

Feb. 25, 1930.

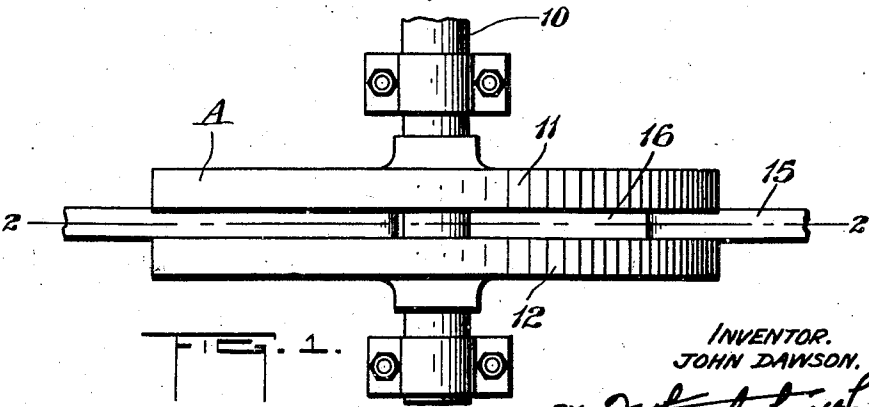
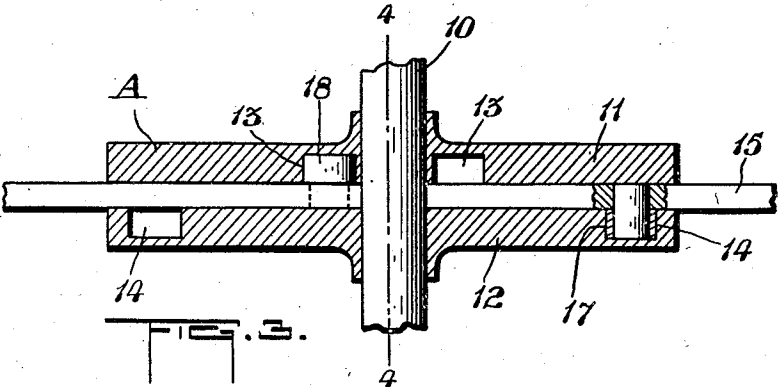
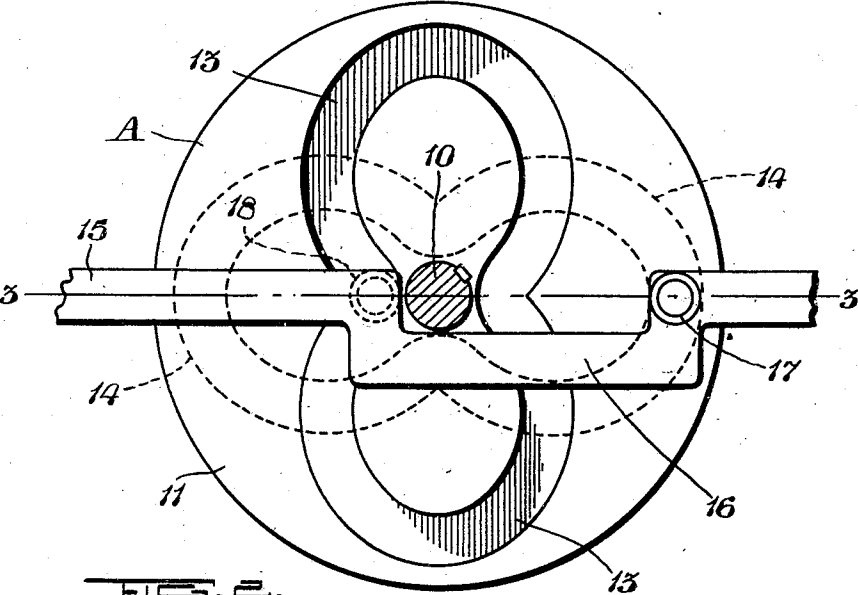
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1,748,443

CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 1



INVENTOR.
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Feb. 25, 1930.

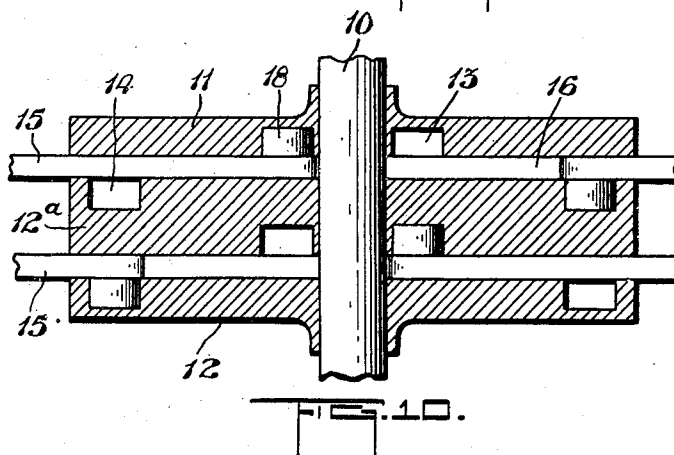
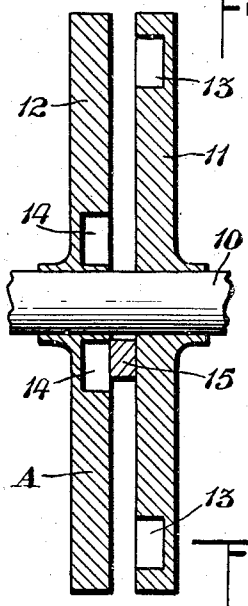
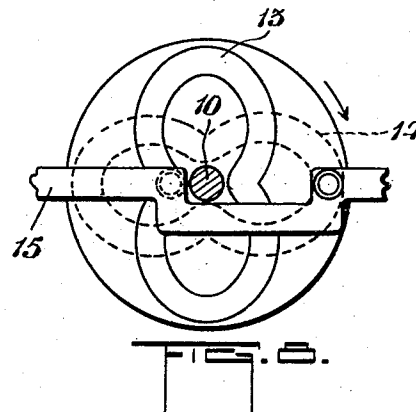
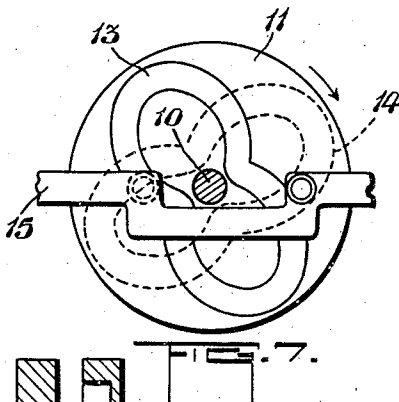
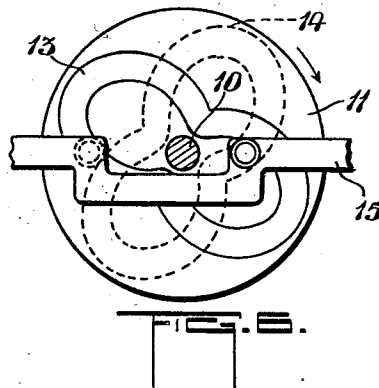
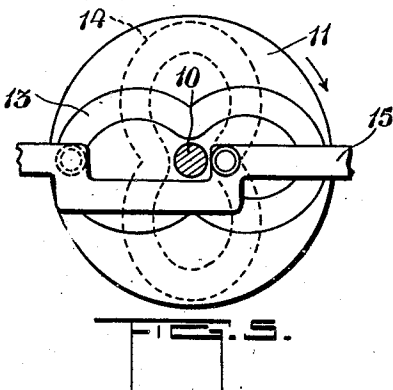
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1,748,443

CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 2



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1,748,443

CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 3

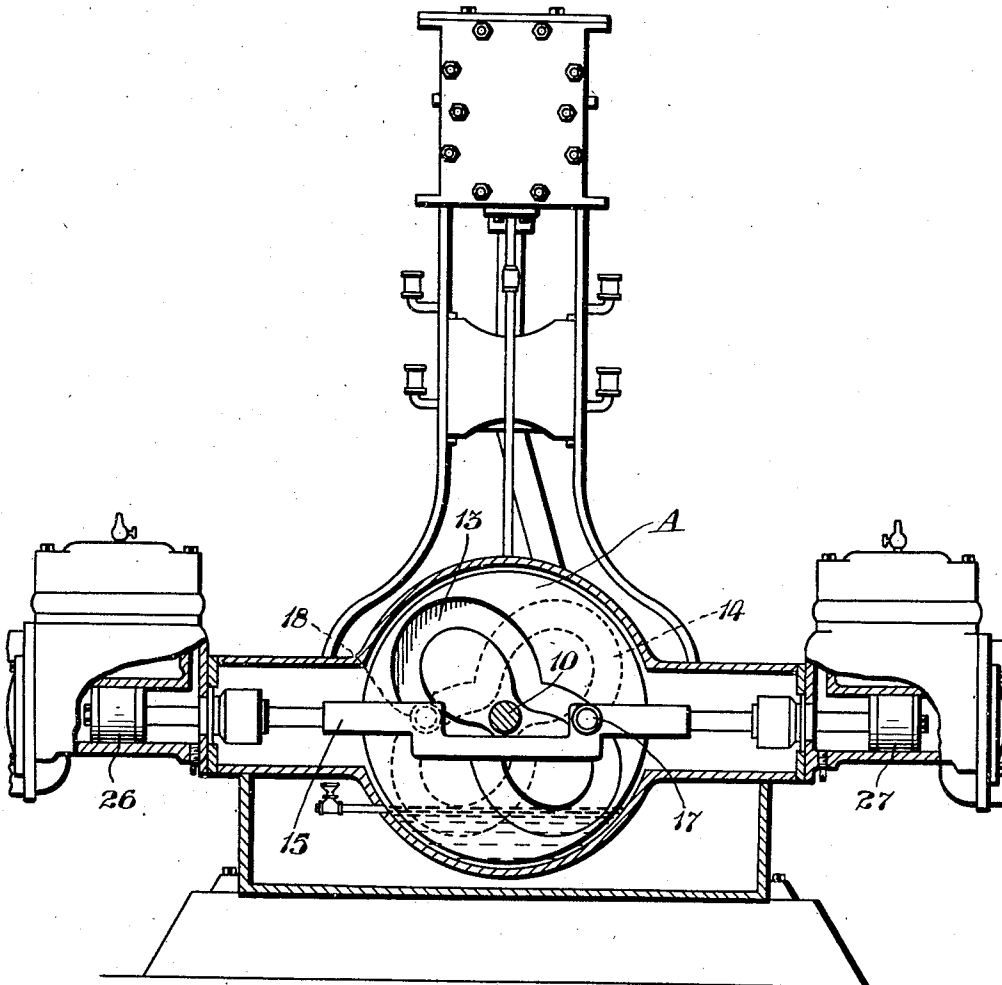


FIG. 3.

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1,748,443

CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 4

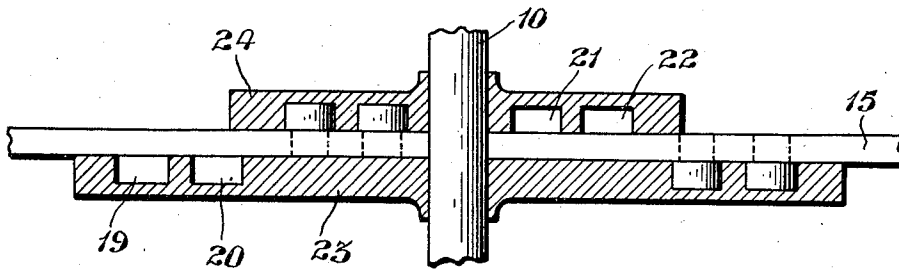


FIG. 12.

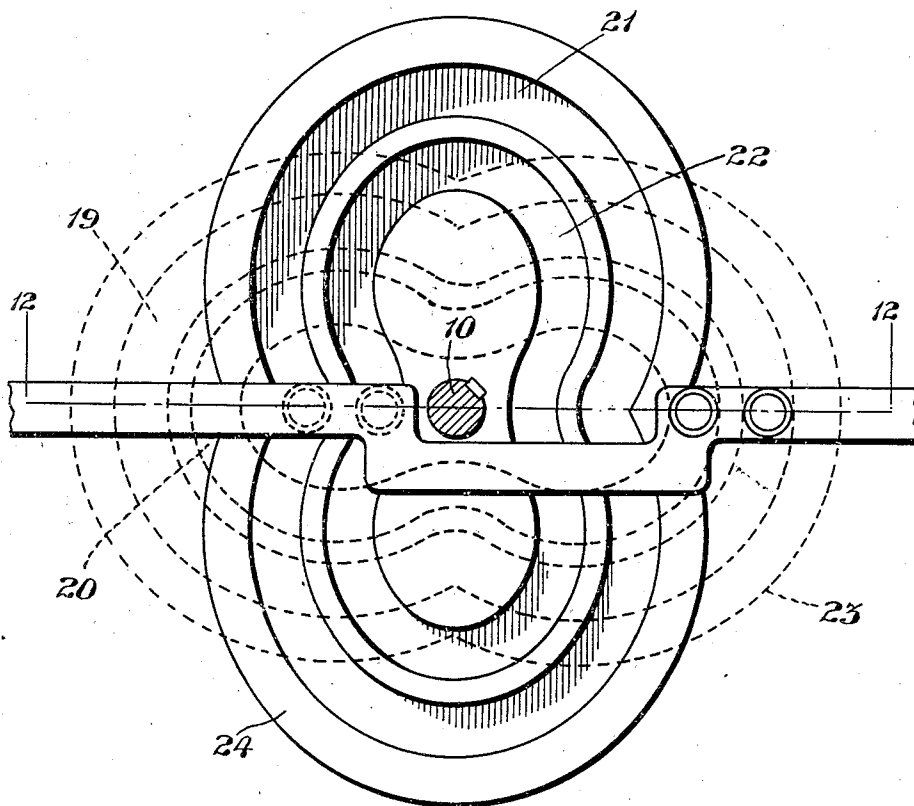


FIG. 11.

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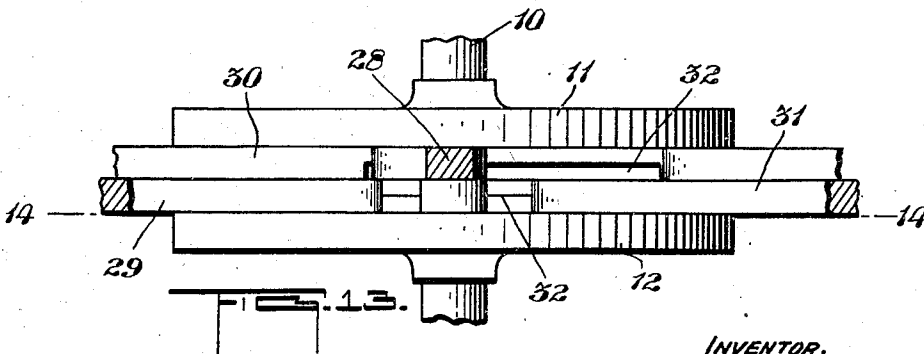
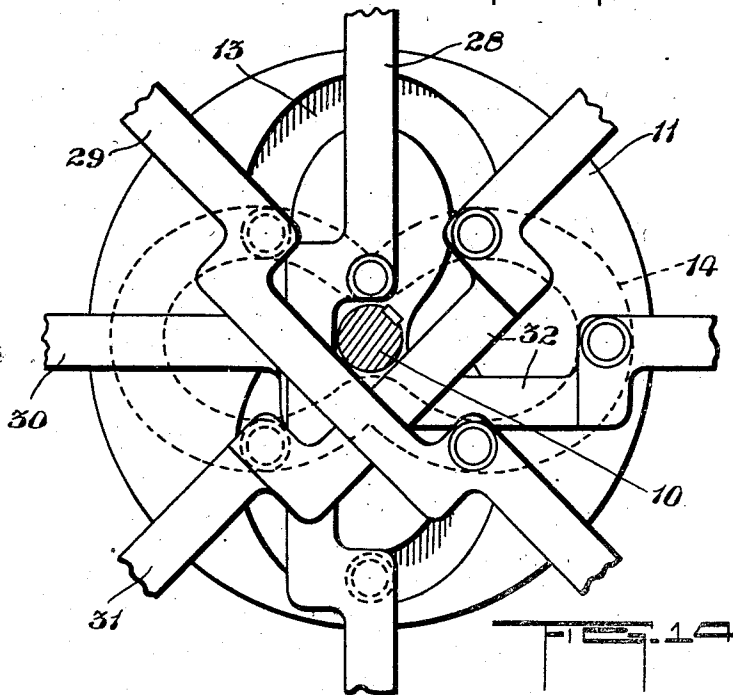
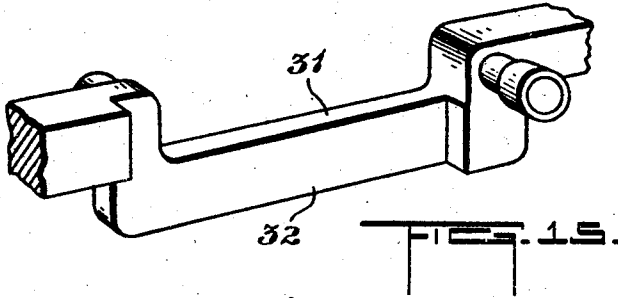
Feb. 25, 1930.

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CRANK MECHANISM

1,748,443

Filed May 9, 1927

12 Sheets-Sheet 5



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1,748,443

CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 6

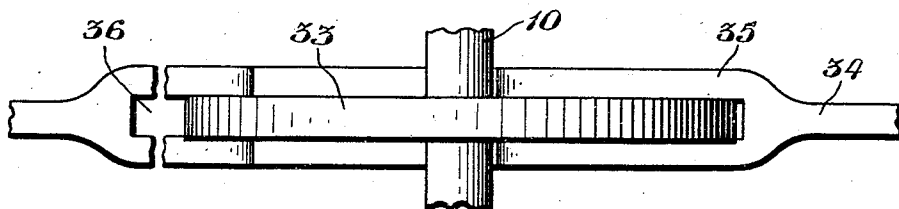
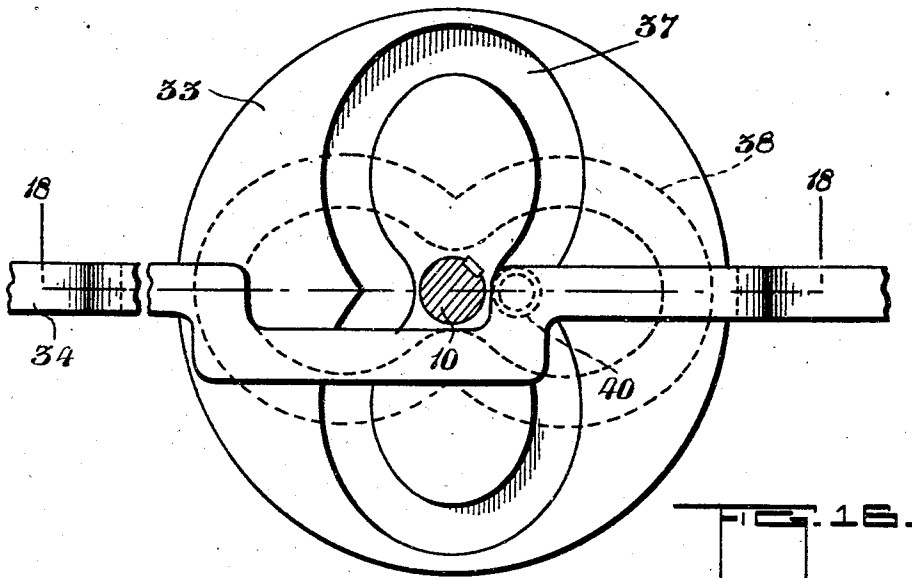


FIG. 17.

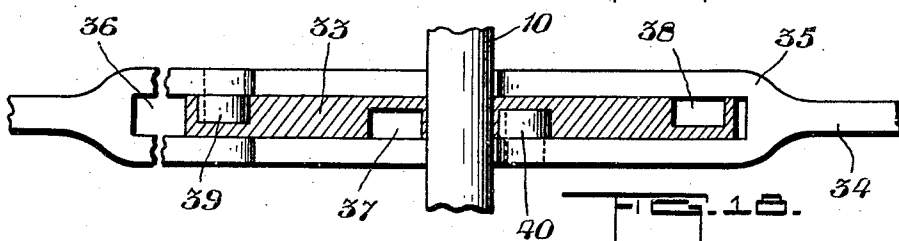


FIG. 18.

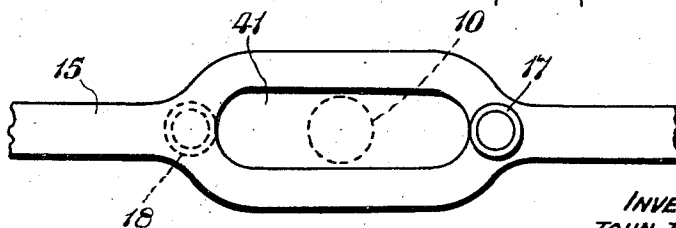


FIG. 19.

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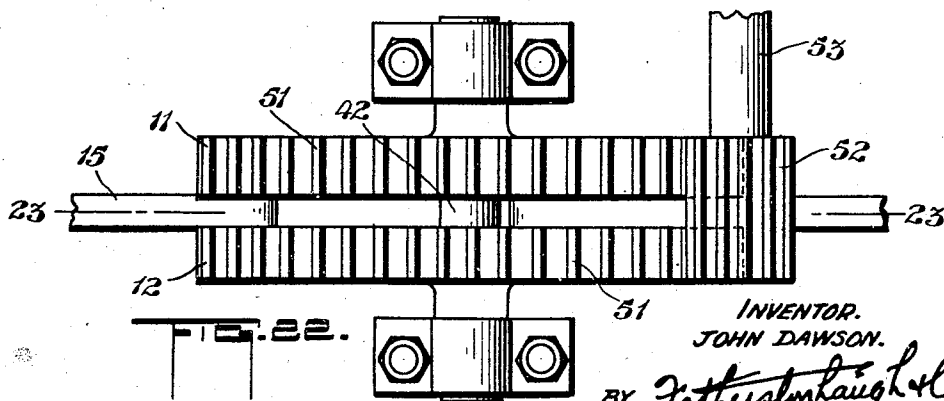
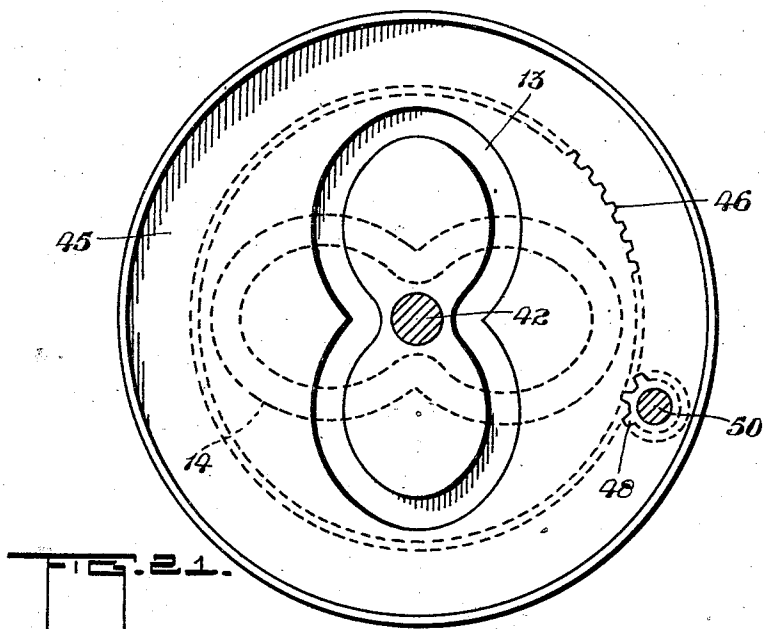
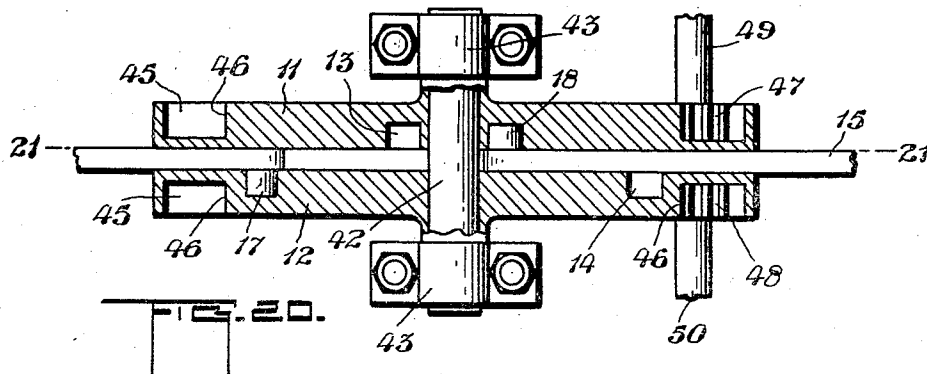
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CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 7



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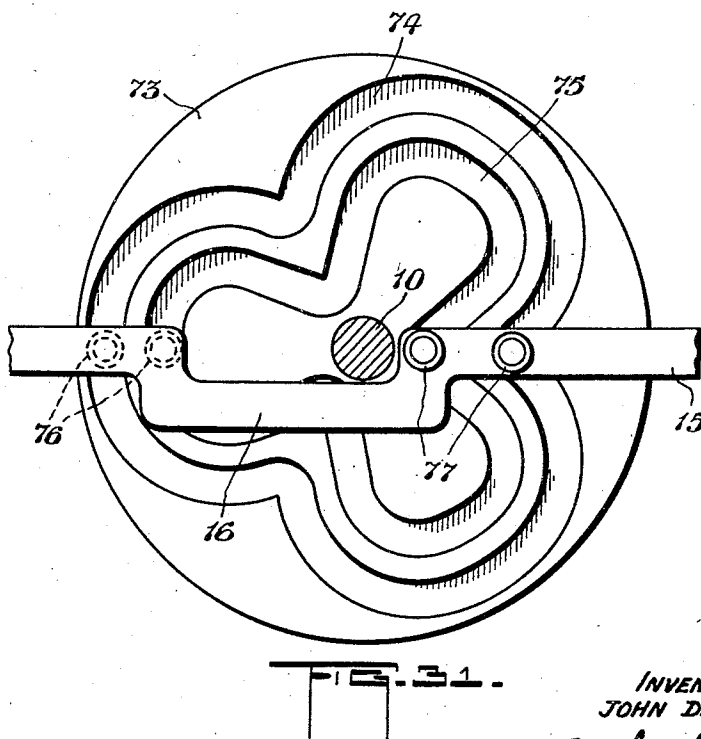
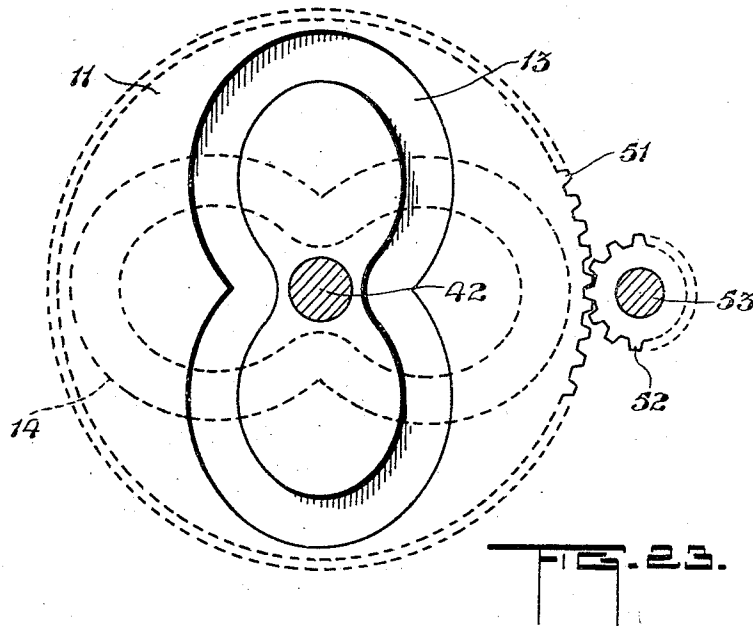
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CRANK MECHANISM

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12 Sheets-Sheet 8



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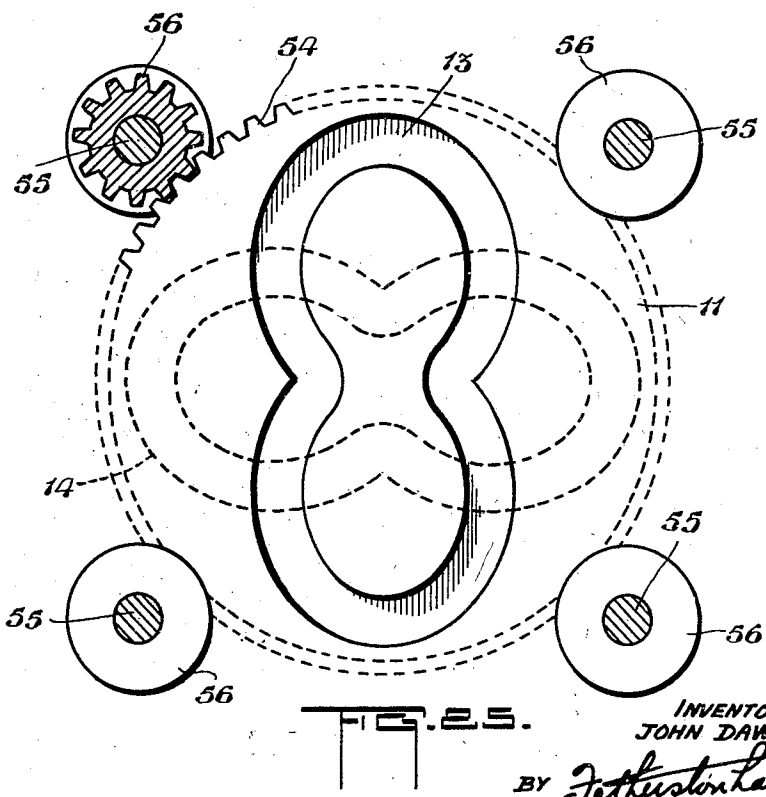
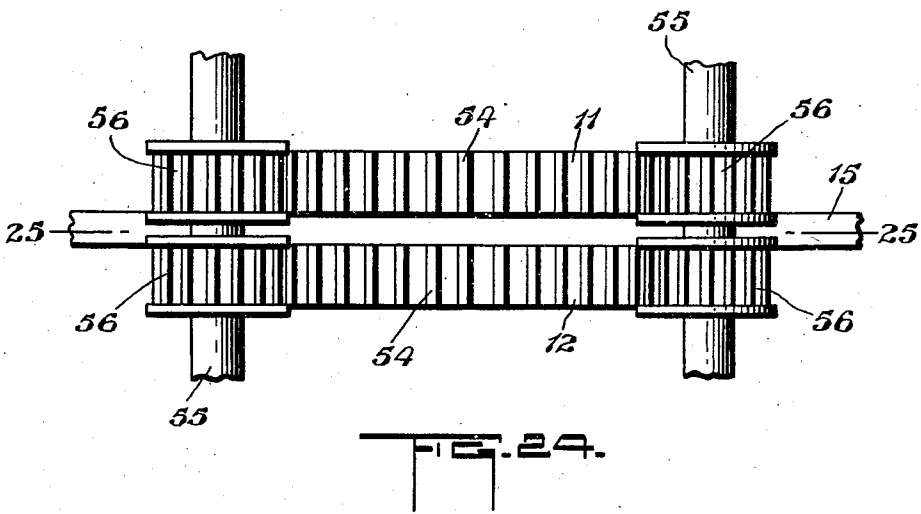
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CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 9



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CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 10

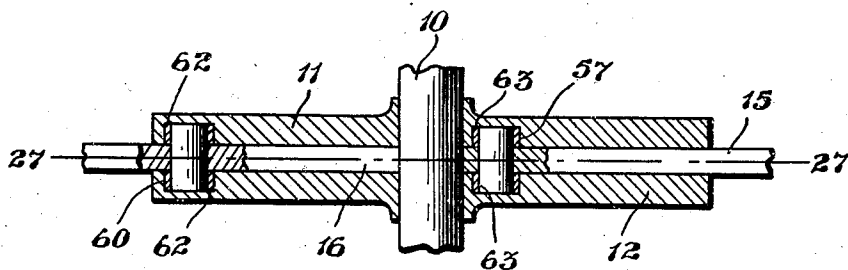


FIG. 25.

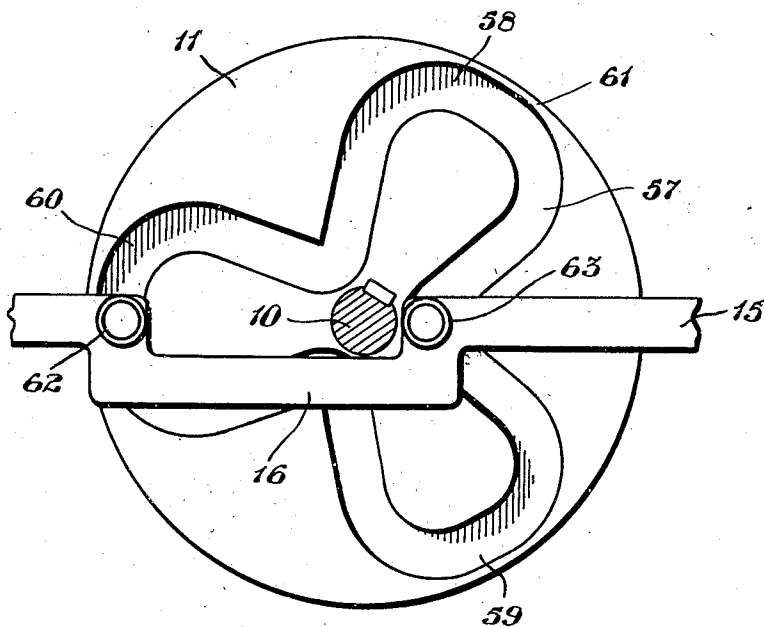


FIG. 27.

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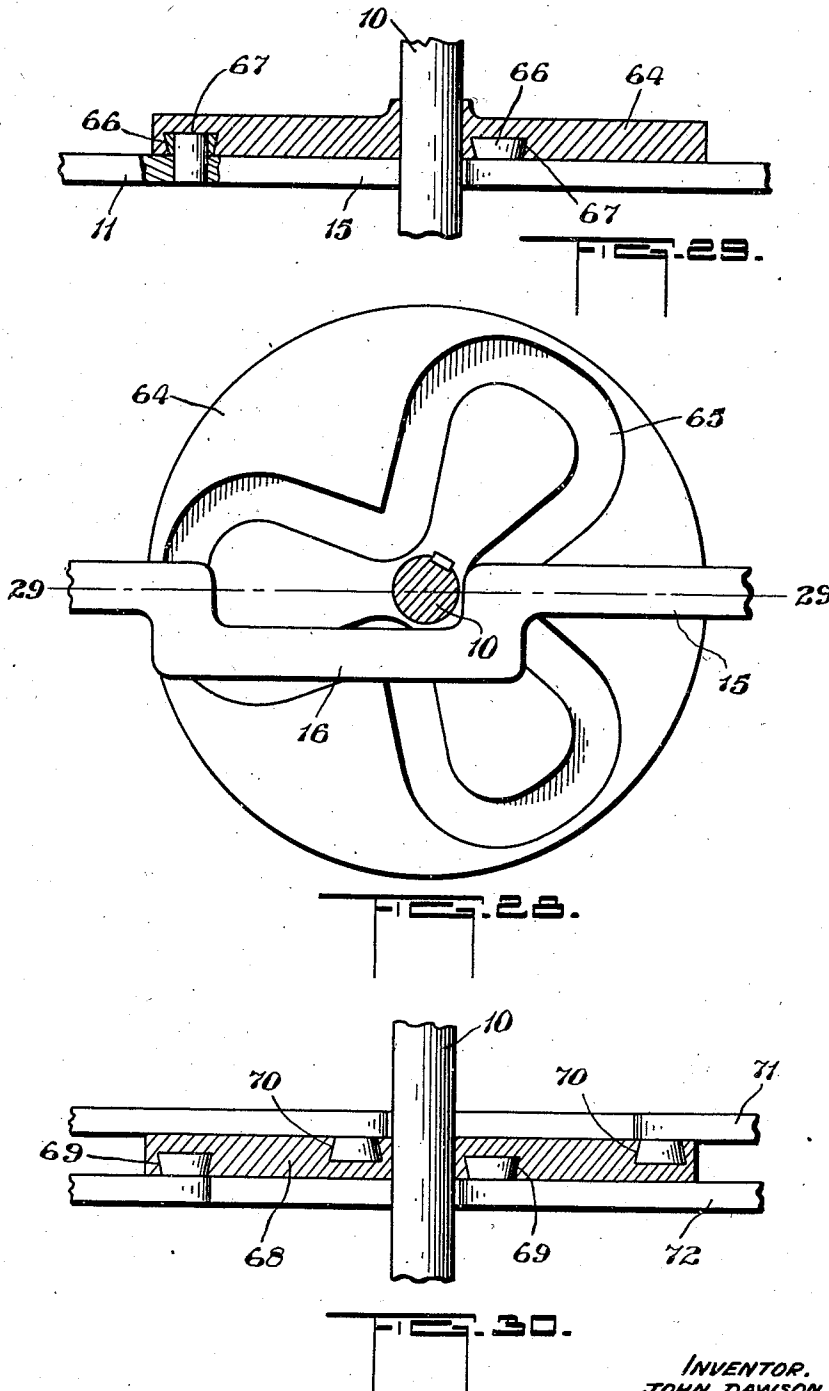
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1,748,443

CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 11



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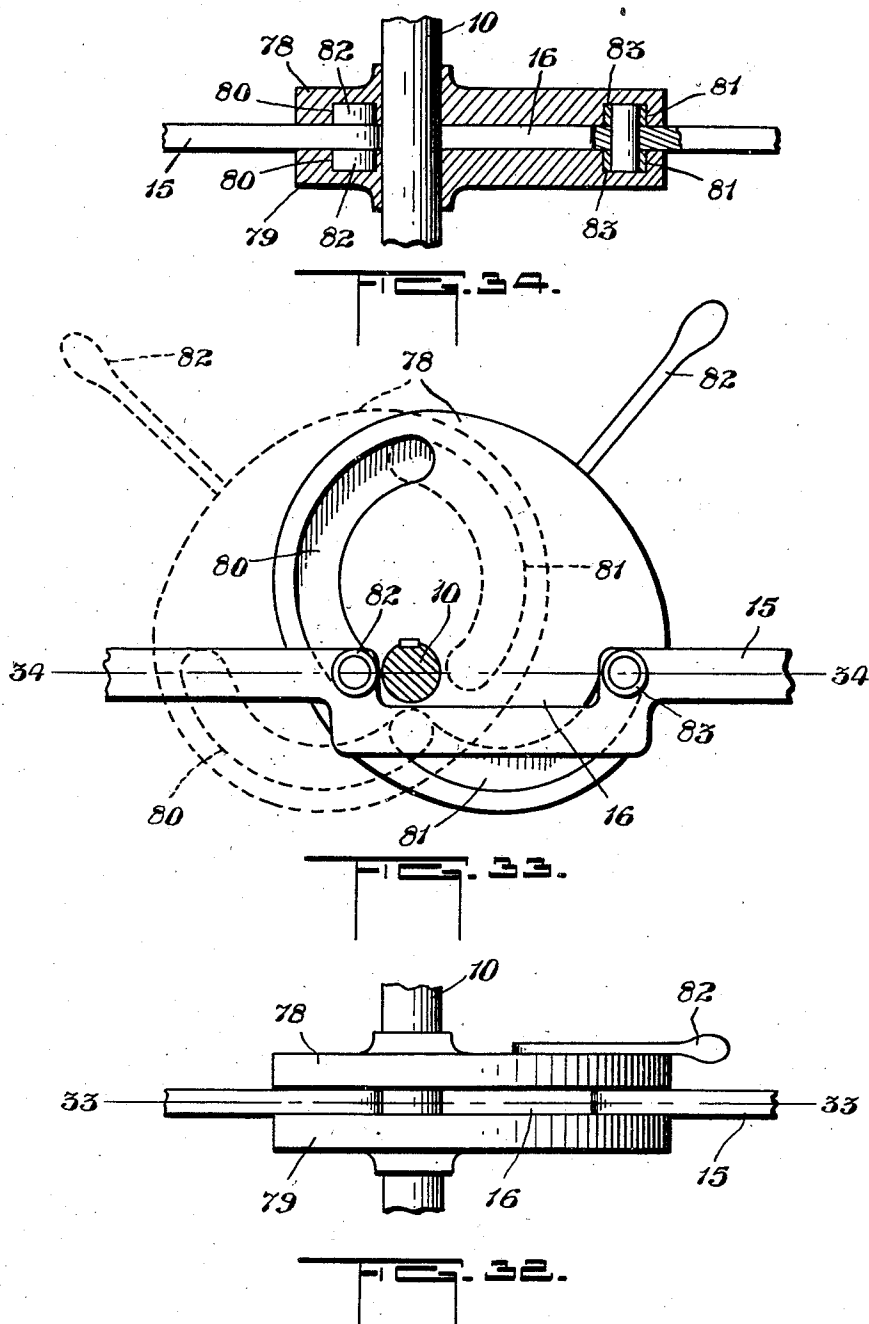
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CRANK MECHANISM

Filed May 9, 1927

12 Sheets-Sheet 12



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UNITED STATES PATENT OFFICE

JOHN DAWSON, OF LEASIDE, ONTARIO, CANADA, ASSIGNOR TO DAWSON RECIPROCATING CRANK ACTIONS LIMITED, OF TORONTO, CANADA.

CRANK MECHANISM

Application filed May 9, 1927. Serial No. 190,012.

This invention relates to improvements in crank mechanisms whereby a driving medium or shaft in the course of one revolution is adapted to impart a plurality of reciprocating movements to an operating medium or shaft.

In accordance with the present invention and contrary to present practice a movable center is provided to form the natural path for contacts across the face of a rotary member. The improved mechanism may be said to embody generally a drive shaft, a connecting rod, and means associated with the drive shaft for automatically imparting to said rod a plurality of reciprocating movements in an even plane simultaneously with a single revolution of the drive shaft.

Referring now to the drawings in which like characters of reference indicate corresponding parts in each figure,

Figure 1 is a plan view of my improved crank mechanism.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is a section on the line 4—4 of Figure 3.

Figures 5, 6, 7 and 8 illustrate the driving plates in a series of movements which constitute one quarter revolution of the plates and one full stroke of the connecting rod, the positions of the plates are shown at 0°, 30°, 60° and 90°, respectively, the arrows indicating the direction of rotation.

Figure 9 is an elevation in section illustrating my improved mechanism as applied to a pump.

Figure 10 is a sectional plan of a form of third trammelled driving plate with double connecting rods whereby alternating reciprocal operation of the connecting rods is obtained.

Figure 11 is a modified form provided with a secondary trammel and in which a corresponding form is placed at right angles permitting the use of a plurality of contacts or rollers.

Figure 12 is a section on the line 12—12 of Figure 11.

Figure 13 is a plan view of a modified form of my invention showing a multiplicity of connecting rods in engagement with the continuous multiple curved grooves in each of the driving plates.

Figure 14 is a section on the line 14—14 of Figure 13.

Figure 15 is a perspective detail of one of the connecting rods showing the structure thereof which enables one member to overlap another though opposed in operation.

Figure 16 is a side elevation of a further modified form showing a single driving plate with curved endless guideways on opposite sides of the surface thereof, each of which is arranged at right angles to the other and a connecting rod centrally and longitudinally enlarged and slotted so as to straddle the plate and provided on each of the sides with pairs of contacts to simultaneously engage with the guideways on both surfaces of the plate.

Figure 17 is a plan view of Figure 16.

Figure 18 is a section on the line 18—18 of Figure 16.

Figure 19 is a further modified form of connecting rod.

Figure 20 is a sectional plan of a further modified form, showing geared channels at the periphery of the driving members.

Figure 21 is a section on the line 21—21 of Figure 20.

Figure 22 is a plan view illustrating peripherally toothed driving member with a single drive gear.

Figure 23 is a section on the line 23—23 of Figure 22.

Figure 24 is a plan view illustrating a plurality of drive gears for the peripherally toothed driving member.

Figure 25 is a section on the line 25—25 of Figure 24.

Figure 26 is a sectional plan illustrating a modification of the trammel construction.

Figure 27 is a section on the line 27—27 of Figure 26.

Figure 28 is an elevation similar to Figure 27, indicating a single driving member.

Figure 29 is a section on the line 29—29 of Figure 28.

Figure 30 is a sectional plan illustrating a single driving member provided with trammels on both surfaces, each trammel being at right angles to the other.

Figure 31 is a view similar to Figure 27, illustrating a double trammel.

Figure 32 is a plan view of a further modification of an application of my improved device.

Figure 33 is a section on the line 33—33 of Figure 32.

Figure 34 is a section on the line 34—34 of Figure 33.

Referring more particularly to the drawings, in which a preferred example of my invention is disclosed, A indicates, as more particularly disclosed in Figure 1, the mechanism as a whole in which 10 designates a drive shaft on which are rigidly mounted in any well known manner and in spaced relationship to one another driving plates 11 and 12 formed on their inner faces with substantially semi-elliptical continuous guideways 13 and 14, the plates being so arranged that these guideways are, as illustrated in Figure 2, opposite and at right angles to one another. Extending between the plates or discs 11 and 12 is a connecting rod 15 centrally U-shaped at 16 to clear the drive shaft 10 and provided with rigidly mounted roller engaging members 17 and 18 one protruding on each side and longitudinally spaced to simultaneously engage with the opposing trammels in each of the plates 11 and 12.

It will thus be seen that the features of the mechanism in the example now disclosed are the combination with the shaft 10 of spaced driving plates 11 and 12 rigidly keyed thereon, said plates having on their inner opposing surfaces endless grooves or guideways 13 and 14 opposed to and at substantially right angles to one another so that when one of the grooves or guideways is normally vertical the opposing guideway is horizontal.

As previously stated a connecting rod passes between the plates and has fixedly mounted thereon, at spaced intervals on opposite sides, engaging members or contacts, such as rollers or the like, 17 and 18 adapted to simultaneously engage with the aforementioned guideways in each of the plates 11 and 12 so that when the drive shaft 10 is operated, (see Figure 5), the guideway 14 on the plate or disc 12 is in a horizontal position with the connecting rod contact 18 engaging therewith at the outer extremity thereof while the opposed contact or engaging member 17 on the connecting rod 15 engages the guideway 13 on the plate 11 substantially midway thereon.

On the rotation of the shaft 10 to the extent of 30°, the position of the engaging members will be as disclosed in Figure 6, in which the trammel or guideway 14 is moved from a horizontal position to a slanting position with

a consequent change in the position of the connecting rod contact 18 while the guideway or trammel 13 will also be moved, as indicated by dotted lines, altering the position therein of the contact member 17, which, it will be noted, will have moved further than the contact 18 although the substantially right angled opposing position of the guideways remains the same.

Referring now to the Figure 7, after 60° have been travelled in the rotation of the drive shaft 10 the position of the trammels or guideways 13 and 14 will be further changed, while coming to the position illustrated in Figure 8 after 90° in the revolution of the drive shaft have been accomplished, it will be noted that the driving plates 11 and 12 are in substantially the opposite right angled position to that which they occupied before the shaft 10 was rotated, the guideway 14 being now vertical in the plate 12 and the guideway or trammel 13 in the plate 11 being horizontal while the position of the connecting rod contact 18 from the extremity of the guideway 13 will be in engagement with the guideway substantially midway thereof and the extremity of the guideway 14 will be in engagement with the engaging member 17. In other words with a quarter revolution of the drive shaft 10 the position of the trammels will be completely reversed and during the reversal one even movement will have been imparted to the connecting rod 15. It will, therefore, be readily understood that, on the drive shaft 10 making a complete revolution, four reciprocating movements will be automatically imparted to the connecting rod 15.

Another feature of my invention is the arrangement of the two driving plates 11 and 12 in pairs, the endless guideways on the faces of each being at right angles to each other and facing one another.

In the modified form as disclosed in Figures 11 and 12, a plurality of guideways 19, 20, 21 and 22 are formed on the opposing faces of the plates 23 and 24 at right angles to one another to engage simultaneously with pairs of contacts on the connecting rod 15.

In Figure 10 is disclosed a third or central plate 12^a rigidly mounted on the drive shaft 10 between the plates 11 and 12 and in spaced relationship thereto. This third plate is trammelled on both sides to engage with the contacts of two connecting rods and whereby in operation an alternating reciprocal movement of the rods is obtained.

In Figure 9 the example of my mechanism is shown as applied to a pump, the pistons 26 and 27 of which are attached to the connecting rod 15 with the result that in operation two reciprocating movements are imparted to each of the pump pistons during a single rotation of the shaft 10.

With further reference to Figure 10, in

which a multiplicity of discs or drive plates 11 and 12 are disclosed for operating a pair of connecting rods, the discs can be so arranged as to cause the rods to move in the same direction at the same time or they can be, as it were, arranged in staggered relationship to one another to cause the rods to move in opposite directions, so that when one connecting rod begins its stroke or reaches the limit of its stroke the other connecting rod will have travelled to any intermediate part.

It will be noted from the foregoing, that, in contrast with present mechanisms in which the driven member has an arcuate reciprocating movement, the driven member with my construction has a plurality of reciprocating movements in an even plane and further that, in the engagement of the driven member with the driving medium, when one contact has reached the outer extremity of its travel outwardly the other contact will be at substantially the centre or inward extremity of its travel. In other words, while one contact is in engagement with the driving medium at a distance from the central source of power, the other contact, simultaneously engaging with the other driving medium, will be close up to or at substantially the centre of the source of power. In this way loss of power is obviated and a balanced distribution maintained that could not possibly be provided with existing constructions.

The driving member and discs with a fixed centre, for example, is considered the source of imparting power or force, while the movable centre is considered the contact or contacts which during operation move simultaneously away from and toward the fixed centre in substantially an elliptical path of travel. This movement is caused by the movable path or trammel. It will, therefore, be seen from the foregoing that a maximum force is imparted to the axially disposed movable contact which will respond to a minimum force, while the peripheral contact will require a medium amount of force. As power is applied to the movable centre a change simultaneously takes place in the position of the movable path of travel with respect to the movable centre. Therefore, at each slight movement imparted the minimum force is increased and the maximum force is decreased, all of which will not only balance the distribution but increase the force imparted, the force referred to not having been heretofore utilized.

In the modified form of my invention as disclosed in Figures 13, 14 and 15 a plurality of connecting rods 28, 29, 30 and 31 are adapted to clear the driving shaft 10, as disclosed. The essential feature of this construction is the adaptability of a series of connecting rods, each of which operate in a different plane. From the illustration shown in Figure 15 it will be seen that each rod is par-

tially recessed, as indicated at 32, to permit overlapping of the connecting rods where a multiplicity of them are used. In this particular instance the contact arms are extended so as to overcome the difference in space caused by the added rods. It should also be noted here that although a plurality of rods are adapted to the invention, the contacts operating the rods are operated by the two trammels as disclosed.

The modified form, as just described, would be particularly adaptable when driving air compressors or like devices, a pair of circular plates, as heretofore mentioned, being keyed in spaced relationship to one another on the driving shaft 10 and having on their opposing inner surfaces an endless curved guideway arranged at substantially right angles to one another.

In the further modified form of my invention as disclosed in Figures 16, 17, and 18, the essential feature is the use of a single driving plate 33. The connecting rod 34, as illustrated, is centrally enlarged as at 35 and slotted longitudinally of the enlarged portion, as at 36, so as to straddle a single driving member. The faces of the driving member are formed with non-intersecting arc-shaped continuous guideways 37 and 38 arranged at right angles to one another.

It will thus be seen that the slotted connecting rod, being provided in the slotted portion with contact members 39 and 40 on opposite sides thereof, will simultaneously engage with the guideways 37 and 38 on both surfaces of the plate, thus enabling one driving plate to efficiently perform the functions of two separate driving plates.

Figure 19 illustrates a modified form of connecting rod centrally slotted at 41 to straddle the drive shaft 10.

In Figures 20 and 21 a modified form of the invention is disclosed in which the driving members 11 and 12 are provided with endless grooves or trammels therein arranged at right angles to one another as previously described. The driving members are mounted on an idle spindle 42 supported in suitable bearings 43 and have extending therebetween a connecting rod 15 provided on opposite sides and at spaced intervals with contacts or engaging members 17 and 18 to engage simultaneously with the endless grooves on each of the discs.

Instead of providing a shaft 10 to rotate the driving members, as heretofore disclosed, I provide the driving members with an integrally formed peripheral channel 45, the inner periphery of which is toothed as indicated at 46 and is adapted to be engaged by gears 47 and 48 keyed to the shafts 49 and 50, so that when the latter is rotated the gears 47 and 48 engaging with the toothed periphery will cause the driving members as a whole to rotate. In other words, this is a

different construction for driving the intermediate power conveying medium between a rotating member and reciprocally operable member to impart, during one revolution of the former, a multiplicity of reciprocal revolutions to the latter automatically.

In Figures 22 and 23 the outer periphery of both driving members is toothed as at 51 to engage with a gear 52 keyed on a shaft 53, by which means power is applied to rotate the driving members 11 and 12.

Figures 24 and 25 show the outer periphery of the driving members toothed as at 54 and instead of a single rotatable shaft having a gear thereon, a plurality of shafts 55 are employed, each of which is provided with a pair of flanged gears 56 adapted to engage with the toothed peripheries of both driving members simultaneously. Furthermore, the idle spindle 42, shown in Figure 20, is dispensed with and the members 11 and 12 as a whole are supported and driven by the gears 56 carried by the shafts 55.

In the modified form of the invention as illustrated in Figures 26 and 27, the discs or circular plates 11 and 12 are trammelled on their inner opposing faces to provide endless guideways 57 in the form of three substantially radially extending loops 58, 59 and 60 with their outer extremities merging on the periphery 61 of the trammelled plates 11 and 12 and their inner restricted portions converging to the centre of the plate or disc adjacent the rotatable drive shaft 10.

The driven member or connecting rod 15, as previously described, is U-shaped as indicated at 16 to clear the drive shaft and is provided in spaced relationship to one another with a pair of contacts or roller members 62 and 63 with a view to eliminating friction and designed to travel, as indicated in Figure 26, in the continuous or endless grooves or guideways 58, 59 and 60 whereby, on the drive shaft being rotated and the discs or plates thereon revolved, a multiplicity of reciprocating movements will be imparted to the connecting rod or member 15 in the course of one revolution of the shaft 10.

It should be noted that the trammels of the plates 11 and 12, which form the driving means, register with one another, while those of the preferred form are positioned at right angles to one another.

In the modified form as illustrated in Figures 28 and 29 a single plate 64 is provided having a single endless trammel 65 on one surface thereof. The rollers 66, as indicated in Figure 29, by reason of their substantially inverted pyramidal shape, are retained in the trammel 67 of similar shape.

The further modification illustrated in Figure 30 shows a single plate 68 having trammels 69 and 70 on each side thereof and with said trammels oppositely disposed with respect to operation, so that in operation a

plurality of opposed movements is simultaneously imparted to each of the driven members or connecting rods 71 and 72.

In Figure 31 is disclosed a single driving member 73 with double trammels 74 and 75, otherwise similar in form to the trammels or endless grooves disclosed in Figures 27 and 28, the connecting rod being provided with pairs of engaging members 76 and 77 to simultaneously engage with the double trammels.

In the example as illustrated in Figures 32, 33 and 34, the drive shaft is designated by the numeral 10 and the driven pitman or connecting rod by the numeral 15. The drive shaft has keyed thereon in spaced relationship to one another a pair of trammelled driving plates 78 and 79 formed on their opposing surfaces with separate substantially semi-circular grooves or guideways 80 and 81. The connecting rod or pitman 15 is U-shaped as at 16 to clear the crank or drive shaft 10 and is provided with spaced contact members 82 and 83 on opposite sides thereof, the contacts on one side being designed to simultaneously engage, as illustrated in Figure 33, with the separate semi-circular grooves 80 and 81 in the plate 78 and with the separate semi-circular grooves in the plate 79.

In Figure 33 is shown in dotted lines the movement imparted to the driving members and discs through the handle or operating member 82 which is rigidly connected thereto and which on being moved from right to left causes the plates to travel as indicated by the dotted lines and with them the shaft 10 on which they are keyed to perform a partial revolution, so that a reciprocating movement is thus imparted to the connecting rod and the principle of equal distribution of force is increased through the leverage exerted.

By reference to Figure 33 it will be noted that one of the contacts is arranged substantially concentric at this particular point in operation, while the opposing contact is at the outer extremity of the semi-circle. Therefore, with the movement of the plates anti-clockwise, a greater leverage force is imparted to the concentric contact while the usual leverage force is imparted to the outer contact. Thus we have a greater leverage of force with an equal distribution.

While in Figures 32, 33 and 34 an example of my invention using two plates, with trammels approaching but not cutting the axis, is shown, it will be understood, in accordance with all recognized procedure, that a single plate can be used as well as a plurality of plates; also that a plurality of connecting rods can be used, and further that where a single plate is used with the trammel cutting the axis, a straight connecting rod can be used instead of the U-shaped rods.

As shown in Figures 20 to 25, a variation

of speed and force is imparted by suitably shaped peripherally geared plates. Furthermore, the trammelled forms may be staggered in relationship to an elliptical design of plate. In other words, they may not be at right angles to the plates, thereby producing, at any portion of the stroke of the connecting rod, a given speed or ratio of force, and, as previously mentioned, a single, pair or plurality of plates may be used with the same trammelled forms and general characteristics of all modifications without departing from the spirit or scope of the invention as claimed.

The apparatus and modifications thereof, as hereinbefore described, relate to improvements in the means disclosed in my previously filed United States application No. 120,782, filed July 6th, 1926, for making useful my discovery in conceiving the art of imparting to one or more driven members, as therein described, several reciprocating movements by a single revolution of a driving member.

As many changes could be made in the above construction, and many apparently widely different embodiments of my invention, within the scope of the claims, constructed without departing from the spirit or scope thereof, it is intended that all matter contained in the accompanying specifications and drawings shall be interpreted as illustrative and not in a limiting sense.

What I claim as my invention is:

1. An apparatus for imparting reciprocal movements to one or more members by a single revolution of a rotatable member, comprising rotatably mounted spaced discs, a continuous guideway on one disc leading inwardly towards and outwardly from the axis thereof in a horizontal plane, a similar guideway similarly arranged on the opposing disc but in a vertical plane, a connecting rod provided with a pair of fixed contacts simultaneously engaging with the guideways on both of said discs, whereby on the rotation of the discs one contact moves outwardly from the axis and the other contact moves inwardly to the axis.

2. An apparatus for imparting reciprocal movements to one or more members by a single revolution of a rotatable member, comprising spaced discs rotatably mounted and formed with a continuous guideway or groove curving inwardly from adjacent the perimeter towards the axis, the continuous groove on each disc being at substantially right angles to the continuous groove or guideway on the opposing disc.

3. An apparatus for imparting reciprocal movements to one or more driven members by a single revolution of a driving member, comprising a drive shaft, spaced plates keyed thereon and adapted to receive therebetween a connecting rod, a continuous guideway formed in the opposing faces of said mem-

bers and comprising a plurality of substantially arc-shaped grooves curving inwardly from adjacent the perimeter towards the axis, arranged in staggered relationship to one another, and spaced contacts on the driven medium adapted to simultaneously engage with the outer extremity of the guideway in one member and the inner extremity of the guideway in the opposing member.

4. In an internal combustion engine of the character described, a revolvably mounted shaft having two elongated cams fixed thereon at right angles to one another, two reciprocable elements active on the two cam faces on opposite sides of the shaft, means for reciprocating the same and a link directly interconnecting the two elements.

5. In an internal combustion engine of the character described, a revolvably mounted shaft having two elongated cams fixed thereon at right angles to one another, two reciprocable elements active on the two cam faces on opposite sides of the shaft, means for reciprocating the same, means for directionally guiding the two elements and a link directly interconnecting the same.

6. In an internal combustion engine of the character described, a revolvably mounted shaft having two elongated cams fixed thereon at right angles to one another, two reciprocable elements active on the two cam faces on opposite sides of the shaft, means for reciprocating the same, a link directly interconnecting the two elements and made to straddle the shaft.

In witness whereof I have hereunto set my hand.

JOHN DAWSON.