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Kienhofer

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[54] **ROTARY AND AXIAL DRIVE MECHANISM**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.**............ **74/22 R,** 242/1.1 R, 214/1 BB, 74/56, 92/136

[51] **Int. Cl.**.. **F16h 21/00**

[58] **Field of Search**............. 74/56, 57, 29, 99, 110, 74/89.12, 89.15, 22; 91/336, 366; 242/1.1 R; 92/136

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Assistant Examiner—Wesley S. Ratliff, Jr.

[57] **ABSTRACT**

An input member consists of a rotatable cam slot sleeve formed with a cam slot. An output member consists of a cam follower sleeve, which is coaxial with said cam slot sleeve and rotatable and axially movable relative thereto and carries a cam follower in engagement with said cam slot sleeve in said cam slot. Angular stop means limit the angular movement of said cam follower sleeve from an initial position to a limiting angular position. Axial stop means limit the axial movement of said cam follower sleeve relative to said cam slot sleeve. Said cam slot and cam follower are adapted to impart to said cam follower sleeve an angular movement in unison with an angular movement of said cam slot sleeve between said initial position and said limiting angular position, and to impart to said cam follower sleeve an axial movement relative to said cam slot sleeve in response to an angular movement of said cam slot sleeve beyond said limiting angular position. Input drive means comprise a fluid-operable actuator and are operable to impart to said input member an oscillating angular movement from said initial position to and beyond said limiting angular position and back to said initial position. A drum coaxially surrounds and is non-rotatably connected to said input member. Control means are provided to control said input drive means in response to the angular movement of said drum. Said control means comprise adjustable cam means carried by said drum for rotation therewith and valve means which communicate with said actuator and are arranged to vary the speed of said actuator under control by said cam means.

27 Claims, 5 Drawing Figures

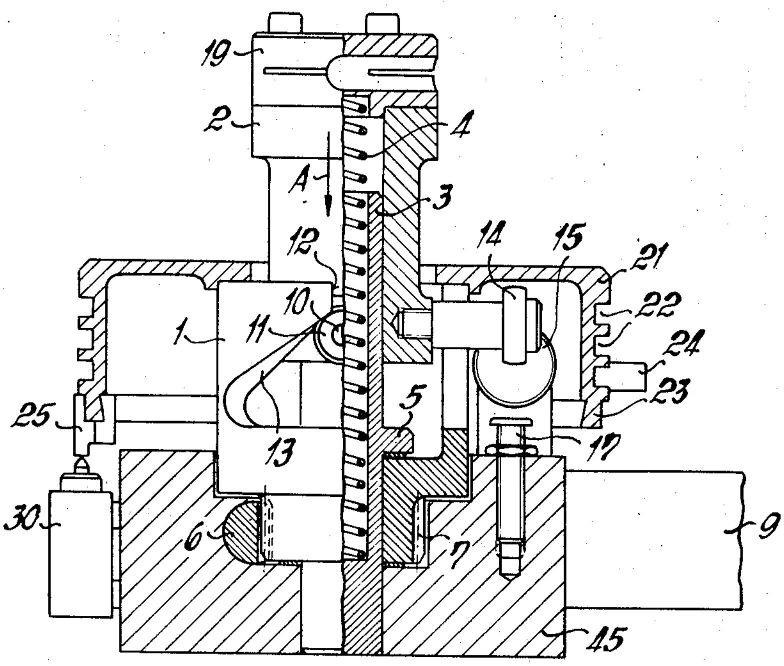

FIG. 1

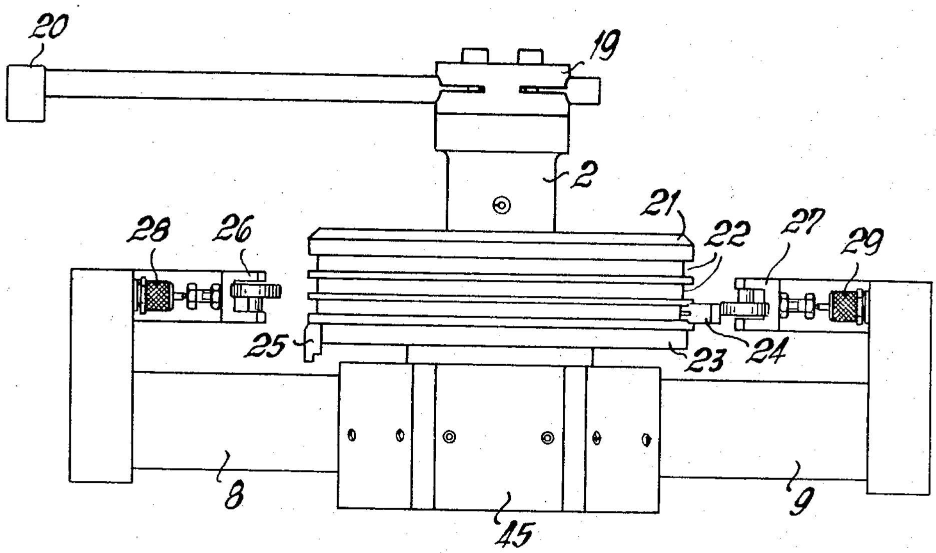
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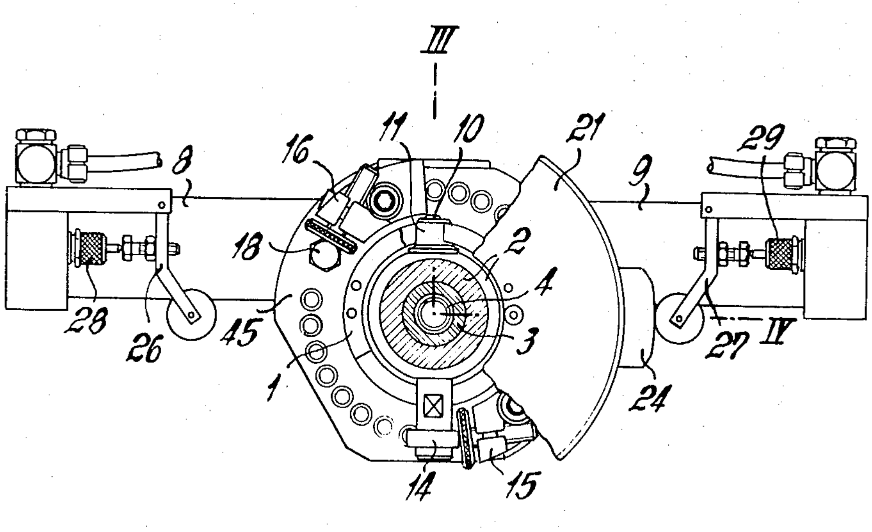
FIG. 2


III
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IV
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FIG. 3

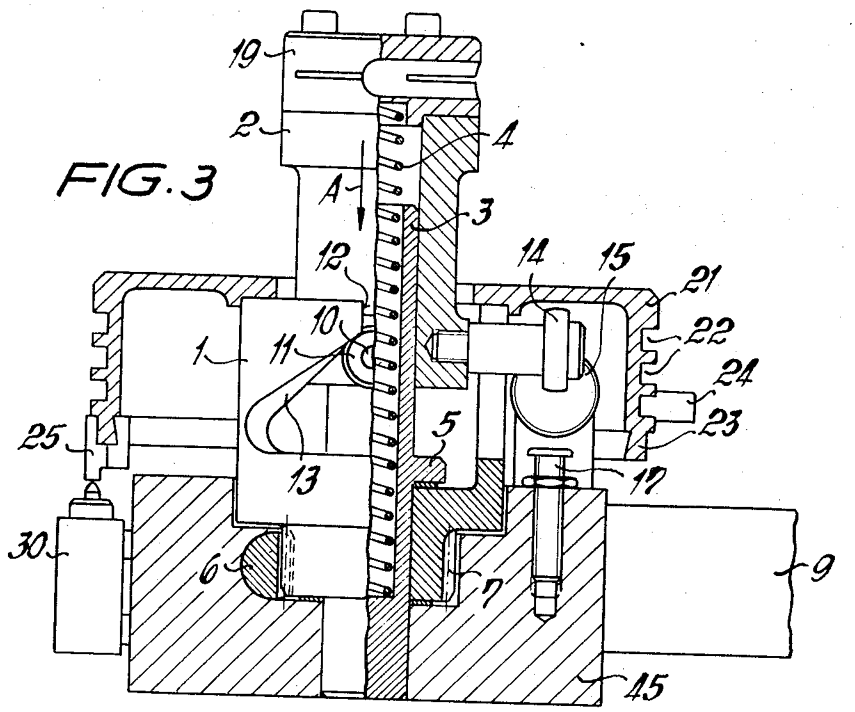
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FIG. 4

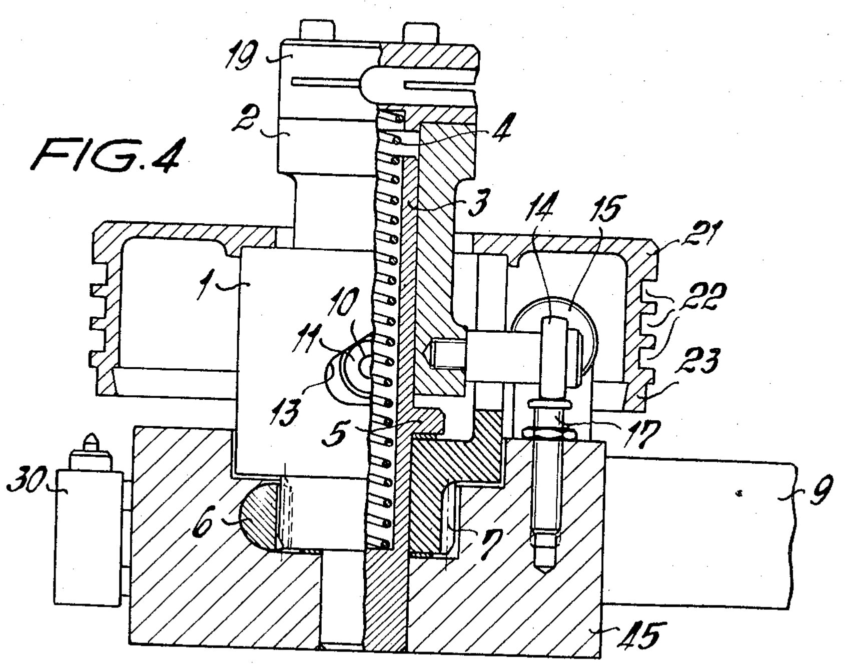
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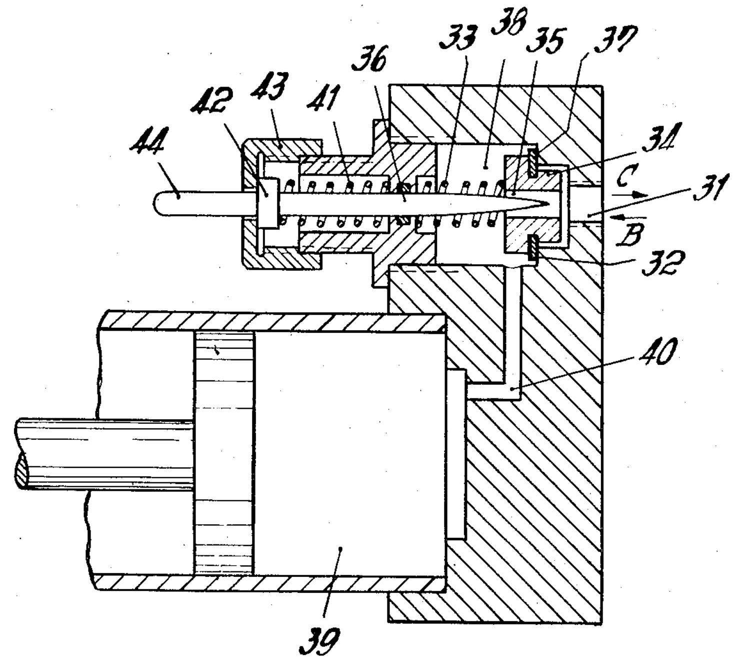
FIG. 5



ROTARY AND AXIAL DRIVE MECHANISM

This invention relates to a rotary and axial drive mechanism, e.g., for driving a feeder.

An optimum utilization of modern manufacturing plants and a prevention of accidents to a high degree require the use of reliable feeders in all manufacturing operations. These feeders should provide for a continuous adjustment of all movements, a short setting-up time and a handling of different workpieces. These objects are accomplished by the use of the mechanism according to the invention. The mechanism according to the invention serves to feed parts made from varous materials to presses, drilling, boring, milling and riveting machines and to joining and assembling machines of all kinds. The mechanism may also be used to remove and transfer workpieces from such machines.

The rotary and axial drive mechanism according to the invention serves preferably to drive a feeder and comprises a driven assembly comprising a rotatable cam slot sleeve and a cam follower sleeve which is rotatable and axially movable so that controlled rotational and axial movements can be performed in alternation and limited by preferably adjustable stops. An adjustable work holder may be provided to accommodate the workpiece to be transferred. The cam slot sleeve and the cam follower sleeve are guided on a stationary column. The cam follower sleeve is rotatably and axially movably mounted on the column to follow the input cam slot sleeve. The cam slot sleeve and the cam follower sleeve are coupled by a finger, which extends into the cam slot and preferably carries a removable cam follower roller.

Further details of the invention will be described hereinafter with reference to the drawing, in which

FIGS. 1 and 2 are a side elevation and top plan view showing a complete rotary and axial drive mechanism, which in FIG. 2 is shown with parts cut away.

FIGS. 3 and 4 are views showing partly in transverse section the mechanism of FIG. 1 in its top and bottom dead center position, between which the cam slot sleeve has performed one angular stroke.

FIG. 5 is a sectional view showing a cylinder cover with a built-in damping valve.

As is apparent from the drawing, the rotary and axial drive means according to the invention comprises a rotatable cam slot sleeve **1** and a rotatable and axially movable cam follower sleeve **2.** The sleeves **1** and **2** are guided on a stationary column **3.** The cam follower sleeve **2** is rotatably and axially movably mounted on the column **3** with a compression spring **4** interposed. The input cam slot sleeve **1** is held on the lower portion of the column **3** by bearing flanges **5** to be rotatable and held against an axial movement. Rotation is imparted to the cam slot sleeve **1** by a rack **6** in mesh with the gear teeth **7** of the sleeve **1.** The rack is driven by pistons, which are reciprocated in the two cylinder halves **8, 9** under valve control. The cam slot sleeve **1** and the cam follower sleeve **2** are coupled by a finger **10,** which carries a cam follower roller **11,** which is removable so that the cam follower sleeve can be removed through the slot **12.** In the present embodiment, the cam slot **13** is symmetrical. The cam follower roller **11** is subjected to a spring force tending to hold the roller **11** in its uppermost position shown in FIG. 3 so that the cam follower sleeve **2** follows the oscillating angular movement of the cam slot sleeve **1** until the stop roller **14** engages either of the abutments **15** and **16,** which limit the rotation in both senses. Owing to the engagement of the stop roller **14** of the cam follower sleeve **2** the continued rotation of the cam slot sleeve **1** is transformed into a vertical movement in a direction A against the force of the spring **4** until the end position shown in FIG. 4 is reached. This position is determined by vertical stops **17** and **18.** A reverse rotation results in a return stroke in the direction opposite to direction A under the action of the spring until the end position shown in FIG. 3 is reached so that the cam follower sleeve **2** and the cam slot sleeve **1** are rotated back in unison.

The cam follower sleeve **2** carries a bracket **19,** to which a work holder can be adjustably secured. In the present case, the work holder consists of a solenoid **20.** Alternatively, the work holder may consist of a pneumatic or hydraulic collet or chuck. These work holders are not shown. The abutments **15** and **16** are adjustably mounted on the lower portion **45** of the column so that the position in which the angular movement of the cam follower sleeve **2** and the work holder is succeeded by the vertical movement can be adjusted as desired and the angular output movement of the mechanism can be limited. The vertical stops **17** and **18** for limiting the vertical movement are also adjustable, as is apparent from FIGS. 3 and 4. These adjustable stops constrain the cam follower sleeve to perform a controlled reciprocating angular and vertical movement. The adjustable work holder consisting in the present case of the solenoid **20** serves to carry the workpiece to be transferred.

It is also apparent from the drawing that the cam slot sleeve **1** is surrounded by a drum **21,** which rotates with the sleeve **1** and is formed with grooves **22** and a collar **23** for confining control cams **24** and **25.** In the present embodiment, the cam **24** serves to damp the movement of the piston during the change from the angular to the vertical movement and for this reason is connected by two cam follower arms **26** and **27** to respective throttle-check valves **28** and **29,** which are connected to the ends of respective cylinder portions **8, 9** and control the supply of pressure fluid. In accordance with FIG. 5, such throttle-check valve **28** or **29** is manually adjustable to set the maximum speed and is controlled by means of the adjustable cam **24** and the cam follower arms **26** and **27** to determine accelerating and retarding phases. The additional control cams **25** serve to operate switches **30** for additional switching and control functions to be performed by the feeder itself or the machine to be fed.

In accordance with FIG. 5, each of the throttle-check valves **28** and **29** has following mode of operation:

The pressure fluid enters through the bore **31** and is discharged through the same when it has performed work. In this combined inlet-outlet valve for controlling the supply and discharge of pressure fluid, a shoulder **32** at the inlet is engaged by a valve disc **34,** which is loaded by a spring **33** and formed with a through bore **35** containing a throttling needle **36.** Pressure fluid supplied in direction B causes the seal **37** at the rim of the disc **34** to be lifted so that the pressure fluid can enter around said seal. When the seal **37** is forced against the shoulder **32,** pressure fluid can be discharged through the bore **35** in direction C. The valve chamber **38** communicates with the cylinder chamber **39** through a conduit **40.** The position of the throttling needle **36** relative to the bore 35 in the valve disc 34 is controlled by a collar 42, which is carried by the needle and urged by a spring 41 against the cap nut 43, which is manually adjustable to control the maximum speed of the piston. At its end opposite to the valve disc, the needle has a portion 44 which is engageable by the control cam 24 to operate the needle.

The cap nut 43 is thus manually adjustable to determine the maximum speed of the piston. The cam 24 or corresponding different cams may be used for an additional control of the speed of the piston in any position thereof.

What is claimed is:

1. A rotary and axial drive mechanism, which comprises

an input member consisting of a rotatable cam slot sleeve formed with a cam slot,

an output member consisting of a cam follower sleeve, which is coaxial with said cam slot sleeve and rotatable and axially movable relative thereto and carries a cam follower in engagement with said cam slot sleeve in said cam slot,

angular stop means limiting the angular movement of said cam follower sleeve from an initial position to a limiting angular position, and

axial stop means limiting the axial movement of said cam follower sleeve relative to said cam slot sleeve,

said cam slot and cam follower being adapted to impart to said cam follower sleeve an angular movement in unison with an angular movement of said cam slot sleeve between said initial position and said limiting angular position, and to impart to said cam follower sleeve an axial movement relative to said cam slot sleeve in response to an angular movement of said cam slot sleeve beyond said limiting position.

2. A mechanism as set forth in claim 1, in which said sleeves have vertical axes.

3. A mechanism as set forth in claim 1, which comprises input drive means operable to impart to said cam slot sleeve an oscillating angular movement from said initial position to and beyond said limiting angular position and back to said initial position.

4. A mechanism as set forth in claim 3, in which

said cam slot sleeve is axially fixed and

said input drive means comprise

a gear nonrotatably connected to and coaxial with said cam slot sleeve,

a rack in mesh with said gear, and

a fluid-operated actuator adapted to reciprocate said rack.

5. A mechanism as set forth in claim 3, in which

said cam slot sleeve is coaxially surrounded by and nonrotatably connected to a drum, which carries cam means for rotation therewith, and

said input drive means are arranged to be speed-controlled by said cam means in response to the rotation of said drum.

6. A mechanism as set forth in claim 5, in which

said cam means are adjustable, and

said input drive means comprise a fluid-operable actuator and valve means which communicate with said actuator and are arranged to vary the speed of said actuator under control by said cam means.

7. A mechanism as set forth in claim 6, in which

said actuator comprises a cylinder and

said valve means communicate with said cylinder.

8. A mechanism as set forth in claim 7, in which said valve means comprise two valves, which communicate with respective ends of said cylinder.

9. A mechanism as set forth in claim 6, in which said valve means comprise a throttle-check valve for supplying pressure fluid to and for throttling the discharge of pressure fluid from said actuator.

10. A mechanism as set forth in claim 6, in which said valve means are manually adjustable to determine the maximum speed of said actuator.

11. A mechanism as set forth in claim 1, in which said angular stop means comprise at least one angularly adjustable stop.

12. A mechanism as set forth in claim 1, in which said axial stop means comprise at least one axially adjustable stop.

13. A mechanism as set forth in claim 1, which comprises a column on which the cam slot sleeve is mounted to be rotatable and axially fixed relative to the column and on which the cam follower sleeve is mounted to be rotatable and axially movable relative to the column.

14. A mechanism as set forth in claim 13, which comprises a compression spring interposed between said column and said cam follower sleeve and opposing the axial movement performed by said cam follower sleeve in response to an angular movement of said cam slot sleeve beyond said limiting angular position.

15. A mechanism as set forth in claim 13, in which said angular stop means comprise

a stop carried by said cam follower sleeve and

two angularly spaced apart and angularly adjustable stops carried by said column and engageable by said stop carried by said cam follower sleeve.

16. A mechanism as set forth in claim 13, in which said axial stop means comprise

sleeve-carried stop means and

column carried stop means carried by said column and engageable by said sleeve-carried stop means to limit the axial movement of said cam follower sleeve.

17. A mechanism as set forth in claim 1, in which said cam follower comprises a finger extending into said cam slot.

18. A mechanism as set forth in claim 17, in which said finger carries a removably mounted cam follower roller engaging said cam slot sleeve in said cam slot.

19. A mechanism as set forth in claim 1, in which said angular stop means comprise a stop carried by said cam follower sleeve.

20. A mechanism as set forth in claim 19, in which said stop carried by said cam follower sleeve carries a stop roller.

21. A mechanism as set forth in claim 1, which comprises an adjustable work holder carried by said output member.

22. A mechanism as set forth in claim 21, in which said work holder is adjustably connected to an arm carried by said output member.

23. A rotary and axial drive mechanism, which comprises

a rotatable input member,

a drum coaxially surrounding and nonrotatably connected to said input member, an output member which is coaxial with and rotatable and axially movable relative to said input member,

means for imparting to said output member an angular movement in unison with an angular movement of said input member between an initial position and a limiting angular position, and to impart to said output member an axial movement of said input member beyond said limiting angular position,

input drive means comprisising a fluid-operable actuator and operable to impart to said input member an oscillating angular movement from said initial position to and beyound said limiting angular position and back to said initial position, and

control means for controlling said input drive means in response to the angular movement of said drum, said control means comprising adjustable cam means carried by said drum for rotation therewith and valve means which communicate with said actuator and are arranged to vary the speed of said actuator or under control by said cam means.

24. A mechanism as set forth in claim **23,** in which

said actuator comprises a cylinder and

said valve means communicate with said cylinder.

25. A mechanism as set forth in claim **24,** in which said valve means comprise two valves, which communicate with respective ends of said cylinder.

26. A mechanism as set forth in claim **23,** in which said valve means comprise a throttle-check valve for supplying pressure fluid to and for throttling the discharge of pressure fluid from said actuator.

27. A mechanism as set forth in claim **23,** in which said valve means are manually adjustable to determine the maximum speed of said actuator.

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