Sept. 8, 1959 W. E. POLLOCK 2,902,876

MULTI-TURN HUNTING TOOTH STOP

Filed Dec. 12, 1957

FIG. 1

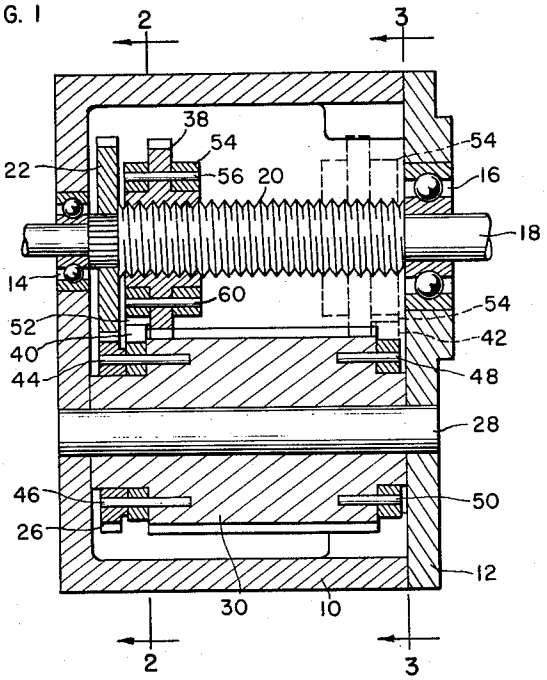


FIG. 2

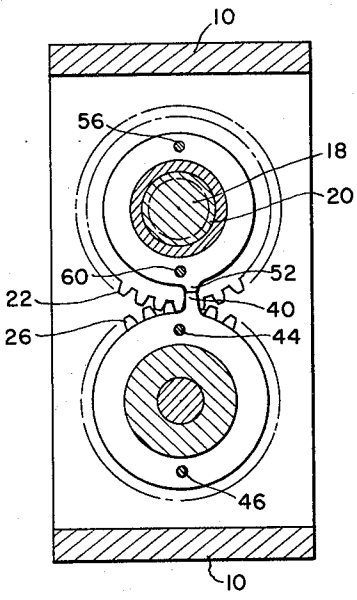


FIG. 4

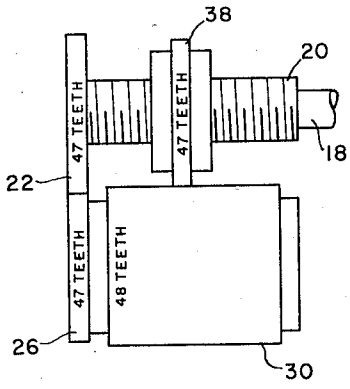
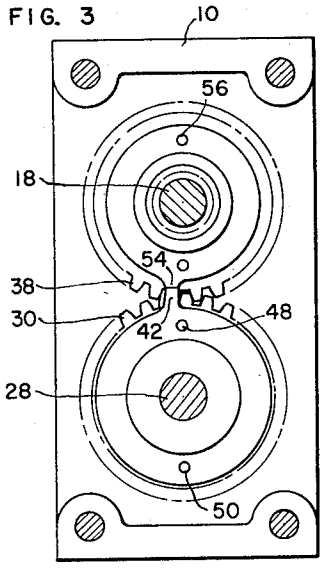


FIG. 3



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MULTI-TURN HUNTING TOOTH STOP

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13 Claims. (Cl. 74—414)

This invention relates to limit stop mechanisms and more particularly to a multi-turn hunting tooth stop mechanism for providing a relatively large integral number of turns between positions of engagement.

The present invention provides an extremely compact and lightweight stop mechanism which is sufficiently simple in design to afford ease and economy in construction. This invention also provides a relatively large number of complete shaft rotations between its terminal positions and provides a positive stopping action at said terminal positions.

The advantages enumerated above are achieved by the novel design of this stop mechanism which employs the principle of the hunting tooth stop modified to separate the fixed stop abutments by the length of a lead screw. The rotating stop abutments approach the desired terminal positions by differential movement along the lead screw.

An object of the present invention is to provide a hunting tooth stop mechanism operable over a relatively large number of turns.

Another object is to provide a mechanically simple stop mechanism operable over a relatively large number of whole revolutions.

Still another object is to provide an inexpensive rotation limiting device which allows for quick and easy changes of stop limits.

Other and more specific features, objects and advantages of this invention will become further evident from the following description and drawings in which:

Figure 1 is a longitudinal section of the stop mechanism embodying this invention showing the stop abutments engaged in one terminal position in solid lines and showing the stop abutments engaged in the other terminal position in dotted lines;

Figure 2 is a cross-sectional view taken on the line 2—2 of Figure 1 showing the stop abutments engaged at one terminal position;

Figure 3 is a cross-sectional view taken on the line 3—3 of Figure 1 showing the stop abutments engaged at the terminal position opposite from that shown in Figure 2;

Figure 4 is a schematic view of one embodiment of the present invention.

Referring to Figure 1, a support structure consisting of frame member **10** and an end plate **12** support the stop mechanism. The support structure is journaled to receive bearings **14** and **16** which support a rotatable input shaft **18**. The input shaft **18** has a threaded portion cut in the form of a lead screw **20**. Splined onto shaft **18** is a gear **22** which engages a mating gear **26** which is rotatably mounted on a fixed shaft **28**. Also rotatably mounted on the shaft **28** is an elongated gear **30**. The gear **30** meshes with a gear **38** which has a threaded inner portion which is carried by the threaded portion **20** of the input shaft **18** as shown in Figures 1 and 2. The gear ratio between gears **22**, **26**, **30** and **38** is of critical importance and for a detailed explanation of

this feature of my invention reference is made to the explanation relating to Figure 4. Differential rotation between gears **22** and **38** causes the gear **38** to advance along the lead screw **20**. A rotatable stop abutment **40** shown in Figures 1 and 2 is mounted on the shaft **28** between the gears **26** and **30** and another rotatable stop abutment **42** is also mounted on the shaft **28** at the other end of the elongated gear **30**. The rotatable stop abutment **40** and the gear **26** are held in position by pins **44** and **46** passing through into elongated gear **30**. The rotatable stop abutment **42** is held in position by pins **48** and **50** passing into gear **30**. Another set of rotatable stop abutments **52** and **54** are attached to the gear **38** by pins **56** and **60** as best shown in Figure 1. In the position shown in Figure 1, the rotatable stop abutment **52** is engaged with the rotatable stop abutment **40** and is shown at one of the limits of rotation of the input shaft **18**. This limiting position is also shown in cross-section through the section **2—2** in Figure 2. The dotted lines in Figure 1 show the movable stop abutment **54** engaged with the rotatable stop abutment **42**. This position defines the opposite limit of rotation of the gear **38** on shaft **18**, and is further shown in more detail in Figure 3.

Figure 4 shows a schematic diagram illustrating the tooth ratios between the various gears of the stop mechanism. The gear **22** meshing with a mating gear **26** is shown as an illustration and only for the purpose of explaining the relationship of these gears to the stop mechanism as having the same number of teeth as the gear **26**.

The gear **26** may be constructed to have less teeth than the gear **22**. In such a design, a more rapid advance of gear **38** will take place along the lead screw **20** for each revolution of the shaft **18** and the stop will allow fewer turns of the shaft **18** between terminal positions. Thus, the gear **26**, shaft **28** and gear **30** will rotate one revolution for each revolution of the input shaft **18**. Gear **30** having one more tooth than gear **26** rotates with gear **26**. Thus, the elongated gear **30** rotates one revolution for each revolution of the input shaft **18**. The gear **30** has one more tooth than the gear **38**. Since the gear **38** has one less tooth than its mating gear **30**, it rotates one revolution plus one tooth for each revolution of the gear **30**. Thus, for one revolution of the input shaft **18** the gear **38** rotates one revolution plus approximately one tooth. Since the gear **38** has a differential rotation of one tooth for each revolution of the input shaft **18**, it will advance along the lead screw **20** by one tooth for every revolution of the shaft **18**. This advance along the shaft **18** of a relatively small part of a revolution along the thread for each turn of the input shaft **18** enables the construction of a device which will advance very slowly into a stopped position.

One further design requirement should be pointed out. During the time in which the gear **38** makes one revolution relative to the gear **30**, the gear **38** must advance, along the lead screw **20**, a distance sufficient to bring the stop abutment **52** into a position completely clear of stop abutment **40**. This will be accomplished when the gear **38** has a differential rotation of one tooth relative to the gear **22** for each revolution of the input shaft **18** if the width of the stop abutment **52** is less than the pitch of a single thread of the lead screw **20**. In general, the width of the stop abutment **52** can be made the same number of pitch widths (lead screw **20**) as the differential rotation measured in number of teeth of gear **38** between the gear **38** and the gear **22** for each revolution of the input shaft **18**. The same requirement applies to the width of the stop abutment **54**.

Some previous stop mechanisms have utilized various other means for differential advance along a lead screw, however, stopping action is obtained by a type of clutch-

ing action rather than by the principle of the hunting tooth stop. Thus, when a terminal position is approached, an engagement of the clutching mechanism insufficient to hold the shaft is first attained. On successive rotations of the shaft, firmer engagements of the clutching mechanism are made until finally a complete engagement is reached and the shaft can rotate no further. Thus the stop, at positions near the terminal position, offers increased resistance to the turning of the driving shaft until sufficient resistance is encountered to hold the shaft. This is undesirable, since completely free rotation up to the terminal position is most often desired and also since the position of engagement may depend on the force being supplied to turn the shaft.

This invention provides a limit stop mechanism which provides a positive stopping action at the terminal position and which allows completely free rotation of the shaft at all positions short of the terminal position. This results from the use of the hunting tooth principle. When the movable stop abutment approaches the terminal position, it comes into a partially overlapping relationship with the rotatable stop abutment. However, no contact can result from this overlapping until the stop abutments are in the proper angular relationships. Thus, according to this invention, we reach the proper angular relationships only after the stop abutments are completely overlapping at the position of most positive stopping action.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

I claim:

1. In a stop mechanism for preventing rotation beyond desired limits of a support, a shaft rotatably mounted on said support, a first gear carried by said shaft, means responsive to rotation of said shaft for feeding said first gear progressively along the length of said shaft, a second gear meshing with said first gear, said first and second gears having different numbers of teeth, and a stop abutment mounted on each of said gears and movable therewith, said stop abutment being movable into a common plane and arranged to intercept into a position of locking engagement.

2. A stop mechanism comprising a support, a drive shaft rotatably mounted on said support, a stub shaft mounted on said support parallel to said drive shaft, a first gear carried by said drive shaft, means responsive to rotation of said drive shaft for advancing said first gear progressively along the length of said drive shaft, stop abutments mounted, one at each side of said first gear and movable therewith, a second gear mounted on said stub shaft and maintained in mesh with said first gear throughout the progressive advance of said first gear along the length of said drive shaft, and stop abutments mounted, one at each side of said second gear and rotatable therewith.

3. A stop mechanism according to claim 2 in which the means responsive to rotation of said drive shaft for advancing said first gear progressively along the length of said drive shaft comprises a third gear mounted on and rotatable with said drive shaft, and a fourth gear rotatably disposed about said stub shaft in mesh with said third gear.

4. A stop mechanism according to claim 2 in which said first and second gears have different numbers of teeth.

5. A stop mechanism according to claim 3 in which said first and second gears have different numbers of teeth.

6. A stop mechanism according to claim 3 in which said third and fourth gears have different numbers of teeth.

7. A stop mechanism comprising a support, a drive shaft rotatably mounted on said support, a stub shaft mounted on said support parallel to said drive shaft, a lead screw coaxial with and rotatable by said drive shaft, a first gear threaded upon said lead screw, means responsive to rotation of said drive shaft for advancing said first gear progressively along the length of said lead screw; said means comprising a second gear rotatable by said drive shaft, and a third gear rotatably mounted on said stub shaft in mesh with said second gear, stop abutments mounted one at each side of said first gear and movable therewith, a fourth gear disposed about said stub shaft rotatable with said third gear and maintained in mesh with said first gear throughout the progressive advance of said first gear along the length of said lead screw; the gears of one of said pairs having different numbers of teeth, and stop abutments mounted one at each side of said fourth gear and rotatable therewith.

8. A stop mechanism comprising a support, a first shaft rotatably mounted on said support, a second shaft mounted on said support parallel to said first shaft, a first gear carried by said first shaft, means responsive to rotation of said first shaft for advancing said first gear progressively along the length of said first shaft, a stop abutment mounted on said first gear and movable therewith, a second gear mounted on said second shaft and maintained in mesh with said first gear throughout the progressive advance of said first gear along the length of said first shaft and a stop abutment mounted on said second gear and rotatable therewith.

9. A stop mechanism according to claim 8 in which the means responsive to rotation of said first shaft for advancing said first gear progressively along the length of said first shaft comprises a third gear mounted on and rotatable with said first shaft, and a fourth gear rotatably disposed about said second shaft in mesh with said third gear.

10. A stop mechanism according to claim 8 in which said first and second gears have different numbers of teeth.

11. A stop mechanism according to claim 9 in which said first and second gears have different numbers of teeth.

12. A stop mechanism according to claim 9 in which said third and fourth gears have different numbers of teeth.

13. A stop mechanism comprising a support, a first shaft rotatably mounted on said support, a second shaft mounted on said support parallel to said first shaft, a lead screw coaxial with and rotatable by said first shaft, a first gear threaded upon said lead screw, means responsive to rotation of said first shaft for advancing said first gear progressively along the length of said lead screw; said means comprising a second gear rotatable by said first shaft, and a third gear rotatably mounted on said shaft in mesh with said second gear, a stop abutment mounted at one side of said first gear and movable therewith, a fourth gear disposed about said second shaft rotatable with said third gear and maintained in mesh with said first gear throughout the progressive advance of said first gear along the length of said lead screw; the gears of one of said pairs having different numbers of teeth, and a stop abutment mounted at one side of said fourth gear and rotatable therewith.

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