United States Patent [19]

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[11] **3,731,545**

[45] **May 8, 1973**

[54] **DEVICE FOR TRANSMITTING ACCURATE TRANSLATIONAL AND ROTARY MOVEMENTS**

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[22] Filed: **May 4, 1971**

[21] Appl. No.: **140,134**

[52] **U.S. Cl.** **74/24**, 74/57, 74/567

[51] **Int. Cl.**.....**F16h 27/04**

[58] **Field of Search**.....74/24, 23, 57, 567

[56] **References Cited**

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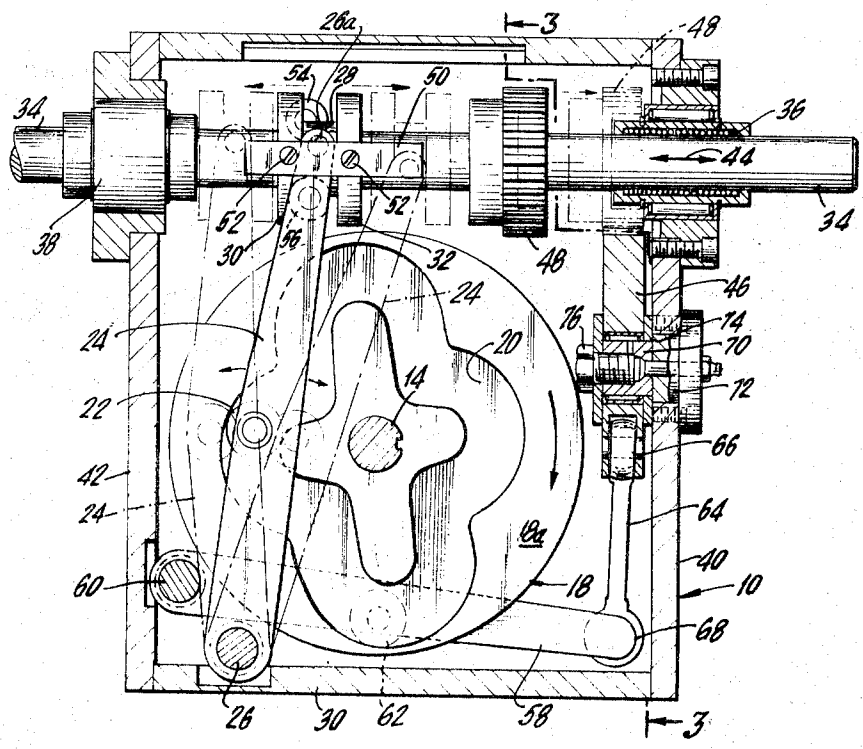
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[57] **ABSTRACT**

A device for transmitting accurate translational and rotary movements includes a rotary input shaft on which is mounted a rotary driving cam which is engaged with a pivotal follower carried on a first lever member intermediate its length. The first lever member is pivoted at its lower end in the housing containing the cam, and its upper end is engaged with the output shaft. The output shaft is guided in rotary roller bearings and linear ball bearings and it is shifted laterally, backwardly, and forwardly by pivotal movement of the first lever as its follower rides in the cam. A second gear control lever is pivotally mounted in the housing to extend transversely in respect to the first lever and it includes a follower which is also engaged in a groove of the cam and this causes the pivotal movement of the second lever. The outer end of the second lever is pivotally connected to a connecting rod which in turn is connected to a gear member in the form of a quadrant through a universal joint connection. The gear member or quadrant meshes with a gear carried on the output shaft to rotate the output shaft. Meshing engagement is only effective when the output shaft moves a predetermined distance transversely so that meshing engagement with the quadrant can be easily effected.

18 Claims, 7 Drawing Figures



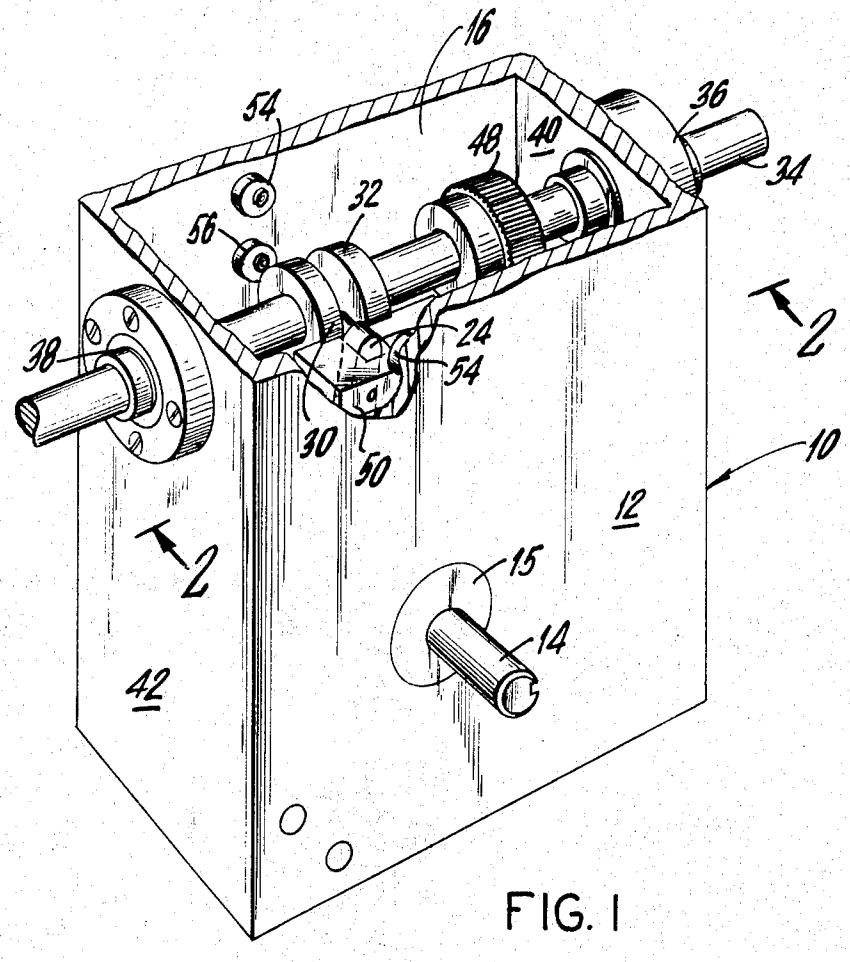


FIG. 1

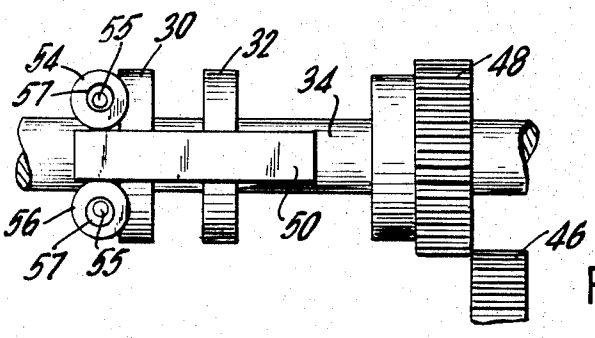


FIG. 5

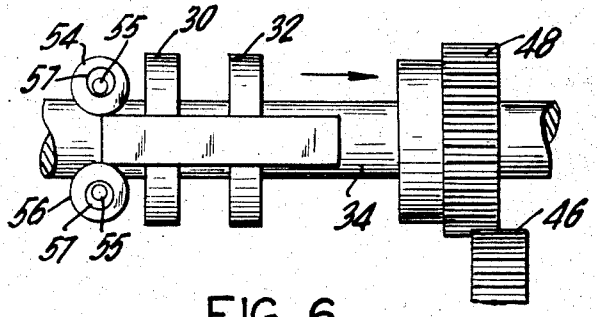


FIG. 6

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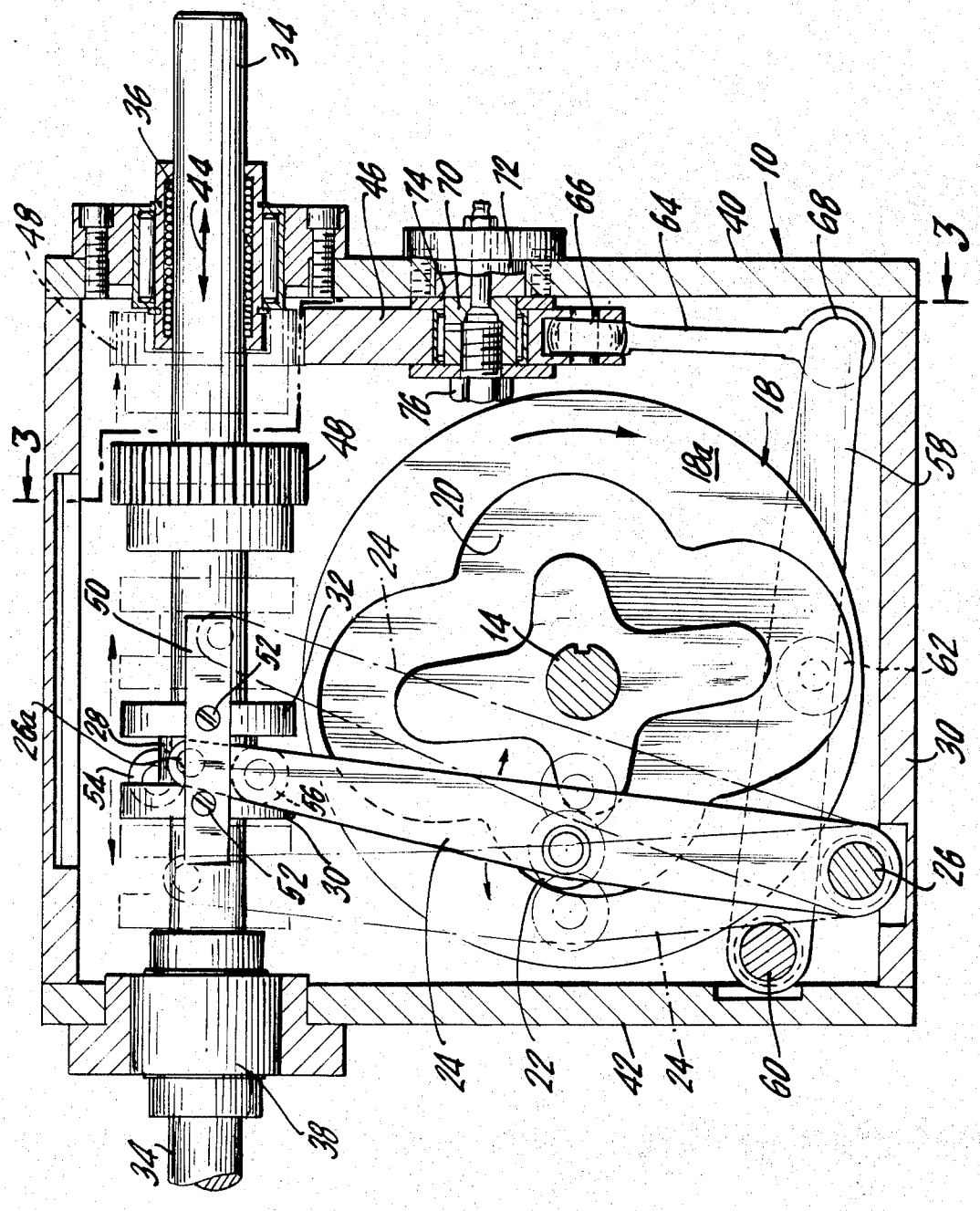


FIG. 2

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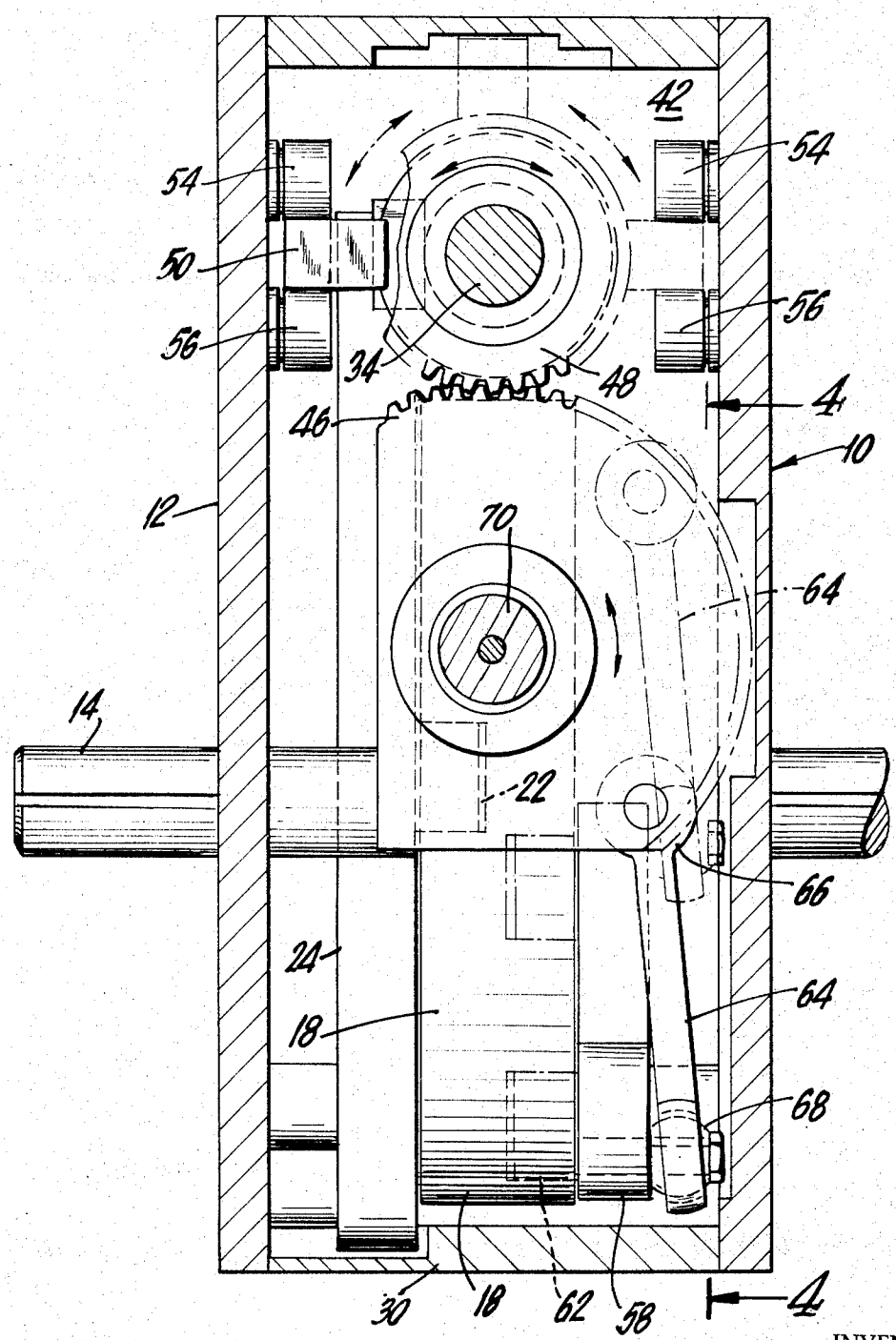


FIG. 3

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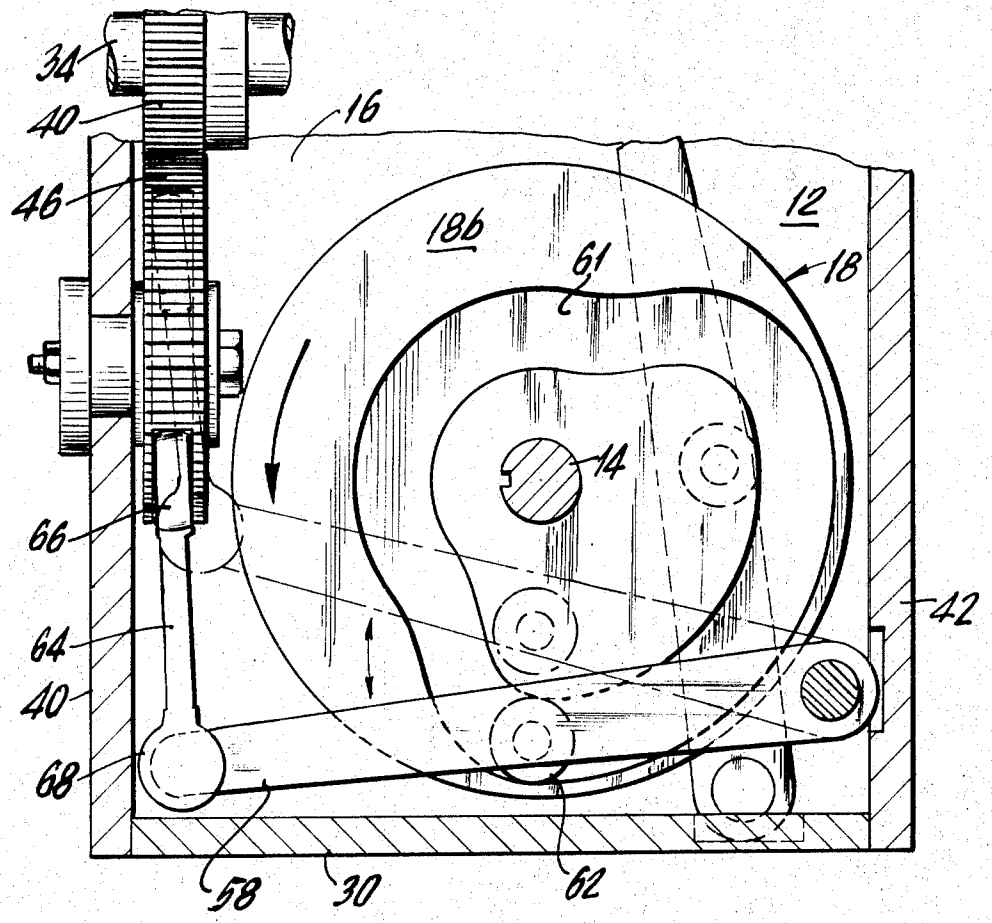


FIG. 4

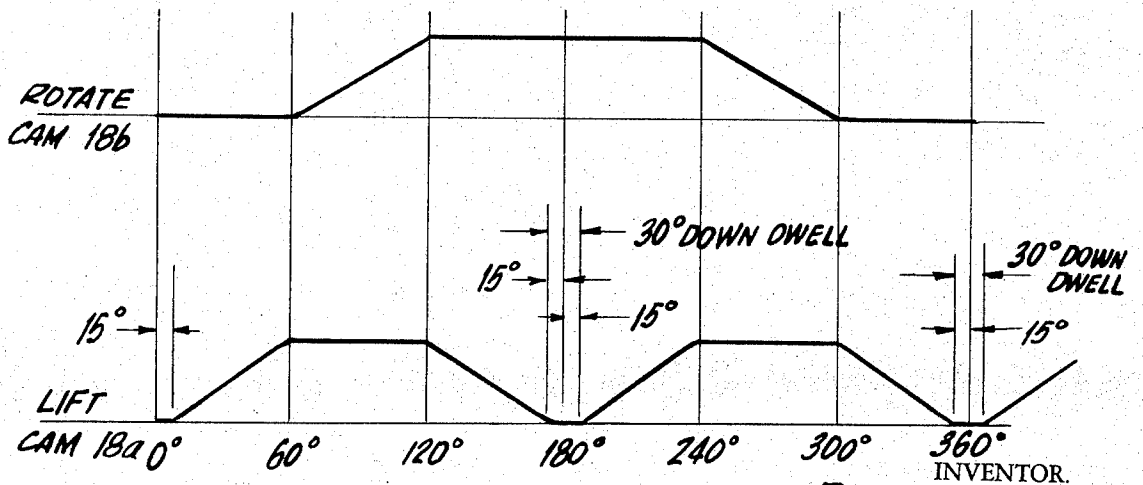


FIG. 7

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DEVICE FOR TRANSMITTING ACCURATE TRANSLATIONAL AND ROTARY MOVEMENTS

SUMMARY OF THE INVENTION

This invention relates in general to a motion transmission device and in particular to a new and useful device for transmitting accurate translatory and rotary movements from a rotary input shaft to an output shaft.

The present invention is an improvement over the mechanism disclosed and described in the copending application Ser. No. 109,229 filed Jan. 25, 1971 by the present inventor, particularly in respect to the mechanism for accurately controlling the translational position and rotary position of an output shaft. The device includes an improved means for providing a controlled rotary movement of the output shaft in the form of a quadrant gear which meshes with a pinion carried on the output shaft after a predetermined translatory movement thereof is effected. The position of the quadrant gear arrangement for controlling the rotary movement of the shaft makes it possible in a simple and compact mechanism to accurately position the output shaft without inhibiting its free movement on linear and rotary bearings. The device provides a simple solution for facilitating the movement of a shaft of a machine element, for example, which must move in a plurality of complicated motion stages to effect a desired machine operation. For example, the device of the invention may advantageously comprise a pick-up and place mechanism which includes an arm carried by the output shaft which, for example, is first positioned in one rotary position, and then moved in a transverse direction, for example to pick up a material, then shifted by rotary movement to a new location and again moved backwardly to a dropping station. The invention provides a simple and accurate mechanism for effecting a movement of the type referred to.

Accordingly, it is an object of the invention to provide an improved device for accurately positioning one part in relation to another and for accurately transmitting from a rotary motion into a controlled proportional motion extending both in longitudinal and also in rotary directions.

A further object of the invention is to provide a device for accurately positioning a member such as a machine part in respect to a pick-up station, for example, and wherein the pick-up member is mounted on an output shaft which is moved by rotary movement on an input shaft, first in a direction along the axis of the output shaft, and then in a direction of rotary movement of the shaft, and any combination of such movements.

A further object of the invention is to provide a device for achieving a plurality of controlled transverse movements in a single plane, or in a plurality of planes, and which is simple in design, rugged in construction, and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference should be had to the accompanying drawing and descriptive matter in which there is illustrated a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front top perspective view partly broken away of a motion transmitting device constructed in accordance with the invention;

FIG. 2 is a section taken along the line 2—2 of FIG. 1;

FIG. 3 is a section taken along the line 3—3 of FIG. 2;

FIG. 4 is a section taken along the line 4—4 of FIG. 3;

FIG. 5 is a partial side-elevational view of the guiding key for the output shaft;

FIG. 6 is a view similar to FIG. 5, indicating the output shaft in a position in which it becomes engaged with the quadrant gear; and

FIG. 7 is a diagram indicating the cam timing.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in particular, the invention embodied therein comprises a motion transmitting device including a housing generally designate **10** of block-shaped configuration which includes a front wall **12** in which is rotatably supported an input shaft **14**. The input shaft **14** extends to the interior space **16** of the housing, and the inner end is secured to a cam **18** which is affixed thereto for rotation therewith. The input shaft **14** is rotatably supported on roller bearings **15**.

In accordance with the invention, the cam **18** includes a first face **18a** (FIG. **2**) with a continuous control groove **20** in which is engaged a roller follower **22** of a first lever member **24**. The first lever member **24** is rotatable on a pivot **26** located at the interior of the housing adjacent the bottom wall **30**. The upper end of the lever **24** includes a pivot **26a** which is articulated to a follower element **28** which is located between and connected to collars **30** and **32** which are affixed to an output shaft **34**. The output shaft **34** is rotatably and translationally supported on combination roller-and-linear bearings **36** and **38** which are mounted in respective side walls **40** and **42** of the housing. When the input shaft **14** is rotated, it causes rotation of the cam **18** and the oscillation of the lever **24** through the engagement of the intermediate follower **22** with the groove **20** of the cam. This oscillation causes the translatory back-and forward movement in the direction of the double arrows **44** of the shaft **34**.

In accordance with a further feature of the invention, the shaft **34** is imparted with a controlled rotational movement in addition to its translatory movement by cam means responsive to rotation of the input shaft **14** and which includes a drive gear in the form of a quadrant gear **46** which meshes with a pinion gear **48** carried on the output shaft **34**. The meshing engagement of the quadrant gear **46** and the pinion gear **48** occurs after the shaft **34** has moved through a predetermined translatory motion. In the embodiment illustrated, the meshing of the gears **46** and **48** takes place when the shaft **34** is moved substantially completely to the right and in order to facilitate the interengagement of the gear **48** with the gear **46**, the shaft **34** is provided with a key way **50** which is secured by bolts **52** to the spaced collars **30** and **32**. The key way **50** rides

between guide rollers **54** and **56**, as shown particularly in FIGS. **5** and **6**, and the key way is maintained in engagement between the rollers **54** and **56** up to the end position in which the gears **48** and **46** begin to mesh. The meshing of the gear **46** with the gear **48** is accomplished when the gear **46** is advantageously maintained at a stationary position.

As shown in FIGS. **5** and **6** each of the key way guide, rollers **54** and **56** are rotatably supported on shaft **55** which may be shifted toward and away from key way **50** by rotation of a bushing **57**. This permits the adjustment of the guide rollers to remove any play and maintain zero rotational shake between the key **50** and the guide rollers in order to maintain an operation of the device so that it can be accurately positioned during each repetitive type of motion.

The mechanism or cam means for effecting the rotation of the gear **46** includes a second lever **58** which is rotatable on or with a pivot **60** which is carried at one side of the housing adjacent to the side wall **42**. The lever **58** includes an intermediate roller follower **62** which rides in a groove on a side face **18*b*** of the cam **18**, as shown in FIG.**4**. The rotation of the cam **18** causes the upward and downward movement of the lever **58** and it is connected through a rod member **64** to the gear **46** by means of a universal joint **66**. A universal joint **68** may also advantageously be provided at the connection of the rod member **64** with the lever **58**.

The gear **46** is rotatably mounted on a journal **70** which is carried on an eccentric member **72**. The eccentric member **72** may be rotated in its bushing **74** in order to shift the journal **70** in a direction either toward or away from the shaft **34**. In order to rotate the bushing **74**, the bolt **76** is loosened and the bushing is rotated in order to accurately position the gear **46** in respect to the gear **48** and thereby to remove any backlash which may occur in respect to their interengagement.

FIG. **7** indicates a timing diagram in respect to the amount of translational and rotary motions effected by the rotating cam mechanism comprising the groove **61** defined in a cam face **18*b*** and the lifting cam mechanism defined by the groove **20** in a rotating cam face **18*a*** during the rotation of the input shaft **14**. The rotational movement of the input shaft is indicated as extending from 0° to 360°. It will be noted, when referring to FIG. **7**, that the lift cam may be set to cause a lifting motion or a translatory motion of the shaft **34** in a direction of one of the double arrows **44**, after the input shaft is rotated 15°, for example. The complete translatory or lifting motion is carried out by the time the input shaft rotates 60°; and when this motion stops, or simultaneously with the end of this motion, the rotatable cam is started in operation to cause a rapid rotation of the output shaft **34** until the input shaft has rotated a complete 120°. Thereafter rotation is stopped to permit the translatory or lift cam **18*a*** to move back downwardly and this movement is accomplished 15° before the 180° input shaft rotational mark. A 30° down dwell is indicated as being selected although a greater or smaller dwell may be effected as desired. The renewed translatory movement is carried out between the end of the down dwell period and 240°, at which time this motion stops, and the rotational motion begins up to 300°. When the rotational motion stops at 300°, the translatory or lift motion is again effected down to the next dwell stage.

The inventive device provides means for accurately positioning an output member such as a shaft member which, for example, must be moved in a translatory or an up and down motion, in order to pick up or place parts and then moved in a rotary motion in order to shift the position of the picked up parts and to position it for down-placement at a new location. The camming diagram which is shown in FIG. **7** is only a typical diagram, but any number of other possibilities may be chosen in accordance with the desired motion which is to be carried out. The device thus provides a simple means for controlling the type of translatory or up and down movement, as well as rotary movement, in order to accomplish certain machine part movements or parts lift-up and placement movements.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A motion transmitting device, comprising a rotary input shaft having rotary control cam means thereon, a rotary and axially movable output shaft having a pinion gear thereon, means supporting said input shaft for rotary movement and said output shaft for rotary and axial movement, first lever means engaged with said cam means and said output shaft and being movable by said cam means to shift said output shaft axially, and second lever means connected to said cam means and including a drive gear rotated by said second lever means engageable with said pinion gear axial movement of said output shaft to rotate said output shaft in one axial position and being disengageable from said drive gear to permit axial movement without rotation, and means to hold said output shaft against rotation when said drive gear is engaged and disengaged from said pinion gear

2. A device, according to claim **1**, including means mounting said drive gear for movement of its axis toward and away from the axis of said output shaft.

3. A motion transmission means according to claim **1**, wherein said first lever means includes a first lever pivotally mounted at one end and having an intermediate roller follower, said cam means including a first cam face having a cam groove engaged by said intermediate roller follower of said first lever, said first lever having an outer end articulated to said output shaft for moving said shaft.

4. A motion transmitting device according to claim **1**, wherein said second lever means includes a second lever pivotally mounted adjacent its one end and having an opposite end, and a second roller follower mounted intermediate its ends, said cam means including a cam having a groove therein engaged by said second roller follower, said opposite end of said second lever being connected to said gear and causing rotational movement of said gear upon pivoting of said lever.

5. A motion transmitting device according to claim **1**, wherein said output shaft is mounted in combination rotary and linear bearings for rotational and linear roller bearing movement.

6. A motion transmitting device comprising a housing, linear and rotary bearing means in said housing an output shaft rotatably and linearly movable on said rotary and linear bearing means, an input shaft rotatably mounted in said housing at an angle to the axis of said output shaft, a cam carried on the interior of said housing and connected to said input shaft for rotation therewith and having a first face with a first cam groove and a second face with a second cam groove, a first lever pivotally mounted in said housing at one end and having an opposite end connected to said output shaft for shifting said output shaft linearly and having a first lever intermediate follower engaged in said first groove and being pivotal by engagement of said groove with said follower, a second lever pivotally mounted within said housing and having an intermediate second follower engaged in said second groove being pivotal by engagement of said follower and said groove, said second lever having an outer end, a drive gear rotatably supported in said housing and being connected to said second lever adjacent the outer end, a pinion carried on said output shaft being affixed thereto for movement therewith in both linear and rotational directions and being engageable with said drive gear when said output shaft is moved to a predetermined linear position.

7. A motion transmitting device according to claim 6 including a key carried by said output shaft, and roller guide means in said housing for guiding said key therebetween to hold said shaft against rotative movement during its translatory movement, but disengageable from said key to permit rotative movement after said pinion is engaged with said drive gear.

8. A motion transmitting device according to claim 7, wherein said roller guide means comprises first and second rollers, said key way being of a length to move out of engagement with said first and second rollers when said gear on said output shaft engages with said drive.

9. A device according to claim 6, including a rod interconnected between the outer end of said second lever and said drive gear, and universal joint means connecting said rod with said drive gear.

10. A motion transmitting device, comprising a rotary input shaft having rotary control cam means thereon, a rotary and axially movable output shaft having a pinion gear thereon, means supporting said input shaft for rotary movement and said output shaft for rotary and axial movement, first lever means engaged with said cam means and said output shaft and being movable by said cam means to shift said output shaft axially, and second lever means connected to said cam means and including a drive gear rotated by said second lever means engageable with said pinion gear after a predetermined movement of said output shaft to rotate said output shaft, said drive gear comprising a quadrant gear.

11. A motion transmitting device comprising a first rotary shaft, a second rotary and axially movable shaft adjacent said first shaft, a first rotatable gear rotatably mounted adjacent said first and second shafts in a fixed location, a second gear affixed to said second rotary shaft for rotation therewith and for axial movement therewith and being movable into and out of engagement with said first gear upon axial movement of said second shaft, drive means connected between said first and second rotary shafts and said first gear for shifting said second rotary shaft backwardly and forwardly axially and for rotating said first gear upon rotation of said first shaft, said first gear being rotated only when it is engaged with said second gear at which time it rotates said second gear with said second shaft, and guide means adjacent said second shaft for holding said second shaft against rotary movement during its axial movement when said second gear is shifted into and out of engagement with said first gear but permitting a rotary movement when said second gear is engaged with said first gear.

12. A motion transmitting device according to claim 11, wherein said first rotary shaft comprises an input shaft, said second shaft comprising an output shaft and a housing having means for supporting said second shaft for rotational and axial movement and for supporting said input shaft for rotational movement, said input shaft being disposed at an angle to said output shaft.

13. A motion transmitting device according to claim 10, wherein said first gear comprises a quadrant gear, said driving means including a lever connected to said quadrant gear to rotate said quadrant gear upon rotation of said first rotary shaft.

14. A motion transmitting device according to claim 11, wherein said guide means comprises first and second spaced apart rollers mounted adjacent said second shaft, said second shaft having an axially extending keyway affixed thereto movable between said rollers to hold said second shaft against rotation when said second gear is moved into and out of engagement with said first gear.

15. A motion transmitting device according to claim 14, including means mounting at least one of said rollers permitting the shifting of the axis of said roller toward and away from said keyway for adjusting the clearance between said rollers.

16. A motion transmitting device according to claim 11 wherein said drive means comprises a cam carried by said first shaft for rotation therewith, a first lever pivotally mounted at its one end and having a follower portion engaged with said cam and being connected to said second shaft and being shiftable by said follower upon rotation of said shaft to move said second shaft backwardly and forwardly axially, and a second lever pivotally mounted adjacent said cam and having a second follower portion engaged with said cam and being movable backwardly and forwardly by rotation of said cam to rotate said first gear.

17. A motion transmitting device according to claim 17, wherein said first gear comprises a quadrant gear, said second lever being connected to said quadrant gear to rotate said quadrant gear.

18. A motion transmitting device according to claim 17, including a link connected between said second lever and said quadrant gear and universal joint means at the connection of said link to said second lever, and means mounting said quadrant gear for rotation and for displacement of the axis of rotation toward and away from said second shaft.

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