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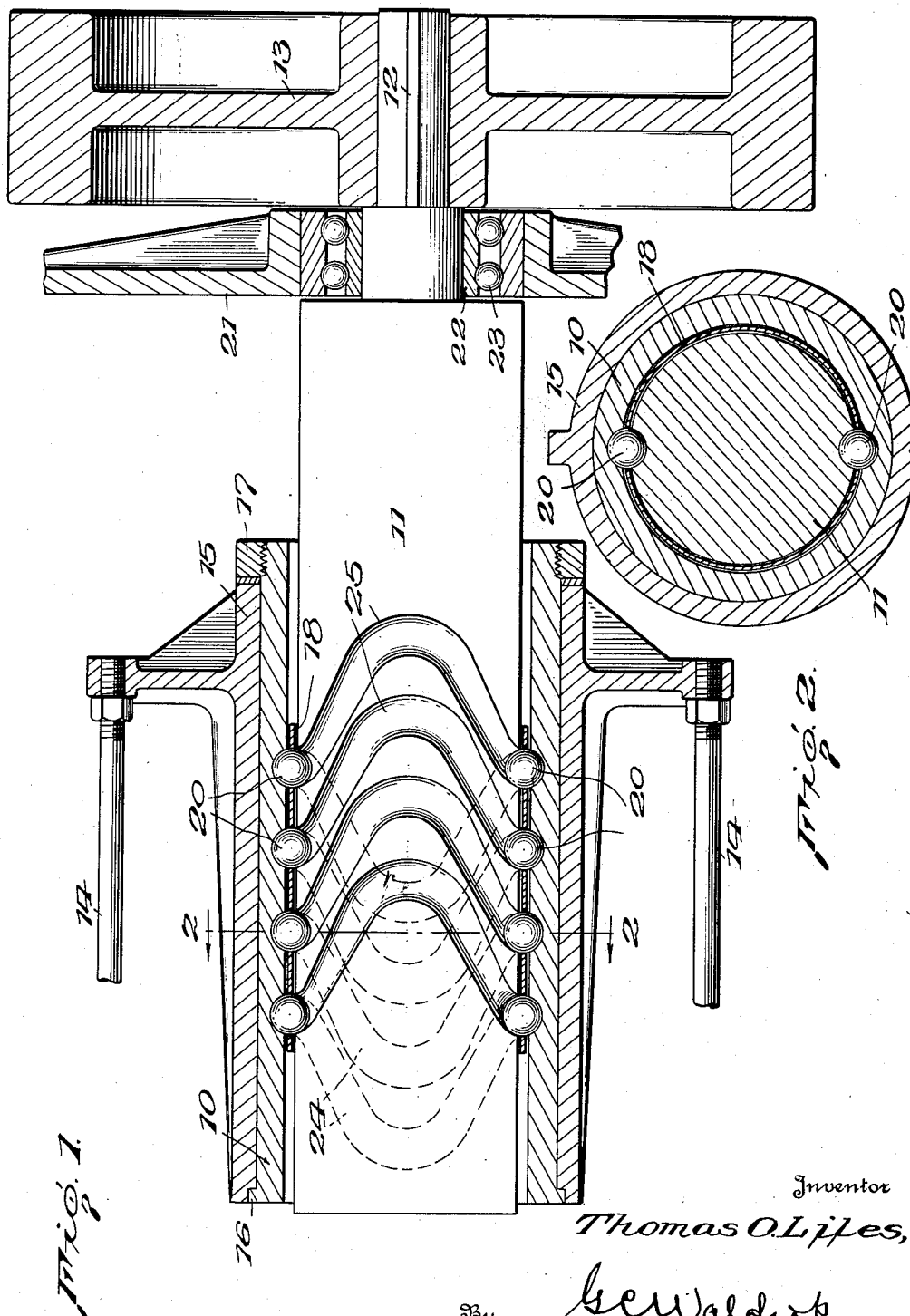
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MECHANICAL MOVEMENT

Filed May 5, 1933

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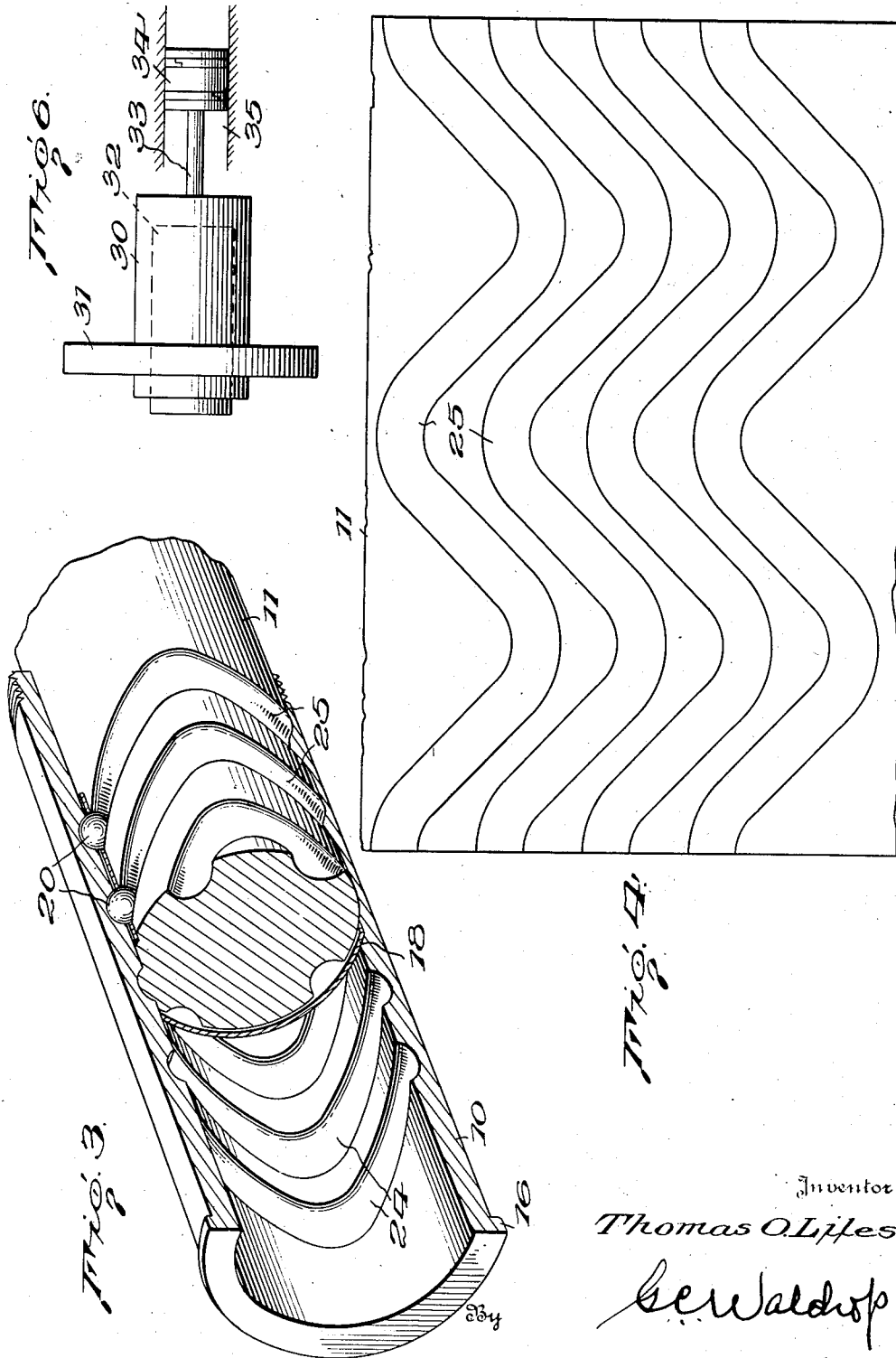
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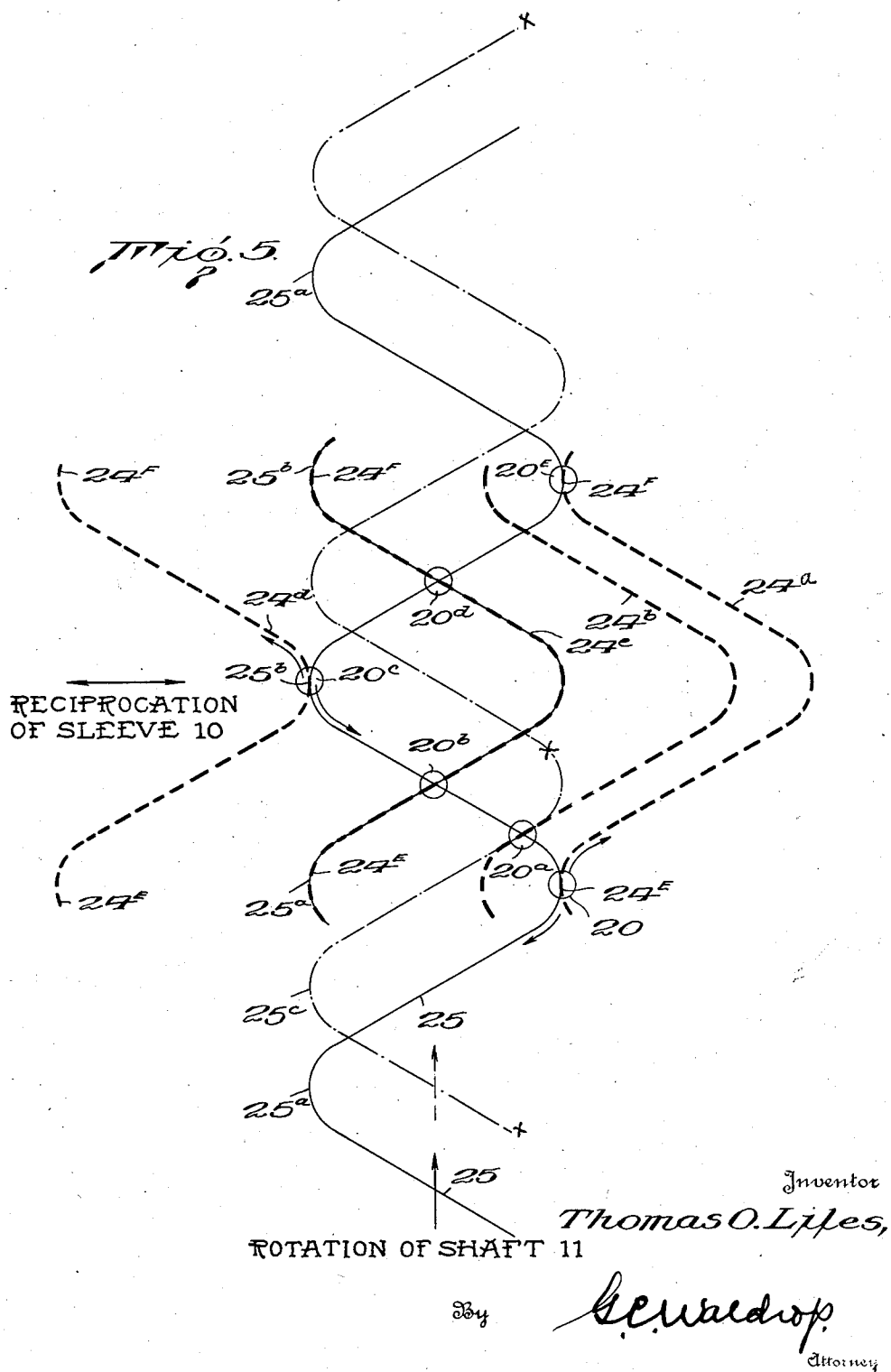
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UNITED STATES PATENT OFFICE

1,985,901

MECHANICAL MOVEMENT

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17 Claims. (Cl. 74—57)

This invention relates to mechanical movements and more particularly to a mechanism for converting or changing movement of one kind into movement of another. In its more intense aspect it is directed to the inter-conversion of rotary and linear or reciprocatory motions.

In order that a clearer perception of the present invention may be had, it is known that various means have been devised from time to time for converting rotary motion into linear motion, or vice versa, depending upon the relative location of the driving and driven elements in the mechanism. The present invention is directed more especially to that type of mechanism in which the relative rotative movement of one part, for example, will produce a multiple of that movement in a reciprocatory manner of the other member.

Accordingly, one of the objects of the present invention is to provide a simple and practical mechanical movement of the above general character, having relatively few parts which may be inexpensively manufactured and assembled.

A further object is to provide a mechanism of the above character in which the motive means may be applied to either of the two main parts for producing a driven movement of the other.

A further object is to provide mechanism of the last above-mentioned character, in which the parts are so positioned and arranged as to produce an even torque on one part when acted upon by the other.

A further object is to provide a reliable and efficient mechanism which will be durable in construction and substantially frictionless in operation.

Other objects will be in part obvious from the annexed drawings and in part hereinafter indicated in connection therewith by the following analysis of this invention.

This invention accordingly consists in the features of construction, combination of parts and in the unique relation of the members and in the relative proportioning and disposition thereof, all as more completely outlined herein.

To enable others skilled in the art to comprehend fully the underlying features of this invention that they may embody the same by the numerous modifications in structure and relation contemplated by the invention, drawings depicting a preferred form of the invention have been annexed as part of this disclosure, and in such drawings like characters of reference denote corresponding parts throughout all of the views, in which—

Fig. 1 is a sectional elevational view illustrating one form or embodiment of the device;

Fig. 2 is a transverse sectional view taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of the two main elements, partly in section or partly broken away;

Fig. 4 is a development of one of the cylindrical members showing the relative shape and location of the grooves, four in number;

Fig. 5 is a diagrammatic or schematic view showing successive positions on the center lines of two cooperating cam grooves, one on the inner or rotating member and the other on the outer or reciprocating member and their relative positions after having traversed through successive quadrants or periods of motion;

Fig. 6 illustrates a modification of the mechanism shown in Fig. 1.

It is unnecessary to go into the numerous applications and uses of a mechanical movement of this character; in fact, it can be used in almost any mechanism or machine where movement of one kind is adapted to be converted into movement of another kind wherein these movements are of rotary and reciprocatory character.

In Fig. 1 wherein is illustrated in its simplest form one embodiment of the invention, let it be assumed that 10 indicates an outer cylindrical sleeve conveniently secured against rotation, which, for convenience, will be termed the driving member, while 11 indicates a shaft centrally and telescopically disposed with respect to the sleeve 10 and having keyed thereto, as at 12, a fly wheel 13 or the like from which power is delivered. Associated with the sleeve 10 are two rods 14 which are connected to any suitable source of power, such as a gas or steam engine cylinder, for producing reciprocation of the sleeve, and this sleeve is adapted, through cam mechanism hereinafter described, to cause a rotary movement of the shaft 11 and the driven fly wheel 13. Conversely, the fly wheel 13 may be driven from any suitable source of power, such as a motor, thereby to produce a reciprocatory movement of the parts 14.

For convenience of assembly, the sleeve 10 may be formed of two or more parts permitting of ready assembly about the shaft 11 and over balls 20, hereinafter referred to. This sleeve reciprocates upon the shaft 11 and is provided with an outer member 15 adapted to be slipped endwise over the sleeve to abut a collar 16 at one end and to be held in locked position by means of annulus 17. The internal diameter of the sleeve 10 is preferably slightly larger than the

external diameter of the shaft 11, although the parts may be of substantially the same diameter, making such allowances as may be necessary for working clearance. By having a slight difference in the diameter as herein indicated, there is provided room for a spacing member 18 of relatively thin sheet metal, thereby to carry or hold a plurality of ball or roller bearings 20. These bearings are also applied equidistantly about the shaft, thereby to hold the shaft and sleeve properly centered, and the balls or rollers when so positioned provide an even and uniform transmission of power from one to the other, free from torsional strains. The spacing member or ball retainer 18 may be cylindrical in shape as shown more clearly in Fig. 2.

There is indicated at 21 a supporting frame of any desired character, depending upon the use to which the mechanical movement is put, and the shaft 11 is provided with bearings 22 and rollers 23 thereby to eliminate friction as much as possible.

The internal surface of the sleeve 10 is provided with a series of cam grooves 24 substantially hemispherical in cross-section, and in which balls or rollers are adapted to have relative movement. These grooves extend entirely around the inner surface of the sleeve, thereby to have a wave-like motion as more clearly shown in Fig. 4, illustrating a development of these grooves. The external surface of the shaft 11 is also provided with complementary or co-acting grooves 25 which are similar in size and shape except for such changes as may be necessary due to differences in the internal and external diameters of the sleeve and shaft, respectively, but these grooves are operatively oppositely positioned as clearly appears in either Fig. 1 or Fig. 3, or Fig. 5.

As shown in Fig. 5, illustrating the relative position of a single wave of each of these grooves 24 and 25 as the shaft rotates with respect to the reciprocatory movement of the sleeve 10, for example, we find that the rollers or balls drift laterally back and forth as one part reciprocates to cause rotation of the other, or the grooves in the two main members cooperate with the interposed roller resulting in a progressive reciprocatory movement of the sleeve as the shaft rotates twice the relative movement of the rollers, or vice versa. When the rollers reach the crest of the cam grooves, then an opposite movement of the reciprocating member occurs causing continued rotative movement of the shaft, thus completing the cycle.

Referring now particularly to Figure 5 in which groove 24 of the reciprocating element 10 is represented by the line of dashes and its position at one end of reciprocative movement as illustrated in the figure as 24a, it will travel in the direction of the double pointed arrow to a position indicated as 24b, 24c and 24d in one direction, then in reverse a like distance. In Figure 5 it will be noted that the movement laterally of sleeve 10 is equal to twice the distance between a line drawn through the apices or points of the grooves. The full line represents the groove 25 of the shaft 11, it being noted that for purposes of a simple and clear description of the relative action between the parts a single groove each is shown. It will be further noted that along the groove 24 from 24e to 24f is one-half of a single groove 24. Likewise the distance from 25a to 25b is one-half of groove 25, the two points 25a and 25b being on opposite sides of shaft 11.

Starting with ball 20 at 24e of groove 24, as that groove moves toward position 24b the ball will travel along groove 24 in the direction indicated by the arrow pointing along groove 24 from point 24e and will travel along groove 25 from point 24e in the direction of the arrow along that groove from point 24e, but will drift in the direction of rotation of shaft 11, also in the direction of movement of sleeve 10, so that when sleeve 10 has brought groove 24 to the position indicated at 24b, shaft 11 will have been caused to rotate and groove 25 will occupy the position indicated as 25c by the XXX line, and ball 20 will then occupy position 20a. As sleeve 10 brings groove 24 to the position indicated at 24c, shaft 11 will have been caused to rotate in the direction of the arrow 25 and groove 25 will occupy a position directly facing groove 24, in which position on the Fig. 5, 25a coincides with 24e and 25b coincides with 24f, and ball 20 occupies the position indicated at 20b. When sleeve 10 moves to the end of its stroke indicated at 24d, ball 20 will then occupy the position 20c, shaft 11 having been rotated one-half revolution, the point 25a now occupying the position shown as 25b, Fig. 5, while ball 20 has moved about the shaft 11 a distance equal to one-quarter of its circumference and has moved laterally of sleeve 10 a distance of one-half of the distance of the travel of sleeve 10.

On the return stroke of the sleeve 10, the shaft continuing to rotate in its same direction, the ball 20 from point 20c will take the direction along groove 25 indicated by the arrow along the groove 25 at 20c and along groove 24 as indicated by the arrow along groove 24 at point 20c. When groove 24 has returned to the position indicated at 24c, groove 25 again has moved into a position opposite thereto and ball 20 has moved into the position 20d, and moves on to position 20e at the end of the stroke returning sleeve 10 to its original position, while shaft 11 has been caused to rotate another one-half revolution and points 25a and 25b occupy their original respective positions.

It will be noted that while sleeve 10 has completed two strokes or cycles and returned to its original position, shaft 11 has been caused to rotate one complete revolution and ball 20 has moved to a point with relation to shaft 11 exactly opposite from its starting point.

With two balls 20 in grooves 24 and 25, one each at 24e and 24f, their actions would coincide throughout and the ball at point 24e would arrive at 24f, and the ball 20 originally at 24f would arrive at 24e on one complete revolution of shaft 11.

It of course is readily understood that any number of grooves 24 and 25 may be employed as desired and that the action of balls 20 would be the same in each groove. Also that the number of points in the grooves may be varied to effect any rotation of the shaft desired relative to the reciprocating action of the sleeve.

While I have described in detail the action of my mechanical movement when the sleeve is reciprocated, while secured against rotation, to cause rotation of the shaft, the balls act identically in imparting reciprocatory motion to the sleeve should the shaft be rotated.

The inertia of the moving parts tends to free the balls from dead centers at the end of the stroke of the reciprocative element.

These grooves, as herein shown, are substantially of the harmonic motion type having uni-

formly accelerated and retarded end motions in order to prevent shocks when the direction of motion of one member, that is, the reciprocating sleeve, for example, changes, in order to obtain a gradual change of velocity of the sleeves at the ends of the period of movement and to give a uniform rotative movement of the shaft when and if the shaft is the driven member. Conversely, if the shaft is the driven member, this would probably be operated at a uniform rate of speed as by a motor, for example, in which case the sleeve may be reciprocated without pounding at the ends of its stroke. Modification of the grooves, however, and the resulting movement may be employed to cause a pounding if actually desired.

In this mechanism, it is particularly to be noted that the roller means or balls 20 are of the freely floating type as distinguished from mechanisms of this broad general character where the roller occupies a relatively fixed position with respect to one of the members. This reciprocative movement, which is more apparent in Fig. 5, is equal to twice the movement heretofore produced where the roller occupied a fixed position. This ratio obviously may be modified by a modification of the cams, as for example, to produce twice the number of reciprocations relative to the number of rotations of the other main member by simply increasing the number of waves.

In Fig. 6 there is illustrated diagrammatically a modification in which the sleeve member 30 is provided with a fly wheel or gear 31 thereby to produce a rotation of the sleeve and a consequent reciprocation of the internal member or part 32, heretofore called the shaft. This element may be connected as by means of a piston rod 33, provided with a piston 34 traversing in any form of cylinder 35. Likewise, if motive means is applied to the piston 34 to cause a reciprocation of the part 32, then 31 becomes the driven member and delivers rotation.

From the above it will be seen, with particular reference to Fig. 5 showing developed but one wave in each member, that in operation, as one member rotates, the ball or roller 20 is carried relatively up one cam incline and relatively down the other cam incline, thereby drifting gradually towards one side and then the other, which causes a progressive lateral and multiple movement of the other member as the first member rotates.

From the foregoing it will be seen that the present invention contemplates a simple and practical mechanical movement, well adapted to accomplish among others all of the objects and advantages herein set forth. The device is strong and durable in construction and has relatively few parts which may be easily manufactured and quickly assembled. The device is equally applicable to a rotary driving or driven member, or to a reciprocating driving or driven member. In either case the relative movement of one member is a multiple of the relative movement of the other, as distinguished from prior devices of this general character.

Without further analysis the foregoing will so fully reveal the gist of this invention that others can by applying current knowledge readily adapt it for various applications without omitting certain features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and therefore such adaptations should and are intended to be comprehended within the

meaning and range of equivalency of the following claims.

I claim:

1. A mechanism for converting movement of one kind into movement of another, including a driving and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates.

2. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said floating roller and grooves permitting a relative movement of one member equal to a multiple of a developed movement of the other.

3. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said grooves being of the harmonic motion type.

4. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said grooves being of the harmonic motion type with portions giving uniformly accelerated and retarded changes in velocity of the member having a change in its direction of motion.

5. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said floating roller and grooves permitting a relative movement of one member equal to a multiple of a developed movement of the other, said grooves being of the harmonic motion type.

6. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said floating roller and grooves permitting a relative movement of one member equal to a multiple of a developed movement of the other, said grooves being of the harmonic motion type with portions giving uniformly accelerated and retarded changes in velocity of the member having a change in its direction of motion.

7. Apparatus for the inter-conversion of rotary and linear motion consisting of a pair of telescoping main members having their adjacent surfaces of cylindrical shape provided with co-acting grooves, a floating rotary member engaging with the grooves whereby upon linear move-

ment of one of the main members the other will be caused to rotate.

8. Apparatus for the inter-conversion of rotary and linear motion consisting of a pair of telescoping main members having their adjacent surfaces of cylindrical shape provided with co-acting grooves partially in registry, floating rotary members equidistantly spaced of the main members engaging with the grooves whereby upon linear movement of one of the main members the other will be caused to rotate, and means securing the floating rotary members longitudinally of the main members.

9. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, the grooves in each of the driving and driven members being plural in number and having a plurality of rollers in each groove.

10. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, each of the driving and driven members having a plurality of grooves and a plurality of rollers in each groove, and a spacer interposed between the driving and driven members for holding the rollers in relative position.

11. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said floating roller and grooves permitting a relative movement of one member equal to a multiple of a developed movement of the other, each of the driving and driven members having a plurality of grooves and a plurality of rollers in each groove.

12. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, said floating roller and grooves permitting a relative movement of one member equal to a multiple of a developed movement of the other,

each of the driving and driven members having a plurality of grooves and a plurality of rollers in each groove, and a spacer interposed between the driving and driven members for holding the rollers in relative position.

13. Apparatus for the inter-conversion of rotary and linear motion consisting of a pair of telescoping main members having their adjacent surfaces of cylindrical contour provided with co-acting grooves, a floating rotary member engaging with the grooves whereby upon linear movement of one of the main members the other will be caused to rotate, each of the driving and driven members having a plurality of grooves and a plurality of rollers in each groove.

14. Apparatus for the inter-conversion of rotary and linear motion consisting of a pair of telescoping main members having their adjacent surfaces of cylindrical shape provided with co-acting grooves, a floating rotary member engaging with the grooves whereby upon linear movement of one of the main members the other will be caused to rotate, each of the driving and driven members having a plurality of grooves and a plurality of rollers in each groove, and a spacer interposed between the driving and driven members for holding the rollers in relative position.

15. A mechanism for converting movement of one kind into movement of another, including a driving member and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a floating roller in the grooves whereby as one member rotates the other reciprocates, each of the driving and driven members having a plurality of grooves and a plurality of rollers in each groove, and a spacer interposed between the driving and driven members for holding the rollers in relative position both longitudinally and circumferentially.

16. A mechanism for converting movement of one kind into movement of another, including a driving and a driven member, one of which may be a grooved sleeve and the other a grooved shaft, and means operatively connecting said parts including a plurality of balls held circumferentially and longitudinally spaced in the grooves whereby as one member rotates the other reciprocates.

17. In a mechanism of the character described, in combination, a rotary member, a reciprocating member, both of which are provided with grooves and a floating roller connecting said members and traveling in said grooves whereby the rotary movement of one is converted into the reciprocating movement of the other.

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