United States Patent

Ryan

[15] **3,641,828**

[45] **Feb. 15, 1972**

[54] ROTARY-LINEAR MOTION CONVERTER

[72] Inventor: **John J. Ryan,** 18 Ellwood St., Glen Cove, L.I., N.Y. 11542

[22] Filed: **Aug. 28, 1970**

[21] Appl. No.: **67,944**

[52] **U.S. Cl.** **74/49,** 91/496, 417/273

[51] **Int. Cl.** **F16h 21/18**

[58] **Field of Search** .....74/49, 571; 123/43 C, 43 R; 91/496; 417/273

[56] **References Cited**

UNITED STATES PATENTS

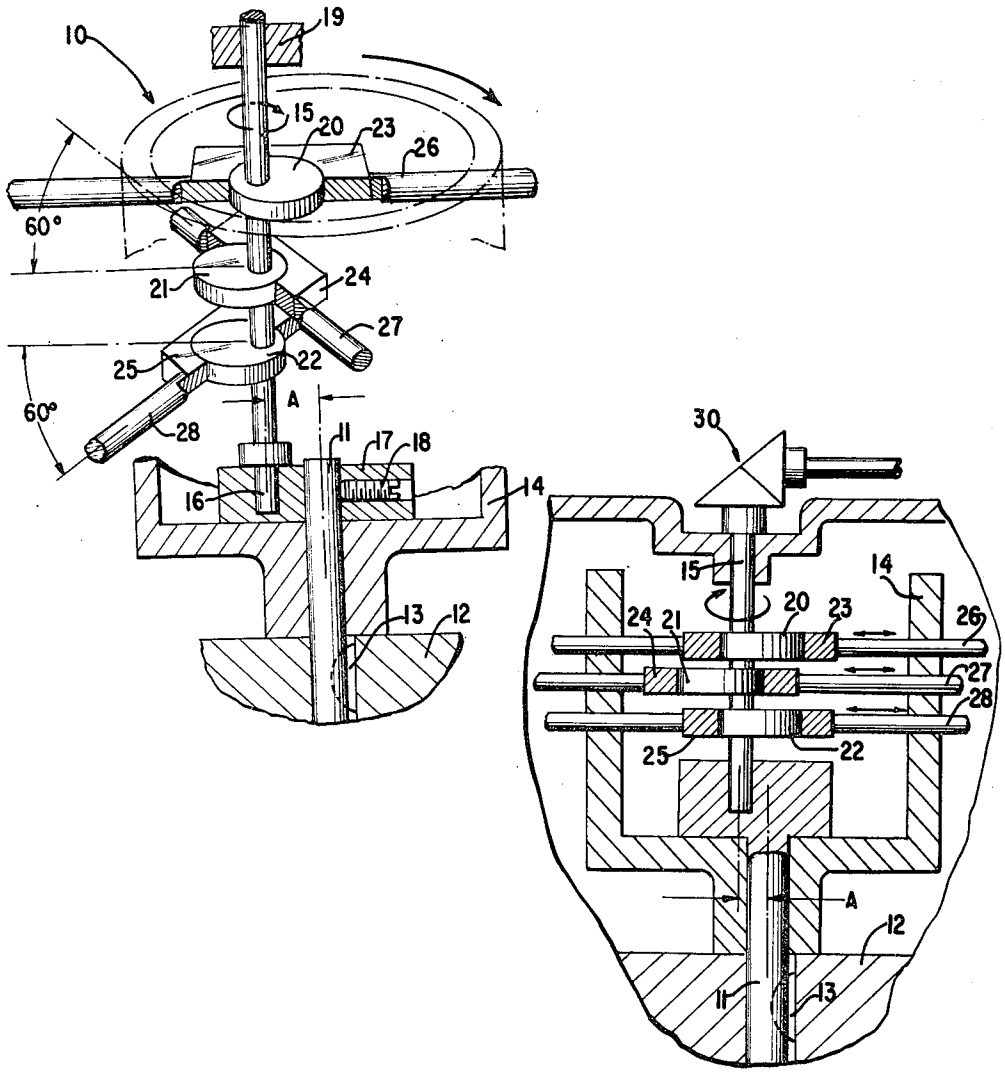
409,563	8/1889	Curtis	91/496
733,139	7/1903	Bullock	74/49
2,801,596	8/1957	Sewell	417/273
2,900,839	8/1959	McKintosh	74/571
2,936,632	5/1960	Palmer	74/49
3,176,667	4/1965	Hammer	123/43

Primary Examiner—William F. O'Dea
Assistant Examiner—Wesley S. Ratliff, Jr.
Attorney—Smythe & Moore

[57] **ABSTRACT**

A rotary-linear motion converter has a rotatable housing and a shaft within the housing offset from the rotary axis thereof and having a number of journal or cam discs eccentrically fixed on the shaft. The journal discs are rotatably positioned within corresponding openings in a corresponding number of slide members which are slidably mounted in the housing for reciprocatory movement so that rotation of the shaft causes the slide members to reciprocate and to rotate the housing.

4 Claims, 8 Drawing Figures



PATENTED FEB 15 1972

3,641,828

SHEET 1 OF 3

FIG. 2

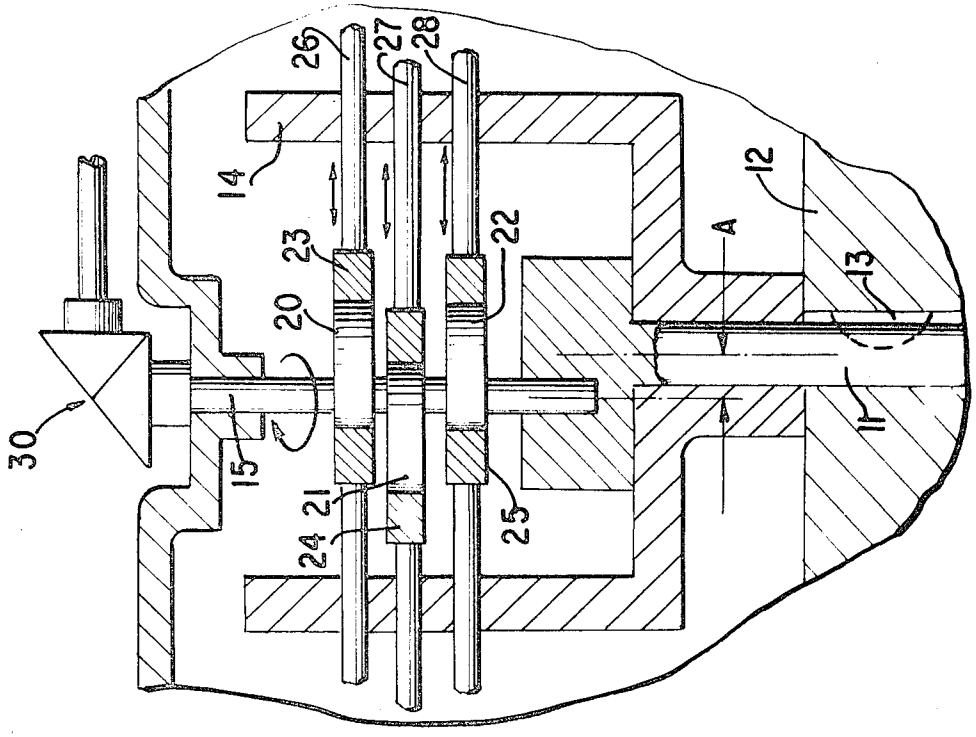
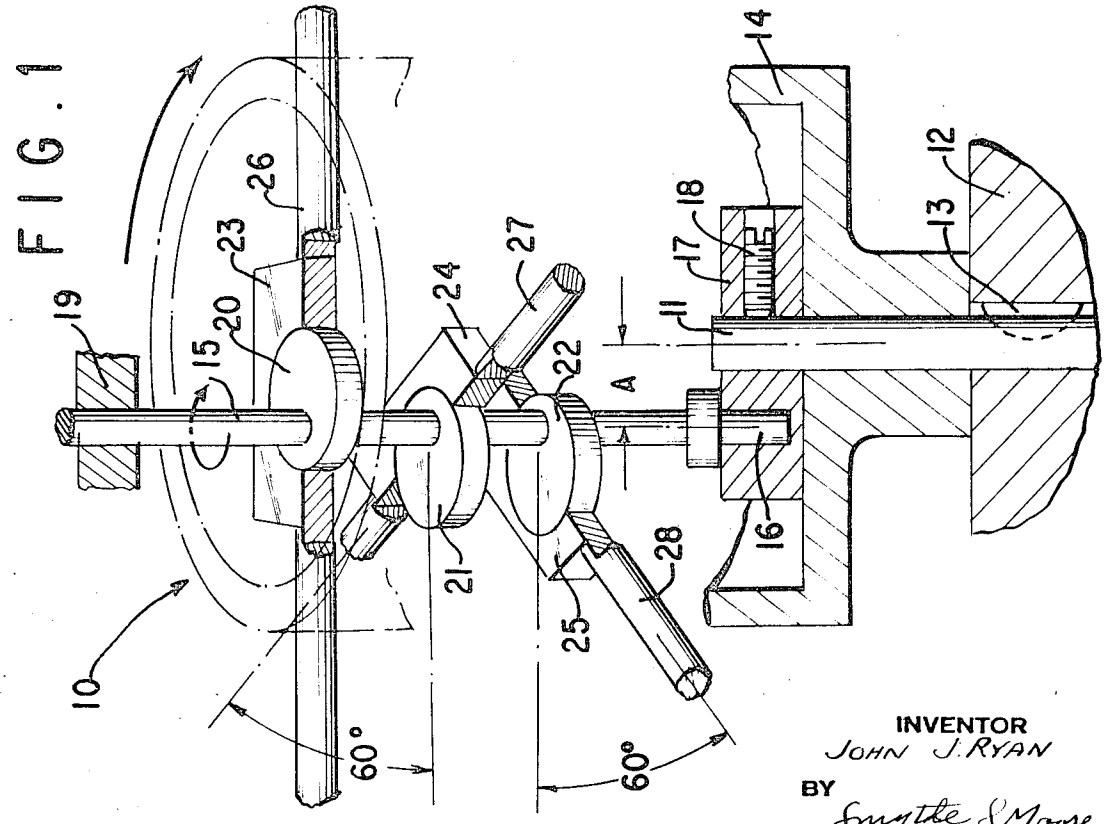
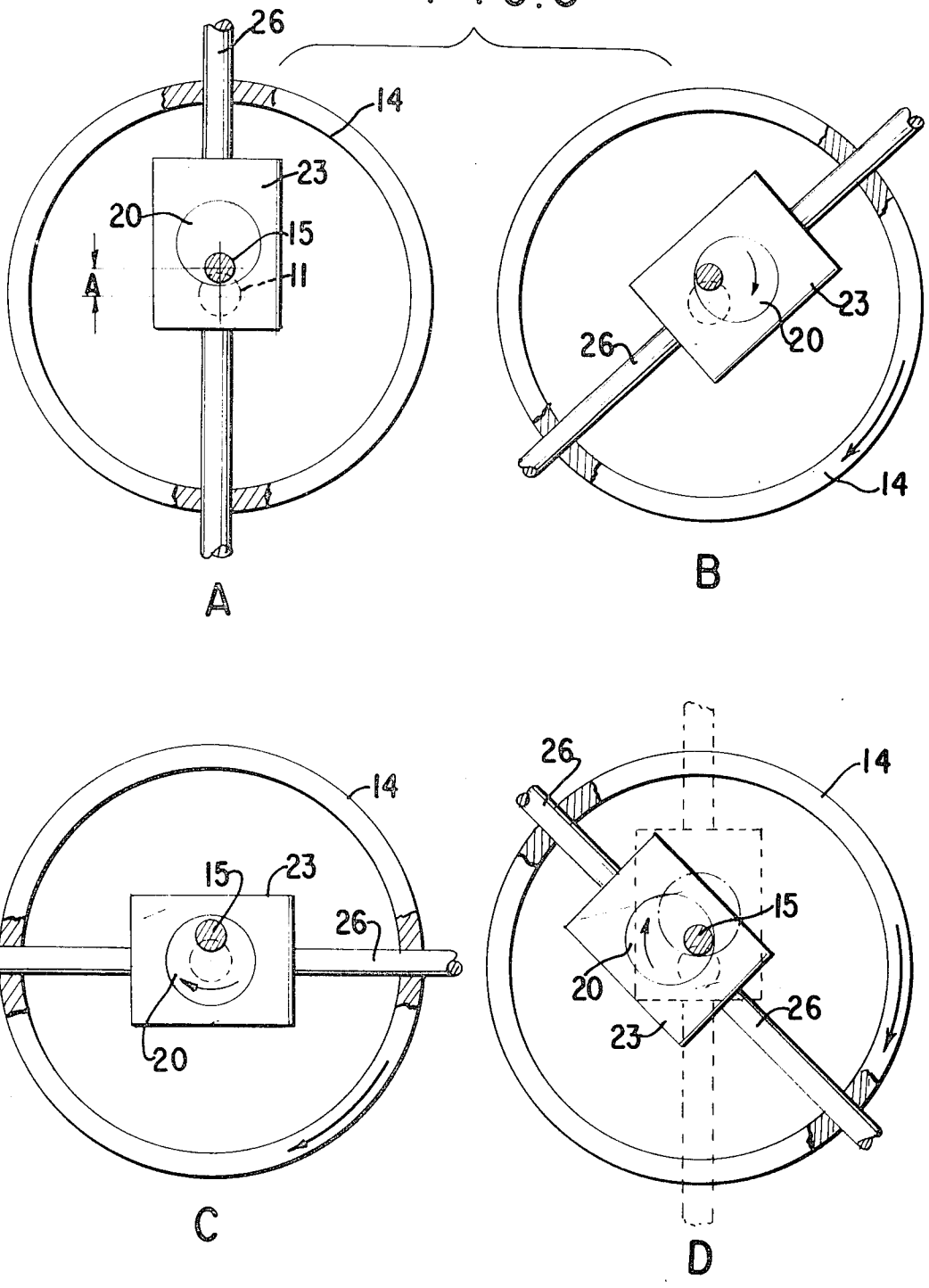


FIG. 1



INVENTOR
JOHN J. RYAN
BY
Smythe & Moore
ATTORNEYS

FIG. 3



INVENTOR
JOHN J. RYAN

BY
Smyth & Moore
ATTORNEYS

FIG. 4

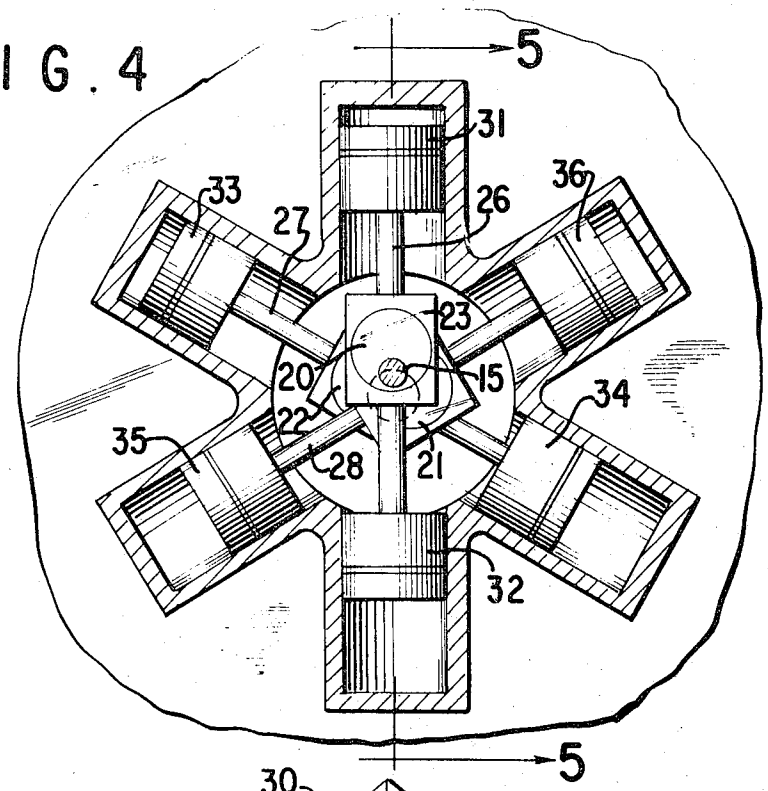
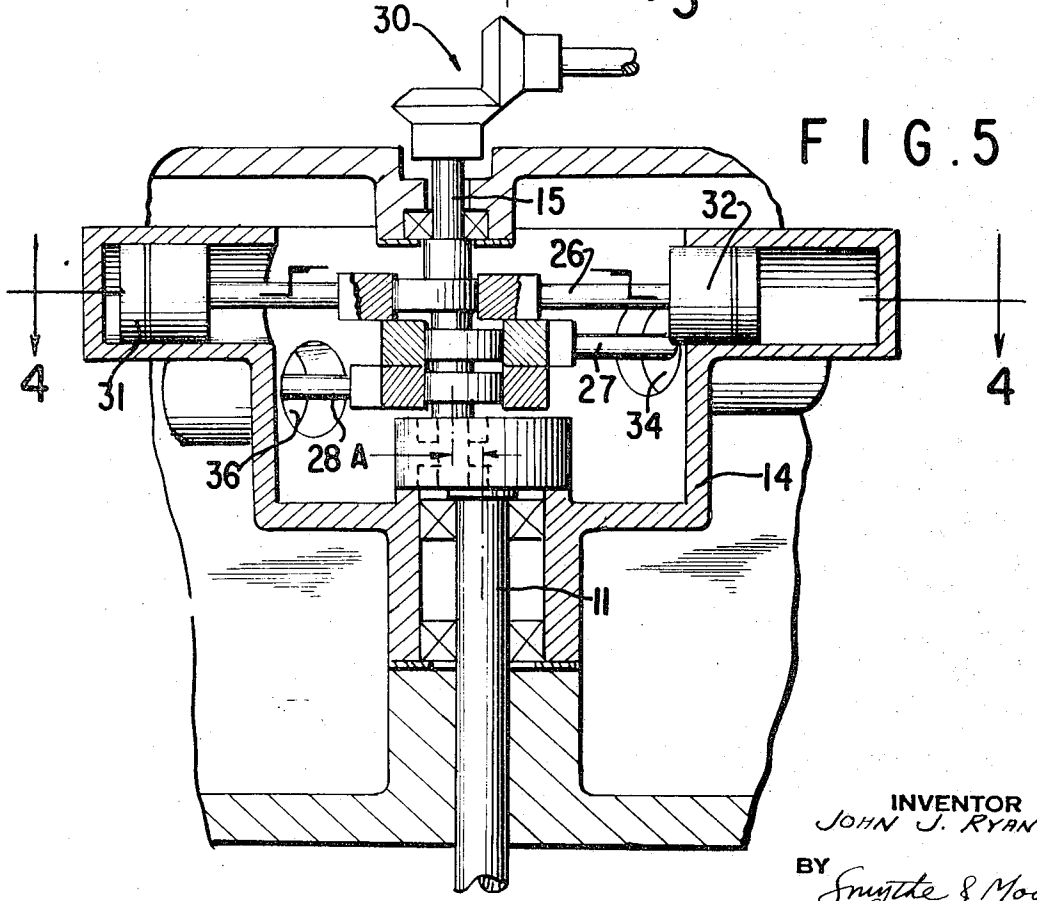


FIG. 5



INVENTOR
JOHN J. RYAN

BY Smythe & Moore
ATTORNEYS

ROTARY-LINEAR MOTION CONVERTER

Mechanisms and mechanical movements have been known for converting rotary to linear reciprocating motion and vice versa. Such mechanisms have also been developed where a plurality of axes are involved along each of which there occurs linear movement. Such mechanisms are generally characterized by excessive side or lateral forces which produce an unduly rapid wear of the moving components. The wear is particularly objectionable in those forms of mechanism, such as a pump having a piston and cylinder, which must deliver a precise amount of fluid, or in a fuel pump, which has to deliver precise amounts of liquid fuel to an internal combustion engine. The induced side load on the pistons and any other type of piston mechanism, such as used in pumps, engines, and compressors, tend to produce a wear pattern which is out of round and rapidly reduces the sealing characteristics of the piston within the cylinder. In those mechanisms where the side load can be eliminated, the wear pattern remains round so as to result in a considerably longer piston-cylinder operating life.

A further disadvantage of such prior art mechanisms is that a considerable number of components are required in translating linear motion from a cylindrical to rotary motion of a crankshaft. The use of connecting rods between the pistons and the crankshaft sets up excessive side loads on the sliding member which in the case of engines and pumps is usually a piston within a cylinder. The result is a nonsymmetrical wear between the sliding components which is objectionable in many mechanisms.

It is an object of the present invention to provide an improved mechanism for converting rotary to linear motion and vice versa.

It is another object of the present invention for providing a mechanism for converting rotary to reciprocating motion along a plurality of axes.

It is still another object of the present invention to provide arrangement useable in an internal combustion engine wherein reciprocating motion is converted to rotary motion but which utilizes a considerably fewer number of parts than a conventional engine.

According to one aspect of the present invention, a mechanical movement or mechanism for converting rotary to linear motion may comprise a housing rotatably mounted on a housing shaft and a second shaft within the housing and extending from the housing shaft but offset therefrom. A plurality of cam discs are fixed on the second shaft with their centers offset from the center of the second shaft and equally spaced from each other around the second shaft. Each journal or cam disc is offset a distance equal to the offset distance between the second shaft and the housing shaft. A corresponding plurality of slide members are slidably mounted for reciprocatory movement in the housing, and each slide member has an opening therein for rotatably receiving one of the journal discs. The slide axes of the slide members are equally spaced around the second shaft.

In operation, the housing shaft may be fixed against rotation, and the second shaft may be rotated whereby the second shaft will follow a planetary path around the housing shaft, and the slide members will reciprocate within the housing.

Other objects, advantages and features of the present invention will be apparent from the accompanying description and drawings, which are merely exemplary.

In the drawings:

FIG. 1 is an exploded view showing schematically a mechanism according to the present invention having three reciprocable axes;

FIG. 2 is a vertical sectional view of the mechanism shown in FIG. 1;

FIG. 3A–D schematically illustrate positions of a slide during a cycle of rotation of a cam disc;

FIG. 4 is a plan view showing schematically an engine utilizing the mechanism in FIG. 1 with portions of the engine being shown in section; and

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4.

Proceeding next to the drawings wherein like reference symbols indicate the same parts throughout the various views, a specific embodiment of the present invention will be described in detail.

As may be seen in FIG. 1, a mechanism according to the present invention is indicated generally at **10** and comprising a housing shaft **11** which is fixed against rotation within a mount **12** by means of a key **13**. A cylindrical housing **14** is rotatably mounted on the housing shaft **11**.

A second shaft **15**, which is in effect a crankshaft, has one end **16** journaled in block **17** which is mounted on the end of the housing shaft **11** by means of a set screw **18**. The upper end of the shaft **15** may be rotatably supported in a journal **19**. The rotary axis of shaft **15** is parallel to that of shaft **11** but is offset therefrom by a distance A as indicated in FIG. **1**.

A plurality of circular journal discs **20**, **21** and **22** are fixed eccentrically on the shaft **15** with the centers of these discs being equally spaced from each other around the shaft. Where three cam discs are used, as in the embodiment of FIG. **1**, the centers of the discs are spaced 120° apart.

Each of the discs is rotatably received in a correspondingly shaped circular opening formed in blocks **23**, **24** and **25** which are slidably positioned by means of rods **26**, **27** and **28** in the cylindrical housing **14** for reciprocatory movement therein. A mounting or positioning of the shafts **26**, **27** and **28** in the housing **14** may be more clearly seen in FIG. **2**. The rods **26** to **28** may be connected to pistons within cylinders, as shown in FIG. **4**, or to other suitable devices.

In the operation of the mechanism of FIG. **1**, the shaft **11** is fixed against rotation and the housing **14** is rotatable about this shaft. The shaft **15** can be rotated by any suitable mechanism such as through a suitable gearing or drive arrangement indicated generally at **30** in FIG. **2**. The axis of rotation of the shaft **15** is now fixed, and the shaft **15** will rotate with the discs **20**, **21** and **22** also rotating. As may be seen in FIG. **3**, rotation of the disc **20** will cause the slide member shaft **26** to rotate to the positions successively shown in FIGS. **3A–D**. Upon a complete revolution of disc **20**, the slide shaft **26** will be rotated one-half revolution to the position shown in FIG. **3D**. At the same time, the shaft **26** will reciprocate within the housing **14**. The housing **14** will thus rotate at one-half the speed of shaft **15**.

It is to be noted that the center of disc **20** is offset from the central axis **15** by a distance equal to the offset distance A between shaft **15** and housing shaft **11**. The same relationship exists for discs **21** and **22**.

While the embodiment of the mechanism, as illustrated in FIG. **1**, utilizes three discs, it is pointed out that two equally spaced discs could also be used. Regardless of the number of discs employed, the centers of these discs are spaced equally about the shaft **15**.

As an alternative arrangement of the mechanism in FIG. **1**, the housing **14** could be fixed against rotation and the housing shaft **11** driven through a suitable source of input power. As a result, the rotation of shaft **11** will rotate the block **17** and, accordingly, the shaft **15** will follow a planetary path while rotating at twice the speed of shaft **11**. The rotation and planetary movement of shaft **15** will bring about reciprocatory movement of the several slide member shafts **26**, **27** and **28** by the interaction of the respective discs within their slide blocks **23**, **24** and **25**, respectively.

Reference to FIGS. **4** and **5**, there is shown a modification of the mechanism of FIG. **1** wherein pistons are mounted on the ends of the several slide members. As may be seen in FIG. **4**, pistons **31** and **32** are mounted on opposite ends of slide rod **26**, pistons **33** and **34** on the opposite ends of slide rod **27** and pistons **35** and **36** on the ends of slide rod **28**. Each of these pistons reciprocates within a respective cylinder as shown in FIG. **4** with suitable mechanism being provided for the firing and supplying of fuel to each of the cylinders.

The pistons on opposite ends of a slide rod are rigidly connected so that, in effect, there are three pairs of pistons with each pair of pistons being rigidly connected to each other through a slide rod.

In the operation of the engine of FIGS. 4 and 5, the firing of the cylinders in the appropriate order will cause the reciprocation of the respective slide members 26 to 28. These successive reciprocating movements of the slide rods will cause the shaft 15 to move in a planetary path and, as a result, will rotate the shaft 11 which functions as the output shaft.

It will be understood that various details of construction and arrangement of parts may be made without departing from the spirit of the invention except as defined in the appended claims.

What is claimed is:

1. In a mechanical movement for converting rotary to linear motion, and vice versa, the combination of a housing shaft, a housing rotatably mounted on said housing shaft, a second shaft within said housing and extending from said housing shaft but offset therefrom, a plurality of discs fixed on said second shaft with their centers being offset from the center of the second shaft and equally spaced from each other around said second shaft, each disc being offset equal to the offset distance between said second shaft and said housing shaft, a corresponding plurality of slide members slidably mounted in said housing and each having an opening rotatably receiving

one of said discs therein, the slide axes of said slide members being equally spaced around said second shaft.

2. In a mechanical movement as claimed in claim 1 wherein said housing shaft is fixed against rotation and said second shaft is rotated about its axis whereby said housing will be rotated about the housing shaft under the action of the discs rotating within said slide members which slide said housing and rotate about a moving center of rotation.

3. In a mechanical movement as claimed in claim 1 wherein said housing is fixed against rotation and said housing shaft is rotated whereby said second shaft will follow a planetary path while rotating at twice the speed of said housing shaft and said slide members will reciprocate within said housing.

4. In a mechanical movement as claimed in claim 3 with there being a piston on each end of a slide member and a cylinder receiving each piston, means operatively associated with each cylinder and piston for actuating said cylinder and piston in a cycle of an internal combustion engine whereby the reciprocating movement of said slide members rotates said housing shaft.

* * * * *