

Oct. 18, 1927.

J. P. JOHNSON
STARTING MECHANISM
Filed Sept. 30, 1925

1,646,202

3 Sheets-Sheet 1

Fig. 1.

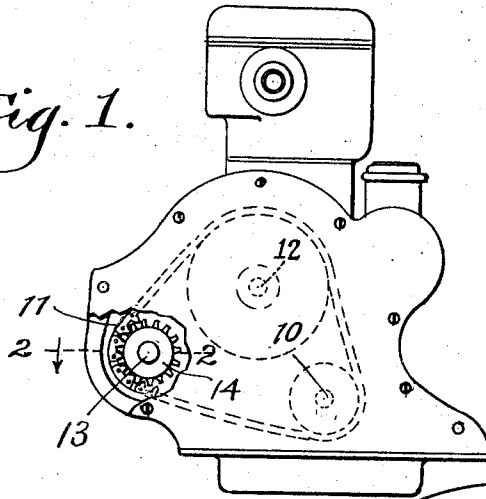


Fig. 4.

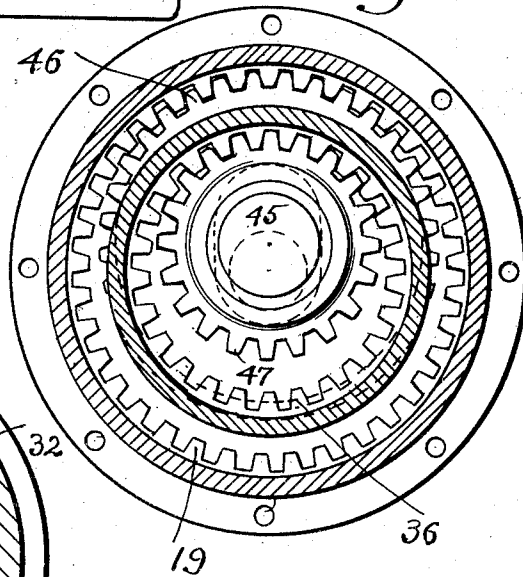
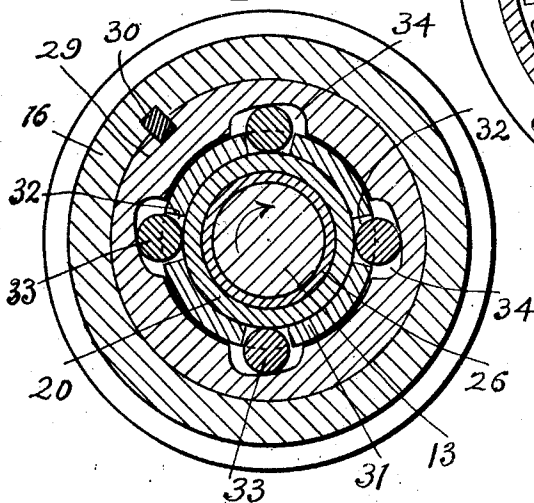


Fig. 3.



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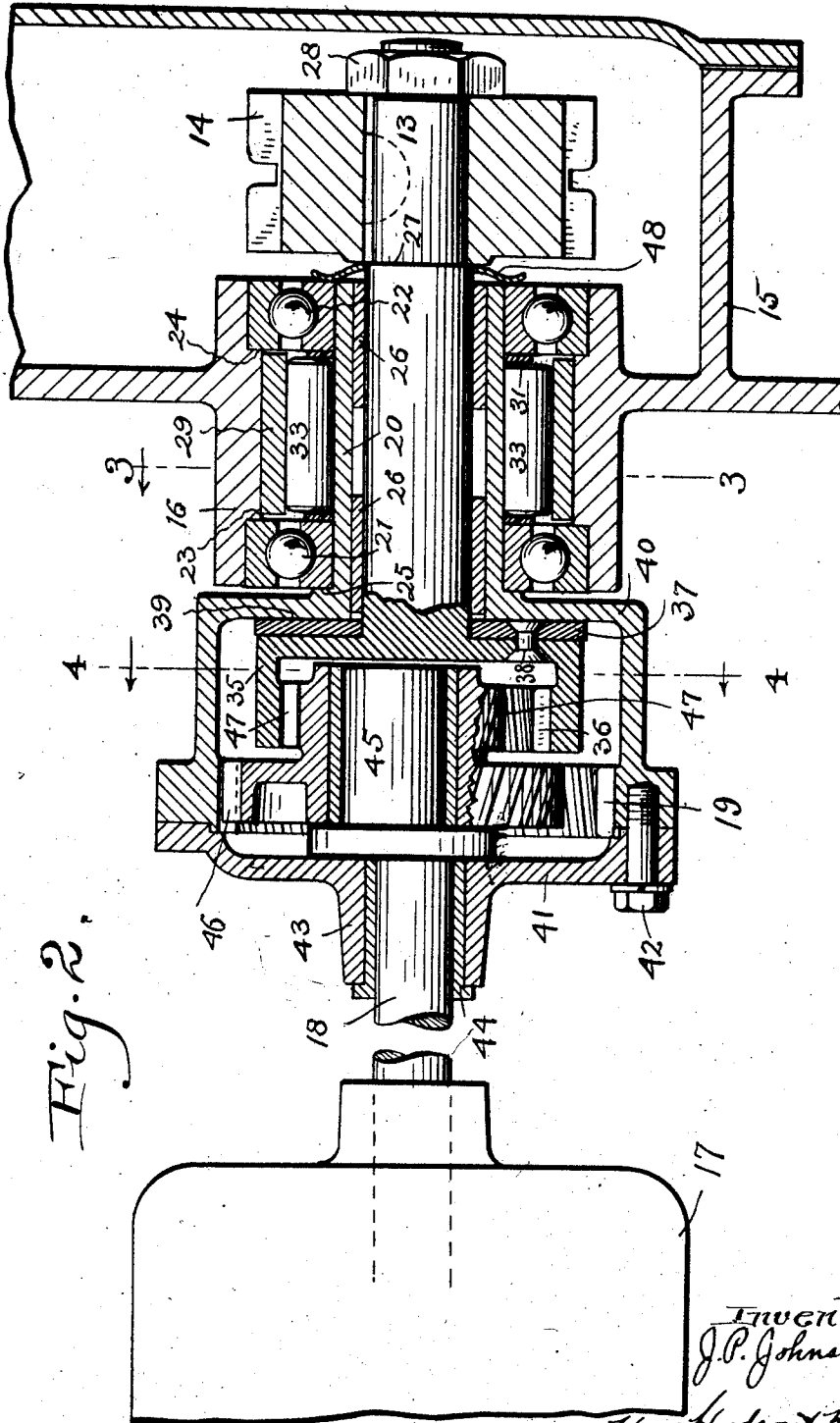


Fig. 2.

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3 Sheets-Sheet 3

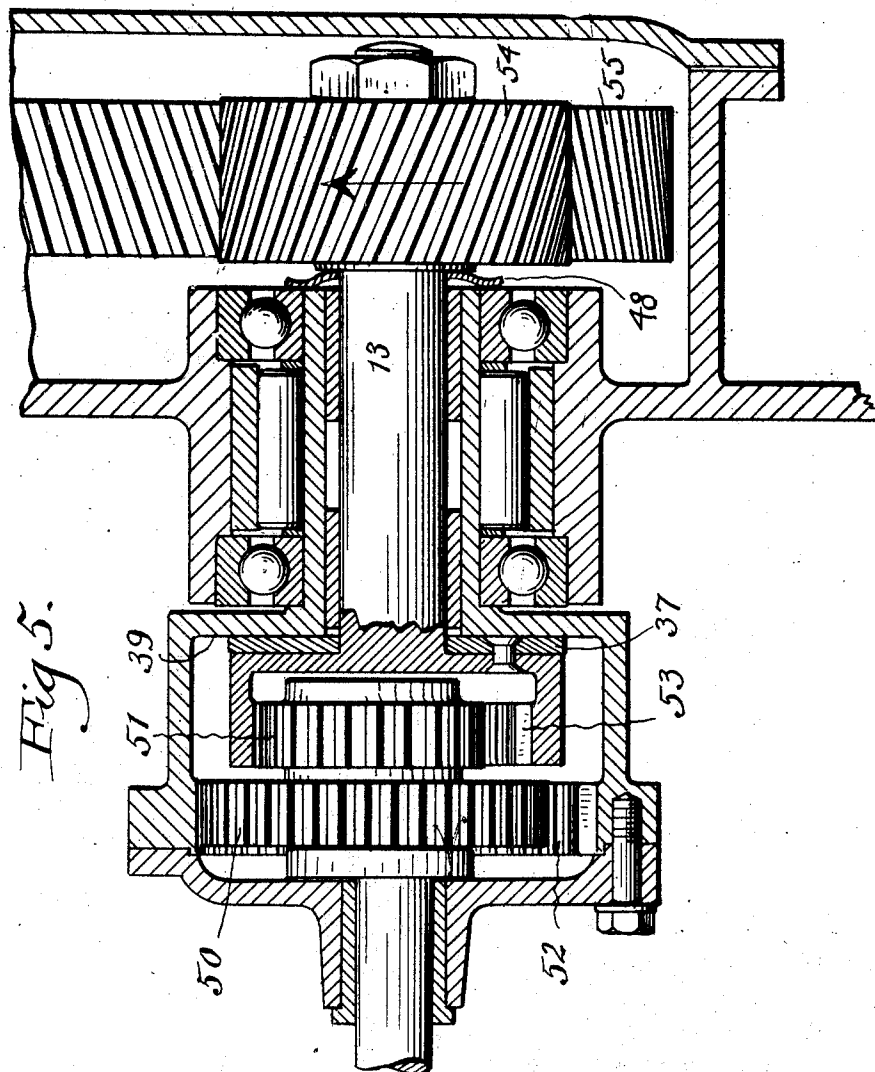


Fig. 5.

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UNITED STATES PATENT OFFICE.

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STARTING MECHANISM.

Application filed September 30, 1925. Serial No. 59,455.

This invention relates to gearing and more especially to gearing for operatively connecting a motor-generator with the crank shaft of an internal combustion engine which, when running, drives the motor generator at a desired speed, the gearing being adapted to provide a speed-reduction so that the motor-generator, when acting as a motor, may rotate the crank shaft for the purpose of starting the engine.

One of the objects of the invention is to provide a relatively simple gearing, for the purposes specified, which will be efficient and reliable in operation and which may be manufactured so economically that it is adapted for commercial production to compete with existing forms of starting mechanism and generator drives.

A further object of the invention is to provide a suitable form of gearing which will permit the use of a single electrical unit, in connection with an internal combustion engine, as a generator and as a starting motor.

A further object of the invention is to provide a gearing of the type specified in which all the working parts are thoroughly housed, for the purpose of excluding dust and to permit these parts to be efficiently lubricated, and in which the gears are permanently meshed and operate quietly and without the clashing that is incident to driving gears now commonly used.

Other objects of the invention and the features of novelty will be apparent from the following description taken in connection with the accompanying drawings in which I have illustrated the application of the invention to a gearing for operatively connecting a motor-generator and the crank shaft of an internal combustion engine, it being understood that this particular application of the invention is merely for the purpose of illustrating the principles thereof, although the invention is applicable for other purposes. In the drawings,

Fig. 1 is an end elevation of a conventional type of internal combustion engine, having my invention applied thereto;

Fig. 2 is a longitudinal section through a gearing embodying my invention, the section being on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2; and

Fig. 5 is a view similar to Fig. 2 but showing another form of the invention.

Referring to the drawings, 10 indicates the crank shaft of the internal combustion engine and 11 the usual driving chain that is arranged at the front end of the engine for the purpose of operatively connecting the crank shaft with the cam shaft 12 and the auxiliary shaft 13, there being a sprocket 14 on the latter, with which the chain 11 meshes. While I have illustrated what is known as the chain-drive, in connection with the engine, it is also customary to dispense with the chain and use intermeshed gears for driving the different shafts and it is, therefore, to be understood that the sprocket 14 may also represent a gear on the auxiliary shaft by means of which the latter is driven.

The chain 11 and the sprockets with which it cooperates are usually enclosed in a housing 15 and said housing is provided with a hub 16 through which the shaft 13 projects. A motor-generator is indicated at 17 and is secured to the side of the engine in any suitable manner (not shown) and has a shaft 18 which is in alignment with the shaft 13. An internal gear 19, preferably having spirally arranged teeth, has a tubular extension 20 which is supported in the bearings 21 and 22, in the hub 16. The outer races of the bearings 21 and 22 are held in proper spaced relation by means of the shoulders 23 and 24, respectively, in the hub 16, and the extension 20 has a shoulder 25 which engages the inner race of the bearing 21 to hold the gear 19 against axial movement toward the housing 15. The sleeve 20 is lined with the bearing bushings 26 in which the shaft 13 is rotatably mounted. The sprocket 14 is keyed to the shaft 13 and is held against axial movement thereon by the shoulder 27 and the nut 28.

A ring 29 is fitted in the hub 16, between the bearings 21 and 22 and held against rotation therein by means of the key 30. A cage 31 is loosely mounted on the sleeve 20 and provided with a series of pockets 32 for the hardened steel rollers 33, there being four of these rollers shown in drawings. The ring 29 has pockets 34 therein, for the rollers 33, these pockets varying in depth, as shown in Fig. 3, so that the sleeve 20 will

be permitted to rotate in the direction of the arrow, in Fig. 3, but will be held against rotation in the opposite direction, the construction being a well-known device for accomplishing this result.

The shaft 13 has an enlargement 35 containing the internal gear 36, which is preferably formed with spiral teeth inclined in the same direction as the teeth of the gear 19. A disc 37, of friction material, is secured to the end of the enlargement 35 by rivets 38, or in any other suitable manner, and is adapted to engage the face 39 on the inner side of the wall 40 which connects the internal gear 19 with the sleeve 20. A cover-plate 41 is secured to the side of the gear 19 by the bolts 42 and has a hub 43 that is provided with a bushing 44 in which the shaft 18 has a bearing. The shaft 18 has a gear or eccentric 45 which projects within the gears 19 and 36 and on which there is rotatably mounted a pair of gears 46 and 47 which mesh, respectively, with the gears 19 and 36. The gears 46 and 47 are preferably formed integral so that they will rotate as a unitary structure, thus constituting what is commonly known as a cluster-gear.

A spring disc 48 is arranged between the bearing 22 and the hub of the sprocket 14 and normally tends to move the shaft 13 toward the right, in Fig. 2, so that the disc 37 will be held in frictional contact with the face 39 of the wall 40.

The operation is as follows: When it is desired to start the engine, current is supplied to the motor-generator from a storage battery or other source, in the usual manner, this causing the shaft 18 to rotate. Since the crank shaft of the engine is stationary, the sprocket 14 and shaft 13 will be held thereby against rotation. It is necessary that the speed reduction in the mechanism shall be sufficient to enable a relatively small motor-generator to start the engine and, for practical purposes, a speed reduction of 13.8 to 1 will be satisfactory, this speed reduction being secured by having the gears of the proper tooth ratios. This speed reduction may be accomplished by having 26 teeth in the gear 47 and 42 teeth in the gear 36. The gears 19 and 46 will have 48 and 42 teeth, respectively, the teeth being of approximately the same size so that the gear 19 will be considerably larger than the gear 36.

The gear 36 being held stationary, by the engine, the rotation of the shaft 18 will cause the cluster-gear to be carried around by the eccentric 45 and rotated thereon by the engagement of the teeth of the gear 47 with those of the gear 36. This will cause the gear 46 to tend to rotate the gear 19 in the counter-clockwise direction, as shown in Fig. 4, which, of course, tends to rotate the sleeve 20 in that direction and carry the

rollers 33 into the shallow parts of the recesses 34 so as to lock the sleeve 20 to the stationary ring 29. The gear 19 will be thereby held against rotation and this will cause the cluster-gear to rotate on the eccentric 45 and effect the rotation of the shaft 13 in the clockwise direction, as seen in Fig. 3, the gear ratios being such that the shaft 18 will then make 13.8 revolutions for each revolution of the shaft 13.

When the engine starts under its own power, the chain 11 will continue the rotation of the shaft 13, after current has been shut off from the motor-generator 17, the shaft 13 rotating in the same direction as before. Theoretically, the shaft 18 would be rotated 13.8 times the speed of the shaft 13 but this would require that the gear 19 be held stationary. However, there is nothing to hold the gear 19 stationary and there is sufficient friction in the parts, taken in connection with the friction between the disc 37 and the wall 40, due to the end thrust caused by the spiral teeth of the gears, to cause all of the gears, as well as the shaft 18 to rotate as a unit with the shaft 13, there thus being a speed ratio of 1 to 1 between the shafts 13 and 18.

It will be noted from the drawings that all of the gears are housed within a chamber formed by the gear 19, the wall 40 and the cover-plate 41, thus providing adequate space for lubricant for the gears and entirely housing them from dust and other foreign substances so that the mechanism is adapted for reliable and efficient service and will be subjected to little wear because there is no relative rotation of the gears except when the mechanism is used for starting the engine.

Referring to Fig. 5, it will be noted that the construction is essentially the same as that previously described with the exception that the gears 50 and 51 and the internal gears 52 and 53 have straight spur teeth so that the meshing of these gears does not produce any axial thrusts therein. However, the gear 54, which corresponds to the sprocket 14, has spiral teeth which mesh with a spiral gear 55, the latter being geared to the crank shaft of the engine. In this form of the invention, we have a gear drive between the crank shaft 10 and the auxiliary shaft 13, instead of the chain drive shown in Fig. 1. The shaft 13 rotates in the direction of the arrow, shown in Fig. 5, and when the mechanism is used to start the engine and the shaft 13 is, in this case, used as a driving shaft, the reaction between the gears 54 and 55 produces an end thrust in the shaft 13 toward the left which disengages the friction disk 37 from the surface 39 and permits the gears 52 and 53 to rotate independently in accordance with the reduction in speed effected by the gearing. Under

these circumstances the speed reduction produces a relatively large torque in the gear 54 so that the reaction between the gears 54 and 55 is sufficient to overcome the tension of the spring 48. When the engine is running and the mechanism acts as a driver for the motor-generator 17, the torque which acts on the teeth of the gear 54 is relatively small and insufficient to overcome the tension of the spring 48 so that this spring holds the shaft 13 against movement toward the left and keeps the disk 37 in contact with the surface 39.

It will thus be seen that the modification, shown in Fig. 5, will function in substantially the same manner as that shown in Fig. 2 but the end thrust in the shaft 13 will be produced by the thrust reaction between the gears 54 and 55 instead of the thrust reaction between the gears 36 and 47.

Having thus described my invention, I claim:

1. In apparatus of the class described, the combination of a shaft adapted to be operatively connected with the crank shaft of an engine, a spiral internal gear on said shaft, a motor-generator shaft, an eccentric on said motor-generator shaft, a spiral internal gear rotatably mounted with respect to said shafts, a pair of gears rotatable as a unit on said eccentric and meshing, respectively, with said internal gears, said internal gears having cooperating friction means that are forced into engagement by the end thrust produced by the meshing of said internal gears with said pair of gears, and means for rotation of one of said internal gears in one direction.

2. In apparatus of the class described, the combination of two aligned shafts either of which may drive or be driven by the other, and means for operatively connecting said shafts so that one may drive the other at a different speed or be driven thereby at the same speed comprising a pair of coaxial relatively rotatable internal gears, one of said internal gears being fixed on one of said shafts and the other rotatable with respect to both of said shafts, a pair of unitary gears which mesh respectively with said internal gears and are rotatably mounted on an eccentric carried by one of said shafts, friction means for operatively connecting said internal gears for rotation as a unit

when one of said shafts acts as the driver, and means for preventing rotation of said other internal gear in one direction.

3. In apparatus of the class described, the combination of a stationary housing, an internal gear having a tubular hub rotatably mounted in said housing, means for preventing rotation of said gear in one direction but permitting rotation thereof in the opposite direction, a shaft rotatably mounted in said hub and carrying an internal gear, said shaft being axially movable, friction for operatively connecting said internal gears to cause them to rotate as a unit when said shaft functions as the driver for the apparatus, spring means cooperating with said shaft to move it axially in one direction to make said friction means operative and yieldable to permit said shaft to move in the opposite direction to render said friction means inoperative, a shaft having an eccentric thereon, and a pair of gears rotatable as a unit on said eccentric and meshing respectively with said internal gears.

4. In apparatus of the class described, the combination of a stationary housing, an internal gear having a tubular hub rotatably mounted in said housing, means for preventing rotation of said gear in one direction but permitting rotation thereof in the opposite direction, a shaft rotatably mounted in said hub and carrying an internal gear, said shaft being axially movable, friction for operatively connecting said internal gears to cause them to rotate as a unit when said shaft functions as the driver for the apparatus, spring means cooperating with said shaft to move it axially in one direction to make said friction means operative and yieldable to permit said shaft to move in the opposite direction to render said friction means inoperative, a spiral gear on said shaft the teeth of which are so inclined as to shift said shaft in opposition to said spring means to render said friction means inoperative when said shaft is driven by said apparatus, a shaft having an eccentric thereon, and a pair of gears rotatable as a unit on said eccentric and meshing respectively with said internal gears.

In testimony whereof, I hereunto affix my signature.

JAMES P. JOHNSON.