

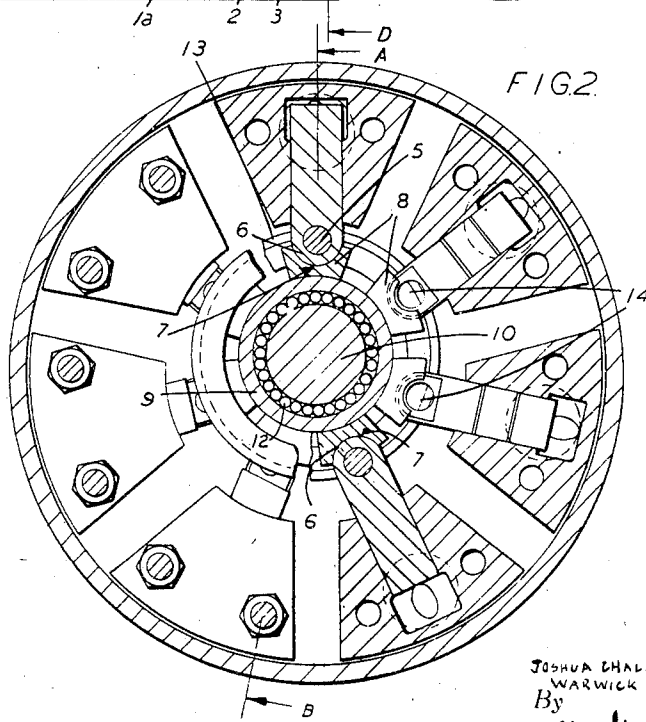
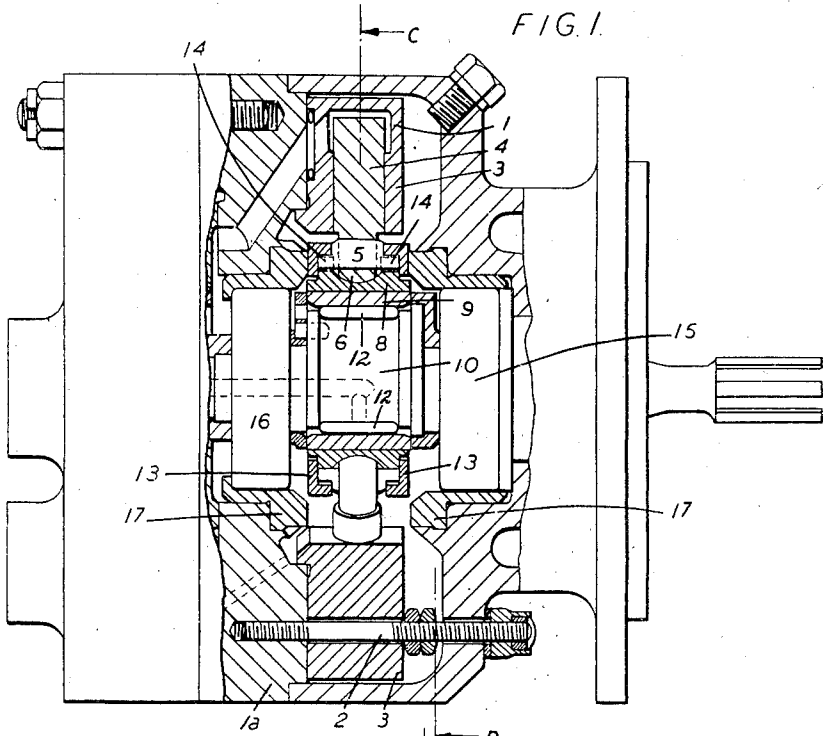
March 8, 1949.

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RECIPROCATING PUMP OR MOTOR

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4 Sheets—Sheet 1



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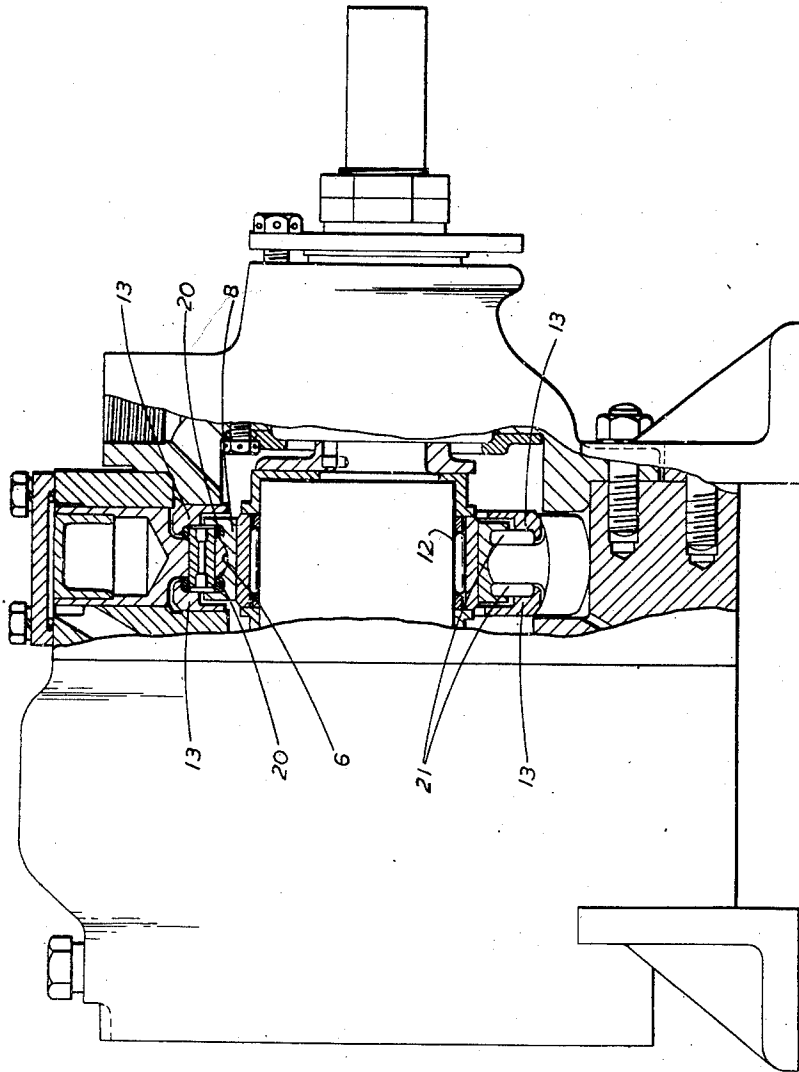


FIG. 3

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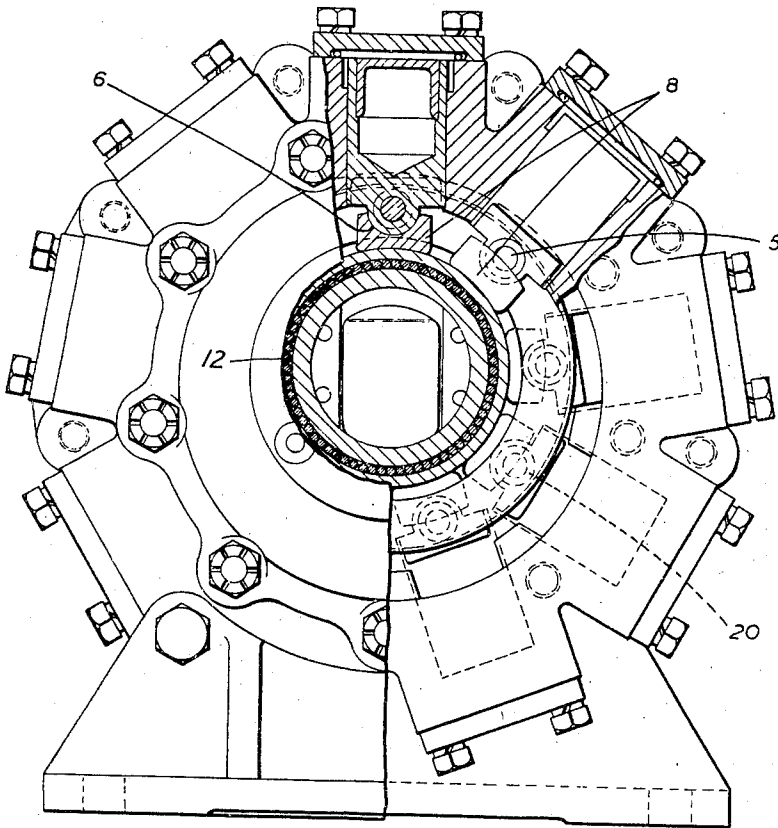
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FIG. 4.



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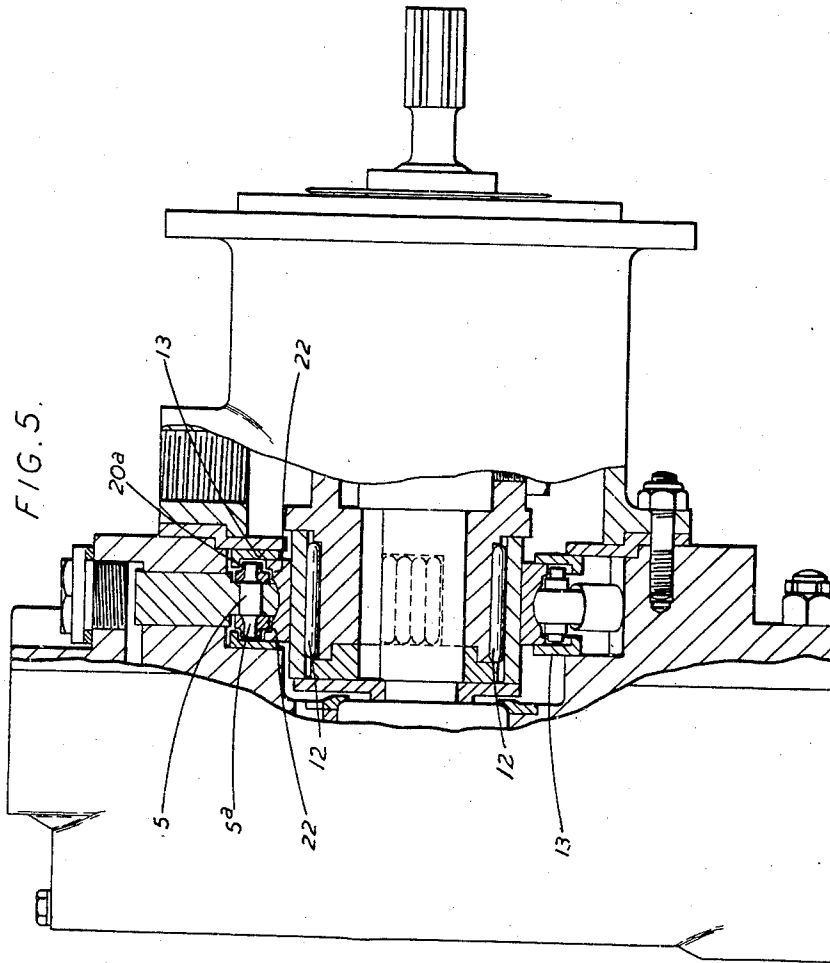
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UNITED STATES PATENT OFFICE

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RECIPROCATING PUMP OR MOTOR

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8 Claims. (Cl. 74—51)

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This invention relates to means for transmitting movement from an eccentric to pistons, e. g. as adapted in reciprocating pumps or motors hereinafter referred to as pumps for use in hydraulic services which include cylinders containing reciprocable pistons, the reciprocation of the pistons within the cylinders in the case of a pump resulting from rotational movements of a driving shaft and an associated eccentric in driving connection with the piston, the degree of eccentricity of the eccentric and effective stroke of the piston being either fixed or variable. Examples of such radial pumps are described and illustrated in the specifications and drawings accompanying copending patent application No. 505,491 filed October 8, 1942 which issued as Patent 2,404,175 July 16, 1946, and application No. 505,490 filed October 8, 1942.

It has been proposed in the case of radial pumps which are eccentric operated to fit the eccentric with a surrounding annular ring said ring being freely revoluble about said eccentric, and to interpose between said ring and said pistons a series of slippers, the latter being shaped to the peripheral shape of the ring and being connected with their associated pistons by transversely arranged pins located within the borings formed in the slippers and pistons, the slippers being maintained in contact with their associated ring by retaining rings which encircle the piston pins or slippers, the slippers and pistons being thereby retained in engagement with their associated ring during the inward or suction stroke of the pistons.

With the object of making such pumps as compact as possible, that is to say to reduce their overall dimensions to a minimum, this being particularly desirable in the case of pumps intended for use in aircraft, it has also been proposed to cut away the piston pins at their extremities for engagement with the retaining rings, so that their overall thickness, or the diameter of the retaining rings, was reduced at such points.

The disadvantage associated with such pumps as hitherto constructed particularly the type of pump wherein the piston pins had their overall thickness reduced at their extremities, was that the piston pins were called upon to take all the loads and stresses resulting from the axial inwardly directed radial pressure applied to the pistons, and consequently were liable to shear or wear leading to separation of the pin from the piston. Furthermore, difficulty was experienced in obtaining squareness of the cylinder bores with the driving shaft, which was liable to

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cause trouble due to uneven loading of the parts and sideways movement of the parts under wedging action, this being particularly objectionable where needle bearings were used.

The present invention consists broadly in engaging the appropriate ends of the pistons directly with the slippers so as to transmit the load strokes directly from the slippers to the pistons where the piston ends and slippers contact or vice versa. A highly efficient and practical manner of achieving the foregoing direct driving contact between pistons and slippers is to form each slipper or other member with which the piston is to be associated with a part spherical seating for the reception of the inner end of the piston, the latter being similarly shaped so that the two parts make contact with each other during the load stroke without the interposition of a pin, the piston and slipper or like member being connected by means of a pin for the purpose of the return stroke only.

With such an arrangement a self-aligning seating is provided for the piston, the slipper being free to move slightly under the force applied thereto and position itself about the piston ball end between this and the annular ring, thereby compensating for wear or for any inaccuracy in the construction of the component parts during manufacture, whilst furthermore by retaining a pin connection between the piston and its associated annular ring and/or slipper, the pin provides a positive means for effecting retraction or return movement of the piston, this being particularly desirable in the case of a pump operating at high speed.

In order that the invention may be clearly understood and readily carried into effect drawings are appended hereto illustrating embodiments thereof, and wherein:

Figure 1 is a diametrical section on the line A—B of Figure 2, showing the invention applied to one form of pump and in which there is combined with the part spherical piston ends, and correspondingly recessed slippers, piston pins with stepped or cut-away ends to engage retaining rings, Figure 2 being a section on the line C—D of Figure 1;

Figure 3 is a diametrical section through the cylinder block and eccentric in which the piston pins carry plain rollers to engage the retaining rings and in which the rollers engage retaining grooves in the slippers;

Figure 4 is a cross section through Figure 3; and

Figure 5 is a diametrical section through the

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cylinder block and eccentric of another form of pump and showing the piston pins carrying stepped rollers on reduced diameter ends.

Referring to the drawings, in the embodiment shown in Figures 1 and 2 the radial cylinders 1 accommodating the pistons 4 are formed in segmental blocks 3 fixed in the pump casing 1a by studs 2. The pistons make direct engagement in the segmental section slippers 8 by means of part spherical ends 6 seating and positioning in correspondingly radiused parts spherical recesses 7 in the slippers, the slippers contacting concentrically with the outer ring 9 of the eccentric body 10, needle bearings 12 being interposed between the ring 9 and body 10.

Each piston is bored transversely for the reception of a diametrically disposed piston pin 5, the axis of which intersects the centre of radius of the part spherical head of the piston, the ends of the pin which project from the piston being cut away for approximately half the pin diameter to provide stepped ends 14 having arcuate faces parallel with the pin's axis, these arcuate faces facing away from the eccentric and corresponding in curvature with the internal radius of two L section retaining rings 13 which surround the pins and serve to maintain the part spherical ends of the pistons in contact with their associated seatings in the slipper, and the slippers in contact with the annular ring 9 surrounding the eccentric. The reason for the retaining rings each being of "L" section is to obtain an inwardly directed web on each ring, which webs by virtue of their rubbing engagement with the ends of the pins, serve to locate each pin lengthwise within its boring in its associated piston, the outer faces of the retaining rings making light facial contact with opposed annular faces of two rings 17 which serve to locate ball or roller races 15 and 16 in the casing to support the shaft 11. The inner edges of the retaining rings thus serve to prevent movement of the pins 5 in a direction parallel with the axis of the pump driving shaft 11, it being understood that the part-spherical ends of the pistons position the slippers.

In an alternative construction as shown in Figures 3 and 4, each slipper 8 is again formed with a part spherical seating 7 for the reception of the corresponding part spherical end of the appropriate piston 4. In this arrangement although each piston is bored for the reception of a transversely arranged piston pin 5 as aforesaid, each pin is not reduced in diameter at its extremities, but each extremity carries a roller 20 retained in an arcuate section radiused groove 21 in the appropriate slipper, each roller providing rolling contact with the inner peripheral surface of a retaining ring 13, each retaining ring extending inwardly over the roller and adjacent extremity of the pin to retain said parts against endwise movement relatively to their associated piston. The retaining rings in the case of breakage of the pin serve to retain the rollers against outward movement, sideways movement of the rollers being prevented by their engagement with the part circular grooves 21.

In a further arrangement as shown in Figure 5, the pins are reduced in diameter at their extremities as at 5a, and carry rollers 20 which enter arcuate shaped recesses 22 formed in the slippers 8, the rollers being also reduced in diameter as at 20a where they engage the retaining rings 13. In this construction it will be seen that the pins are held against endwise movement by rea-

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son of the engagement of their annular shoulders with the rollers, and as in the preceding construction shown in Figures 3 and 4 the pins are free to rotate about their axes.

It will be appreciated that in the case of the three arrangements hereinbefore described the piston pins are relieved of all shear stresses during the power stroke of the pistons, the end loads on the pistons during the power stroke being taken by the part spherical seating surfaces formed in the slippers contacting the annular ring surrounding the eccentric and the correspondingly shaped part spherical ends of the pistons and the inter-engagement of the associated parts, i. e., pins and/or rollers, slippers and side plates serve to prevent the pistons from rotation on their own axes.

We claim:

1. A radial cylinder type of pump or motor comprising a plurality of radial cylinders, pistons in such cylinders and an eccentric adapted to produce relative reciprocation between the pistons and cylinders, a part spherical protuberance on the end of each piston remote from the end which operates within the appropriate cylinder; a plurality of slippers slidable about the periphery of the eccentric, a seating in each slipper, said seatings affording abutment surfaces for direct engagement with the part spherical ends of the pistons so that the pistons can oscillate relatively to the slippers and the load strokes are transmitted directly across the slippers and pistons, and means between the slippers and the cylinders to maintain contact of said part spherical protuberances with said seatings during the idle or return strokes of the piston, so that the slippers take the load of the working or pressure strokes and the said latter means take the load of the idle or return strokes.

2. A radial cylinder type of pump or motor comprising a plurality of radial cylinders, pistons in such cylinders and an eccentric adapted to produce relative reciprocation between the pistons and the cylinders, a part spherical protuberance on the end of each piston remote from the end which operates within the appropriate cylinder, a plurality of slippers corresponding in number and opposed to the pistons and slidable about the periphery of the eccentric, a seating in each slipper, said seatings receiving the part spherical ends of the pistons directly for oscillation of the pistons relatively to the slippers so that the load strokes are transmitted directly across the slippers and pistons, and means between the slippers and cylinders to maintain contact of said part spherical protuberances with said seatings during the idle or return strokes of the pistons, and adapted to take the load of such latter strokes, said means comprising abutments disposed diametrically with respect to the part spherical ends of the pistons and a pair of retaining rings disposed opposite sides of the eccentric and engaged within their perimeters simultaneously by all of said abutments.

3. A radial cylinder type of pump or motor comprising a plurality of radial cylinders, pistons in such cylinders and an eccentric adapted to produce relative reciprocation between the pistons and cylinders, a part spherical protuberance on the end of each piston remote from the end which operates within the appropriate cylinder, a plurality of slippers slidable about the periphery of the eccentric, a part spherical seating in each slipper, said seatings receiving the part

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spherical ends of the pistons directly for oscillation of the pistons relatively to the slippers so that the load strokes are transmitted directly across the slippers and pistons, and means between the slippers and the cylinders to maintain contact of said part spherical protuberances with said seatings during the idle or return strokes of the pistons, said means comprising pins passed through the part spherical ends of the pistons diametrically with respect to such part spherical ends and a pair of retaining rings disposed opposite sides of the eccentric and engaging all of said pins simultaneously by their inner peripheries.

4. Means for transmitting movement from an eccentric to a plurality of pistons disposed substantially radially with respect to the eccentric, comprising slippers interposed between the periphery of said eccentric and the ends of the pistons opposed to the periphery of the eccentric, part spherical surfaces comprising said ends of the pistons, and jointless seatings in said slippers engaged directly by said part spherical ends, and means additional to and extraneous of said slippers common to all of the pistons for maintaining their part spherical ends constantly in engagement with said jointless seatings.

5. Means for transmitting movement from an eccentric to a plurality of pistons disposed substantially radially with respect to the eccentric, comprising slippers interposed between the periphery of said eccentric and the ends of the pistons opposed to the periphery of the eccentric, part spherical surfaces on said ends of the pistons, bearing directly against said slippers, and means common to all of the pistons maintaining their part spherical ends constantly in engagement with said slippers, said means comprising lateral projections on the pistons and members connected across said projections to operate as abutments against outward displacement of said projections relatively to the said slippers.

6. Means for transmitting movement from an eccentric to a plurality of pistons disposed substantially radially with respect to the eccentric, comprising slippers interposed between the periphery of said eccentric and the ends of the pistons opposed to the periphery of the eccentric, part spherical surfaces comprising said ends of the pistons, and seatings in said slippers engaged directly by said part spherical ends, and means common to all of the pistons maintaining their part spherical ends constantly in engagement with said seatings, said means comprising a pair of lateral projections with each piston, such projections being disposed co-axially and diametrically with respect to the part

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spherical end of the appropriate piston, and a pair of retaining rings disposed opposite sides of the eccentric and overhanging and engaging simultaneously all of the said projections.

7. Means for transmitting movement from an eccentric to a plurality of pistons disposed substantially radially with respect to the eccentric, comprising slippers interposed between the periphery of said eccentric and the ends of the pistons opposed to the periphery of the eccentric, part spherical surfaces comprising said ends of the pistons, and seatings in said slippers engaged directly by said part spherical ends, and means common to all of the pistons maintaining their part spherical ends constantly in engagement with said seatings, said means comprising a pair of co-axial lateral projections with each piston, anti-friction members carried by said projections and a pair of retaining rings common to and engaging all of said anti-friction members simultaneously so as to oppose displacement of the pistons away from the slippers.

8. Means for transmitting movement from an eccentric to a plurality of pistons disposed substantially radially with respect to the eccentric, comprising slippers interposed between the periphery of said eccentric and the ends of the pistons opposed to the periphery of the eccentric, part spherical surfaces comprising said ends of the pistons, and seating in said slippers engaged directly by said part spherical ends, and means common to all of the pistons maintaining their part spherical ends constantly in engagement with said seatings, said means comprising with each piston a pair of co-axial lateral projections disposed substantially diametrically with respect to the part spherical end of the appropriate piston, rollers carried by said projections, arcuate recesses in the slippers radiused to receive parts of the peripheries of said rollers, and a pair of retaining rings disposed on opposite sides of the eccentric, overhanging and engaging simultaneously all of the said rollers.

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