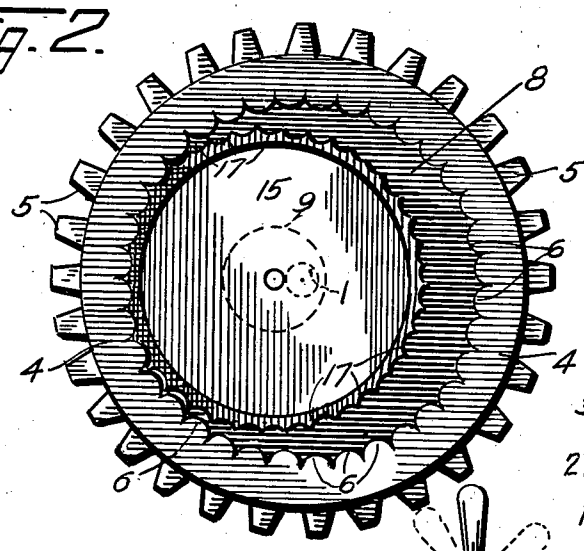
March 9, 1943. M. A. ELLIOTT 2,313,132

SPEED AND DIRECTIONAL CHANGER

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Fig. 2.



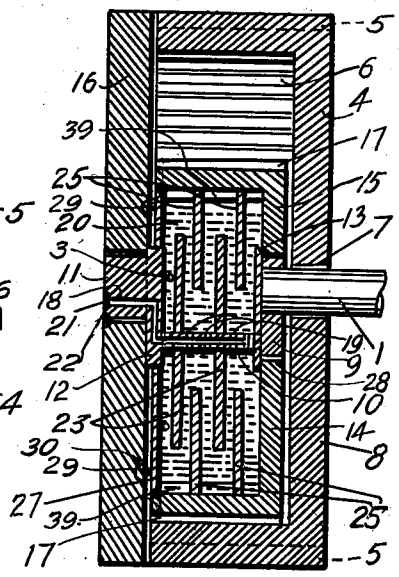
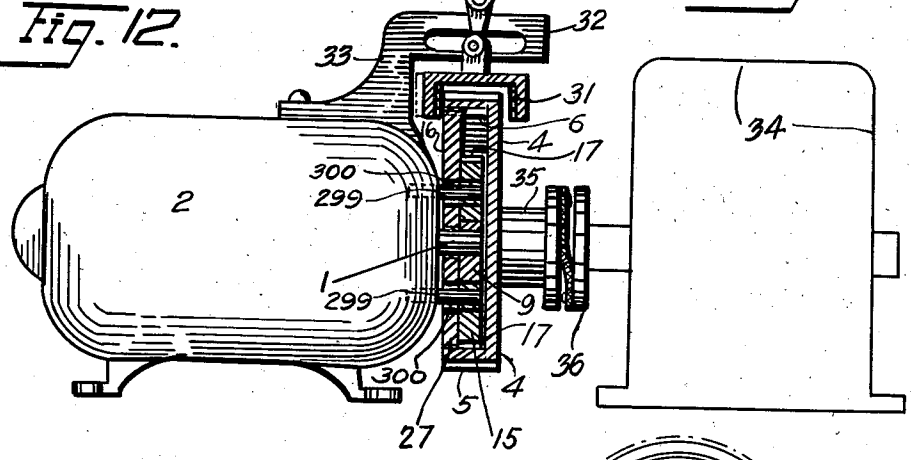


Fig. 1.

Fig. 12.



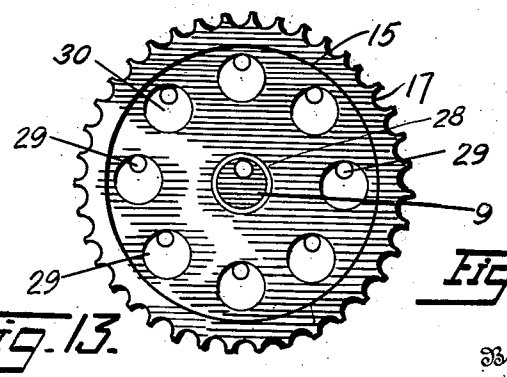
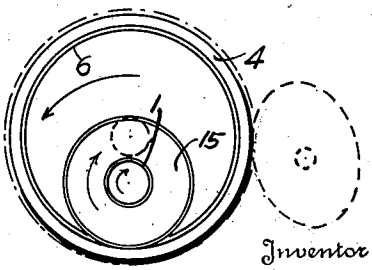


Fig. 13.



Inventor

Fig. 15. MORRIS AUBREY ELLIOTT.

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March 9, 1943. M. A. ELLIOTT 2,313,132

SPEED AND DIRECTIONAL CHANGER

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Fig. 8.

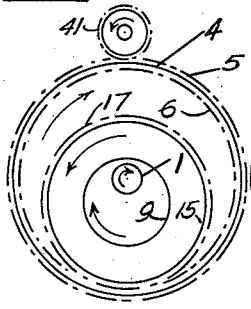


Fig. 9.

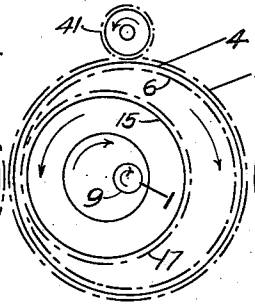


Fig. 10.

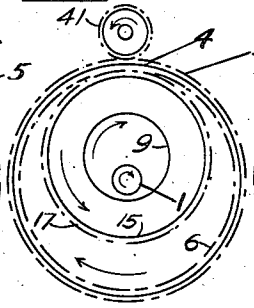


Fig. 11.

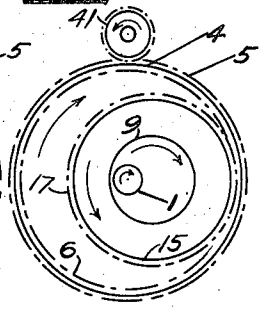


Fig. 14.

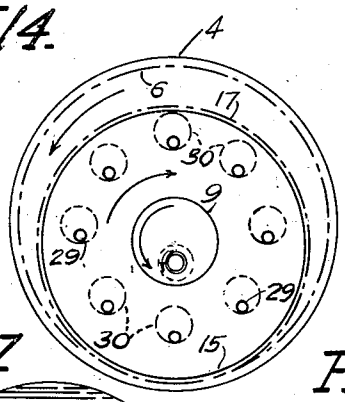


Fig. 3.

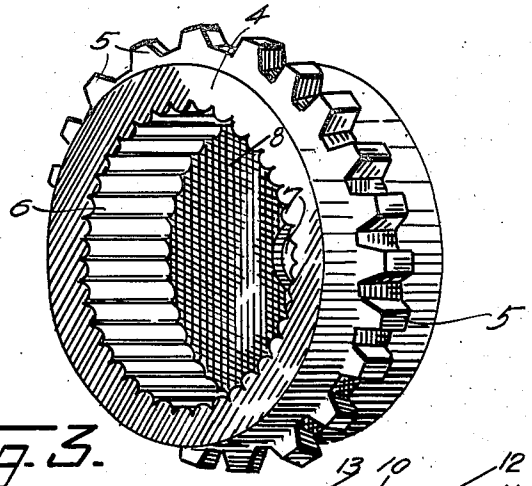


Fig. 7.

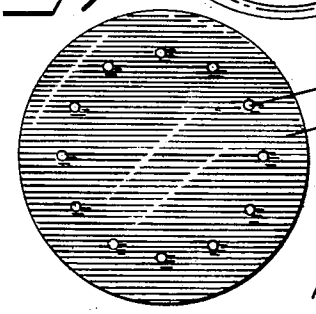


Fig. 5.

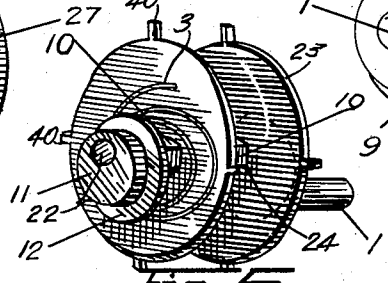


Fig. 4.

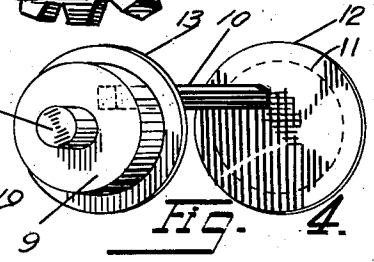


Fig. 16.

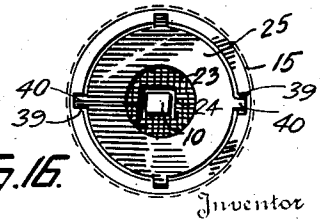
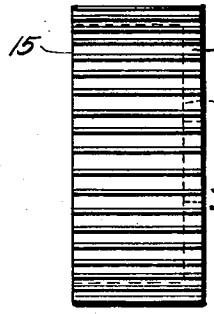


Fig. 6.



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SPEED AND DIRECTIONAL CHANGER

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Fig. 18.

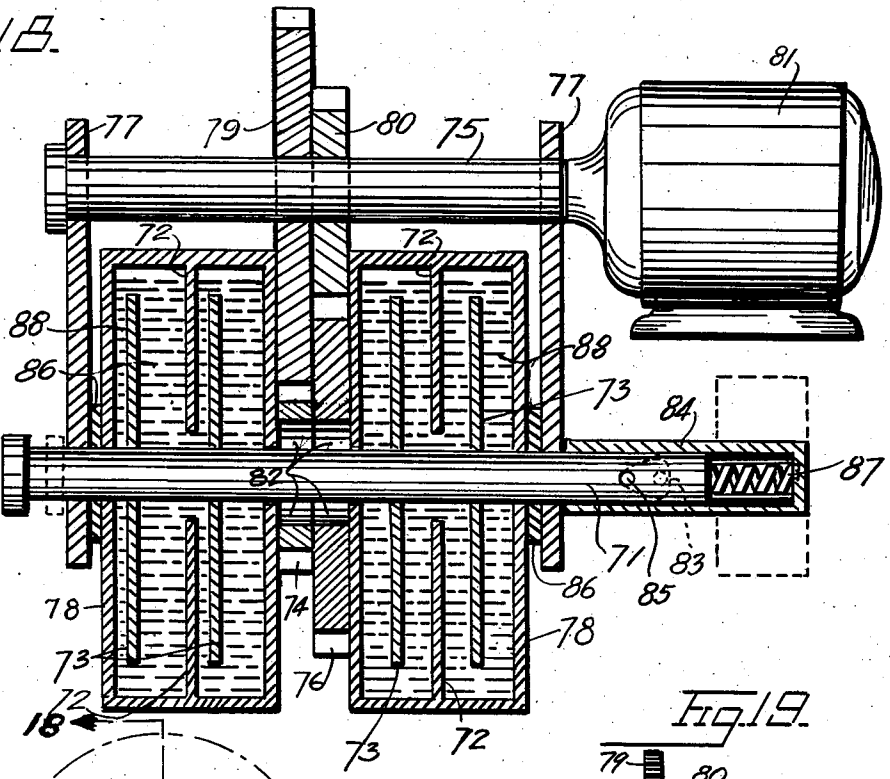
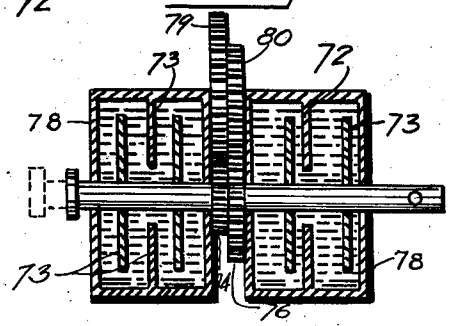


Fig. 19.



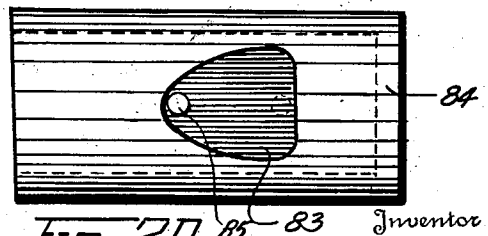


Fig. 20.

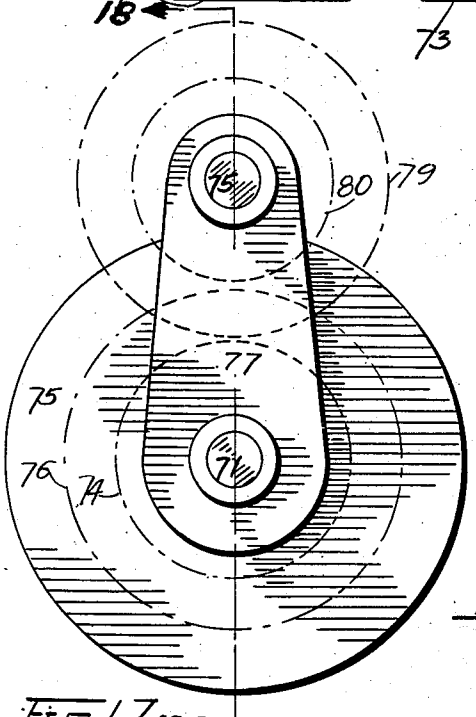


Fig. 17

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Patented Mar. 9, 1943 2,313,132

UNITED STATES PATENT OFFICE

2,313,132

SPEED AND DIRECTIONAL CHANGER

Morris Aubrey Elliott, Baltimore, Md.

Application September 9, 1940, Serial No. 356,089

4 Claims. (Cl. 74—189.5)

This invention refers to speed reduction and directional changer mechanisms and more particularly to those known as speed changers and transmission system mechanisms. It has the following objects:

To provide a system or arrangement for changing speed obtained from a driver to a driven element, that avoids the use of conventional gearing and chains, yet fully as effective;

To provide an operative mechanism for the device that is of unique form; simple in structure, and one that does not require that accuracy and minute attention in manufacture that other arrangements require, and yet be none the less effective;

To provide for the use of a heavy lubricant not only as a lubricant, but as an element available to the more desirable operation of the device, by using its inherent qualities of adhesiveness and cohesiveness actively in cooperation with the movements of the parts;

To provide a device of this nature that will be comparatively noiseless while in operation;

To provide for cushioning effects and shock absorbing arrangements; and to have the parts of the mechanism arranged that they can automaticaly adjust themselves to matters of speeds and load without the manual or external operation of clutches, levers, arms and the like to do so;

To provide a mechanism capable of providing for a large range of speed changing, within the limits of two specially designed interlocking parts and eccentric moving parts that have this adaptable function.

Other objects will become apparent as the invention is more fully set forth.

The conventional form of speed changer consists of a system of gears whose teeth fully interlock with one another in a conventional manner, and in some cases utilize more or less noisy chains and links. This invention avoids the use of the conventional gears, chains and links and operates with its stresses gradually distributed throughout its parts, is noiseless and does not have the capacity to wear out its parts with stringent contacts and stresses usually involved in other devices of the class. It employs an eccentric action that operates a modulated wheel connected with it, through an annular path. This wheel has its external periphery indented with a series of similarly formed slots uniformly and evenly distributed, which cooperatively engage with projections on another wheel in annular arrangement, (or vice-versa) and forces the second wheel to rotate in proportion to the ratio of the slots and projections, and any slip caused by the loads incurred in the work that the device has to do. Heavy oil is used in the enclosure for adhesively acting on the eccentric parts and wheels to give the operation of the device a smoother and tension action, and otherwise cooperate with their movements. Clutch plates are also appropriately employed to lessen the shocks incurred in operation and to distribute the stresses that arise. The device may be used for the delivery of power in various directions and be other wise formed to adapt its action to various desirable features suitable in the use of a speed or direction changer. The type of contact may be entirely frictional in place of modulated wheels, the latter being used to get more active frictional or resistive action. For purposes of illustration, the modulated wheels indicate the principles in a clearer manner.

In the drawings, which illustrate an example of this invention:

Figure 1 is a sectional view taken diametrically through a speed changer embodying this invention;

Figure 2 is a detail of the annular casing and internal cylinder member employed in the form shown in Figure 1, with the cover removed to show its internal construction;

Figure 3 is a detail in perspective of the annular casing, using external teeth of restricted width;

Figure 4 is a detail in perspective of the shaft and eccentric element used in connection with the operating of the internal cylinder member;

Figure 5 is a detail in perspective of the clutch plate assembly used in this form of the invention;

Figure 6 is a detail of the side elevation of the internal cylinder;

Figure 7 is a detail of a cover plate adaptable for use on the internal cylinder member;

Figure 8 shows a diagram of the annular casing and inner cylinder and other parts in a first position relatively, with arrows indicating their rotative directions;

Figure 9 is another diagrammatic view with the parts progressed to the second position;

Figure 10 is another diagrammatic view with the parts progressed to a third position;

Figure 11 is a diagram showing the parts progressed to a fourth position;

Figure 12 shows an elevation of a modified form of the invention without clutch plates, attached in assembly to a motor for driving it,

and a machine that it operates, the parts of the device being partially broken away and sectioned to indicate their internal structure;

Figure 13 is an elevational view of the internal cylinder member used in Figure 12, to portray the movement of the pins in regard thereto during operation;

Figure 14 is a diagrammatic view of the annular casing, and inner cylinder member in relation to each other, and to show the pin movements;

Figure 15 is a diagrammatic view of the annular casing and cylinder member modified in form, employing an operation and structure in reverse to the previous forms;

Figure 16 is a side elevation of the internal cylinder member with clutch plates installed therein;

Figure 17 is a side elevation of a modified form of the device applicable for transmission of power at variable reductions;

Figure 18 is a sectional view through the form shown in Figure 17 taken along line 18—18, the clutch acting on the high speed side;

Figure 19 is a sectional view similar to Figure 18, but with the clutch acting on the low speed side; and

Figure 20 is a detail of the shaft and connecting sleeve structure.

Similar reference characters refers to similar parts throughout the drawings.

In the drawings, 1 represents a shaft connected to a motor 2, or other source of power, through a suitable coupling if necessary, and is for the sake of illustration and identification rotated in a clockwise direction looking towards the motor. The speed changer consists of an annular casing 4, with its external periphery provided with gear teeth 5, or other structure suitable for the transfer of power therefrom, in a manner to be more clearly described in a later portion of the specification. The casing has its internal peripheral surface formed with curved protuberances or teeth 6 having segmental curve contours equivalent to about one-third of the circumference of which they are composed. The casing in the illustration offered in this case is circular, and its peripheral surfaces with the teeth thereon are built up on exterior and internal peripheral circles. This casing is also provided with a central hole 7, in the disc-like wall 8 thereof. This hole 7 is sufficiently large to allow the shaft to pass freely through it, so that the casing is loose on it and does not necessarily turn with the shaft, when the latter is operated. An eccentric circular plate 9, is mounted on the shaft 1 and turns eccentrically against the inner surface of the wall 8. This plate is set off-center as indicated and supports hollow post 10 of rectangular cross section extending from its central portion at right angles to the plate 9. It terminates in a round portion 11, whose axis is aligned with the axis of the shaft 1 in the wall of the casing wall 8, opposite. Collars 12 and 13 are provided to respectively retain the disc-like wall 14 of an internal circular hollow cylinder 15 on the eccentric plate 9, and cover wheel 16 in the position shown in front of both casing and cylinder. The cylinder 15 is scalloped with peripheral curved depressions or grooves 17, that can engage over the protuberances 6, and ride on same. The size of the inner cylinder 15 is determined by the number of grooved teeth 17, and the difference between such number and the number of teeth 6 determines the maximum rate of speed change from the shaft to the latter. The post 10 is made hollow by reason of the passage 18 therein, from which the orifices 19 branch to lead a heavy lubricant 20 into the cylinder. A passage 21 is provided in the round portion 11, and aligned with the passage 18 for directing the lubricant therethrough from a point external to the round portion 11. This passage 21 is closed with a suitable plug 22. The post 10 supports a series of clutch plates 23 on it, which have rectangular holes 24 situated centrally therein so they cannot turn by themselves on this post, although otherwise they may be placed on loose, and are so disposed that the orifices 19 feed between them and other clutch plates 25 that extend inwardly from the peripheral wall 26 as shown and slotted to lock loosely on the cylinder 15 so as to turn therewith. When the lubricant, which is about the consistency of 600W is charged into the interior of the hollow cylinder 15, and enclosed therein by the cover plate 27 screwed into the latter, it forms a mixture which tends to adhesively connect all the internal parts 23 and 25 together. A spring 3, is placed to keep the clutch plates under sidewise tension.

In the operation of the device, the shaft 1 rotates in a clockwise direction and turns the eccentric member 9 like a crank. As the member 9 is circular and actuates within a hole 28 in the central portion of the cylinder 15, it eccentrically rotates the latter with it, and in turn the groove teeth 17 ride over the teeth 6 and cause the cylinder 15 to walk on the internal surface of the annular casing 4, if there is no resistance to its doing so. Cylinder 15 will rotate in the opposite direction to the shaft. This walking motion is not rotation of cylinder 15, but a type of gyrating movement that brings adjacent inner teeth against the outer teeth they coact with.

The annular casing is assumed to be stationary at the time. This would be the case when the load resisting the turning of the outer casing is excessive compared with the propelling action of the internal cylinder 15, especially if no lubricant 20 is enclosed. It should be noted that the eccentric 9 will rotate completely around in the hole 28 during one revolution of the shaft 1. The inner cylinder will walk on the annular casing in counterclockwise direction. It will walk or advance the number of teeth that the annular casing has in excess of it.

The formula that the applicant prefers is based on the following items:

A=The number of internal teeth (6) of annular casing.

B=The number of external teeth (17) of the internal cylinder in contact with teeth A.

Z=The speed ratio between the driving shaft 1, and the driven speed obtained through the annular casing.

$$Z=\frac{A}{A-B}$$

For example; if the annular casing (A) has 100 teeth, and the internal cylinder (B), has 75 teeth, then the formula gives the following results:

$$Z=\frac{100}{100-75}=\frac{100}{25}=4 \text{ to } 1 \text{ ratio}$$

The speed of the inner cylinder 15 is the same as that of the shaft and annular casing, when the annular casing is running free, the two parts will rotate with the shaft as a common center

without making any progress in relation to each other, and they will operate in the same direction.

If the annular casing 4 is kept still and not rotated, the pressure exerted by the teeth 17 of the cylinder 15, tries to force it around, in the opposite or clockwise direction.

However if we fill the cylinder 15 with heavy lubricant, and rotate the shaft 1 again, it will in turn rotate the cylinder 15 in the same manner as described above, and in addition the clutch plates 23 will adhesively tend to drag the clutch plates 25 along with them to follow the rotation with the shaft. This makes the cylinder actuate quasi-integrally with the shaft 1, and provides for a clutch effect that is proportional to the load acting against the cylinder 15 and annular casing 4. The cover wheel 16 normally does not turn, as the shaft rotates, but pins 29 projecting from the face of the cover plate 27 evenly spaced on the same circle, turn through a small eccentric movement in holes 30 in this cover 16 during the gyratory motion of the cylinder 15. The various effects of the slip at the clutch plates enable the shaft to turn in numerous ratios, and apparently disregard the formula. The maximum ratio possible using the same annular casing and inner cylinder member is that given by the formula, but other ratios are possible due to the loads placed on the parts from that maximum to zero, and slippage of the gears in relation to each other.

In Figure 15, is shown a view with the parts reversed so that power may be increased instead of reduced. In this case the shaft is secured directly to the inner member at its central portion instead of eccentrically, and the annular casing becomes eccentric in its travel movement and may use a special oval gear or like mechanism to transmit the power uniformly, to a stationary machine arranged to receive it.

The guide grooves 39 are provided on the internal peripheral surface of the internal cylinder member to receive the lips 40 provided on the periphery of the clutch plates 25. When the plates are in position the lips in the grooves prevent them from turning by themselves. The plates are slid readily into position. The other clutch plates 23 are mounted on the square shaft 10 and rotate therewith. The clutch plates are more or less loose longitudinally and are kept close as desired to each other by the pressure from the spring 3. The gear 41 indicates any suitable means for taking off power or motion from the annular casing 4. In Figure 12, the cover plate is loose from the annular casing 4, and from the shaft 1. The pins 299 project through the holes 300 and as the internal cylinder member carries on its gyratory movement, it rotates under the action of the eccentric member 9 without obstruction from the pins, which are encircled around by the holes during the movement.

The structure indicated in Figures 17, 18, 19 and 20 is intended primarily for the transfer of power from one reduction to another. It utilizes radial clutch plates 73 fastened onto the shaft 71 in any suitable manner, such as by press fit, welding or keying-in. The plates are operated within a duplex rotatable casing 78, which also has peripheral mounted clutch plates 72 as indicated, that are attached to and rotate with the casing, and are normally spaced between the former plates 73. The shaft 71 having a horizontal reciprocating movement in the casing moves the radial clutch plates 73 close to the plates 72 in one portion of the casing, while at the same time increasing spacing between similar plates 73 and 72 on the other portion of the casing. The casing portion shown to the left of Figure 18 is termed the high speed reduction, while that to the right is the low speed reduction.

The casing walls have gears 74 and 76 externally fastened rigidly to them respectively so as to rotate with them. A frame member 77 is mounted on the driven shaft 71 exterior to the casings and serves to support another driving shaft 75 in predetermined relation to the first. This driving shaft 75 has a set of gears 79 and 80 which are respectively large and small and mesh to operate the gears 74 and 76 at high and low speeds. The shaft 75 is operated by a motor 81 or other suitable power device. The gears 74 and 76 are securely fastened to the casing so as to rotate with same, and have holes 82 through them to allow the shaft 71 to pass freely through them. The travel or reciprocation of the shaft 71 is determined by the length of a groove 83 formed in a sleeve 84 which is mounted on and connected with the shaft through the use of a pin 85 passing through it transversely. Collars 86 are used to keep the frame and casing separated. The spring 87 is provided in the sleeve for the purpose of forcing the shaft towards the left. The grooves 83 are preferably arcuately formed to give a smooth action against the pin 85 as it moves from one position to another in the groove. The casing portions 78 are filled with oil 88 or other suitable fluid to provide the necessary adhesive tension between the clutch plates while transmitting power, in the manner described for the form shown in Figure 1. It should be noted that the radial clutch plates on the shaft 71 are close to the casing plates in one portion of the casing while those in the other portion of the casing are spaced therefrom (see Figs. 18 and 19). This is so that the adhesive tension will act only on one portion of the casing at a time to turn it, while the radial clutch plates in the other casing are rotating free of adhesion. During the rotation of these latter plates in their casing portion the oil in that casing will be simply churned by them. When the shaft 71 is propelled over from one end of the travel to the other, either mechanically or due to the effect of the loads on the shaft 71, it operates the latter at low or high speed as the case may be.

When the device is placed into operation, by the rotation of the driving shaft 75, the gears 79 and 80 are put into rotation with their teeth meshing with the teeth of gears 74 and 76 respectively. As the gear 74 rotates, it carries the casing to which it is attached along with it, at high speed, as the gear 79 is larger than the gear 74 by a considerable amount. This is because the spring 87 forces the clutch plates towards the left normally. When the gear 74 turns, and the left casing with it, the adhesive closeness of the clutch plates 72 to the radial clutch plates 73, causes the adhesiveness of the oil to rotate the shaft 71 through the clutch plates attached to it. As the resistance on the shaft 71 increases by reason of the load on the sleeve 84, the pin 85 engages with the grooves 83 and rides up the side of same and pulls the shaft over towards the right. This in turn brings the clutch plates of the right hand casing into close proximity with each other so that the adhesiveness of the oil and plates makes the right hand casing turn in cooperation with the low speed gearing, while at the same time the clutch plates in the left casing and its gearing run free, because the spacing between the plates has been

increased, and simply churns the oil. While both portions of the casing are rotating at the same time and at different speeds, the shaft 71 only rotates at the speed caused by the adhesion effects between the plates on one of the casings and its respective plates attached on that portion of the shaft within it. This casing is that which has its plates moved close to each other. This would be the left casing in Figure 18, and the right casing in Figure 19. The device acts automatically since any increased load tends to move the shaft 71 (due to the riding effect of pin 85) to the right against the spring and make use of the low speed but greater power gearing. When the load is decreased, the spring forces the shaft 71 to the left and places the high speed gearing at work because the plates in the left hand casing then actuate the shaft.

In Figure 12 the pins 299 on the motor take the place of the pins 29 and extend out therefrom to project into holes or grooves 309 provided for same in the cylinder member 15. The diagrams Figures 8, 9, 10, 11, 14 and 15 show the various positions of the parts while in operation.

In order to provide a suitable controlling system for the device, the brake 31 mounted on a slidable frame 32 is arranged to press against the side wall surface of the annular casing or other parts as indicated in the drawings. The operation of the brake system is simple and somewhat conventional, and provided with all the usual levers, and mechanisms, etc., as far as needed, which can be so readily arranged that it is not believed that further details or description are required, and such are not considered as a part of the main invention. The arrangement simply has to avoid the interference with gears, etc., that may be used for taking power from the gear teeth on the outer periphery of the annular casing, and to have a suitable support 33 to hold it in position.

In Figure 12 the outline 34 indicates a machine that is propelled from the annular casing through the connections 35 and flexible coupling 36, in order to illustrate the manner in which the device may be used under practical circumstances.

While the forms of the invention shown in the drawings, are limited, in number, it is not desired to limit the application to such or in any other way, otherwise than limited by the principles of the invention and the scope of the claims.

Having thus described the invention, what is claimed is:

1. In a device of the class described, a casing, a shaft supporting the said casing but allowing same to rotate freely thereon, clutch plate sets within the casing, one set of the clutch plates being fastened to the casing and the remaining set fastened to said shaft facing each other in direction but with the plates of each spaced apart from each other, adhesive material in the casing for providing an adhesive clutching action between the plates of the sets aforesaid at predetermined positions thereof in relation to each other, means for reciprocating the shaft operating from the casing structure to vary the relations of the plates of each set to the other and the adhesive reactions of the adhesive material on the same, gear means attached to the exterior of the casing and adapted to rotate therewith, a system of gearing engaging with said gear means for coacting with same, and extended shaft for rotating the said system of gearing and supporting same and arranged for connection to a source of power.

2. In a device of the class described, a casing, a shaft supporting the said casing but allowing same to rotate freely thereon, clutch plate sets within the casing, one set of the clutch plates being fastened to the casing and the remaining set fastened to said shaft facing each other in direction but with the plates of each spaced apart from each other, adhesive material in the casing for providing an adhesive clutching action between the plates of the sets aforesaid at predetermined positions thereof in relation to each other, means for reciprocating the shaft operating from the casing structure to vary the relations of the plates of each set to the other and the adhesive reactions of the adhesive material on the same, gear means attached to the exterior of the casing and adapted to rotate therewith, a system of gearing engaging with said gear means for coacting with same, and extended shaft for rotating the said system of gearing and supporting same and arranged for connection to a source of power, another casing mounted similarly on the first mentioned shaft, additional clutch plate sets within the casing one set being attached to the casing and the others laterally placed beside them attached to the shaft, gearing between the last mentioned casing and the gear system for engaging and coacting with each other, adhesive material in the last mentioned casing for facilitating the clutching reactions between the plates in the last mentioned casing in accordance with the closeness of the sets of plates to one another, the set of plates in one casing being disposed for clutching by the reciprocation of the shaft in one direction while the sets in the other casing are unclutched and the operation of the external shaft coacting to give a rate of rotation in accordance with the casing operating through the clutching and the slip between the plates of the set in accordance with their relative closeness thereof and the adhesiveness of the material in the respective casing.

3. In a device of the class described, a rotatable casing, a reciprocating shaft supporting the said casing but allowing same to rotate freely thereon, a spaced set of clutch plates within the casing attached to the latter and arranged to operate therewith, another set of clutch plates attached to the shaft and disposed between the previously mentioned plates and adapted to revolve therebetween and to be variably moved to and from the same, sets of clutch plates being positioned facing but between each other as aforesaid, a fluid in the casing for providing an adhesive action between the sets of plates and a variable clutching action in accordance with position and spacing of the plates of each set in relation to the other, gearing fastened to the casing and adapted to rotate therewith, shaft means operable free of the casing but linked adjacently thereto, another gearing mounted on the last mentioned shaft means engaging with the aforementioned gearing and operated by said shaft means, another casing with clutch plates mounted on the first mentioned shaft, additional plates mounted on the shaft and spaced similarly to the sets of plates aforementioned and operating similarly therewith, fluid material between the plates provided in the casing for providing adhesive reactions between the casing and shaft plates last mentioned, gearing mounted on the second casing of ratio different from that on the first mentioned casing, gear means on the shaft means engaging

with the gearing last mentioned and acting therewith, said gearing on both casings being arranged to actively operate the shaft independently of each other in accordance with the clutch plates position in the casings, the plates in one casing being in active adhesive relation with the shaft means plates coacting therewith, while those in the other casing are not, and reversible in accordance with the reverse positioning of the reciprocation of the casing shaft.

4. In a device of the class described, a casing, a shaft supporting and passing through the said casing but allowing same to rotate freely thereon in a plane at right angles to it, clutch plate sets within the casing, one set of the clutch plates being fastened annularly to the casing and the remaining set radially fastened to said shaft facing each other in direction but with the plates of each spaced apart from each other, adhesive liquid material in the casing for providing an adhesive and cohesive clutching action between the plates of the sets aforesaid in varying proportions at predetermined positions thereof in relation to each other, pin and groove means for reciprocating the shaft to vary the relation of the plates of each set to the other and the adhesive reactions of the adhesive material on the same, gear means attached to the exterior of the casing and adapted to rotate therewith, a mechanism engaging with said gear means for coacting with same, an extended shaft for rotating the said mechanism and supporting same and arranged for connection to a source of power, another casing disposed adjacent to the first mentioned casing and similarly provided with plates and material, gear means attached to the exterior of the second casing and adapted to rotate therewith, a mechanism connected with said source of power and engaging with said second gear means for coacting with same, and operating the shaft in a reciprocating manner, whereby the second casing will be reduced in speed and disconnected from the shaft when the first mentioned casing is actuating the shaft, and the first casing will be increased in speed and disconnected from the shaft when the second casing is actuating the said shaft.

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