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PATENT SPECIFICATION.

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PROVISIONAL SPECIFICATION.

No. 24,538, A.D. 1922.

Improvements in Unidirectional Driving Devices.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention to be as follows:—

The present invention relates to unidirectional driving devices and is especially suitable in cases in which back lash is to be minimised, and is applicable both in cases in which reversal in the direction of drive is required, and cases in which the driven shaft rotates always in one selected direction.

The invention consists in a unidirectional driving device comprising a sliding member which may be an annular plate having teeth on its two faces, one set of teeth being of smaller size and adapted to engage and disengage with teeth on a rotating member, while the other set of teeth are larger and are adapted to co-operate with teeth on the oscillating member to give the slider a longitudinal movement in the direction to cause engagement of the smaller teeth on the slider with the teeth on the rotating member.

The invention also consists in arranging the larger teeth on the slider on the side which co-operates with the oscillating member so that inertia of the sliding member tends to assist the engagement and disengagement of the smaller sets of teeth.

The invention further consists in combining the above arrangement with springs tending to keep the slider in engagement with the rotating member.

The invention further consists for cases where reversal of rotation is not desired in forming the larger teeth or the smaller teeth or both with inclined faces on one side only, the other face of each tooth acting as a stop to prevent further angular motion of the slider relative to the oscillator and allow free relative movement between the rotor and the oscillator when the latter is moving in one direction.

The invention also consists in the improved unidirectional driving devices hereinafter described.

In carrying the invention into effect according to one example, the slider is in the form of an annular plate having small radial teeth on one side and larger radial teeth on the other side, the larger teeth having their faces on one side at right angles to the plate, and their faces on the other side inclined at an angle of say 30 degrees. The larger teeth co-operate with similar teeth formed on an annular oscillating member and the smaller teeth co-operate with similar teeth formed on the rotor, springs being provided adapted to press the slider away from the oscillating member towards the rotor.

It will be seen that these springs need not be of any considerable strength as the inertia of the slider will tend to cause its engagement with the rotor at the commencement of the driving oscillation and disengagement at the end of the driving oscillation, in fact, in some cases, the spring may be dispensed with.

According to another modification of the invention in which a reversal of the rotation of the rotor is desired, the teeth on the oscillator and the corresponding teeth on the slider may be symmetrically about radial planes suitable stops being provided as described in my Patent Specification No: 22,188 of 1922 to limit the movement of the slider relatively to the oscillator in one direction or the other according to the direction of rotation desired.

According to another form of the invention, the reversal of the direction of rotation may be obtained by providing on the slider radial grooves adapted to

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engage against stops on a sleeve sliding longitudinally on the oscillator. In such a case the direction of rotation may be reversed by giving the sleeve a movement in the longitudinal direction, suitable corresponding keys being provided in the sleeve carried by the oscillator so that when the grooves on the slider are oscillated until they come in contact with the keys on the sleeve, relative movement of the oscillator and slider in one direction is prevented with the result that no resultant movement occurs in the longitudinal direction. This being so, no engagement is possible between the small teeth on the slider and the corresponding small teeth on the rotor. For the reverse oscillation of the oscillator, however, the grooves on the slider come out of contact with the keys on the sleeve, these grooves being always larger than the keys. The inclined surfaces of the large teeth on the oscillator and slider then come in contact and owing to their relative sliding on the inclined surfaces of the teeth a component force is exerted longitudinally on the slider, thus pressing the small teeth on the other side of the slider into engagement with the corresponding small teeth on the rotor. By providing keys on the sleeve in two parallel sets staggered with a suitable angular interval between them so that free play between these slots and keys between the slider and sleeve respectively is in opposite directions for the two staggered sets of keys on the sleeve, the direction of rotation of the rotor is reversed by simply moving the sleeve longitudinally so that one or the other sets of keys come into position opposite the slots in the slider. The sleeve must be arranged in such a way that it oscillates always with the oscillator without angular play, but is free to move longitudinally for the purpose of effecting reversal.

Instead of a sleeve above described with two staggered sets of keys, one set of keys may be provided only, the sleeve being allowed a motion relatively to the oscillator through a certain angle equal to the play between the slots in the slider and the keys in the sleeve, suitable means being provided ensuring that during oscillation the sleeve remains in the desired position to effect engagement in one direction or the other.

Dated the 11th day of September, 1922.

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PROVISIONAL SPECIFICATION.

No. 25,546, A.D. 1922.

Improvements in Unidirectional Driving Devices.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention to be as follows:—

The present invention relates to clutches for various purposes and is applicable to clutches driving in one direction only, or in the reverse direction, as may be required, or the clutch may be applied for various purposes to act as a free wheel or as a blocking device.

The invention is especially applicable to unidirectional driving devices of the type in which there is interposed between an oscillating member and a rotating member a slider having teeth or inclines on the side on which it is in engagement with the oscillator and smaller teeth on the side on which it engages with the rotor, the inclination to the plane of rotation of the incline on the side of the oscillator being less by an amount exceeding the angle of starting friction than the incline faces of the smaller teeth driving the rotor, and so arranged that relative movement in the plane of rotation between the slider and the oscillator results in axial movement of the slider causing engagement between its smaller teeth and the small teeth on the rotor.

The object of the present invention is to provide improved means whereby the necessary axial movement is effected by means of inertia without the aid of friction springs, or the like.

The invention consists in the provision of a mass or inertia member moving with the slider in its rotation, but capable of longitudinal movement independently of the slider.

The invention further consists in providing on the oscillator suitable stops engaging with the inertia member one set of stops preventing movement of the slider relatively to the oscillator on one side of the mean position, while another set prevents movement of the slider relatively to the oscillator on the other side of the mean position, while a third set of stops prevents any relative movement

on either side of the mean position of the slider relatively to the oscillator.

The invention further consists in providing a suitable fork or other means by which the inertia member can be moved axially to engage any one of the sets of stops on the oscillator.

The invention further consists in the improved unidirectional drive and means for reversing the direction of rotation or entirely disengaging the oscillator from the rotor hereinafter described.

In carrying the invention into effect according to one example, the oscillator is constructed with radial teeth on its face, these teeth engaging with similar teeth on the face of a slider mounted coaxially with the oscillator. The slider carries on its other face smaller teeth adapted to engage with small teeth on the rotor which is also co-axial with the oscillator. On the slider there are provided pins projecting parallel to the axis engaging with circular holes on a ring surrounding the slider, so that this inertia member must necessarily rotate with the slider, but can move longitudinally relatively to the slider. On the oscillator there are provided one or more pins also projecting parallel to the axis and engaging with apertures in the inertia member. The pins are cut away so that in one position of the inertia member relatively to the slider, motion of the slider relatively to the oscillator in one direction is prevented, while in another position a similar motion on the other side of the mean position between the oscillator and the slider is prevented. In the intermediate position of the inertia member in the longitudinal direction, no relative motion is possible between the oscillator and the slider. If desired, in a fourth position of the inertia mass free movement relative to the slider may be allowed in either direction in order to prevent relative movement between the oscillator and the rotor in either direction. The clearance between the oscillator, slider and rotor is such that when the slider is in its mean position with the larger teeth in their closest engagement with the teeth on the oscillator, the smaller teeth on the slider are just free of the small teeth on the rotor. In this position the rotor can move relatively to the oscillator in either direction. When the inertia member is moved by means of the fork to either of its extreme positions, the relative sliding allowed between the slider and the oscillator causes engagement of the small teeth on the slider with the small teeth on the rotor. In one extreme position of the inertia member, engagement takes place when the oscillator is moving in one direction, and in the other extreme position of the inertia member the engagement takes place when the oscillator is moving in the opposite direction, so that by moving the inertia member in the longitudinal direction, the driving can be effected in either direction or a free wheel position may be obtained. The inertia of the inertia member moving with the oscillator and sliding longitudinally on the pins on the slider at the beginning and end of each oscillation causes a movement of the slider relative to the oscillator away from and to the mean position, so that the necessary engagement or disengagement takes place, and owing to the fact that the inertia member does not move longitudinally with the slider only the inertia of the latter in the longitudinal direction has to be overcome, so that a very rapid engagement and disengagement is possible.

It will be seen that the force necessary to accelerate the slider in the longitudinal direction, and the force applied to the slider by reason of the inertia of the inertia member will be proportional; and that the engagement will, therefore, be extremely certain and independent of the frequency of the oscillation.

It will be seen that with the above described clutch it is capable of driving in one direction only or in the reverse direction as desired, or can act as a free wheel or locking device as desired. It is capable of very many applications, for example, for traction purposes where a forward and reverse drive and free wheel are required, or for locking purposes such as on lifts or the like where instantaneous locking is required on the occurrence of undue acceleration.

Dated the 21st day of September, 1922.

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PROVISIONAL SPECIFICATION.

No. 34,366, A.D. 1922.

Improvements in Unidirectional Driving Devices.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great

Britain and Ireland, do hereby declare the nature of this invention to be as follows :—

The present invention relates to clutches particularly for converting oscillation motion to motion in one direction.

The invention consists in a clutch mechanism comprising a slider situated between an oscillating member and a rotating member having teeth on one side and a friction device, preferably elastic, on the other side situated in such a position that it can be kept free from oil.

The invention further consists in a unidirectional driving device comprising an oscillating member mounted in suitable bearings in a frame, a rotating member on an axle having its bearing in an oscillating member, a slider having suitably formed teeth on the side nearer the oscillating member and in contact with a rubber or like pad on its other side, the other surface pad being in contact with the driving member of the rotor, the apparatus being arranged so that the motion of the oscillator in one direction jamming takes place between the oscillating member, slider, friction pad and rotor.

The invention further consists in providing such an arrangement with suitable pins or stops whereby relative movement between the slider and oscillator in the rotary direction is prevented in one direction or the other, as desired.

The invention also consists in arrangein the friction surfaces outside the casing of the apparatus so that they are not liable to receive oil from the other parts of the apparatus.

The invention also consists in the improved unidirectional driving mechanism hereinafter described.

In carrying the invention into effect according to one example, the oscillating member is mounted in a suitably fixed frame on plain bearings. The rotor shaft passes axially through the oscillating member and overhangs at one end of the apparatus. On this end of the apparatus there is mounted on the rotor shaft a slider having teeth on one face adapted to engage with corresponding teeth on the oscillating member. The other face of the slider bears against a rubber pad mounted on the rotor axis and on the other side of the rubber pad there is provided a flange keyed to the rotor shaft. A suitable pin is carried by the oscillator adapted to prevent movement of the slider relatively to the oscillator in one direction or, if desired, an adjustable pin or other means may be provided by which the relative movement can be prevented in either direction or both directions or free movement allowed, if desired.

The operation of the above described apparatus is as follows :—

On movement of the oscillator in one direction the slight friction between the rotor and the slider and the inertia of the slider itself causes the slider to move relatively to the oscillator with the consequence that the engaging teeth of the oscillator and slider are given a relative movement causing the slider to be pressed strongly against the rubber pad and drive by means of friction. On the return movement of the oscillating member the stop comes into action and prevents relative movement of the oscillator and slider so that there is no jamming of the slider against the rubber pad for movement in this direction. Consequently the rotor is given an intermittent rotation in one direction.

In order that the device may operate satisfactorily, it is essential that no oil should pass on to the faces of the rubber pad. With the construction as above described, this part of the apparatus overhangs so that the teeth and bearings may be worked immersed in oil without danger of the oil passing to the rubber pad.

Many variations of the above arrangement are possible for the purpose of increasing the initial friction or inertia or both by which the initial relative movement between the slider and oscillator is produced. Further the oscillator, slider and rotor may be arranged axially or radially as desired. In the first case the contacting surfaces will be plane surfaces and in the second cylindrical, and if cylindrical surfaces are employed, the rubber ring may be continuous and the slider may be divided into segments. In some cases it is advisable to produce a partial vacuum in the casing of the apparatus in order that creeping of oil to the friction surface by capillary action may be avoided.

The invention is conveniently applied to driving mechanism constructed in accordance with my Patent Specification No. 185,022. In this form of the invention there is mounted in a fixed casing an oscillating flywheel which is connected to a floating lever having at its middle point a connection for two connecting rods adapted to oscillate the two oscillating members co-axial with a rotor member. The other end of the floating lever is connected to the driving crank. The oscillating members move within ball bearings in the fixed casing and form the bearing for the rotor shaft. Sliders are provided on each side of the appara-

tus having inclined teeth on one face co-operating teeth on the oscillating members and bearing against rubber pads whose other sides bear against flanges keyed to the rotor shaft. The faces of the sliders which bear against the rubber pads are outside the casing of the apparatus so that oil is prevented from passing from the toothed faces and bearings to the friction driving mechanism.

In order to keep the oscillating member moving about a mean position, it is subjected to a constant spring pull by means of a rod passing through a block pivoted in the casing and forming an abutment for a spring whose other end bears against a flange or nuts on the rod.

Dated this 16th day of December, 1922.

W. GRYLLS ADAMS,
87, Victoria Street, London, S.W. 1,
Chartered Patent Agent.

COMPLETE SPECIFICATION.

Improvements in Unidirectional Driving Devices.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

The present invention relates to unidirectional driving devices for various purposes and is applicable to devices intended to drive in one direction only, or driving in two directions, or giving a free wheel or locking position as may be required.

The invention is suitable for unidirectional driving devices which may or may not be reversible in cases in which it is required to transmit considerable forces with as little backlash as possible, and is especially applicable to apparatus for transmitting motion from a steadily rotating shaft to a driven shaft rotating at variable speed and, or against a variable resisting torque.

The invention is applied to unidirectional driving devices of the type in which an intermediary or sliding member is situated between an oscillating member and a rotary member and arranged so that relative angular movement between the sliding member and the oscillating member causes alternate movement of said sliding member at right angles to the movement of rotation, so that for relative motion between the oscillating member and the intermediary member, jamming takes place in one direction, while on the reverse movement of the oscillator, the rotor is allowed to overrun the slider and oscillator.

When such mechanism is applied for the purpose of obtaining continuous rotation of a rotor driven by a rapidly oscillating member, difficulty is experienced in preventing back-lash and in causing sufficiently rapid disengagement between the oscillator and the rotor.

The object of the invention is to construct a unidirectional driving mechanism in such a manner that these difficulties are avoided.

In order to better understand the invention, it is necessary to define certain angles which are of extreme importance if proper functioning of the apparatus is to be obtained.

In apparatus of the type to which this invention relates, certain definite proportions and angles of inclination of the teeth on the two sides of the slider when teeth are employed, or the angle of inclination of the teeth on one side and the angle of friction on the other, are of extreme importance. The angle of inclination of the driving surfaces with the plane of rotation plus the angle of friction between the driving surfaces I have termed the "driving angle", in examples in which the movement of the slider takes place axially. In cases in which the movement of the slider is in a radial direction the "driving angle" is the angle of inclination of the driving surfaces with planes tangential to the circumference of rotation plus the angle of friction.

The present invention consists in apparatus of the type indicated in which the co-operating faces of the oscillating member are constructed so that the driving angle between the oscillating member and the sliding member is smaller than the driving angle between the sliding member and the rotor by an amount just sufficient to secure, that when the oscillating member is oscillated at high frequency alternate engagement and jamming and disengagement of said three members is obtained in order to convert oscillating movement into intermittent rotary movement with a minimum of back-lash.

The invention also consists in such unidirectional driving mechanism in which the sliding member has symmetrical teeth on both sides, the angles of inclina-

tion of the teeth between the sliding member and the oscillating member being greater than the angles of inclination of the teeth between the slider and the rotor.

The invention further consists in such mechanism having a frictional drive between the slider and the rotor, the two sides of the slider being constructed of different material so that the angle of friction between the co-operating surfaces of the slider and rotor is greater than the driving angle of the co-operating surfaces between the slider and the oscillator.

The invention also consists in the provision of suitable stops to limit the movement of the slider relatively to the oscillator in one direction or the other, as desired, in order to provide reversing the mechanism.

The invention also consists in arranging the apparatus so that the inertia of the slider tends to assist engagement and disengagement between the slider and the rotor.

The invention further consists in providing an additional mass or inertia member moving with the slider in its rotation and arranged so that relative longitudinal movement is allowed between the slider and the additional inertia member.

The invention further consists in an improved clutch comprising a sliding member having teeth on its two faces situated between an oscillating member and a rotating member having corresponding teeth, the teeth on one side of the slider being larger and of less inclination than the teeth on the other side, so that engagement of the smaller teeth is effected by relative movement of the slider and the oscillating member or of the slider and the rotating member.

The invention also consists in providing a slider having large teeth on one side and gripping on the other side by means of friction surfaces of rubber or other suitable material.

The invention also consists in arranging the friction surfaces outside the casing of the apparatus so that they are not liable to receive oil from the other parts of the apparatus.

The invention further consists in a clutch as above described having the larger teeth on the slider on the side which co-operates with the oscillating member, so that the inertia of the sliding member tends to assist the engagement and disengagement of the smaller sets of teeth.

The invention further consists in providing an additional mass or inertia member moving with the slider in its rotation arranged so that relative longitudinal movement is allowed between the slide and the additional inertia member.

The invention also consists in providing an elastic connection in the rotary direction between the slider and an additional inertia member.

The invention further consists in providing means whereby permanent friction against relative rotation is provided between the slider and the member carrying the small teeth, such member being either an oscillating or rotating member, in order to obtain the necessary resistance to rotation on the slider to give it a movement at right angles and thereby effect engagement of the small sets of teeth.

The invention also consists in providing on the oscillator a suitable stop or sets of stops or their equivalent engaging with the slider or with the additional inertia member to prevent movement of the slider relatively to the oscillator on one side of the mean relative position, while another stop or set of stops, or the same stops suitably displaced prevents movement of relative rotation of the slider relatively to the oscillator on the other side of the mean position with or without a third stop or set of stops or third position of the same stops, preventing any movement on either side of the mean relative position of the slider relatively to the oscillator.

The invention further consists in cases in which reversal is not required in forming the larger teeth with inclined faces on one side only, the other faces of each tooth acting as stops to prevent angular movement of the slider relatively to the oscillator in one direction and thus allowing free relative movement between the rotor and the oscillator when the latter is moving in one direction.

The invention also consists in an improved clutch or unidirectional driving device comprising a sliding member, in the form of a ring having teeth on its two faces situated between the oscillating member and a rotating member having corresponding teeth; the teeth on one side of the slider being larger and of less inclination than the teeth on the other side so that engagement and disengagement of the smaller teeth is effected by relative movement of the slider and the oscillating member or of the slider and the rotating member.

The invention further consists in a clutch or unidirectional driving device comprising a sliding member in the form of a ring having teeth on its two faces, one set of teeth being of smaller depth and adapted to engage and disengage

with teeth on a rotating member, while the other set of teeth are larger and permanently in engagement and are adapted to co-operate with teeth on the oscillating member to give the slider a longitudinal movement in the direction to cause engagement and disengagement of the smaller teeth on the slider with the teeth on the rotating member.

The invention further consists in means whereby a permanent friction against relative rotation is provided between the slider and the member carrying the small teeth, either the rotating or the oscillating member, in order to obtain the necessary resistance to rotation of the slider to give it a movement of translation and thereby effect the engagement and jamming of the small teeth.

The invention also consists in providing a suitable spring pressing the slider so that the small teeth are in contact with the small teeth on the rotor or oscillator.

The invention also consists in the combination of a mass or inertia member moving with the slider as described above permanent friction with or without springs being provided between the slider or its additional inertia member and the rotor.

The invention also consists in providing means by which the small teeth on the slider are kept out of contact with the teeth with which they co-operate for driving, during the period at which the rotor is overrunning the slider.

The invention further consists in providing a locking plate moved frictionally by the rotor and carrying flat topped teeth co-operating with flat topped teeth on the slider and capable of being moved by the slider or its additional inertia to displace said teeth relatively through a distance of half the pitch of the small teeth when the slider commences to move faster than the rotor in the driving direction and so to allow engagement of the small teeth on the slider with the small teeth on the rotor during the driving period.

The invention further consists in the improved unidirectional driving mechanism and means for reversing the direction or rotation or entirely disengaging the oscillator from the rotor hereinafter described.

Referring to the accompanying diagrammatic drawings:—

Figure 1 is a sectional elevation shewing the general arrangement of one form of apparatus according to the invention as applied to transmission gear of the type described in my Patent Specification 185,022;

Figure 2 is a part sectional elevation at right angles to Figure 1 taken on the line 2—2, Figure 1;

Figure 3 is a part sectional elevation on the line 3—3, Figure 1;

Figure 4 is a sectional plan showing the arrangement of the oscillating mass and floating lever;

Figure 5 is a sectional elevation on the line 5—5, Figure 1;

Figure 6 is a detail view showing a modified arrangement applicable to the general mechanism shown in Figures 1 to 4;

Figure 7 is a detail view showing a further modification;

Figure 8 and 9 are diagrams showing the inclination of the teeth on the slider;

Figure 10 is a sectional elevation showing another form of the mechanism, while Figures 11, 12 and 13 show the same arrangement in different positions;

Figures 14, 15, 16 and 17 show parts of the mechanism in the positions which they occupy respectively in Figures 10 11, 12, and 13.

Figures 18, 20, 21 and 19 are sections at right angles to those shown in Figures 12, 15, 14 and 17, showing the arrangement of the stops for driving in either direction as required, the free position and the position for obtaining a locked gear;

Figure 22 is an elevation at right angles to Figures, 10, 11, 12 and 13 showing the means for changing the sense of rotation of the mechanism;

Figure 23 is a section on the line 23—23, Figure 22;

Figure 24 is a sectional plan of the mechanism shown in Figure 22;

Figure 25 is a sectional elevation of the apparatus applied to a reducing and reversing gear;

Figure 26 is a section on the line 26—26, Figure 25;

Figure 27 shows a sectional side elevation of the mechanism applied to a reducing and reversing gear on the back axle of a motor vehicle;

Figure 28 is a sectional plan of the same;

Figure 29 is a section on the line 29—29, Figure 27;

Figure 30 is a section on the line 30—30, Figure 27;

Figure 31 is a sectional view of another form of reducing and reversing gear;

Figure 32 is a section on the line 32—32, Figure 31;

Figure 33 is a sectional elevation of a reducing gear combined with a differential arrangement constructed according to the invention;

Figure 34 is a transverse section of a modification in which springs are provided between the additional inertia member and the slider, while

Figure 35 is a sectional elevation on the line 35—35, Figure 34;

Figures 36 and 37 show an alternative arrangement in which elasticity is introduced between the additional inertia and the slider;

Figures 38 to 41 show an alternative method of providing adjustable stops for reversing the motion when desired;

Figures 42 to 45 show a modification in which relative movement of rotation between the oscillator and the slider cause a radial movement of the slider to effect locking and unlocking of the device;

Figure 46 shows a modification in which two sliding members are provided between the oscillator and the rotor;

Figures 47 and 48 are diagrams illustrating the preferred method of cutting the teeth with plane surfaces so that the teeth will mesh all over;

Figure 49 is an axial section showing a further modification; while

Figures 50 and 51 show the form of the pin on the slider in engagement with the locking plate;

Figures 52 and 53 show a form of the apparatus in which frictional surfaces are employed instead of small teeth.

In the form of the invention shown in Figures 1 to 5, the drive is effected through a heavy flywheel *a* mounted on the shaft *b* which rotates in ball bearings *c* mounted in a fixed casing *d* which is supported on a vehicle or other apparatus in any suitable manner. The shaft *b* carries at one end an eccentric *e* which is connected by a strap *f* to one end of a floating lever *g*. This floating lever is connected at a pivot *h* to a swinging arm *k* carrying masses at its ends and mounted on a fixed pivot *l*. The other end of the floating lever *g* is pivoted at *m* to a pair of connecting rods *n m* which are connected to two oscillating members *o p* capable of oscillating on a shaft *q* capable of rotating in fixed bearings *r r*. The rotor is keyed to the shaft *q* and comprises two oppositely disposed members *s s* having radial teeth *t* of triangular section on their internal faces always in engagement with similar teeth on sliding members *u u* which have on their other faces small teeth *v* adapted to engage with corresponding teeth on the oscillating members *o p*. The sliding members *u u* are free to move in the axial direction, and the large teeth *t* on the outer side of the slider are formed each with one face in a radial plane through the axis of rotation and the other face inclined at an angle of say 30 degrees with the plane perpendicular to the axis of rotation. The smaller teeth *v* are symmetrical and inclined at an angle of about 45 degrees with the plane perpendicular to the axis of rotation. Other suitable forms of teeth are shown in Figure 9. The depth of the teeth is such that the small teeth are just out of engagement when the large teeth are fully in mesh.

Flat springs *z* are provided acting between the flanges *w* on the sliders and the flanges *y* on the rotor members to keep the small teeth *v* on the sliders in mesh contact with the small teeth on the oscillators. A dashpot or damper 1 is provided connected to the oscillating lever *k* with or without suitable springs in order to maintain a definite mean position of the oscillating lever. In the dashpot 1 which is completely immersed in oil, there is provided a piston rod 2 connected at its upper end to the swinging arm *k* and having within the dashpot a flange 3 co-operating with the cylindrical member 4 having inturned flanges which engages with the flange 3. Suitable apertures 5 are provided through the flanges of the cylindrical member so that the spaces at the ends of the cylinder 1 are alternately placed in communication with apertures 6 through which oil can flow into the ends of the cylinder. The cylinder itself is completely immersed in oil and the internal surface is in the form of two cones meeting at their bases so that as the piston 3 moves away from the mean position in either direction, the area available for the escape of liquid rapidly decreases; with the result that if the swinging member *k* is caused to oscillate on one side of its mean position much larger pressures are created on one side of the piston, so that the apparatus has the effect of ultimately bringing back the centre of oscillation to the required original mean position.

The operation of the above described apparatus is as follows:—

The steadily rotating driving shaft causes the eccentric *e* to oscillate the floating lever *g* which serves to split the movement between the oscillating lever *k* and the connecting rods *n* which are connected to the oppositely moving oscillating members *o p*. The oscillation of the member *o* in one direction owing to the presence of the springs *z* between the flanges *w y* tends to move the slider *u* so that the larger teeth on its outer side move up the corresponding teeth on the rotor *s* with the consequence that for

movement of the oscillating member in this direction, the slider *u* is forced to the left causing engagement between the small teeth on the slider and the small teeth on the oscillating member, so that heavy pressure is created between the oscillator, slider and rotor owing to the different angles of inclination (see Figure 9) of the small and large teeth, with the result that the whole oscillating member, slider and rotor move together in this direction. When the oscillating member *o* moves in the reverse direction, the right angled faces on the large teeth *t* of the rotor prevent any relative sliding movement between the slider and the rotor, and there is no force other than that exerted by the springs *z* tending to move the slider so that its small teeth *v* engage with the small teeth on the oscillator; consequently when the oscillator moves in this direction it does not carry the slider or the rotor with it; the small teeth merely slipping one over the other against the action of the flat spring *z*. During this reversed movement, however, the other oscillating member *p* comes into operation and drives the rotor in the direction in which it was previously driven by the oscillating member *o*. A unidirectional drive on the rotor is thus obtained owing to the alternate impulses given by the oscillating members *o p*.

In the form of the invention shown in Figure 6, a friction pad 31 is provided to exert friction between the oscillator 32 and the slider 33. The friction is exerted between the circular pad 31 and a sleeve 34 connected to the slider by keys and keyways so that axial movement of the slider is allowed. In this case the initial relative movement between the oscillator and slider in the axial direction is obtained by the friction causing the larger teeth *t* on the slider to ride up the inclined teeth on the rotor and so effect engagement of the small teeth *v* on the slider with the small teeth on the oscillator. The arrangement above described may be inverted with advantage; the large teeth being formed on the oscillator side and the small teeth on the rotor side. In this case the friction must be between the rotor and the slider. In this latter arrangement the engagement is substantially assisted by the inertia of the slider itself and the inertia of the pad 31, especially when the frequency of oscillation is high.

In the form of the invention shown in Figure 7, the large teeth 11 are situated on the side of the slider 12 which is adjacent to the oscillator 13 and the small teeth 14 situated on the side of the slider adjacent to the rotor 15. A ring 16 operating as an inertia member surrounds the slider which is free to move axially relatively to the ring on keys 17 which prevent relative movement of rotation between slider and ring.

In this modification of the invention, the necessity for springs to keep the slider and rotor in contact is avoided as the inertia of the ring 16, immediately oscillation takes place in the direction in which engagement is required, causes the slider to slide relatively to the oscillator and effect engagement of the small teeth on the slider with the small teeth on the rotor.

The method of constructing the teeth will be readily understood from the diagrams Figures 8 and 9. The angle of inclination to a plane perpendicular to the axis of the driving faces of the large teeth on the slider α must be equal to the angle of inclination β of the driving faces of the small teeth to the same plane minus an angle at least equal to the angle of friction, that is if α is the angle of inclination of the large teeth, β the angle of inclination of the small teeth, and γ an angle greater than the angle of friction, we must have: $\alpha = \beta - \gamma$.

If desired instead of large teeth a helical gear may be employed in which case the angle α of the helix must be governed by the same relation. Friction surfaces may, if desired, be employed instead of the small teeth. In this case the angle β corresponds to the angle of friction between such frictional surfaces and if the angle α of the teeth or helix does not fulfil nearly enough the above relation of the parts either slip or become firmly locked together and disengagement does not take place except under application of considerable forces.

In practice it has been found that the angle γ must exceed the angle of friction between the material employed when dry. Probably because the film of oil is temporarily expelled by the high pressure between the teeth at the moment of engagement. A value of the angle γ which I have found suitable is about 15 degrees. If the teeth are constructed in this manner a wedging action is obtained which gives a positive sliding action to the slider causing the small teeth on the friction surfaces to engage satisfactorily so that all the parts then become jammed together and slip or disengagement during the driving period is prevented.

In all the mechanisms the clearance between the oscillator, slider and rotor must be arranged in such a way that when the large teeth are in mesh, the

small teeth are clear in order to allow relative rotation.

In the modification of the invention shown in Figures 10 to 24 which is suitable for effecting rotation of the driven shaft in either direction at will or for giving a free and also a locked position, if required, the oscillator 41 is formed with large teeth 42 equally inclined on both sides as shown in Figure 8. The small teeth 43 are also equally inclined and correspond with the teeth on the rotor 44. Keys 45 are provided on the slider as in Figure 7 and the ring 46 is capable of sliding freely in the axial direction relatively to the slider on these keys. Grooves 47 are provided in the ring 46 adapted to engage with the prongs 48 of a fork which is carried by a sleeve 49 on an actuating rod 50 which is capable of being set in four different positions and held by the spring detent 51 engaging in notches 52 on the actuating rod 50.

The various parts are shown in four different positions in Figures 10, 11, 12 and 13; corresponding views being shown at Figures 14, 15, 16 and 17, and Figures 18, 19; 20 and 21. The oscillator carries a pin 53 which is cylindrical in some parts and cut away as illustrated in others. This pin passes through a circular aperture 54 in the ring 46 which is carried by the slider.

In the position shown in Figures 10, 14 and 18, movement of the ring 46 and therefore of the slider relatively to the oscillator 41 is allowed by reason of the notch or cut away portion 55 which is opposite the ring 46 in this position. The result of this is that for movement in one direction the inertia of the ring causes the slider to ride up the large teeth on the oscillator and causes engagement of its small teeth with the small teeth on the rotor.

In the position shown in Figures 11, 15 and 21, the aperture in the ring is prevented from movement relatively to the oscillator by reason that around its whole circumference it is opposite a cylindrical portion of the pin so that no relative movement is possible, with the result that the large teeth cannot ride in either direction therefore allowing free movement between the slider and the rotor in both directions.

In the positions shown in Figures 12, 16 and 20, the opposite side of the aperture in the ring 48 is opposite a notch 56 in the pin on the oscillator, so that relative movement between the slider and the oscillator is possible in the opposite direction to that in which it can occur in the position shown at Figures 10, 14 and 18, with the result that engagement between the slider and rotor takes place due to relative movement and riding up on the large teeth giving rotation in the opposite direction.

In the position shown in Figures 13, 17 and 19, the ring can move relatively to the slider in either direction so that relative movement and riding up of the large teeth can take place in either direction locking the oscillator, slider and the rotor together in either direction.

In the form of the invention shown in Figures 25 and 26 in which the invention is applied to a reversing gear box, the driving shaft 61 carries two similar eccentrics 62 working in phase on which are pivoted two straps 63, 64 adapted to oscillate the members 65, 66 in opposite directions. Sliders 67, 68 as above described, are situated between the oscillators 65, 66 and the members 69, 70 which are keyed to the rotor shaft 71. Cut away pins 72, 73 carried respectively by the oscillators 65, 66 and engaging with the inertia rings 74, 75 are provided for causing the slider to be jammed in one or the other direction as desired or to be free for either direction of oscillation, the inertia rings being mounted on keys on the sliders 67, 68 and moved by forks 76, 77 carried by a longitudinally movable shaft 78, so that they can be set for driving in either direction or to give a neutral position as desired.

In the form of the invention shown in Figures 27, 28, 29 and 30 as applied to a reversing and reducing gear suitable for fitting on the back axle of a motor vehicle, the driving shaft 81 carries two eccentrics 82, 83 which are in phase and are connected to oscillating members 84, 85 mounted so that they operate on a shaft 86 at right angles to the driving shaft 81. The mechanism by which the oscillators drive the shaft 86 is similar to that above described. The oscillators 84, 85 are provided with large teeth 42 on their outer faces, these teeth being always in engagement with corresponding large teeth on the sliders 45 but allowing the necessary clearance for disengagement of the small teeth. These sliders are also provided with keys on which the inertia rings 46 can slide axially. On the outer faces of the sliders 45 small teeth are formed which engage intermittently with the small teeth on the rotor members 44 keyed to the rotor shaft 86 The movement of the inertia ring 46 relative to the oscillating member is controlled by the pins 53 carried by the oscillating members passing through the circular apertures in the rings 46 and capable of being moved in the axial direc-

tion by means of the fork 48 which can be adjusted by the rod 87. The pins 53 are cut away to allow relative movement between the oscillators and slides in the rotary direction or to restrain such movement, as described with reference to Figures 10 to 24.

In the form of the invention shown in Figures 31 and 32 the reducing gear is mounted in a casing 91 and the driving shaft 92 carries three eccentrics 93, 94 and 95 set at 120 degrees apart. Three oscillating members 96, 97 and 98 are employed operated respectively by the straps of the three eccentrics and acting through sliders 101, 102 and 103 on rotary members 104, 105 and 106 keyed to the driven shaft 107. The oscillators carrying pins 108, 109 and 110 passing through apertures in the inertia rings 111, 112 and 113 and acting as stops in the manner above described. These rings can be moved laterally by the forks 114, 115 and 116 keyed to the actuating rod 116 so that the direction of rotation of the driven shaft is determined by their position as previously described.

It is obvious that any number of phases can be similarly adapted for such mechanism and advantage can be taken of this for balancing the rotary and oscillating weights. The larger the number of phases, the more uniform is the torque obtained in the rotor shaft.

In the form of the invention shown in Figure 33 a differential gear is combined with a reducing gear suitable for use in larger motor vehicles. In this modification the driving shaft 121 is connected by an eccentric 122 to a floating lever 123 connected at its ends by two pairs of rods 124, 125 to two pairs of independent oscillating members 126, 127 rotating two independent axles 128, 129 driving the road wheels of the vehicle. The oscillating members are connected alternately with the rotating axles through two pairs of sliders 130, 131, shown diagrammatically in the figure but acting and arranged in the manner previously described. Springs may be provided connected to the floating lever to maintain the mean position of the latter.

In some cases it is desirable that the inertia ring on the slider should be elastically mounted in such a way that the slider is free to move axially but is driven as regards its oscillation about the axis by a suitable elastic coupling to the inertia ring. This may be effected as shown in Figures 34 and 35. In this arrangement the inertia ring 140 is provided with inturned lugs 141 which form an abutment for springs or equivalent elastic material 142 whose other ends rest against lugs 143 formed of an intermediate member 144 which is keyed to the slider by the splines 146. The object of mounting the inertia member on the slider by springs as shown in this modification is to avoid the heavy stresses which would arise owing to the greatly increased inertia effects at high speeds.

The provision of this elastic coupling has the effect of reducing the stresses due to the shock of engagement of the small teeth during the non-driving period when these teeth are overrunning. These stresses may by this means be limited to the high frequency impacts of the small teeth acting on the mass of the slider and the surrounding sleeve only so that the mass of the inertia ring does not operate in increasing the intensity of impact. A similar result may be obtained by constructing the inertia ring itself of rubber cast around or fixed to a light metallic pad or ring on which the keys or castellations engaging with the slider are formed.

Figures 36 and 37 show an alternative arrangement by which elasticity may be introduced between the inertia and the slider by means of external springs. In this modification the inertia member 147 is connected by springs 148 to the ring 149 which is mounted on keys 150 on the slider 151 which has large teeth 152 engaging with the oscillating member 153 and small teeth on the other side engaging intermittently with the small teeth on the rotor 154.

In order to obtain reversal it is not essential that the inertia ring or a sleeve surrounding the slider should be moved axially in the manner above described. The same result can be obtained by other means, for example, by providing a rotatable pin engaging with a suitable aperture in the inertia member surrounding the slider. This method of obtaining reversal is illustrated in Figures 38 to 41. In this form of the invention the stop or pin 155 is carried on a spindle 156 connected by an arm 157 and connecting rod 158 to a hand operated adjusting lever 159. By using this arrangement, the reversing pin may act directly on an extension of the slider itself and it is therefore suitable to make reversible mechanisms like those illustrated in Figure 1 to Figure 6 in which no inertia rings are employed.

In the position shown in Figures 38 and 39 the inertia is locked in both directions.

In the position shown in Figure 40 relative movement is possible in one direction, the stop 155 having been moved through an angle to give the

necessary freedom by means of the lever 159.

In the position shown in Figure 41 the stop 155 has been moved in the opposite direction giving relative freedom of movement in the opposite direction.

It will be obvious that many modifications are possible for providing an adjustable stop to limit the relative movement between the slider and the member carrying the large teeth in one or other direction as desired, and the forms above described are merely examples to illustrate the manner in which it may be effected.

It will be seen that the slider may not be in the form of a complete ring, but may be made in two halves or other number of segments held together by the inertia ring or by a suitable surrounding pad.

Where space does not allow the axial arrangement, slider segments may be arranged so that the relative movement of rotation causes them to move in a radial direction. An example of this form of the invention is shown at Figures 42 to 45.

In this example the slider 161 is arranged so that the movement of the oscillator 162 causes a radial movement of the slider on the square radial guides 169 which effects engagement and locking together of the oscillator 162, slider 161 and rotor 163 by the engagement of the small teeth 164. The direction in which rotation is allowed in this case is determined by the position of the pin 165 which is moved laterally by arms 166 carried by a member 167 mounted on an axially movable shaft 168. The pin 165 in this modification which passes through apertures in the inertia member 170 is cut away to allow the necessary relative movement between the slider and oscillator in a manner similar to that above described.

Another variation of the arrangement is to use two juxtaposed sliders instead of one.

For example, in the form of the invention shown in Figure 46, the oscillator 171 engages with a slider 172 through the large teeth 173. The slider carries an inertia ring 174 on splines as above described and engages intermittently with a second slider 175 through the small teeth 176. This second slider is permanently in engagement with the rotor 177 through the teeth 178. A series of flat springs 179 is provided adapted to press the two sliders into mesh contact. The depth of the teeth between the oscillator and the first slider is substantially the same as the depth of the teeth between the second slider and the rotor and the inclinations of the teeth to a place perpendicular to the axis of the rotor may conveniently be 120 degrees for the teeth between the oscillator and the first slider, 90 degrees for the small teeth between the two sliders, and 60 degrees for the teeth between the second slider and the rotor. Sufficient clearance is allowed so that when all large teeth are in mesh the small teeth can override.

In this modification of the invention, the advantage is obtained that the small teeth are always in mesh and should it happen that at the moment at which the first driving pressure is exerted between the two sliders only the tips of the teeth are in engagement, the give of the second slider pressing against the spring 179 allows immediate slip of the tips and engagement of the teeth follows without damage to the tips.

In order to enable relatively large teeth to be used with a minimum of back lash on the side of the slider on which the teeth are alternately engaged and disengaged, the slider may be divided into a number of segments, say six, so arranged that they are staggered in two or more phases.

It must be noted that if the teeth are staggered, care must be taken that space is allowed for the disengagement of the teeth which are not required to be in mesh. The result of this is that when the slider is moved axially to engage with the rotor or oscillator, only one segment at a time will come into engagement so that the movement of rotation necessary to cause engagement is extremely small and the back lash which can occur will be one-sixth of that which would occur with the same sized teeth if the slider is made in one piece.

It will be seen that if desired two or more segments may be in engagement simultaneously.

A simple method of cutting the teeth on the slider is illustrated at Figures 47 and 48. From these figures it will be seen that flats 221 are cut on the top of the teeth so that the section of each tooth is triangular at its inner end 222 and triangular with the apex of the triangle cut off at the top of the groove at its outer end 223. The lines 224, Figure 48, show the bottom of the grooves between consecutive teeth.

For the large teeth the angle of inclination a may be 30 degrees, the number of teeth may be 12 and the angle a' between the dotted lines shown the direction of movement of the cutter may be 60° 46′. For the small teeth the

number of teeth may be 60, the angle of inclination 45 degrees and the angle n may be 3° 0′.

A more elaborate method is to cut the teeth so that their faces are portions of a helicoidal surface generated by a line through the axis and perpendicular to its and following the profile of the tooth desired. This will give surface contact between the teeth at all stages of engagement.

In the form of the invention shown at Figures 49, 50 and 51, the connecting rod 231 actuates the oscillating member 232, which is permanently in engagement with the slider 233 through large teeth as above described, corrugated plate spring 234 being provided which always press the slider towards the rotor 235. Surrounding the slider there is provided an inertia ring 236 sliding on keys on the slider and controlled by the pin 237 carried by the oscillator, the pin being notched to control the direction of movement in co-operation with the aperture in the inertia ring as fully described above. A distance piece in the form of a ring 244 is provided between the rotor and oscillator. On the rotor 235 there is mounted a locking ring 238 abutting against a hard pad 239 of high friction material and between the ring 238 and the rotor there is also provided a pad 240 of compressed cork or other friction increasing substance. The locking plate carries on the face next to the slider a ring of flat topped teeth 241 of the same pitch as the small teeth on the slider 233 and rotor and is actuated by a pin 242 carried by the inertia ring and engaging an aperture in the flange 243 on the locking plate. The pin is cut away as shown in Figures 50 and 51 so that a relative movement of rotation between the slider and locking plate of a distance equal to half the pitch of the small teeth is possible in one direction or the other according to the axial position of the inertia ring relative to the flange of the locking plate.

The operation of the above described apparatus is as follows:—

Owing to the strong friction between the locking plate and the rotor the locking plate will tend to move with the rotor but immediately the slider commences to move faster than the rotor, as there is only a free movement equivalent to half one of the small teeth, the slider will move the locking plate through this distance. The teeth and stops are so arranged that when the rotor is moving faster than the slider the small teeth on the slider and the teeth on the locking plate are exactly opposite each other, so that no engagement can occur between the small teeth of the slider and the rotor. When the slider accelerates sufficiently to overrun the rotor the pin 242 will move in the aperture in the flange 243 with the result that the top of the teeth on the slider come opposite the groove between the teeth on the locking plate, thus allowing the slider to move axially with resulting engagement of the small teeth on the slider with the small teeth on the rotor. It will be seen that the locking plate will thus prevent engagement during the first and last periods of the driving stroke during which periods the speed of the rotor is greater than the speed of the slider.

It will be seen that locking plates as above described may be employed in all cases in which for the production of a silent gear or other reason all contact on overrunning of the small teeth is to be avoided.

In the form of the invention shown in Figures 52 and 53, the main driving shaft carries a flywheel 252. This driving shaft is connected by the link 253 with the lower end of a floating lever 254 whose other end is connected at the pivot 255 with an oscillating member 256 and flywheel 251. The centre of the floating lever 254 is connected by the connecting rods 257, 258 to a pair of oscillating members 259, 260 working in opposite phase. The rotor shaft 261 passes centrally through the oscillating members and carries flanges 262, 263 firmly keyed to the shaft.

The oscillators are provided with large teeth as in the modifications above described engaging with corresponding large teeth on sliders 264 which are provided with flanges 265 between which and the flanges keyed to the rotor shaft there are provided rubber pads 266. A suitable spring device 267 is provided to maintain the mean position of the oscillating member 256. Packing 268 is provided around the sliders to prevent oil from flowing outwards towards the rubber pads. The parts within the casing are lubricated by means of oil contained in the bottom of the casing.

The operation of the above described arrangement is as follows:—

On movement of each oscillator in one direction, the slight friction between the rotor and slider and the inertia of the slider itself causes the slider to move relatively to the oscillator with the consequence that the engaging teeth of the oscillator and slider are given a relative movement causing the slider to be pressed strongly against the rubber pad and drive by means of friction. The

form of the teeth is such that on the return movement of the oscillating member relative movement of the oscillator and slider is prevented as in the modification previously described, so that there is no jamming of the slider against the rubber pad for movement in this direction; consequently the rotor is given a movement of rotation in one direction, the drive being taken up alternately by the two sliders. A suitable shape of teeth for this illustration is triangular, with one face inclined at $\alpha = 30$ degrees to its base and the other face perpendicular to the base so as to act as stops for the slider.

Many variations of this arrangement are possible for the purpose of increasing the initial friction, or inertia, or both by which the initial relative movement between the slider and oscillator is produced. Further, springs may, if desired, be employed, and the slider and rotor may be arranged either axially or radially as described. In the latter case, the contacting surface will be cylindrical and in such case the rubber ring which forms the friction surface may be continuous and the slider divided into segments.

The means illustrated for keeping the oscillating member 256 moving about a mean position comprises a spring 270 situated between two flanges 271, 272. One of these flanges bears against a block 273 pivoted in the casing while the other bears against nuts screwed on to the rod 267 which is connected at 274 to the oscillating member 256.

It will be seen that many modifications of the invention are possible. Either method of obtaining reversal above described may be used in combination with friction operated or spring operated sliders instead of employing an inertia ring and in such case the notched pin which provides the necessary stops may be arranged so that it engages with a sleeve surrounding the slider, the sleeve allowing the slider to move in the axial direction but being keyed in such a manner that it moves in the rotary direction with the slider.

If the rotary reversing pin is employed in such cases as illustrated in Figure 38, the pin can be made to operate on a projection rigidly fixed with the slider.

In the examples of the invention above described, the clutch device has been applied to mechanically operated oscillators. It will be evident, however, that other means may be employed to obtain the oscillation; for example, hydraulically or pneumatically operated plungers, or alternating tension may be applied by means of wires; or electro-magnetic devices for producing the oscillation may be employed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Apparatus of the type indicated in which the co-operating faces of the oscillating member are constructed so that the driving angle between the oscillating member and one or more sliding members is smaller than the driving angle between the sliding members and the rotor by an amount just sufficient to secure that when the oscillating member is oscillated at high frequency alternate engagement and jamming and disengagement of the several members is obtained in order to convert oscillating movement into intermittent rotary movement with a minimum of back-lash.

2. Apparatus according to Claim 1 in which the sliding member has symmetrical teeth on both sides, the angles of inclination of the teeth between the sliding member and the oscillating member being greater than the angles of inclination of the teeth between the slider and the rotor.

3. Apparatus according to Claim 1 having a frictional drive between the slider and the rotor, the two sides of the slider being constructed of different material so that the angle of friction between the co-operating surfaces of the slider and rotor is greater than the driving angle of the co-operating surfaces between the slider and the oscillator.

4. In apparatus according to Claim 1 suitable stops adapted to limit the movement of the slider relatively to the oscillator in one direction or the other, as desired, in order to provide reversing the mechanism.

5. Apparatus according to Claim 1 arranged so that the inertia of the slider tends to assist engagement and disengagement between the slider and the rotor.

6. Apparatus according to Claim 1 having an additional mass or inertia member moving with the slider in its rotor and arranged so that relative longitudinal movement is allowed between the slider and the additional inertia member.

7. A unidirectional driving mechanism as claimed in Claim 1 comprising a slider situated between an oscillating member and a rotating member, the slider having teeth on one side and a friction device, preferably elastic, on the other side situated in such a position that it can be kept free from oil.

8. A unidirectional driving mechanism

as claimed in Claim 1 arranged so that the inertia of the sliding member tends to assist the engagement and disengagement of the smaller sets of teeth.

9. In a unidirectional driving mechanism as claimed in Claim 1 an additional mass or inertia member moving with the slider in its rotation arranged so that relative longitudinal movement is allowed between the slider and the additional inertia member.

10. In a unidirectional driving mechanism as claimed in Claim 1 an elastic connection in the rotary direction between the slider and an additional inertia member.

11. A unidirectional driving mechanism as claimed in Claim 1 a suitable stop or sets of stops on the oscillator engaging with the additional inertia member to prevent movement of the slider relatively to the oscillator on one side of the mean relative position, while another stop or sets of stops or the same stops suitably displaced prevents movement of the slider relatively to the oscillator on the other side of the mean position with or without a third stop or set of stops or third position of the same stops preventing any movement on either side of the mean position of the slider relatively to the oscillator.

12. An improved unidirectional driving mechanism comprising a sliding member, in the form of a ring having teeth on its two faces situated between an oscillating member and a rotating member having corresponding teeth; the teeth on one side of the slider being larger and of less inclination than the teeth on the other side so that engagement and disengagement of the smaller teeth is effected by relative movement of the slider and the oscillating member or of the slider and the rotating member.

13. A unidirectional driving mechanism comprising a sliding member in the form of a ring having teeth on its two faces, one set of teeth being of smaller depth and adapted to engage and disengage with teeth on a rotating member, while the other set of teeth are larger and permanently in engagement and are adapted to co-operate with teeth on the oscillating member to give the slider a longitudinal movement in the direction to cause engagement of the smaller teeth on the slider with the teeth on the rotating member.

14. In a unidirectional driving mechanism as claimed in Claim 1 the combination of a mass or inertia member moving with the slider as described above permanent friction with or without stops being provided between this inertia member and the rotor.

15. A unidirectional driving mechanism as claimed in Claim 1 having two sliders with teeth formed on each side one of said sliders being permanently in engagement with the oscillator and the other being permanently in engagement with the rotor, the small teeth on the sliders being adjacent and kept in contact by means of a spring.

16. A unidirectional driving mechanism, as claimed in Claim 1 having the sliding members in the form of a number of segments so arranged that the small teeth on the different segments are staggered so that the movement of rotation necessary to cause engagement is small.

17. The improved unidirectional driving mechanism hereinbefore described and illustrated in Figures 1 to 5 of the accompanying drawings.

18. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figure 6 of the accompanying drawings.

19. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figure 7 of the accompanying drawings.

20. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 10 to 24 of the accompanying drawings.

21. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 25 and 26 of the accompanying drawings.

22. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 27 to 30 of the accompanying drawings.

23. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figure 31 and 32 of the accompanying drawings.

24. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figure 33 of the accompanying drawings.

25. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 34 and 35 of the accompanying drawings.

26. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 36 and 37 of the accompanying drawings.

27. The improved means for providing adjustable stops hereinbefore described and illustrated at Figures 38 to 41 of the accompanying drawings.

28. The improved unidirectional driving mechanism hereinbefore described

and illustrated at Figures 42 to 45 of the accompanying drawings.

29. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figure 46 of the accompanying drawings.

30. In a unidirectional driving mechanism as claimed in Claim 1 a slider having teeth cut in the manner illustrated at Figures 47 and 48 of the accompanying drawings.

31. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 49 to 51 of the accompanying drawings.

32. The improved unidirectional driving mechanism hereinbefore described and illustrated at Figures 52 and 53 of the accompanying drawings.

Dated the 12th day of May, 1923.

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Chartered Patent Agent.

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Fig.1.

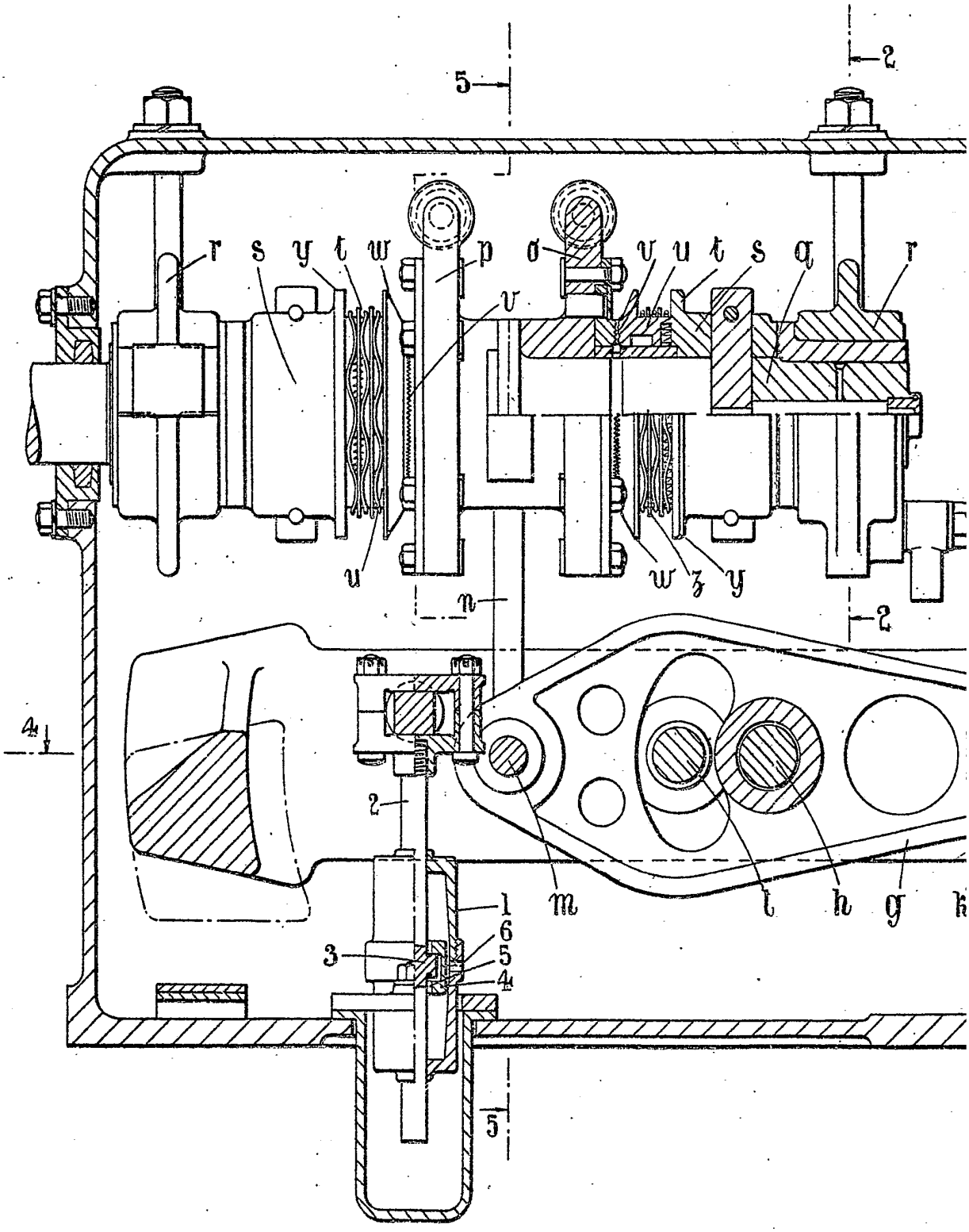

Fig.1.

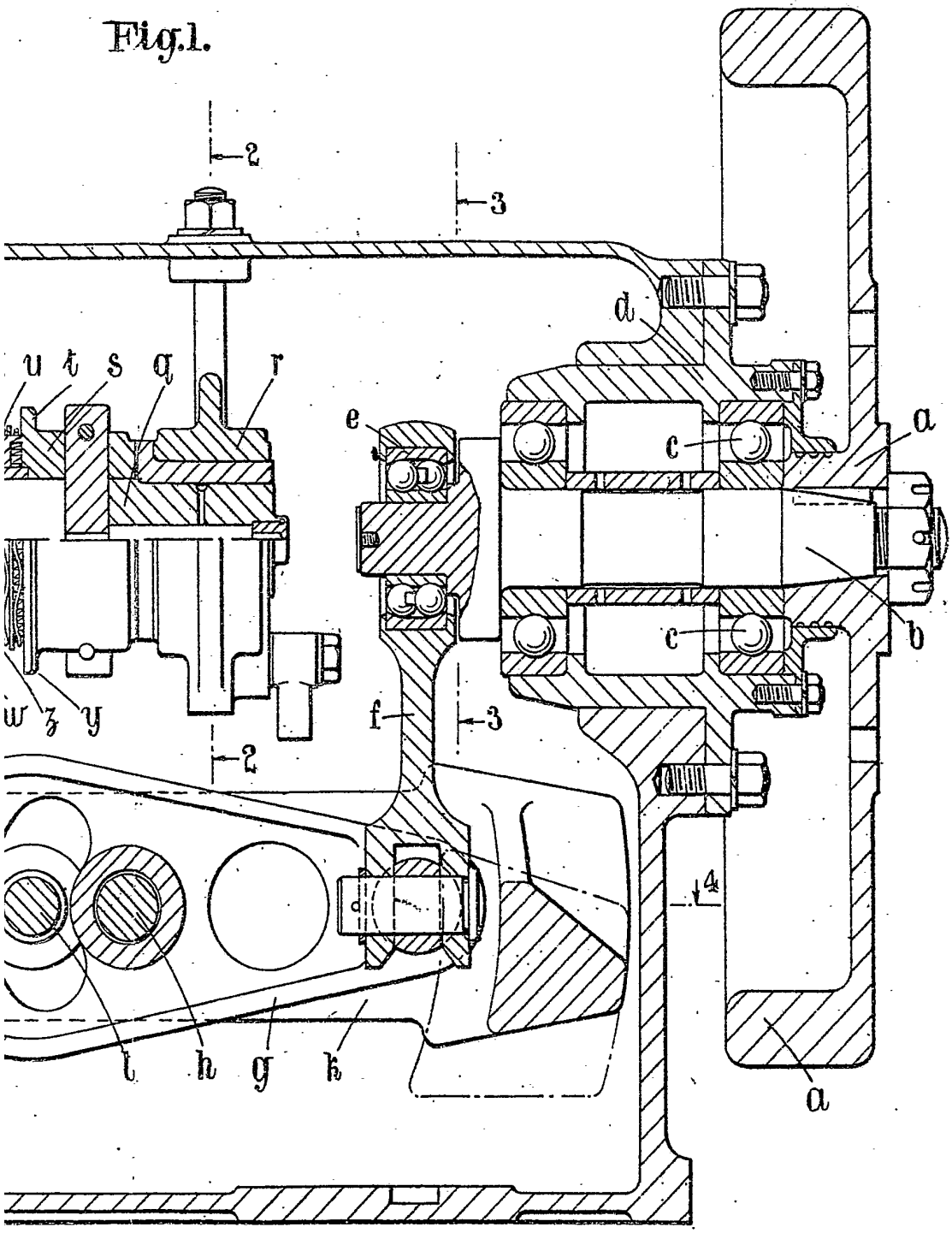

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Fig.1.

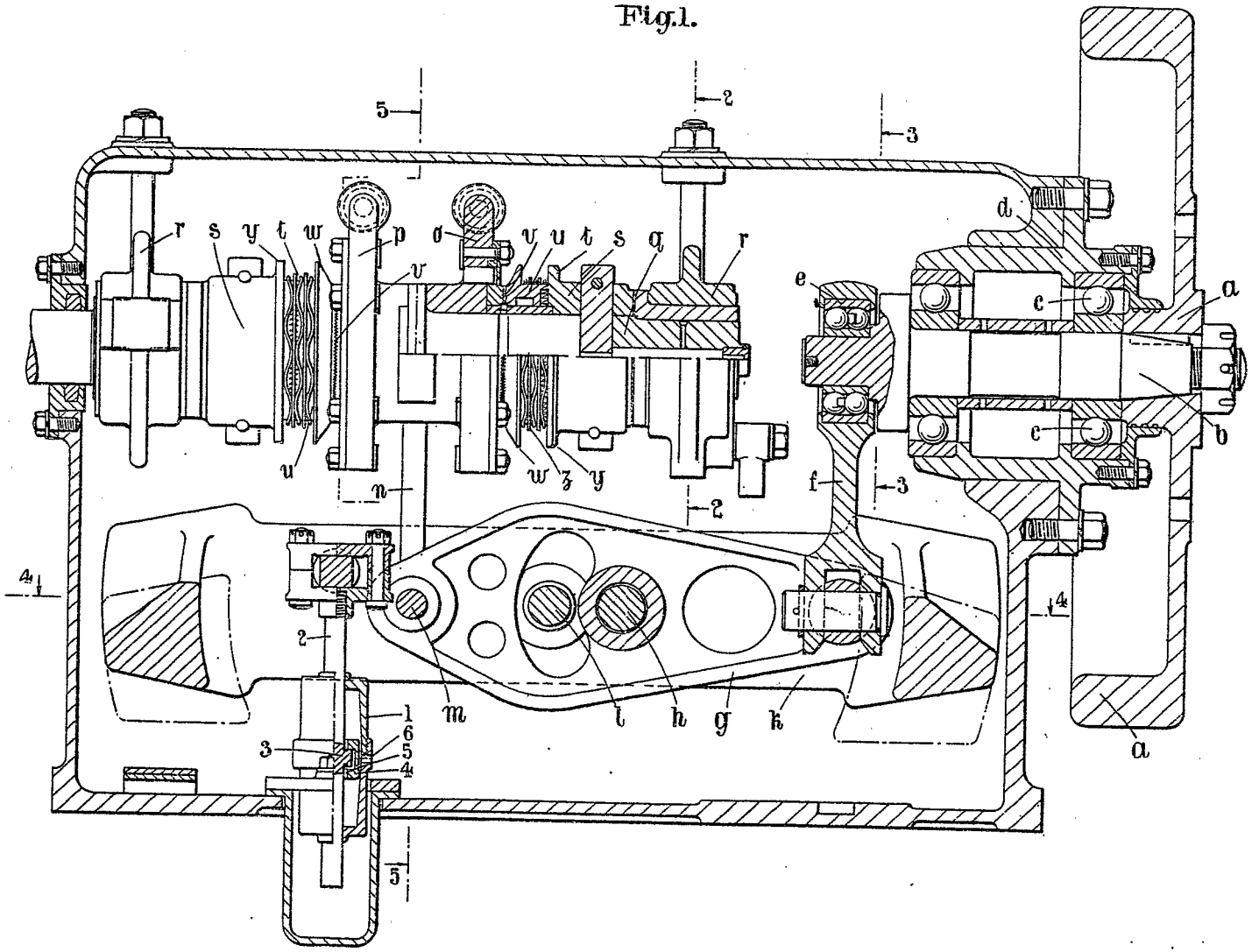

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Fig. 2.

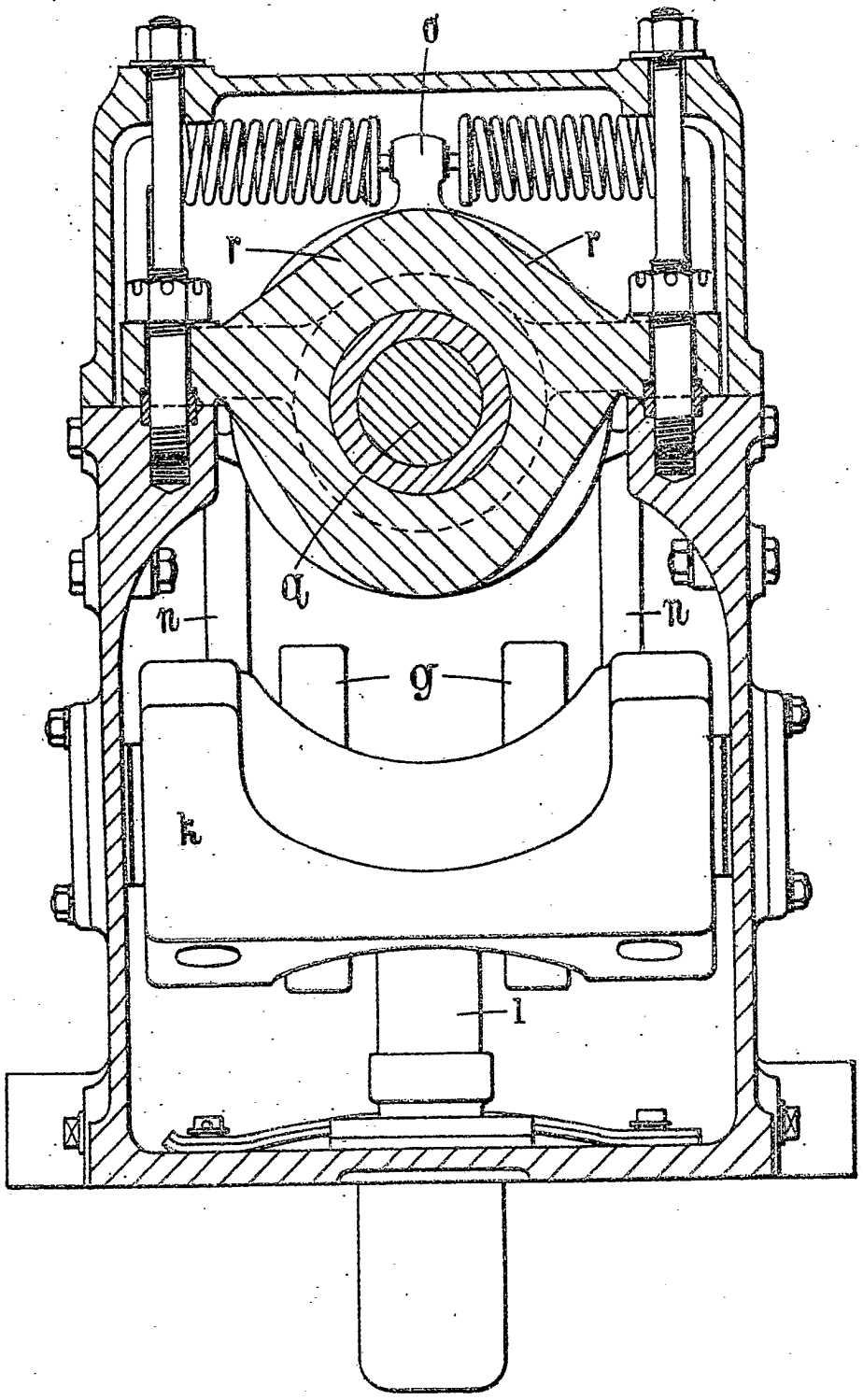

Fig. 3.

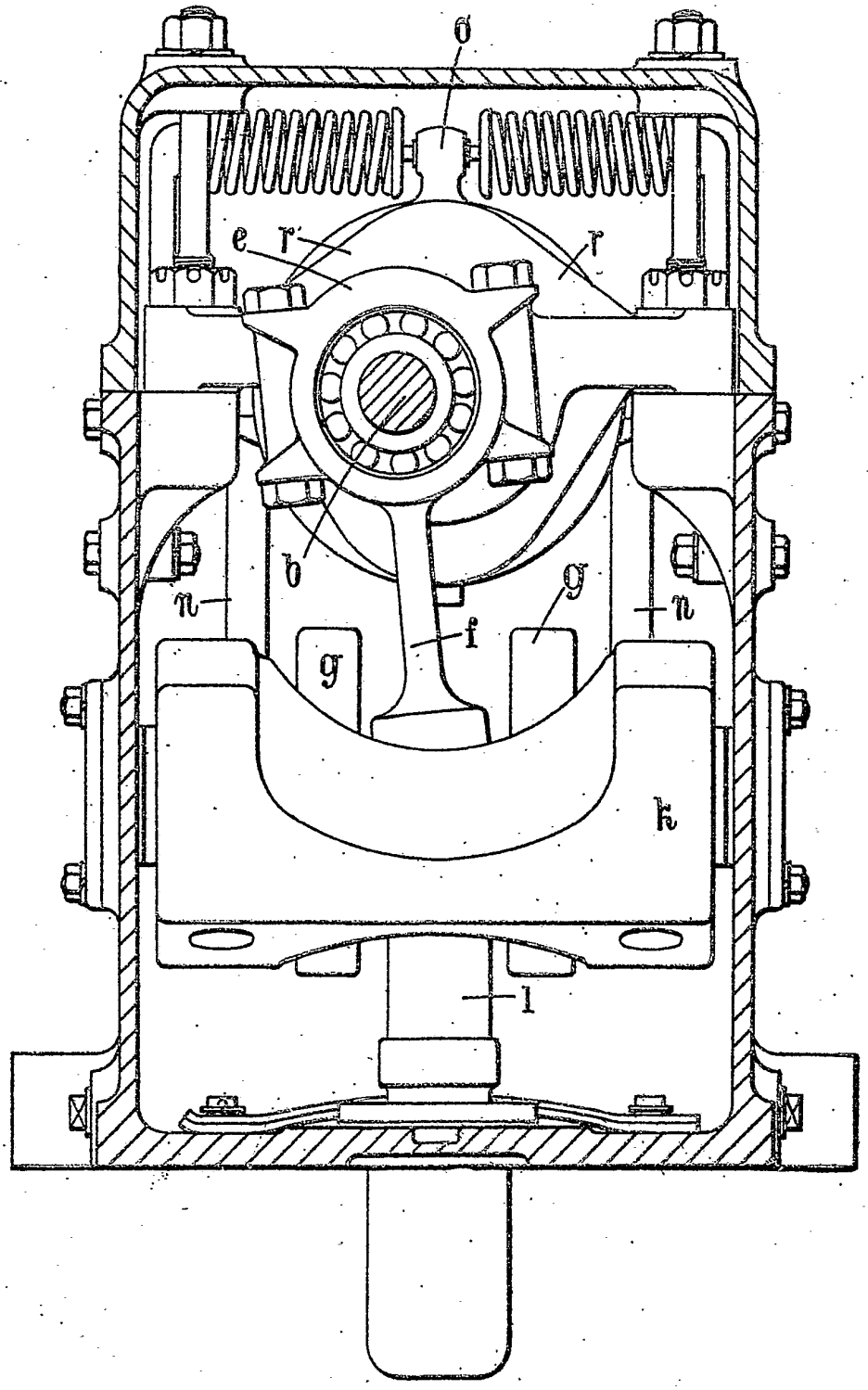

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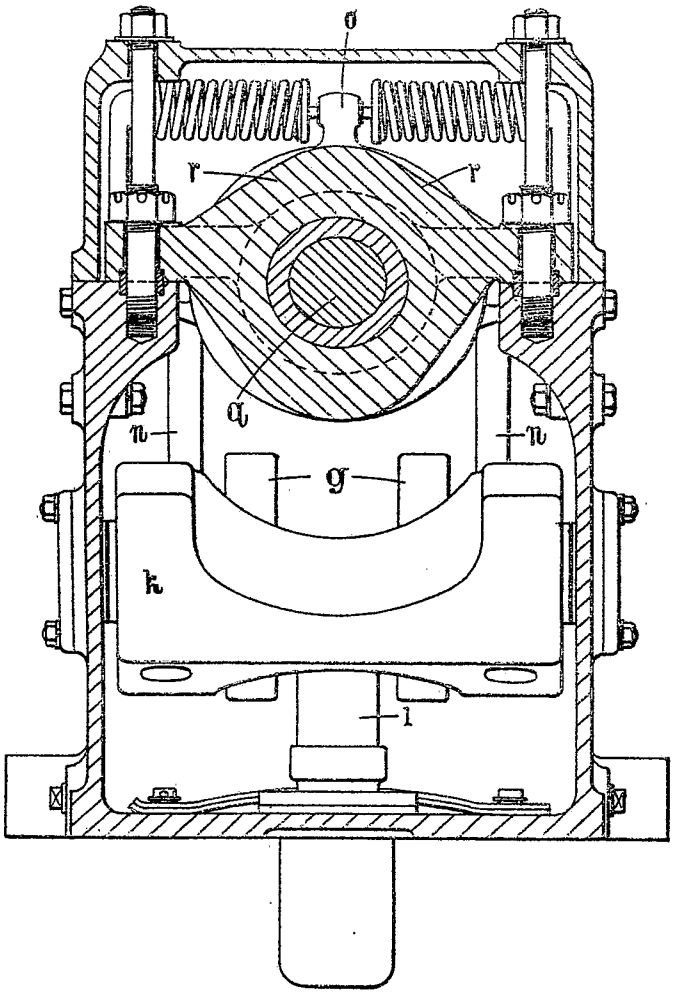
Fig. 2.



SHEET 3

Fig. 3.

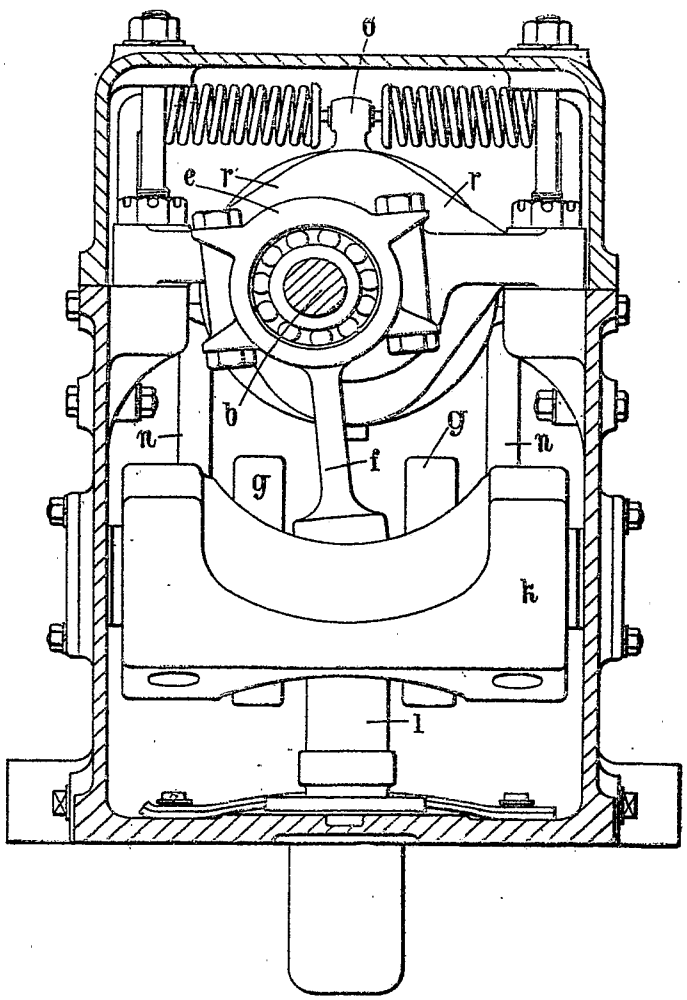


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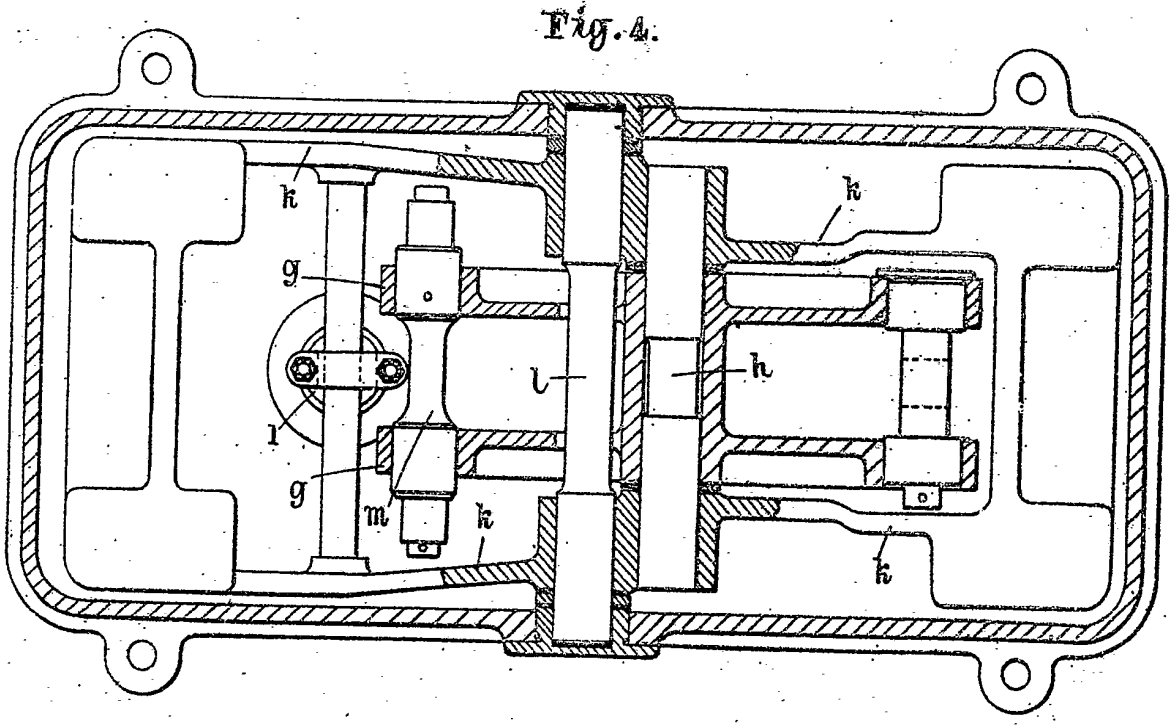
Fig. 4.



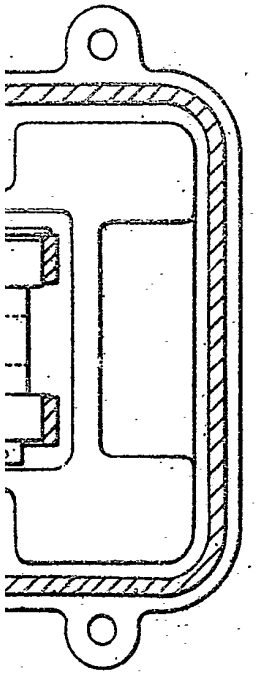


Fig. 5.

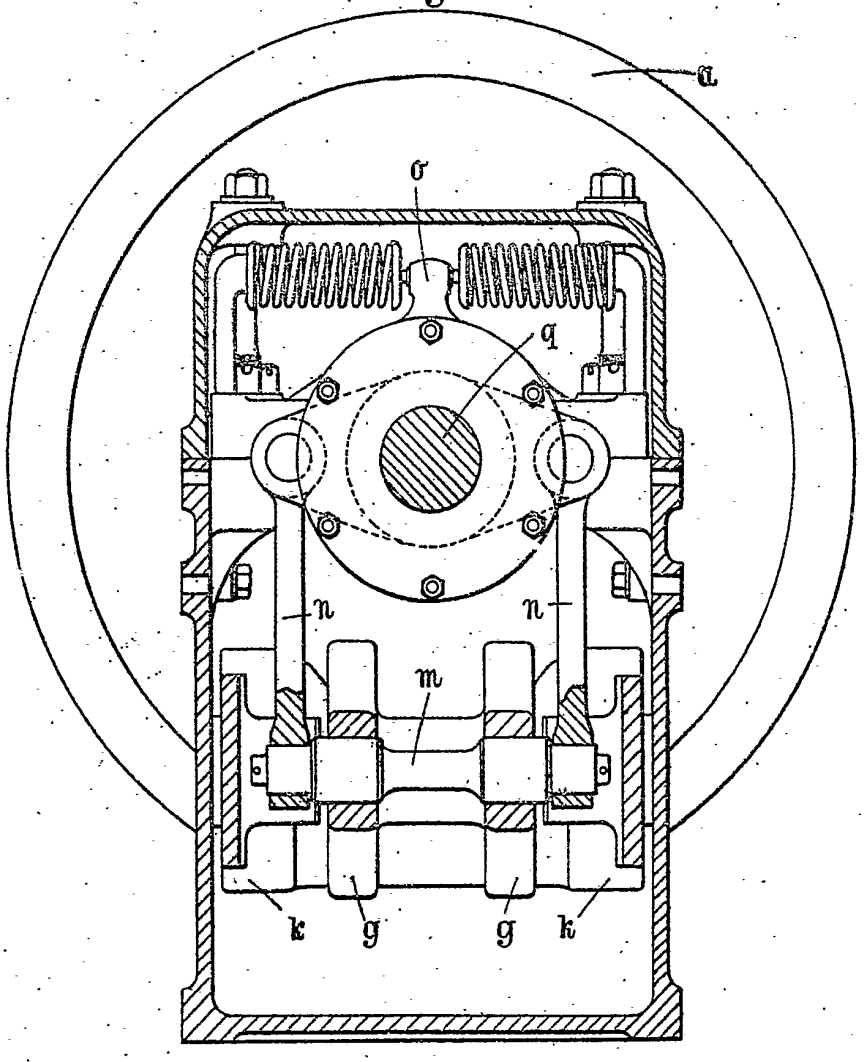


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Fig. 4.

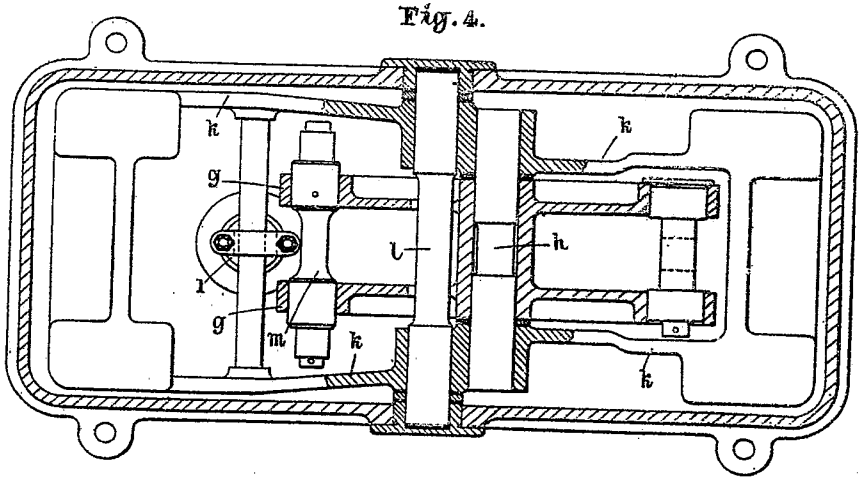

Fig. 5.

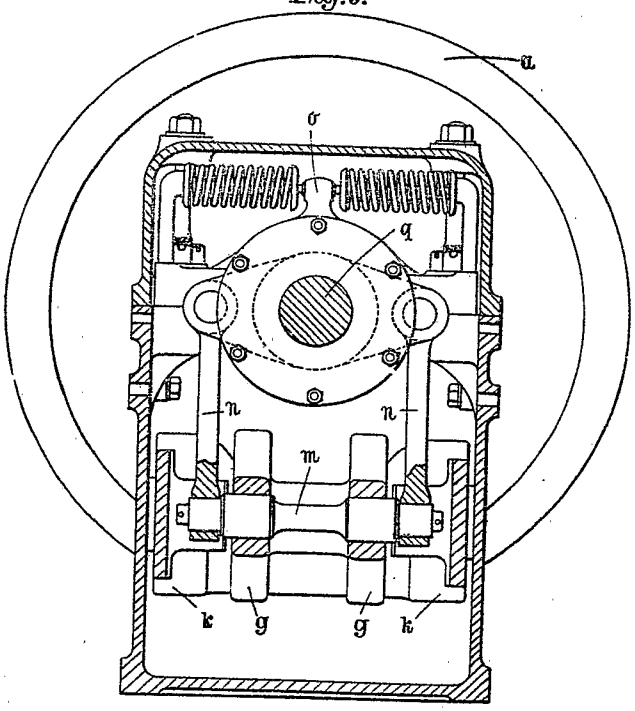

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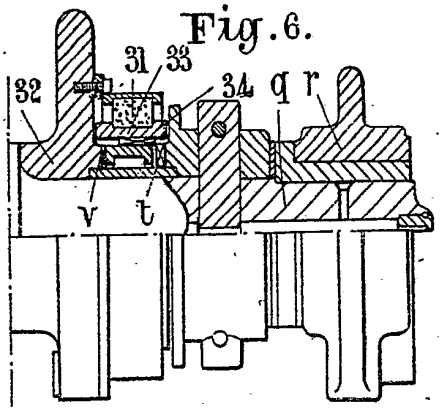
Fig. 6.



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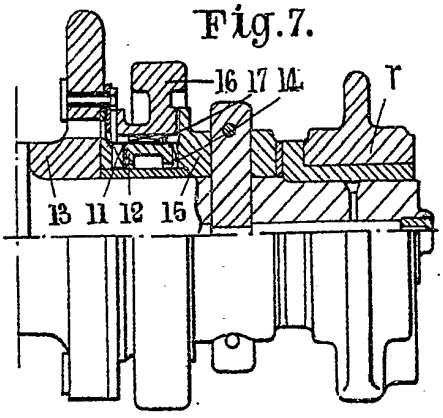

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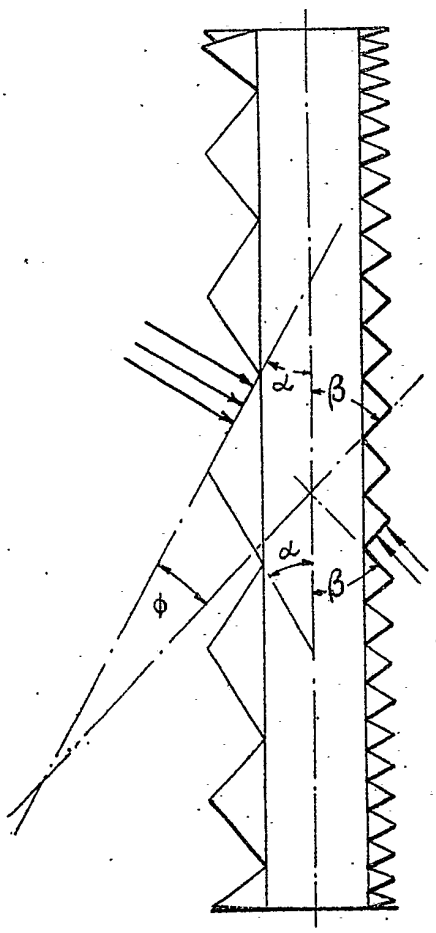

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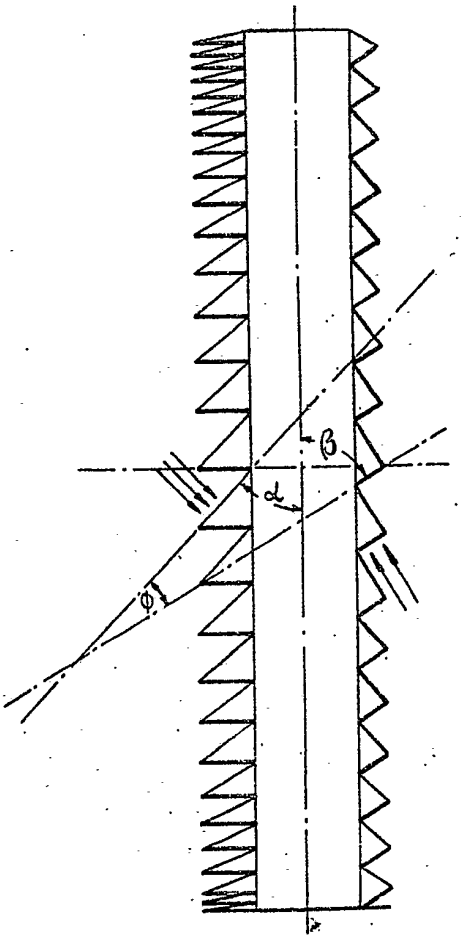

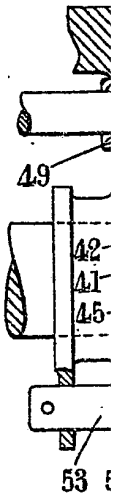

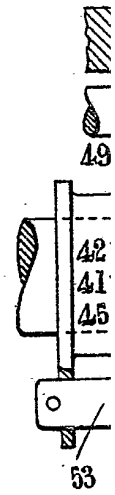

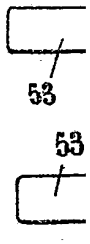

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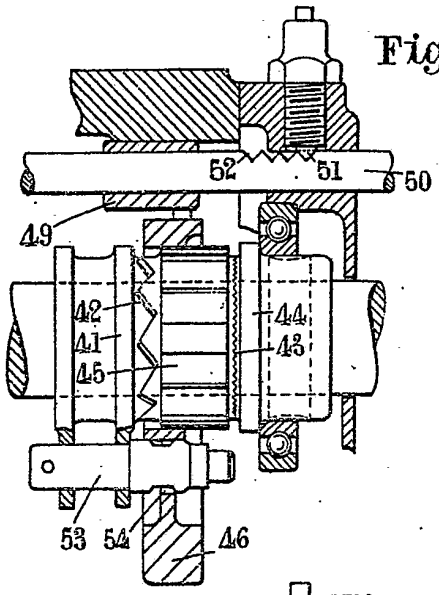

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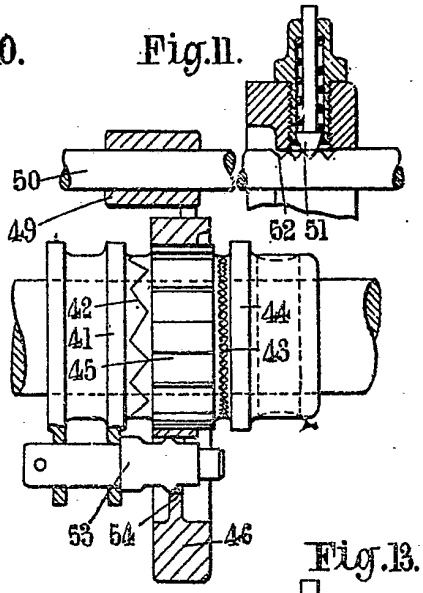

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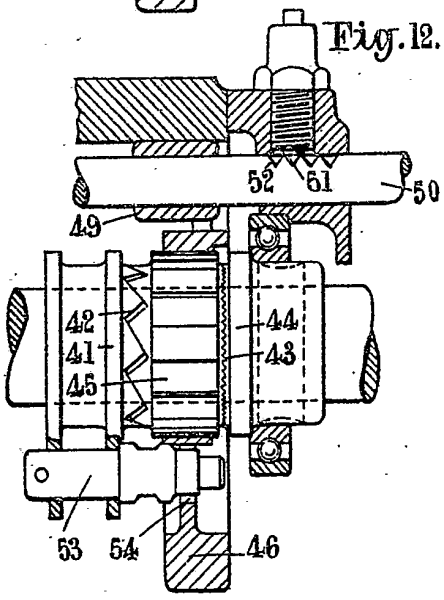

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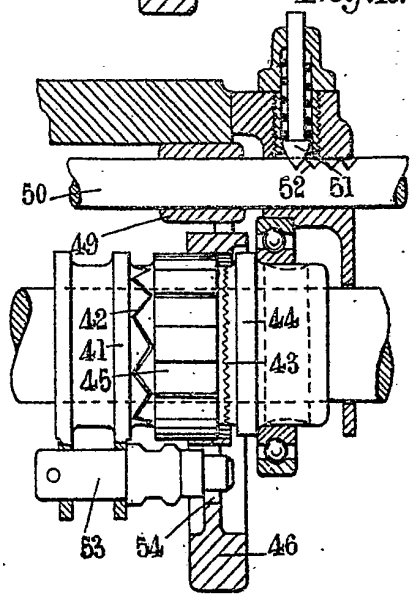

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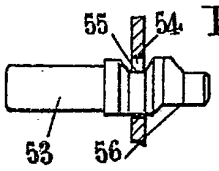

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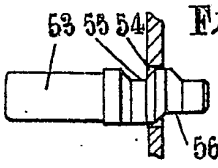

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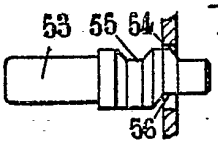

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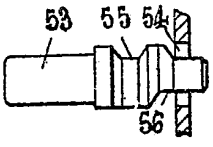

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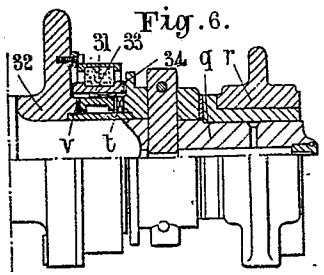

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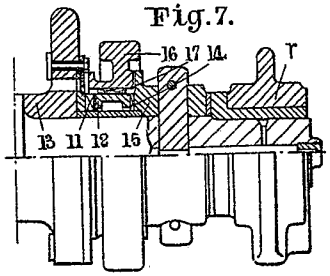

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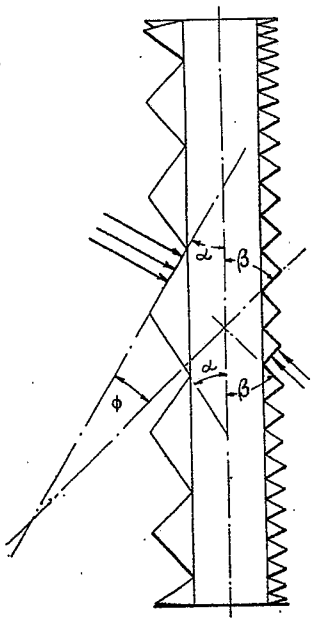

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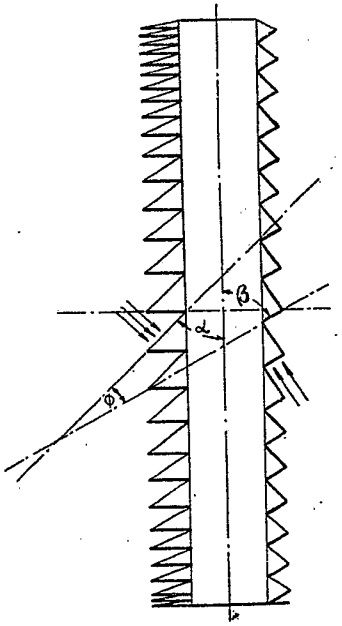

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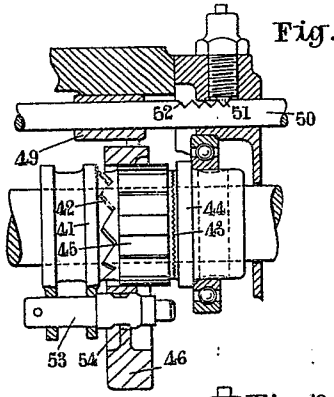

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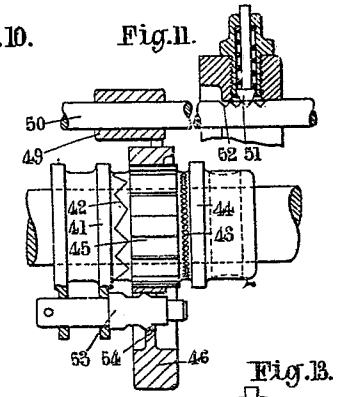

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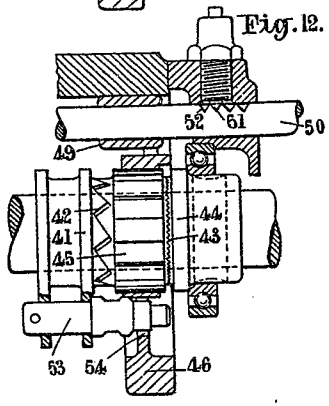

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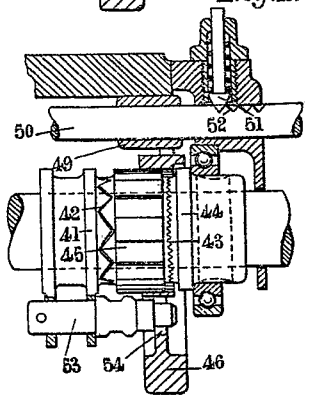

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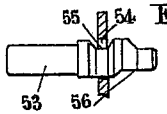

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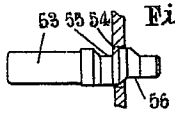

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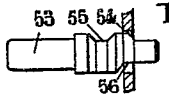

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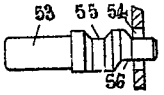

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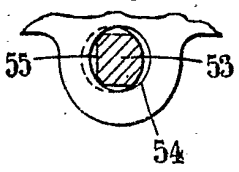

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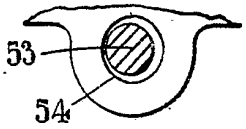

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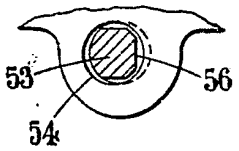

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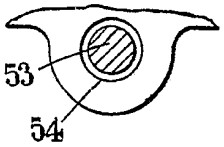

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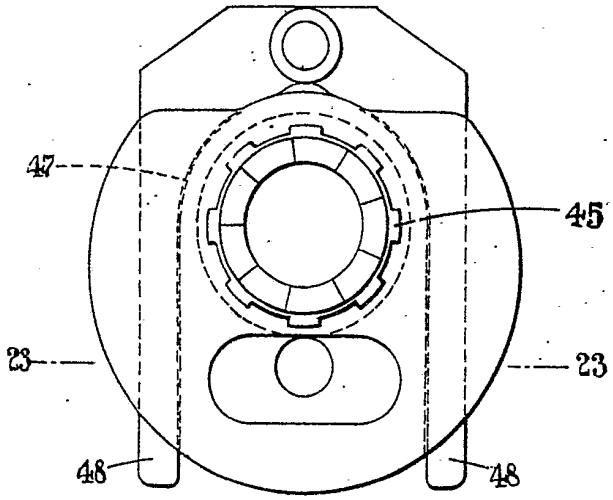

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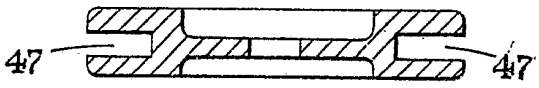

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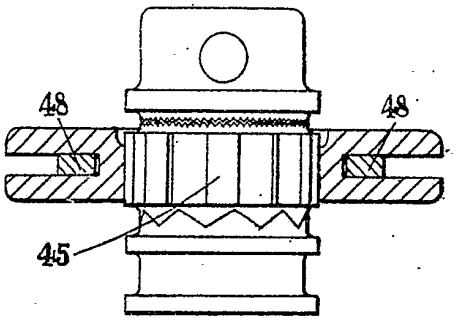

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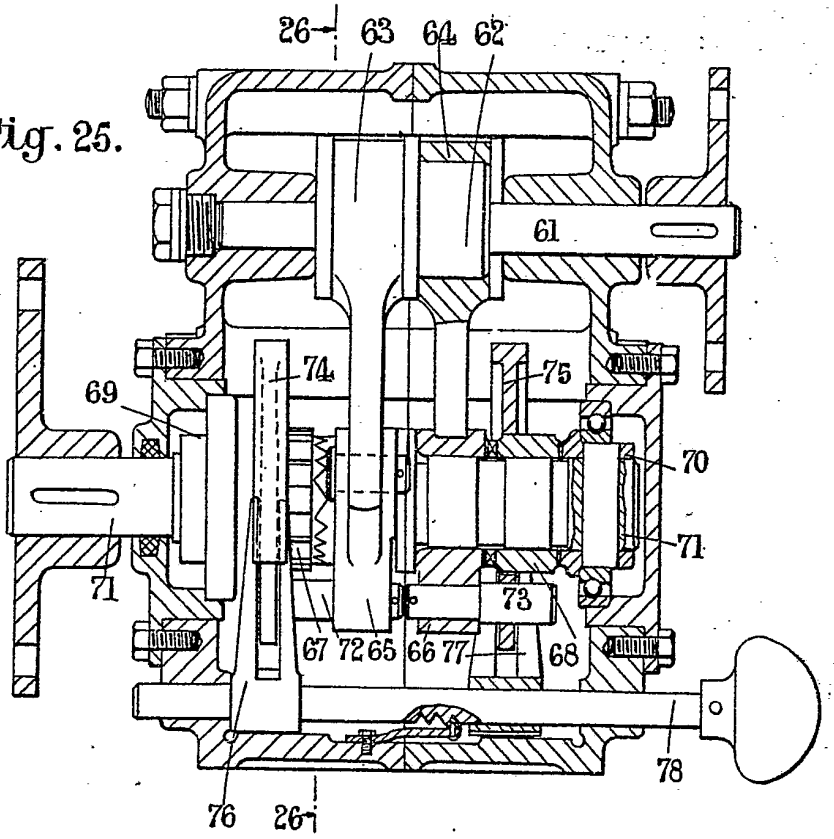

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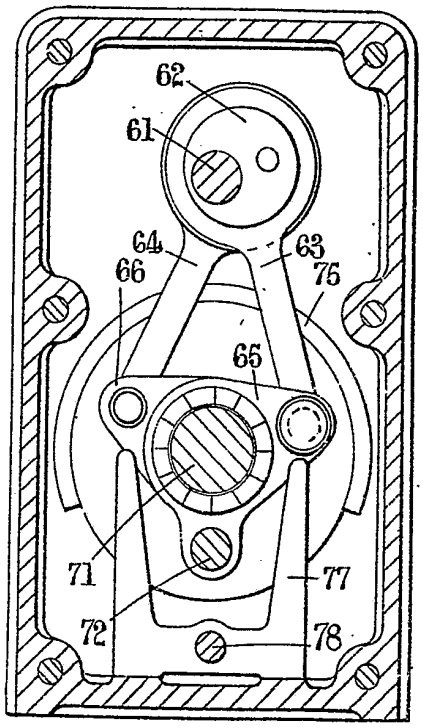

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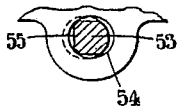

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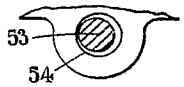

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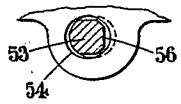

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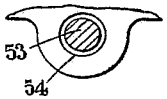

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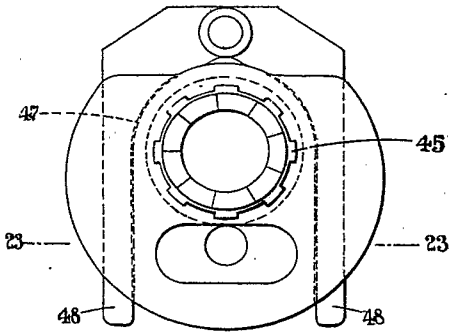

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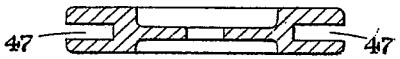

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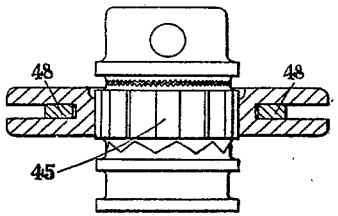

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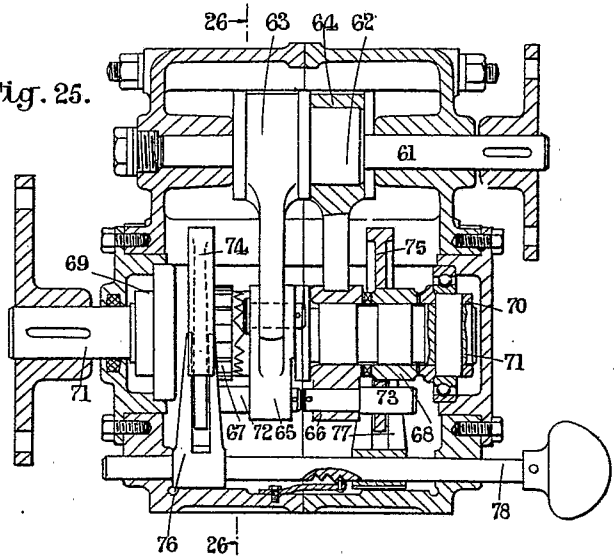

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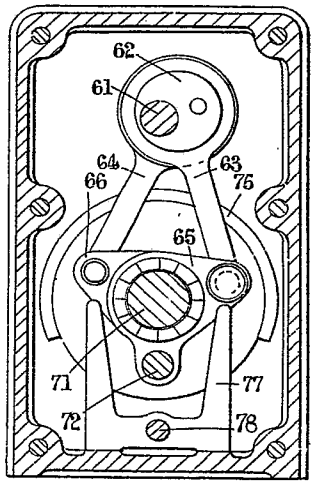

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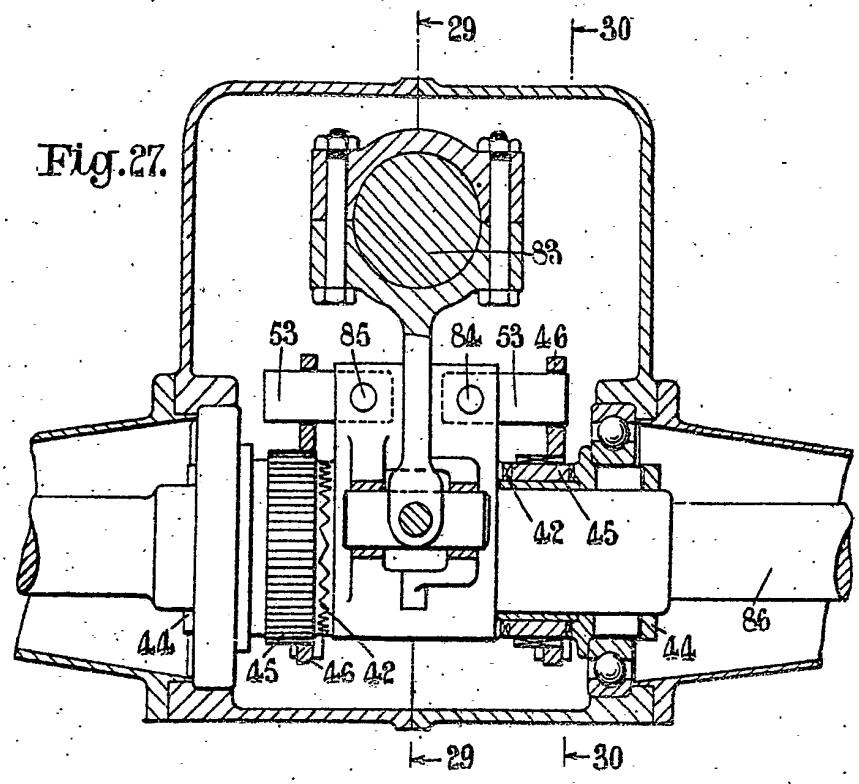

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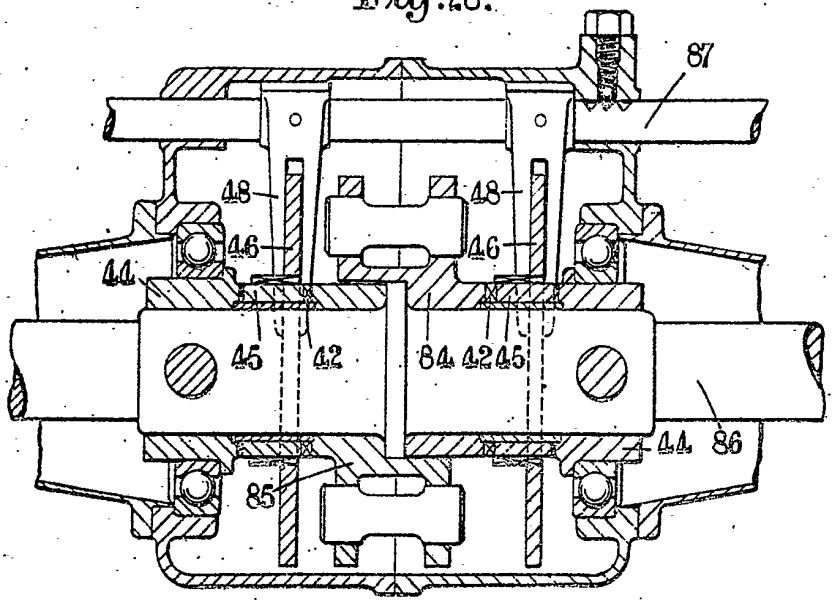

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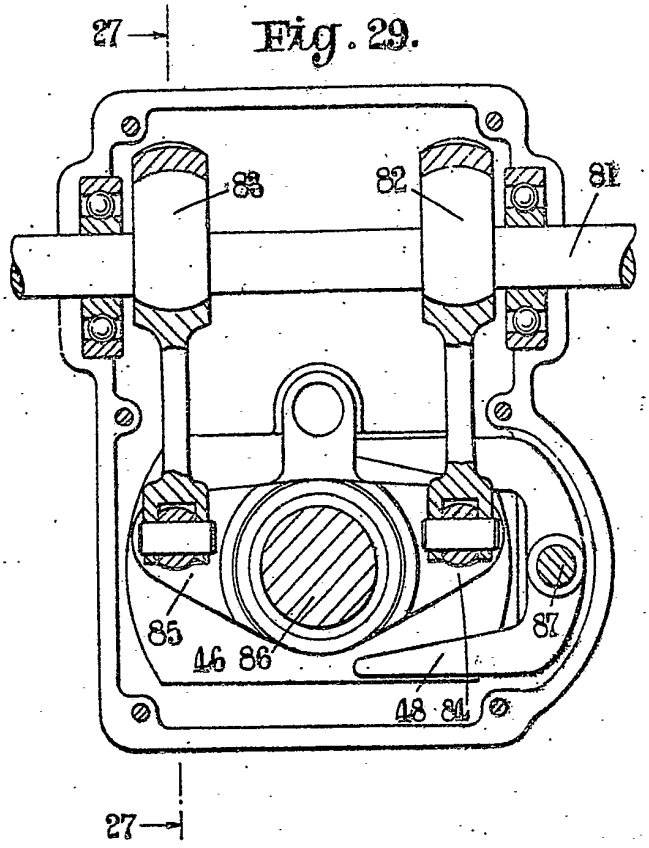

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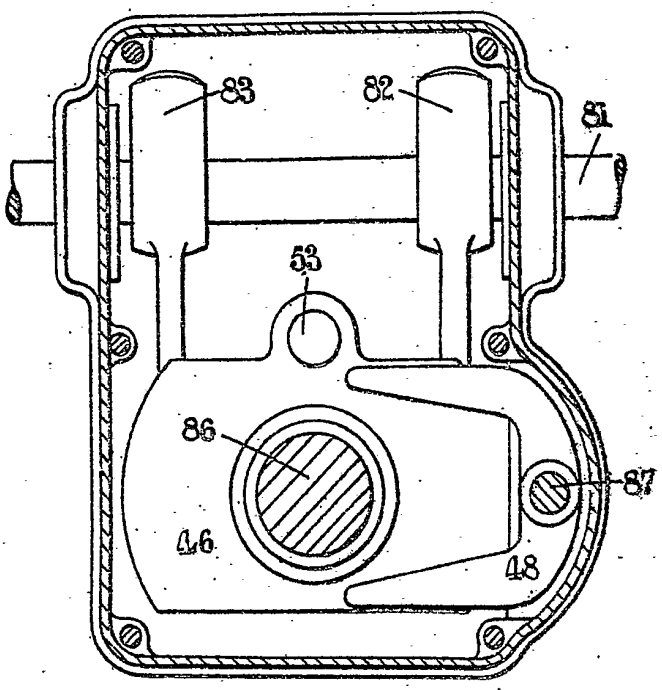

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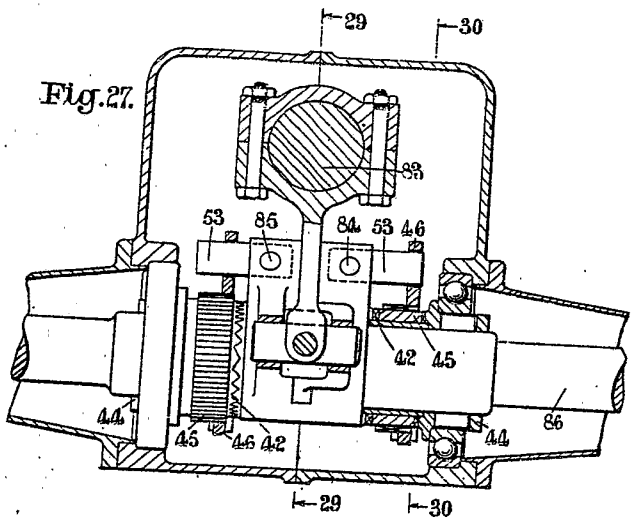
Fig.27.



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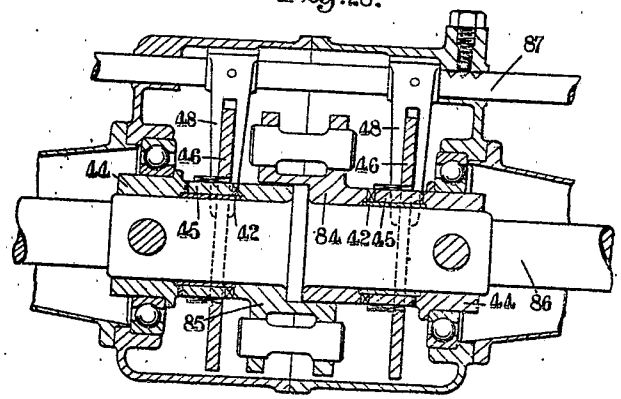

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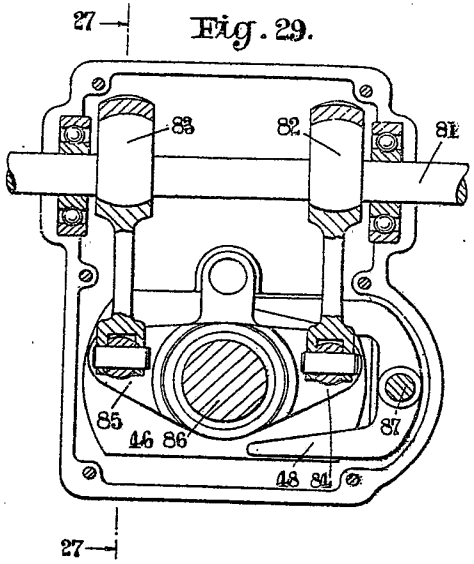

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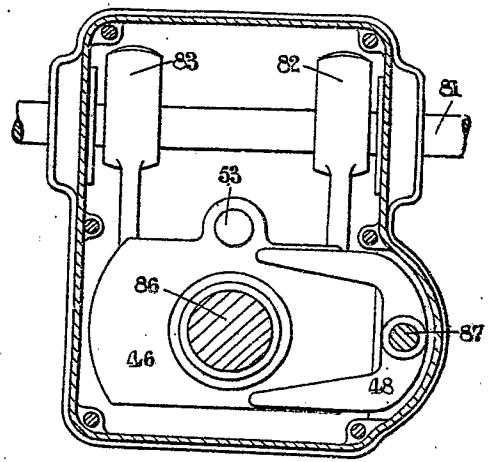

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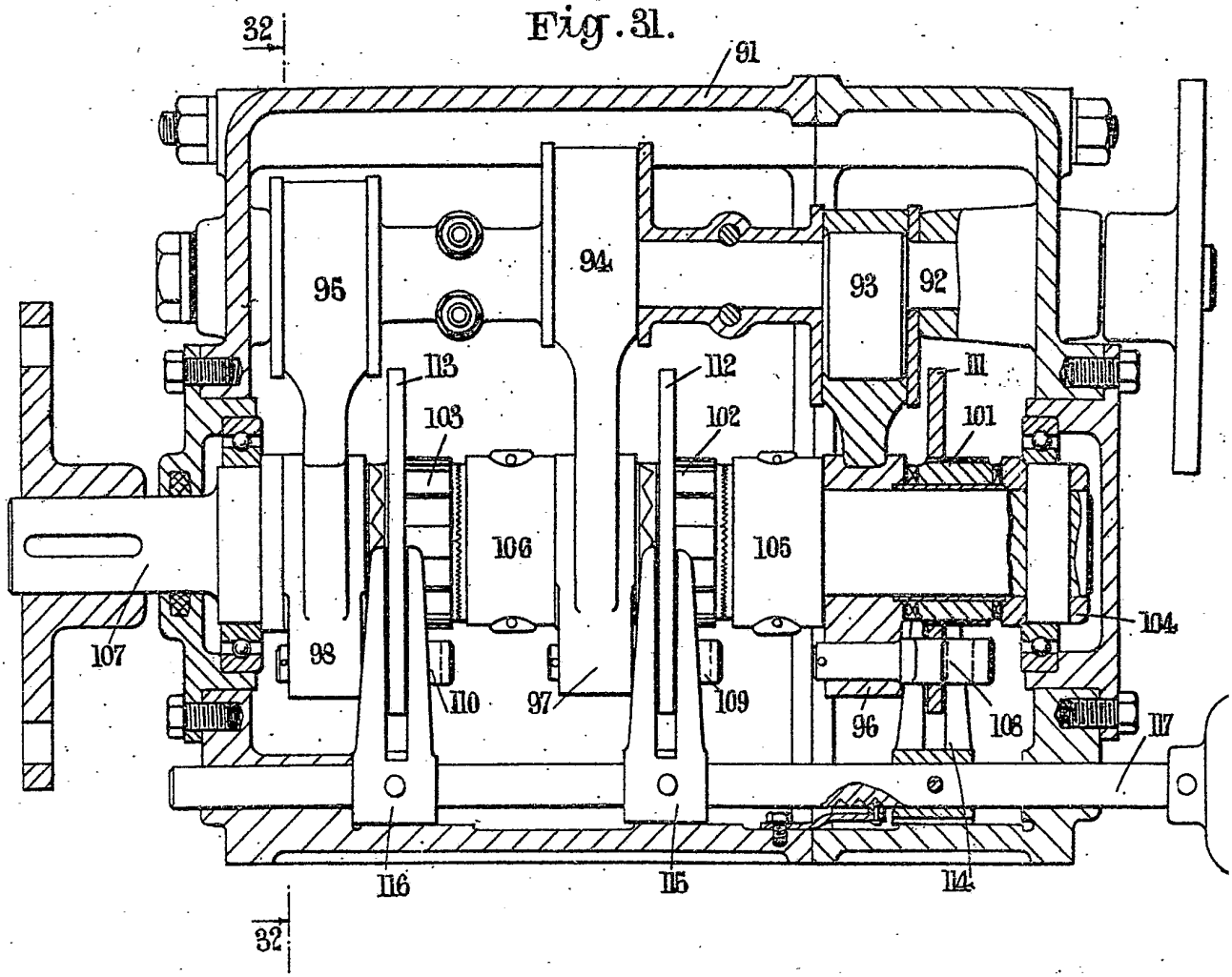

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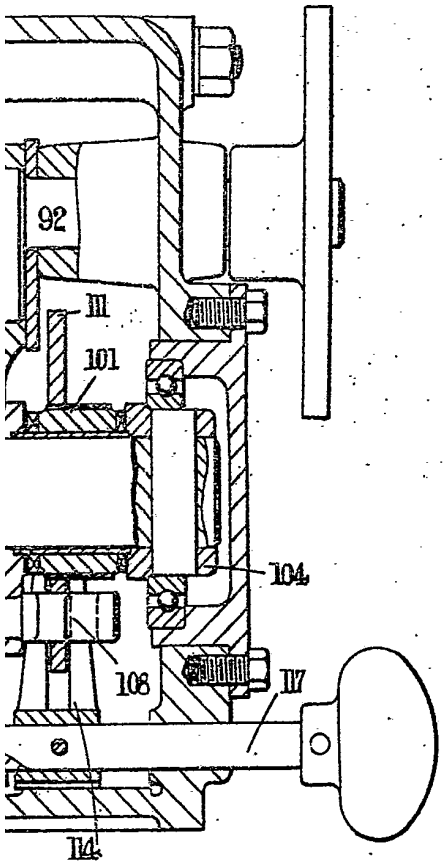

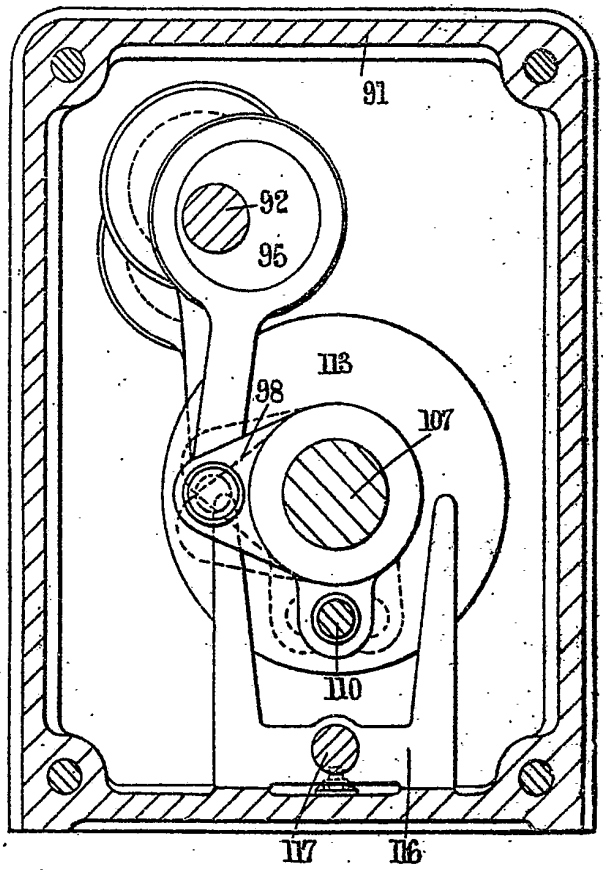

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Fig. 31.

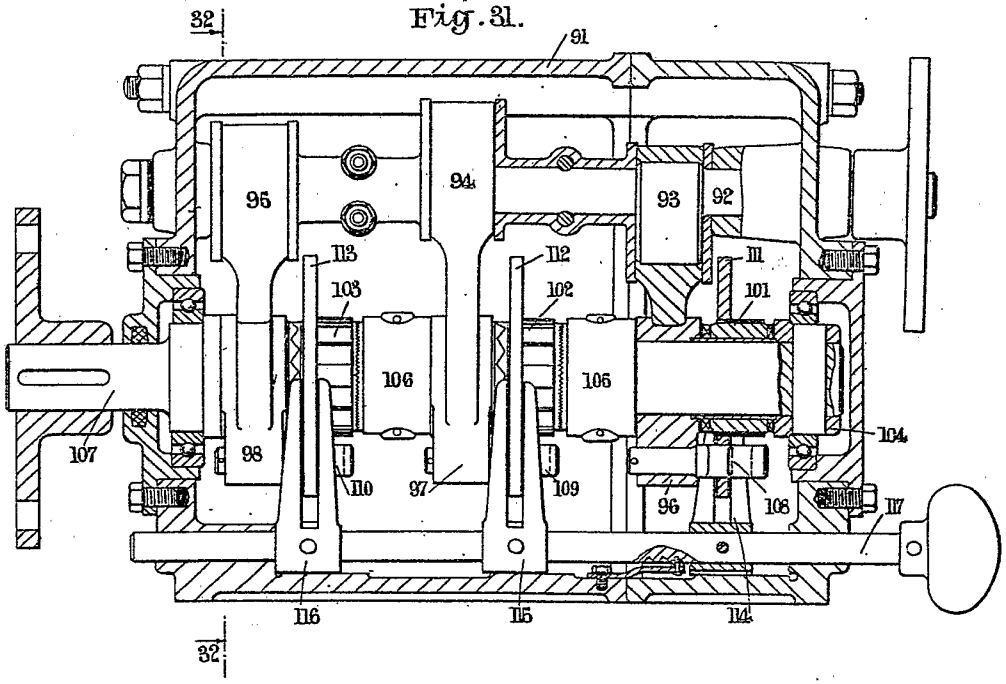

Fig. 32.

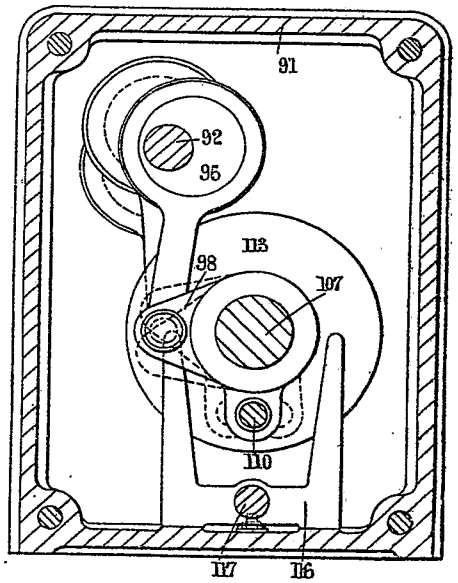

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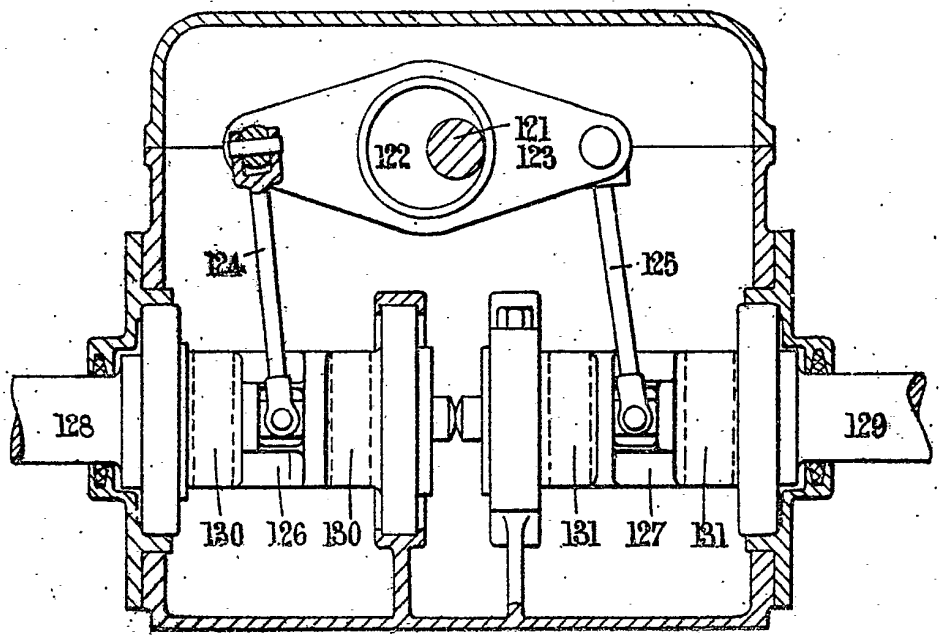
Fig.33.



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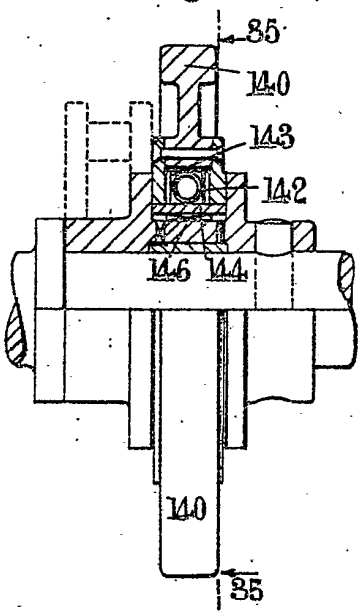

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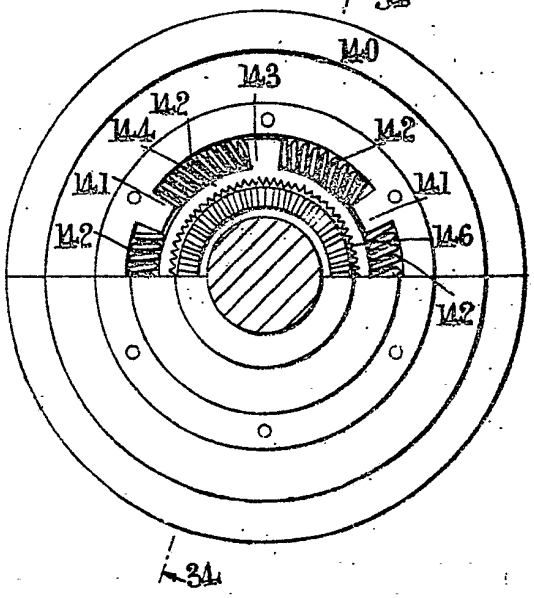

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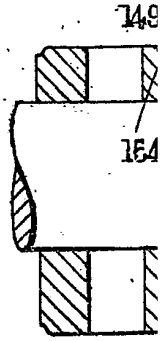

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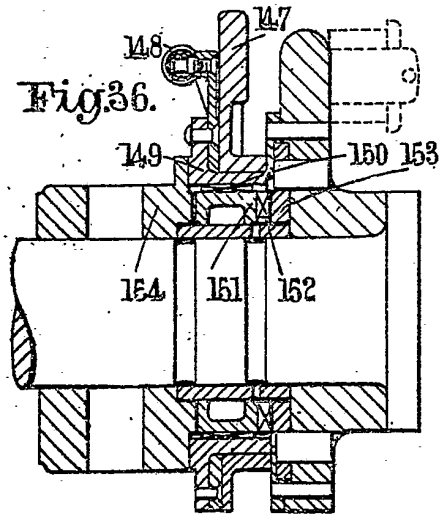

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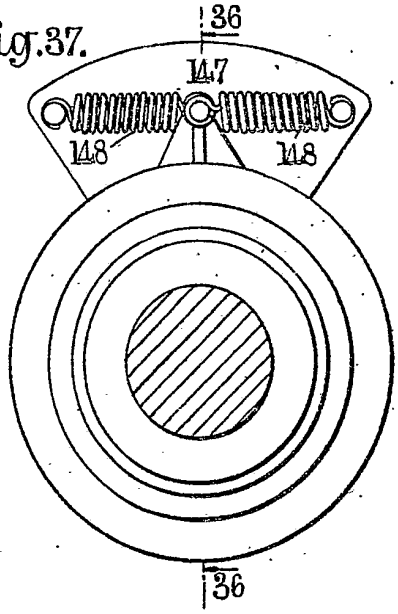

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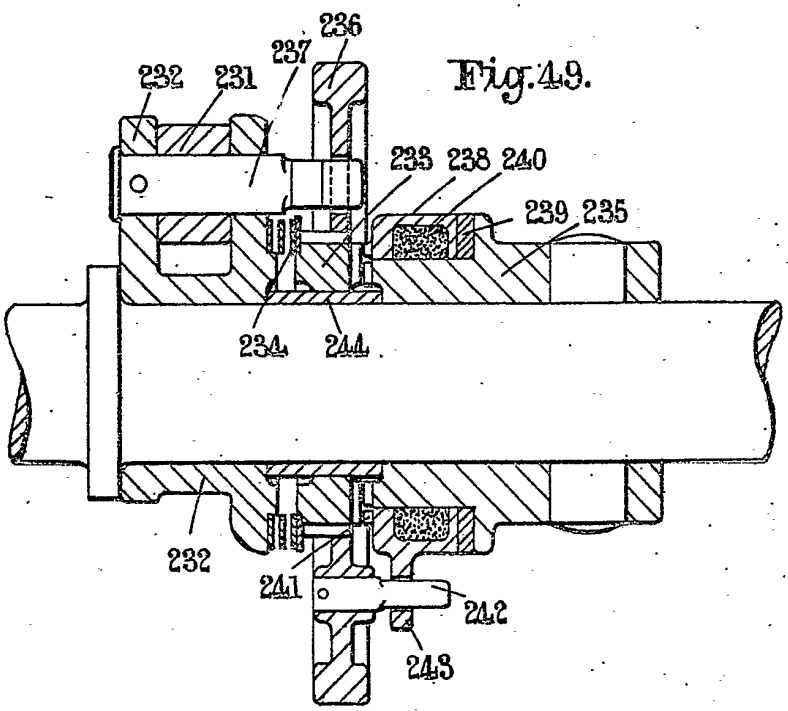

Fig.50.

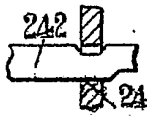

Fig.51.

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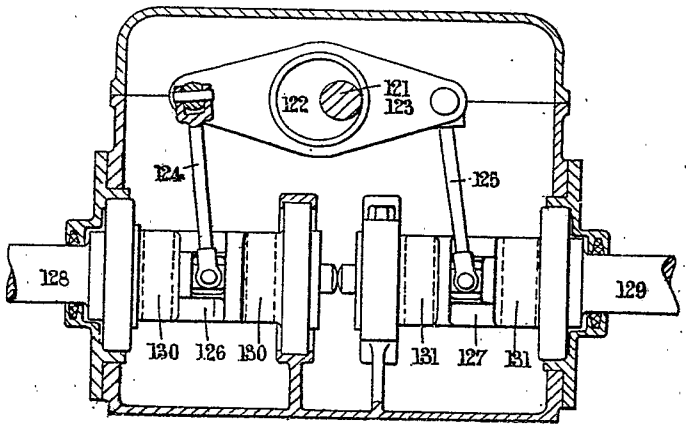
Fig.33.



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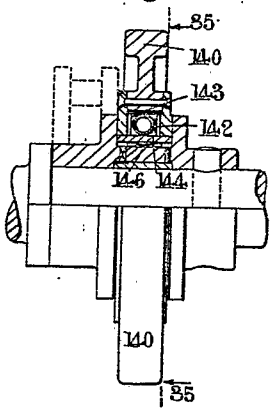

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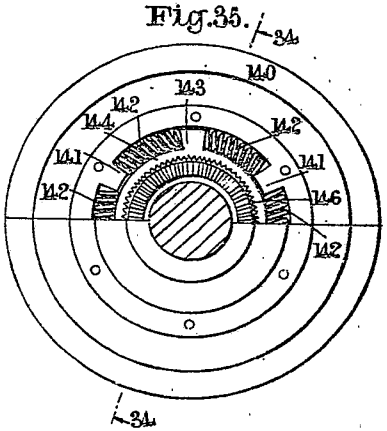

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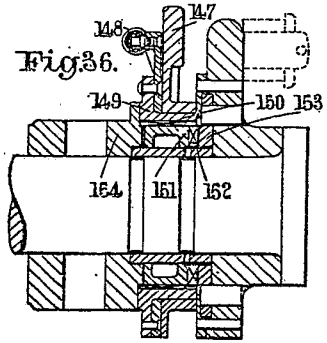

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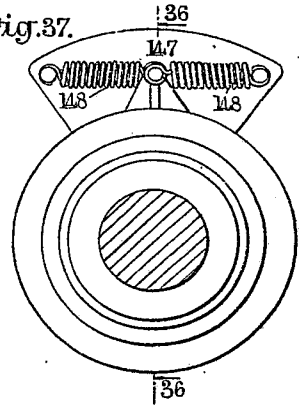

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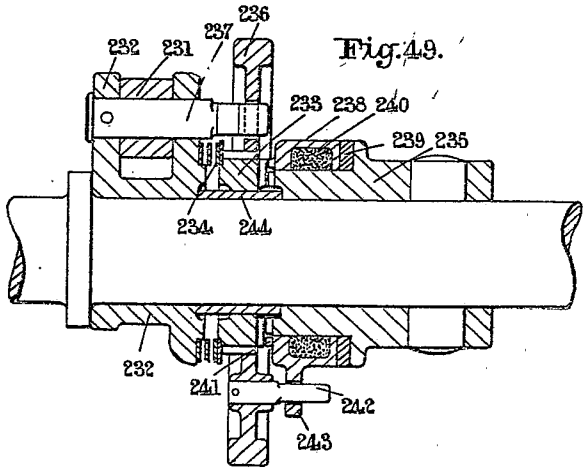

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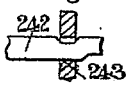

Fig.51.

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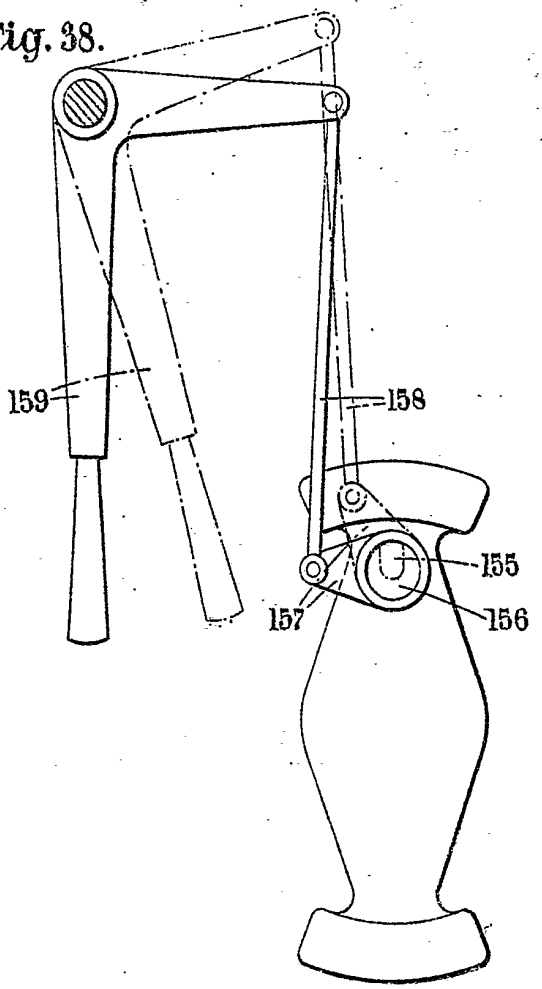
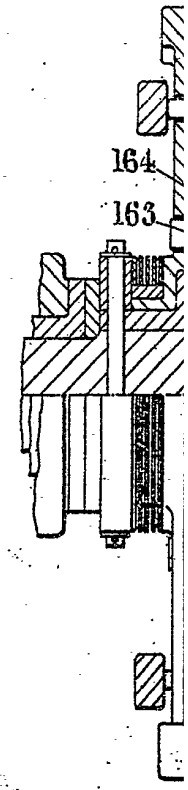
Fig. 38.





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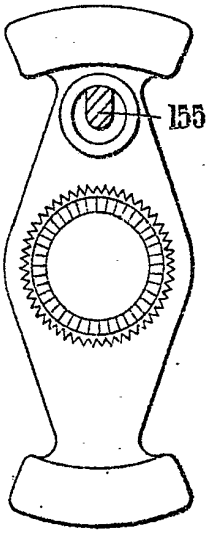

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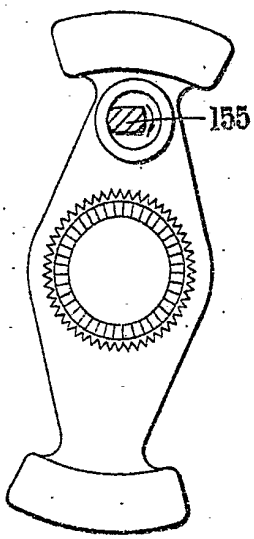

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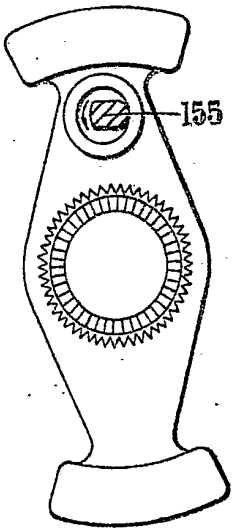

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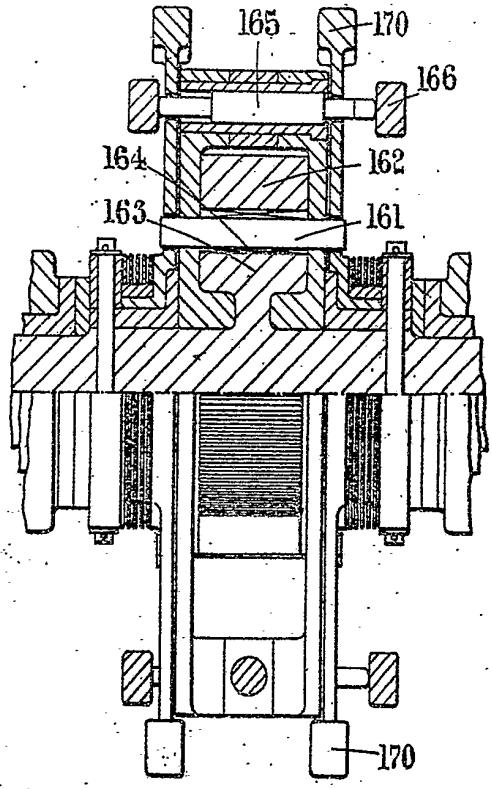

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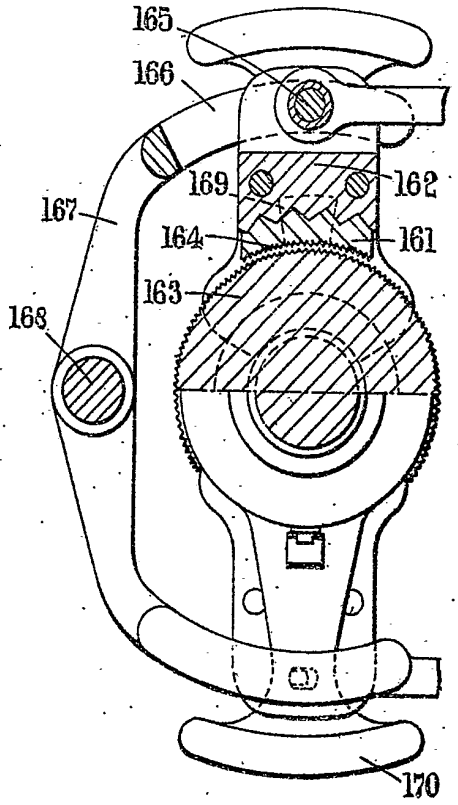

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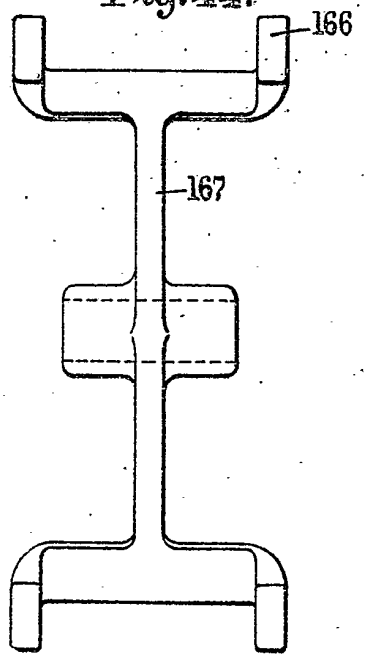

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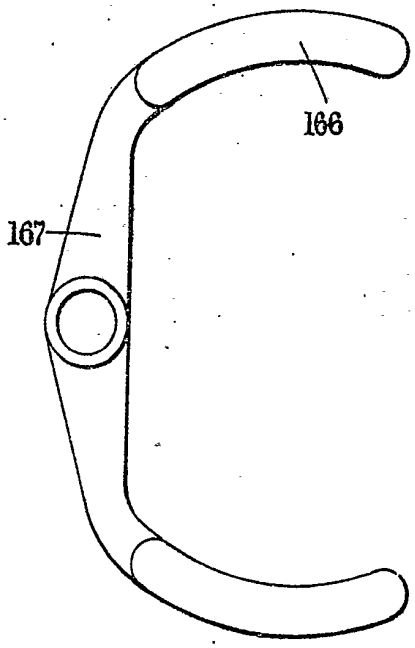

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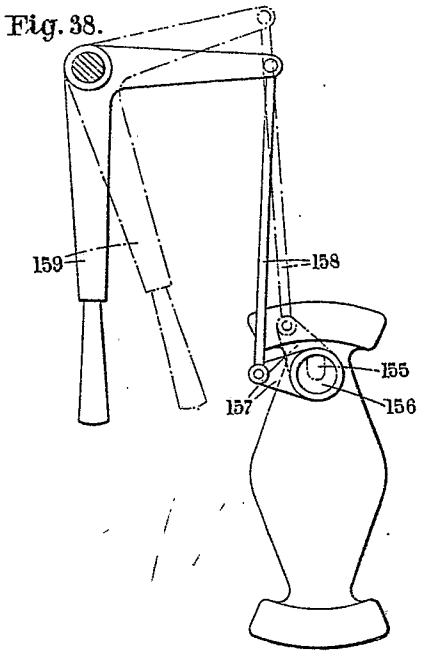
Fig. 38.



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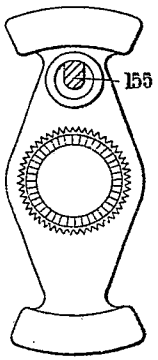

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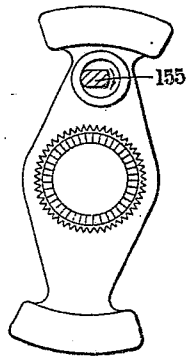

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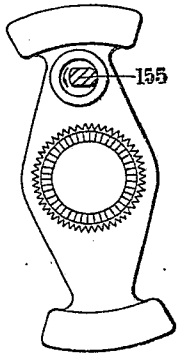

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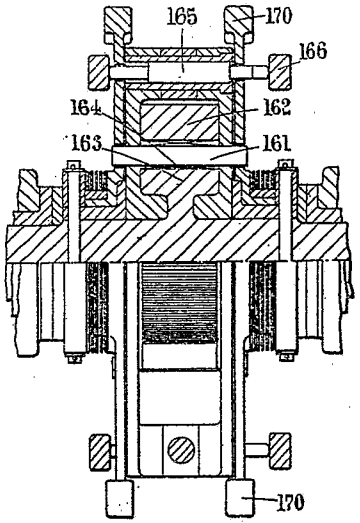

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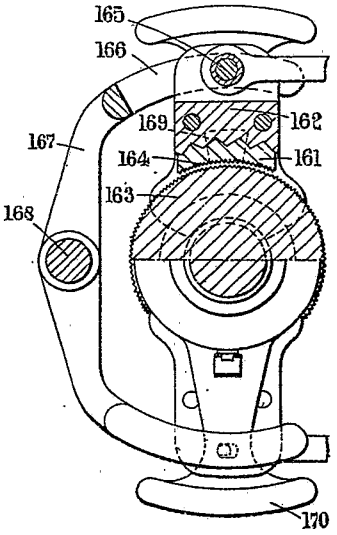

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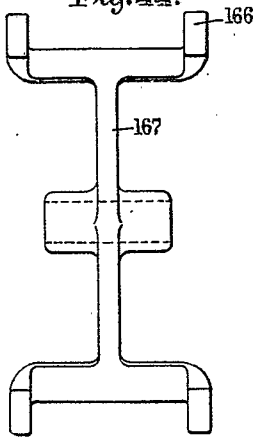

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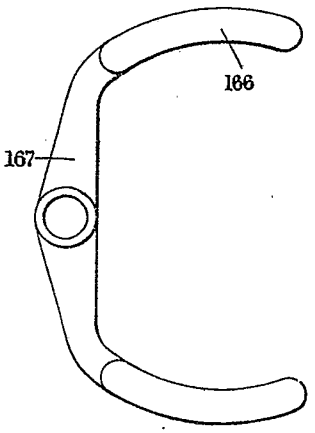

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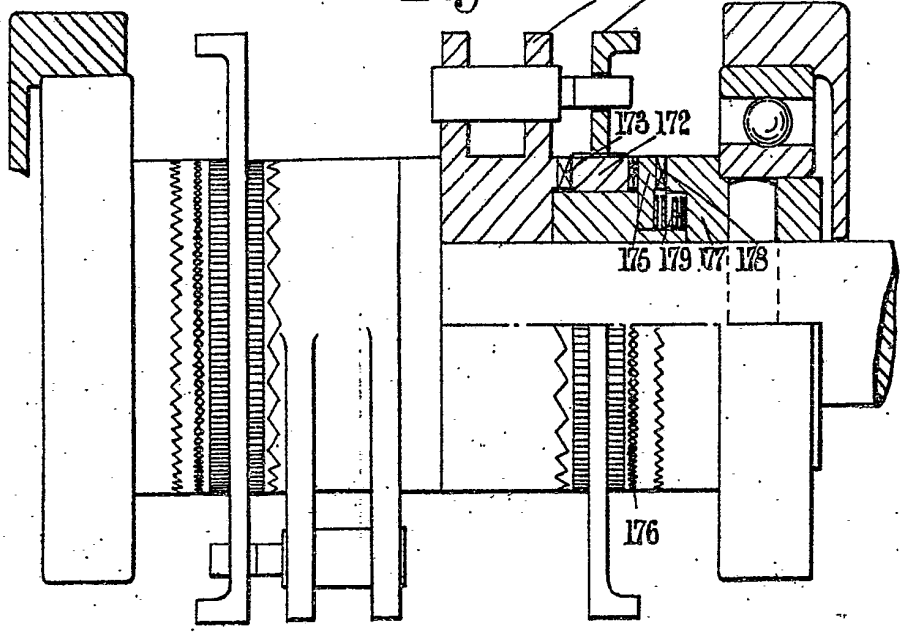
Fig.46.



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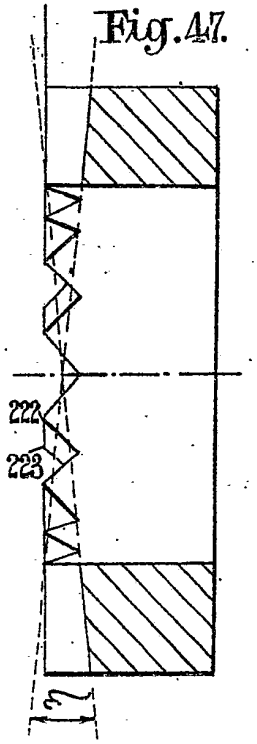

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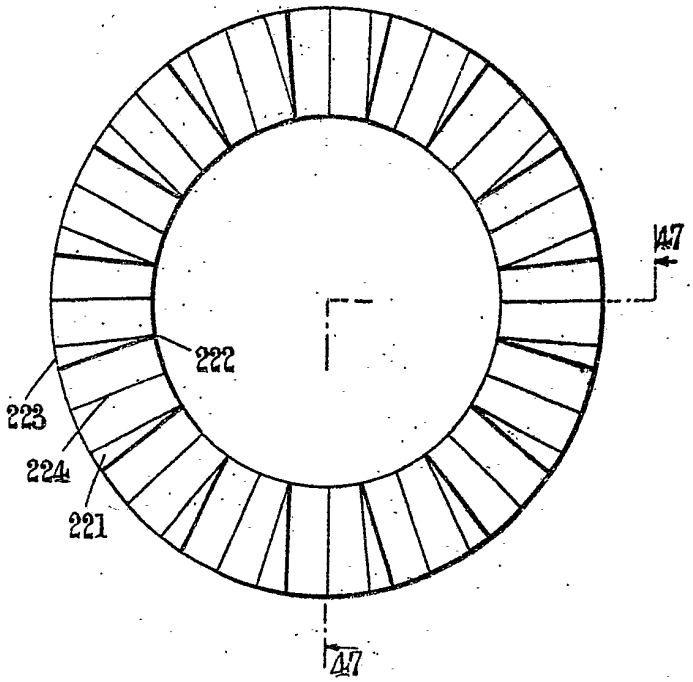

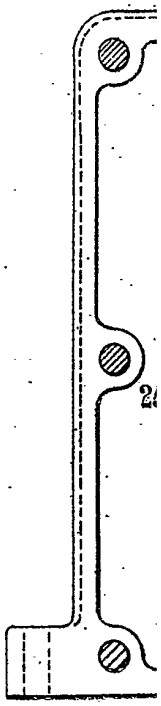

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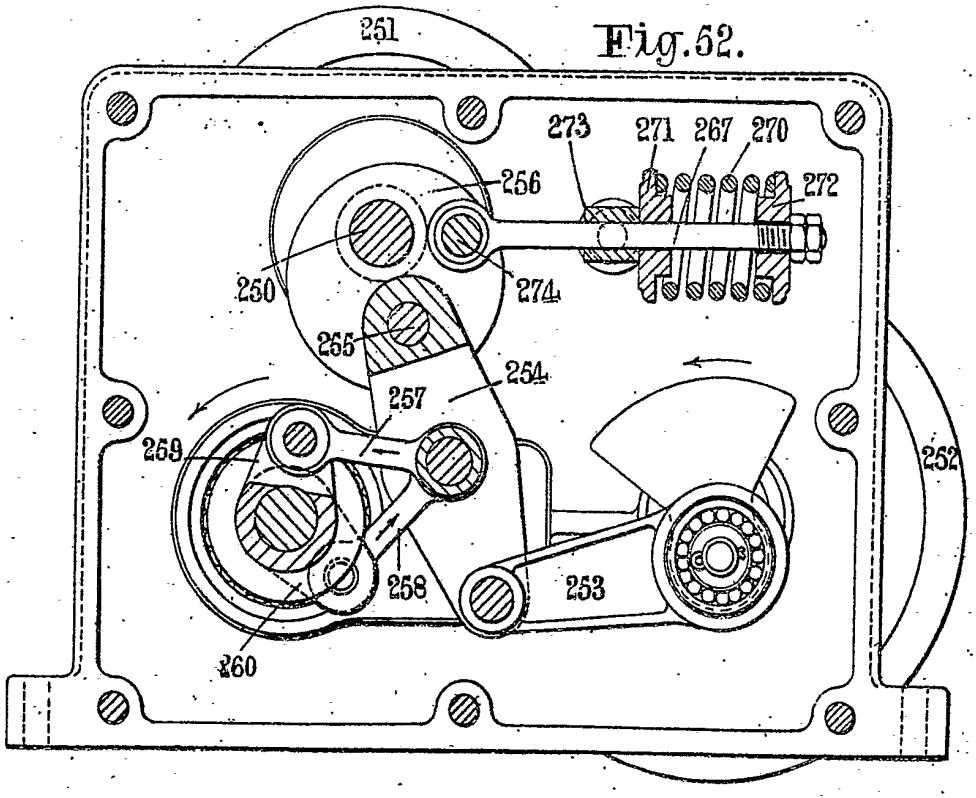

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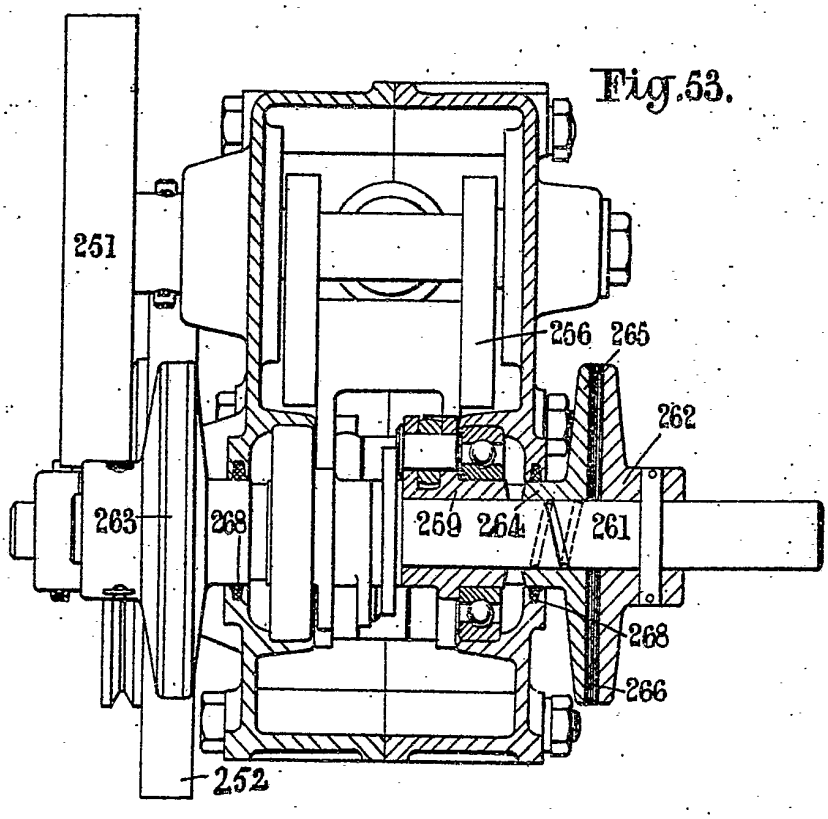

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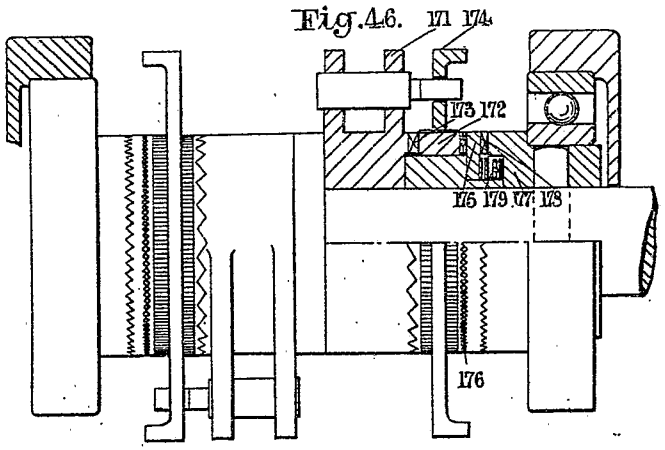
Fig.46.



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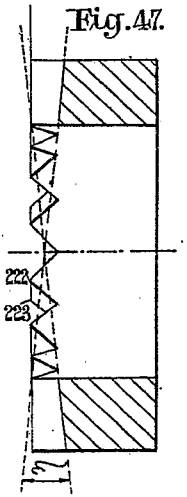

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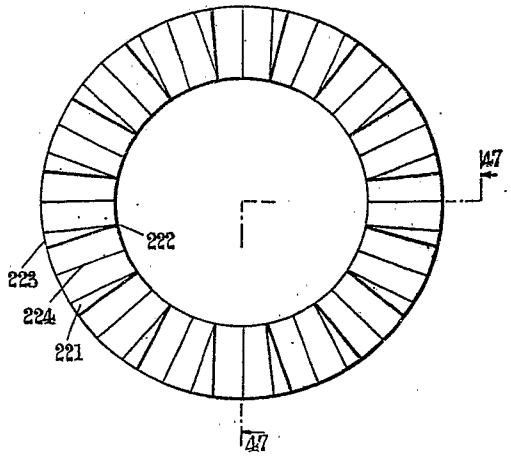

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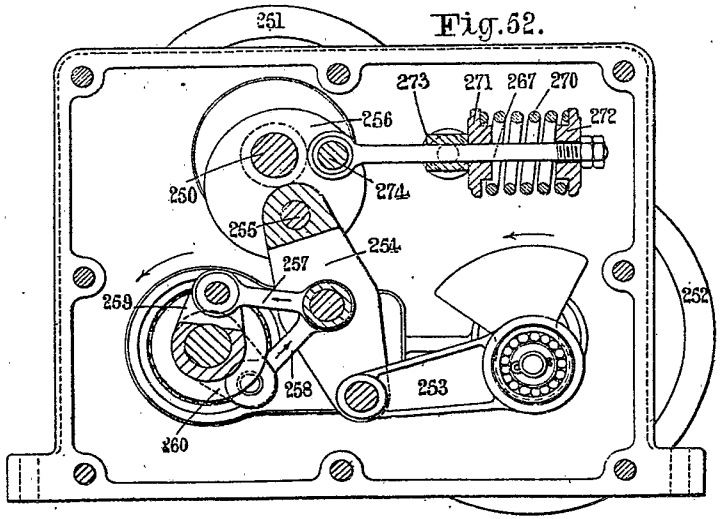

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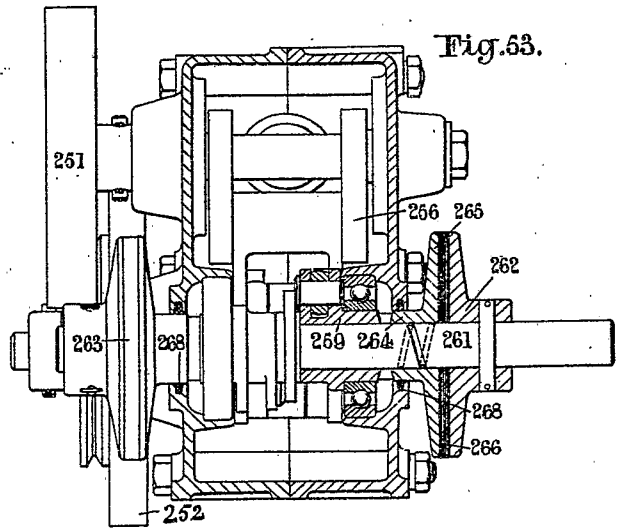

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