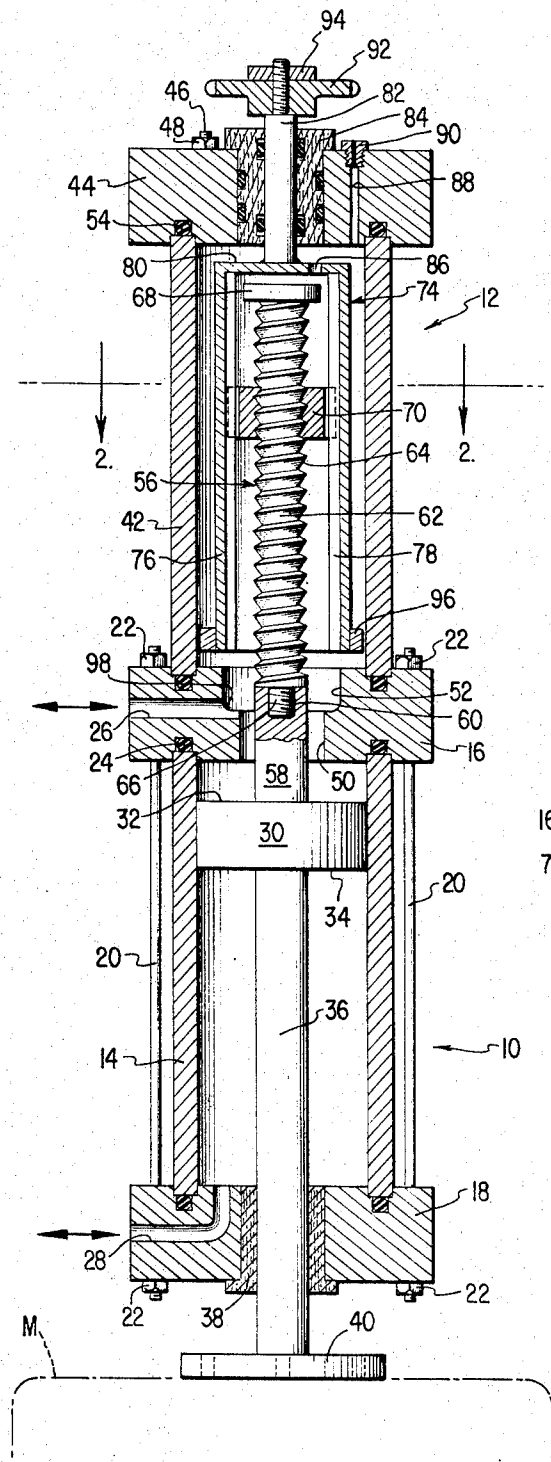
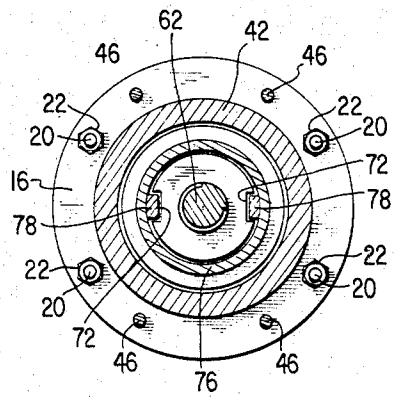



FIG. 1

FIG. 2




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United States Patent Office 3,407,710
Patented Oct. 29, 1968



3,407,710

# STROKE ADJUSTMENT MEANS FOR CYLINDER AND PISTON ASSEMBLY

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Filed Dec. 14, 1966, Ser. No. 601,791
10 Claims. (Cl. 92—13)

## ABSTRACT OF THE DISCLOSURE

A stroke adjusting means for a hydraulic cylinder and piston assembly which includes a casing coupled to the cylinder and communicating with the interior thereof to receive the pressurized hydraulic fluid. A threaded shaft is disposed within the casing and is connected to the piston for movement therewith. A nut is carried by the threaded shaft and a sleeve means is engaged with the nut to normally prevent rotation thereof but to permit the nut to move axially in the casing as the threaded shaft moves. The nut contacts against a stop means to limit the stroke of the cylinder and piston assembly. By rotating the sleeve means, the axial position of the nut along the threaded shaft can be varied to thereby vary the stroke of the assembly.

This invention relates to a stroke adjustment means for a cylinder and piston assembly and more particularly it relates to a positive mechanical stroke stop means whose position can be selectively adjusted to vary the stroke of a hydraulic assembly and of a member operated or moved thereby.

The present invention finds particular utility in hydraulic presses which are used for compacting operations. In a press of this type, either a powder or slurry material is introduced into a die cavity and a pair of cooperating and relatively moving punches or tool members compact the material to form a particular pressed article. A common type of hydraulic press utilizes a bottom punch or tool which is fixed in position and an upper punch or tool which is mounted on a platen which in turn is operated by a hydraulic cylinder and piston assembly. The material to be compacted is introduced into a die cavity between the tools or punches and the upper punch is thereafter lowered through operation of the hydraulic cylinder and piston assembly to properly compact the material in the die cavity and to form the finished article. The degree of movement of the upper tool or punch therefore determines the height of the article being pressed and the amount of density or compaction thereof, and as a result, it is important that this degree of movement be very accurately controlled.

There have, in the prior art, been proposals and attempts to entirely dispense with a stroke adjusting mechanism and to merely use shims or the like to control the height of the article being pressed. This, however, was found to be a rather crude and inaccurate system involving long periods of trial and error. There have also been various suggestions to use some type of a stroke adjusting device for the purpose described hereinabove, but such prior art stroke adjusting devices have not been found to be wholly satisfactory. For example, one suggestion was to place adjustable stop means in the form of elongated screws or the like on the upper platen, but again this was a coarse type of adjustment device and it failed to take into account platen deflection under load. Another example of a prior art stroke adjusting device utilized limit switch signals which controlled a hydraulic flow arrangement to and from the cylinder and piston assembly, but again this system was not accurate enough for precision compacting of articles.

By far the most common type of prior art stroke adjusting device, and one which has heretofore been used with some success, is a mechanical stop means coupled to the piston itself. That is, in the conventional cylinder and piston assembly, the piston rod extends between the piston and the platen to be moved. To form a mechanical stroke stop for this arrangement, an auxiliary rod would extend from the other face of the piston and would carry a stop nut or the like at the outer end thereof. One disadvantage which has been found with this system is that the length of the auxiliary rod between the piston and the maximum adjusted position of the stop nut must be at least equal to the length of the cylinder. Then, the threaded portion at the outboard end of the auxiliary rod along which the stop nut can be adjusted, must be somewhat substantial in length, and as a result, to use a stop arrangement of this type, the overall assembly was approximately triple the normal cylinder length. Naturally, this meant that if the assembly was mounted on the top of a hydraulic press, extra clearance space had to be provided and the adjustment had to be accomplished quite high above the machine. However, another and perhaps even more serious disadvantage resided in the fact that the provision of the auxiliary rod changed the effective surface area of the piston. That is, the normal piston is circular in cross-section and hence has a circular face of a preselected area upon which the pressure can act to move the piston rod and the attached platen. However, when the auxiliary rod is attached to this circular piston face, the effective surface area thereof is converted from a circular shape to an annular shape. Therefore, to get the same force output acting upon the platen, it is necessary to increase the bore of the cylinder until the surface area of the annulus is the same as the surface area of the circular piston would have been before the auxiliary rod was connected thereto. The larger the bore of a cylinder becomes, the more expensive the cylinder and piston assembly is, and as a result, it is desirable to utilize the minimum cylinder bore consistent with the forces desired to be produced.

As a result of the foregoing consideration, it will be appreciated that prior art attempts to provide an adjustable stop means for limiting the stroke on a hydraulic press have not been altogether satisfactory. One of the principal objects of the present invention is to overcome the difficulties and deficiencies associated with such prior art forms of stroke adjusting devices and to provide in their stead, a new and improved stroke adjusting mechanism. However, it should be appreciated that the principles of the present invention are in no way limited to stroke adjusting devices which are useful on hydraulic presses, but instead, are applicable to any situation wherein the stroke of a hydraulic unit is to be selectively adjusted.

Another object of the present invention is to provide a stroke adjustment mechanism which operates in a simple and efficient manner and which can be easily controlled, yet which is highly accurate and reliable.

Another object of the present invention is to provide a stroke adjusting device which can readily be adapted to already existing cylinder and piston assemblies without the need for increasing the bore size of the cylinder and without decreasing the effective forces exerted thereby.

Another object of the present invention is to provide a stroke adjusting device which is particularly adapted for use on a hydraulic press for compacting materials and which can very accurately and reliably control the degree of compaction of such materials, while assuring that the tools or punches utilized in such a press cannot inadvertently crush against one another, even in the total absence of a supply of material.

Other objects, advantages and salient features of the present invention will become apparent from the follow-

ing detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment thereof.

Referring to the drawings:

FIGURE 1 is a longitudinal sectional view of the stroke adjusting means of the present invention in combination with a conventional hydraulic cylinder and piston assembly; and

FIGURE 2 is a transverse sectional view taken substantially along the line 2—2 of FIGURE 1.

In accordance with the principles of the present invention, and as shown in FIGURE 1, there is provided a hydraulic unit in the form of a conventional hydraulic cylinder and piston assembly generally designated **10** and a control means or stroke adjusting means generally designated **12** for selectively adjusting the stroke of the assembly **10**.

The conventional cylinder and piston assembly **10** includes an elongated cylinder body **14** having a pair of opposed end members **16** and **18**. A series of spaced tie rods **20** extend through the end members **16** and **18** and when the nuts **22** at the outer ends of these tie rods are tightened, they tend to draw the end members **16** and **18** toward one another. Suitable sealing means, such as O-rings **24** or the like, can be utilized to prevent any leakage from occurring between the cylinder body **14** and the end members.

The end member **16** is provided with a hydraulic port **26** and the end member **18** is provided with a similar hydraulic port **28**. These hydraulic ports are adapted to be connected through suitable piping or the like which forms no part of the present invention, to a source of pressurized fluid. This pressurized fluid, which can be any suitable form of hydraulic fluid, is introduced through the ports to the interior of the cylinder body **14**. Flow through the ports **26** and **28** is reversible, as indicated by the arrows juxtaposed thereto.

A piston **30** is disposed within the cylinder and includes a pair of opposed substantially parallel faces **32** and **34**. The maximum position which the piston can be moved is from a position whereat the face **32** contacts the end member **16** to an opposite position whereat the face **34** contacts the end member **18**. The total amount of this movement is regarded as the stroke of the assembly **10**.

A piston rod **36** is affixed to the face **34** of the piston and extends or projects beyond the end member **18** through a central opening formed therein. A suitable sealing means, such as a bushing **38** or the like, is mounted in this opening in the end member **18** to prevent the hydraulic fluid in the cylinder from leaking therepast. The piston rod **36** can carry at its outboard end, an enlarged plate or flange **40** which is provided with suitable bolt holes. Thus, any member to be moved can be suitably attached to this plate. As designated in phantom lines in FIGURE 1, a suitable member M in the form of a platen or the like can be attached thereto. It will thus be appreciated that any increment of movement of the piston **30** within the cylinder will cause a corresponding increment of movement of the member M. Hence, as the stroke or degree of movement of the piston **30** is selectively varied, the degree of movement of the member M is likewise varied. When the movement of the piston **30** is stopped, the movement of the member M is likewise stopped.

Referring now to the stroke adjusting means **12**, it will be seen that the same includes a casing **42** coupled with the cylinder and piston assembly **10**. Specifically, the casing can be attached between the end member **16** and still another end member **44**, and suitable tie rod means **46** can be utilized to connect the two together. When the nuts **48** at the end of these tie rods **46** are tightened, the end member **44** is drawn toward the end member **16** and the casing **42** is firmly maintained in position. An enlarged bore **50** and counterbore **52** extend through the end member **16** so that the interior of the cylinder **14** communicates



with the interior of the casing **42**. Thus, the hydraulic cylinder supply through the port **26** not only flows into the cylinder **14** but also flows into and fills the interior of the casing **42**. Suitable sealing means, such as O-rings **54** or the like, are utilized to prevent such fluid from leaking between the casing **42** and the end members **16** and **44**.

A threaded shaft means generally designated **56** is disposed within the casing **42** and is coupled to the face **32** of the piston **30**. In the form shown in FIGURE 1, the means **56** includes a small unthreaded stub shaft **58** affixed to the face **32** of the piston and having a threaded recess **60** at the outer end thereof. The threaded shaft itself includes an axially elongated shaft means **62** carrying screw threads **64** on the exterior thereof, and a reduced diameter portion **66** at one end thereof which threads into the recess **60**. The opposite end of the shaft **62** can carry a flat end plate **68**. The diameter of the stub shaft **58** and the threaded shaft **62** is less than the diameter of the bore **50** so that the same will not interrupt fluid cross flow between the casing **42** and the cylinder **14**. However, by providing the expedient of a separate threaded shaft **62** and stub shaft **58**, it is possible to use various different types of threaded shafts **62** having different screw threads **64** thereon. In the preferred embodiment of the invention, the screw threads **64** are of the buttress type arranged to transmit power unidirectionally toward the piston **30**.

A nut **70** is mounted upon the threaded shaft **62** and is movable axially therealong when such nut and shaft are rotated relatively to one another. That is, as can be seen, the nut **70** is provided with a buttress threaded internal bore which cooperates and meshes in interengagement with the screw threads **64** on the shaft **62**. The nut **70** includes at least one opening means therein, and in the illustrated form of invention, as can best be seen in FIGURE 2, is provided with two slots or channels **72** along the periphery thereof.

The control means **12** further includes a nut engaging means disposed within the casing **42** and generally designated **74**. This nut engaging means includes an axially elongated sleeve **76** disposed in surrounding relationship to the threaded shaft **62**. The sleeve **76** carries a pair of internal ribs **78** which extend along the length thereof, and as will be seen in FIGURE 2, such ribs **78** fit within the channels **72** in the nut **70**. The fit between the channels **72** and the ribs **78** is a relatively loose one which permits the nut to be reciprocated or moved axially relative to the sleeve, but which prevents rotation of the nut **70** relative to the sleeve **76**.

The sleeve **76** also includes an end face **80** disposed adjacent the end face **68** on the threaded shaft **62** but in spaced relation thereto. The nut engaging means **74** further includes a projecting portion in the form of a shaft **82** which projects through the end member **44** and beyond. A suitable seal means in the form of a housing **84** having various sealing rings surrounds the shaft **82** as the same extends through the end member **44**. In this manner, the hydraulic fluid is prevented from leaking through the end member **44**. To assure a complete circulation of hydraulic fluid within the casing **42**, both interiorly and exteriorly of the sleeve **76**, an air vent **86** is provided in the face **80** of the sleeve, a similar air vent **88** is provided in the end member **44**, and an air vent plug **90** is mounted therewithin. Thus, any air trapped within the control means **12** will be expelled.

To continue with the description of the adjusting means portion of the nut engaging means **74**, the projecting shaft **82** has a reduced diameter portion upon which a suitable sprocket **92** is mounted. This sprocket is held in position by means of a locking nut **94**. Although not shown, this sprocket can be engaged with a conventional chain drive which can be operated by means of a hand wheel or the like. It will, of course, be appreciated that rotation of the sprocket **92** by the chain drive will in turn effect a rotation of the sleeve **76**. Finally, it will be seen that a collar **96** is mounted on the lower end

of the sleeve **76** for the purpose of preventing the sleeve from tilting or otherwise canting within the casing.

With the aforementioned description in mind, the operation of the present invention can now be described. It will, of course, be appreciated that the nut **70** serves as the adjustable stop element. The position of this nut axially along the length of the threaded shaft **62** is adjusted through operation of a nut engaging means. Specifically, the sprocket **92** is suitable rotated to effect a concurrent rotation of the sleeve **76**. As the sleeve rotates about the threaded shaft **62**, the ribs **78** in engagement with the nut **70** cause the nut to be likewise rotated. Such relative rotation between the nut and the threaded shaft causes the nut to move axially along the shaft, either upwardly or downwardly, as desired. When the nut finally reaches the selected axial location along the threaded shaft **62**, rotation of the sprocket **92** is terminated and rotation of the sleeve **76** is likewise terminated. Then, hydraulic fluid can be introduced through the port **26** to move a piston **30** within the cylinder **14**. It will be understood and appreciated that the pressure of such hydraulic fluid acts upon the face **32** of the piston which is annular in formation due to the presence of the stub shaft **58**, but it likewise acts upon the end **68** of the threaded shaft. Hence, the total fluid pressure applied is equal to the cross-sectional area of the piston **30**, and as such pressure is applied, the piston starts to move downwardly in the embodiment illustrated in FIGURE 1. As such piston moves downwardly, the threaded shaft **62** moves axially and the nut **70** carried thereby likewise moves axially. Since the only engagement between the nut **70** and the nut engaging means **74** is the rib and channel engagement best illustrated in FIGURE 2, axial movement of the nut is not prevented. Thus, such nut will move downward until it contacts a stop means against which it abuts. In the illustrated form of invention, the stop means is the shoulder **98** of the counterbore **52**. When the nut abuts against that surface, further axial movement is prevented, and accordingly, movement of the cylinder and piston assembly is stopped.

It will, of course, be appreciated that other suitable forms of stop means can be utilized. The only purpose for providing the counterbore **52** is to reduce the total excess height needed for the stop adjusting means **12**. If desired, such counterbore can be entirely eliminated so that the nut **70** would abut against the level top surface of the end member **16**. In fact, if desired, an inwardly projecting flange could be provided from the casing **42** itself, with such flange extending beneath the lower end of the sleeve **76**. In such event, this flange would serve as the stop means against which the nut **70** abuts. It will also be seen and appreciated that in the preferred form of embodiment of the invention, the piston rod **36**, the threaded shaft means **56** and the projecting shaft **82** for the adjusting means are all coaxially aligned.

After reading the foregoing detailed description, it will be apparent that the objects set forth at the outset of the specification have been successfully achieved by the present invention. Accordingly, what is claimed is:

**1.** In the combination of (1) a hydraulic unit including a cylinder means, a piston movably mounted within said cylinder means and a piston rod coupled with one face of said piston and adapted to be connected with a member to be moved, the movement of said member being controlled by the stroke of said hydraulic unit, and (2) a control means for adjusting the stroke of said hydraulic unit; the improvement in said control means comprising:

a casing coupled with said cylinder means and communicating with the interior thereof whereby hydraulic fluid introduced into said cylinder means will likewise be introduced into said casing;

a threaded shaft disposed within said fluid in said casing and coupled with said piston rod;

said face coupled with said piston rod;

a nut mounted upon said threaded shaft and being movable axially therealong through relative rotation between said nut and said threaded shaft;

nut engaging means disposed within said fluid in said casing and engaged with said nut to normally prevent rotation thereof while permitting axial movement thereof as said threaded shaft is axially moved due to movement of said piston;

said nut engaging means including adjusting means for rotating said nut engaging means and for thereby rotating said nut to adjust the position thereof axially along said threaded shaft; and,

stop means interposed in the path of axial movement of said nut whereby, when said nut abuts thereagainst, further axial movement of said threaded shaft is prevented and hence the movement of said piston and piston rod is terminated;

said abutting of said nut against said stop means thereby limiting the stroke of said hydraulic unit and the axial position of said nut along said threaded shaft serving to adjust said stroke.

**2.** The improvement defined in claim **1** wherein said nut engaging means includes a sleeve means rotatably mounted within said casing.

**3.** The improvement defined in claim **2** wherein said sleeve means surrounds said threaded shaft and said nut and includes at least one portion engageable with said nut.

**4.** The improvement defined in claim **3** wherein said nut includes at least opening means therein and wherein said portion is disposed within said opening means.

**5.** The improvement defined in claim **4** wherein said opening means is a groove in the periphery of said nut and wherein said portion is a rib extending along the interior of said sleeve means.

**6.** The improvement defined in claim **1** wherein said nut engaging means includes a projecting portion extending exteriorly of said casing to form at least a part of said adjusting means.

**7.** The improvement defined in claim **6** further including a collar means mounted upon said projecting portion whereby rotation of said collar means rotates said nut engaging means.

**8.** The improvement defined in claim **6** wherein said piston rod, said threaded shaft and said projecting portion are coaxially aligned.

**9.** The improvement defined in claim **1** wherein the end of said threaded shaft remote from said piston is free from contact with said nut engaging means whereby said hydraulic fluid can exert a pressure force thereagainst so that the effective pressure area of said piston is not reduced through coupling of said threaded shaft thereto.

**10.** The improvement defined in claim **1** wherein said cylinder means includes end members, wherein said casing means abuts against one of said end members and wherein at least a portion of said one end member forms said stop means.

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