Dec. 12, 1933. L. GÉRARD 1,939,493

STARTER FOR INTERNAL COMBUSTION ENGINES

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Fig. 1

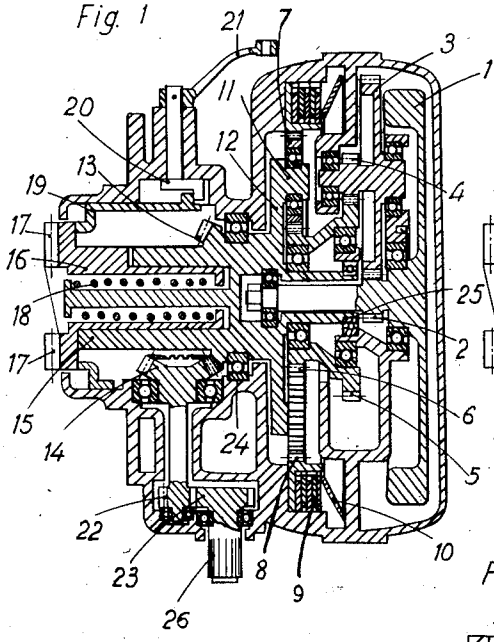


Fig. 2

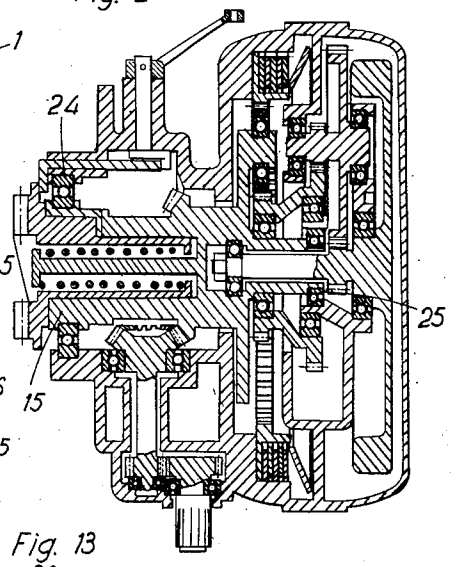


Fig. 13

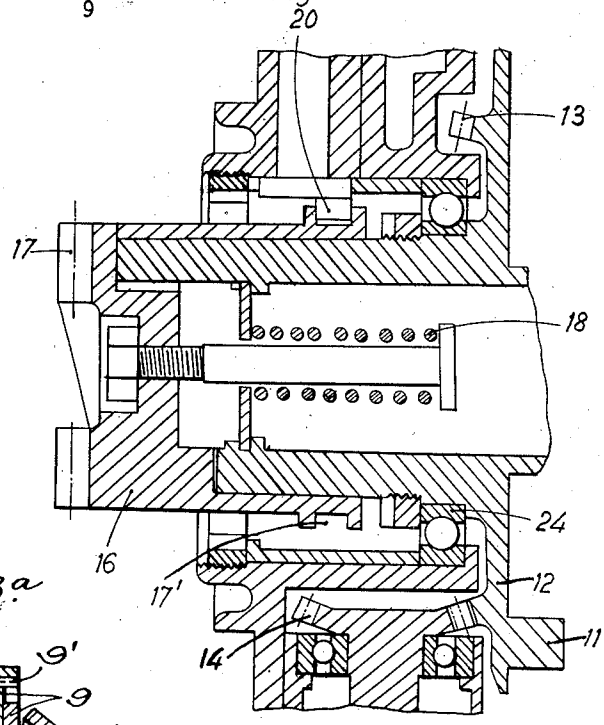
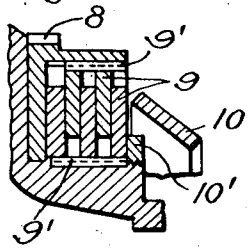


Fig. 3a



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Fig. 3

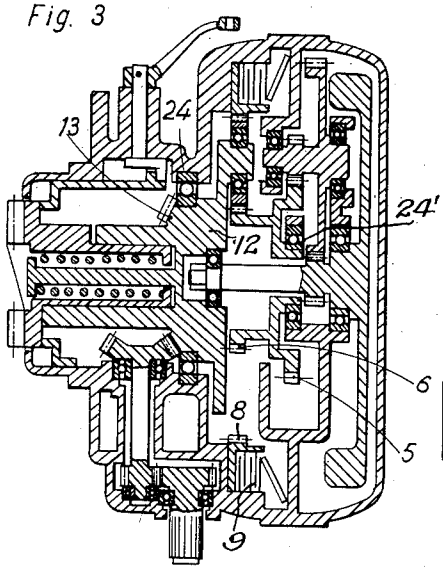


Fig. 14

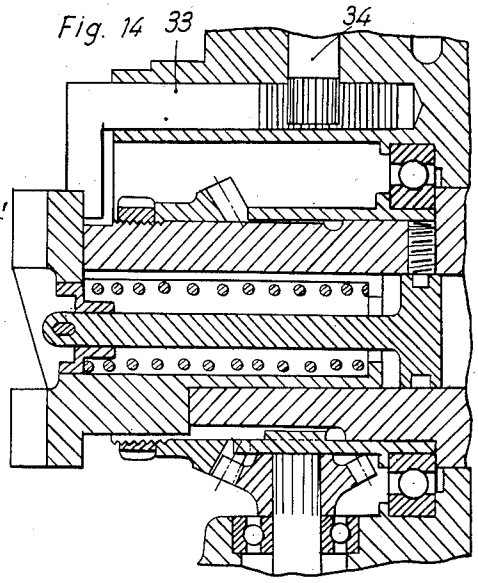


Fig. 15

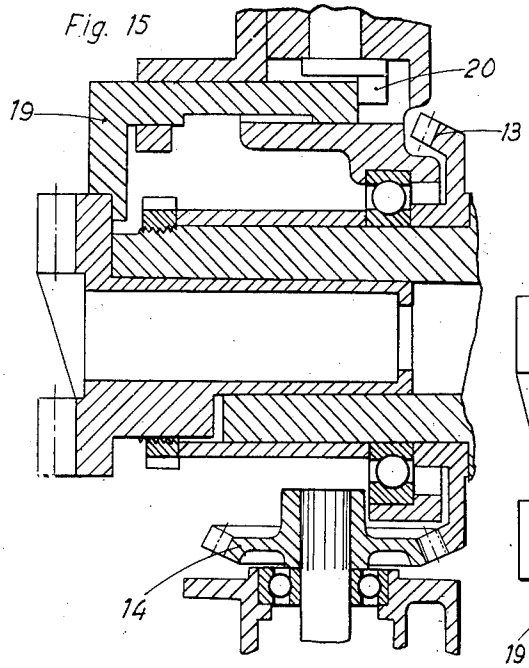
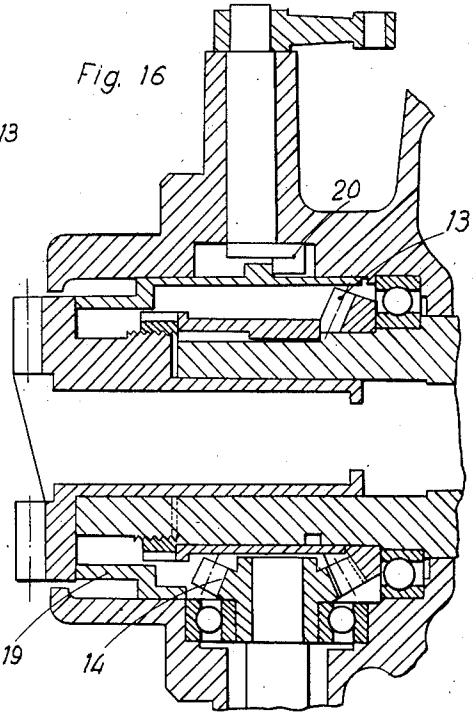


Fig. 16



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Inventor

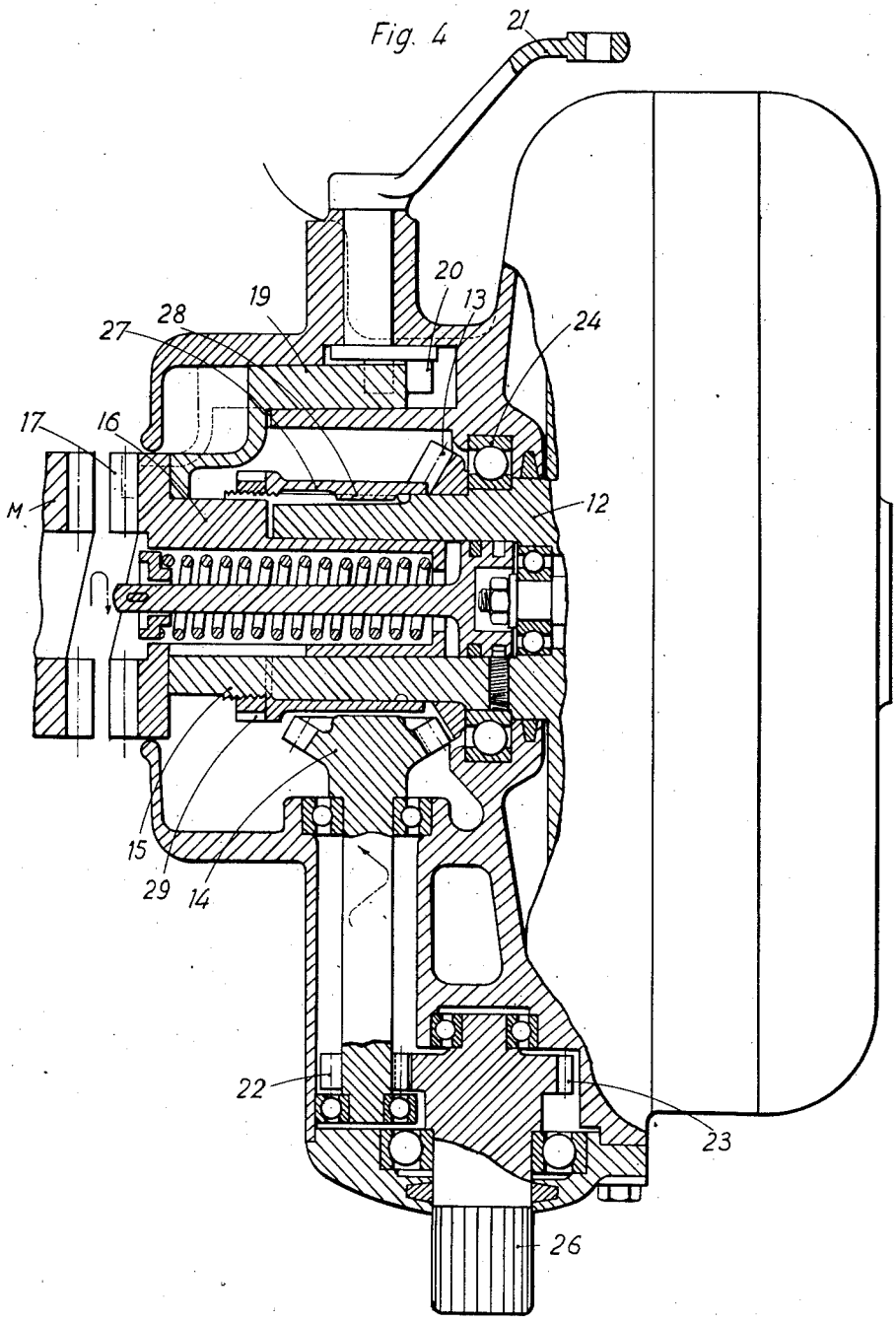
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Fig. 4



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Fig. 5

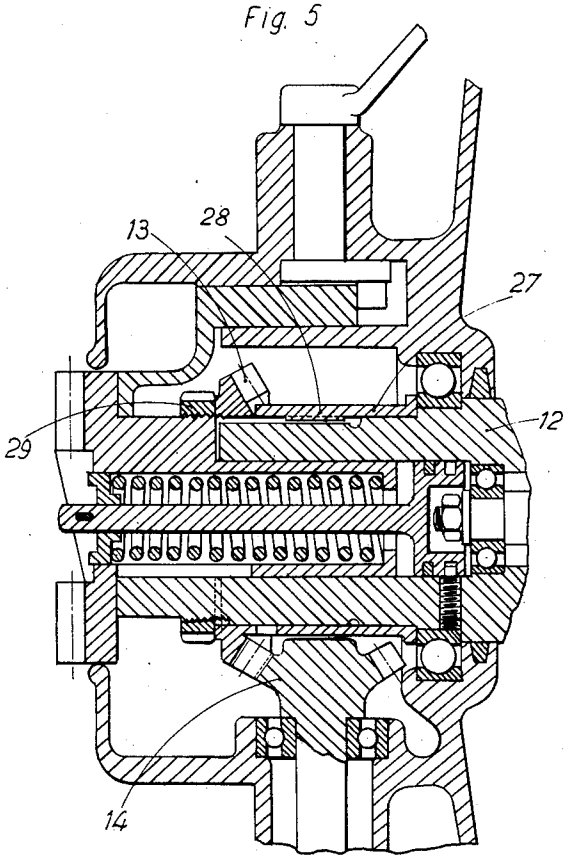


Fig. 7

Fig. 8

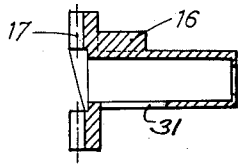


Fig. 9

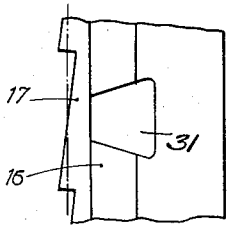


Fig. 10

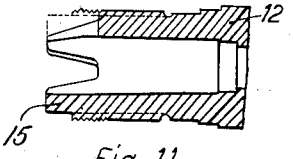


Fig. 11

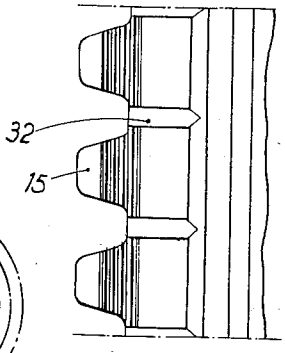


Fig. 12

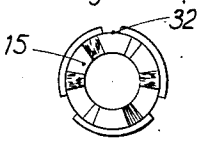
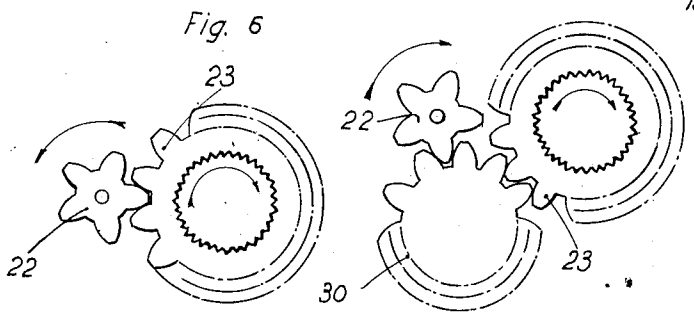


Fig. 6



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Fig. 18.

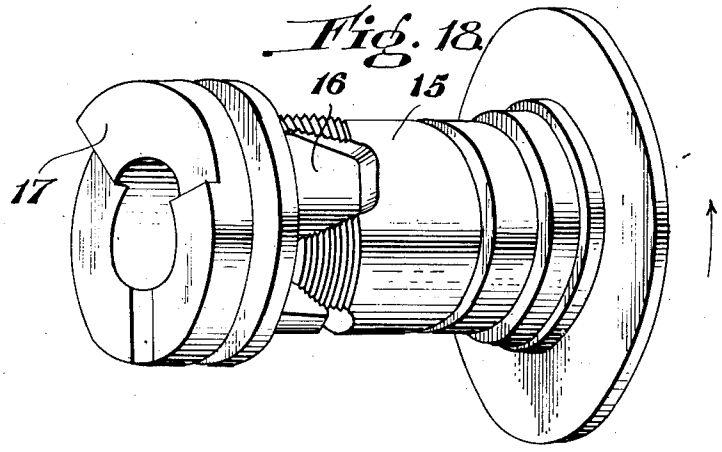


Fig. 19.

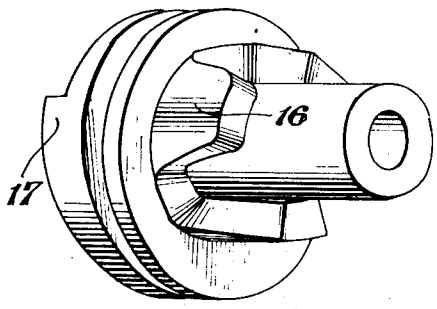


Fig. 20.

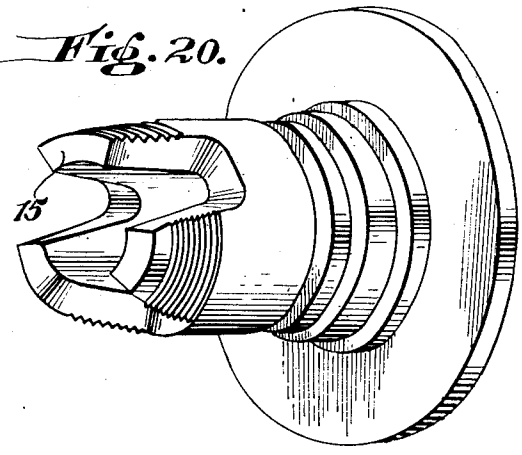
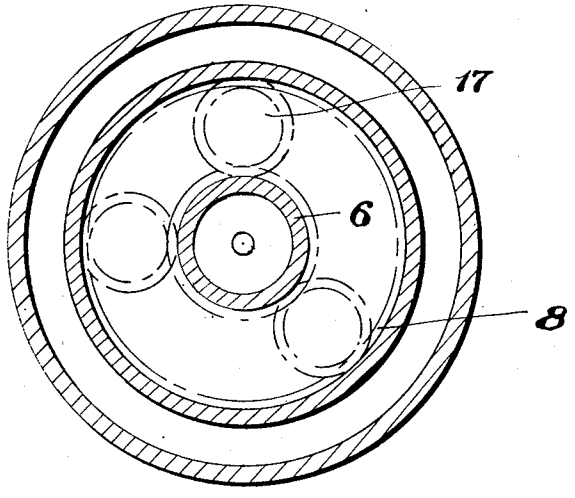


Fig. 17.



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Patented Dec. 12, 1933 1,939,493

UNITED STATES PATENT OFFICE

1,939,493

STARTER FOR INTERNAL COMBUSTION ENGINES

Léon Gérard, Sevres, France, assignor to Paul Viet, Billancourt, France

Application December 27, 1929, Serial No. 416,950, and in France January 28, 1929

1 Claim. (Cl. 123—179)

The present invention relates to starters for internal combustion engines and more particularly to starters of the type in which the kinetic energy of moving bodies is employed.

The starter according to the invention exhibits the following characteristic features:

1. The putting in engagement of the starter with the motor which is to be started is facilitated by the aid of clutch claws in such manner as to eliminate all adjustments immediately after the installation on the engine which is to be started. The starter clutch in order to be better centered and strengthened, is provided with driving members consisting of sleeves having inclined camming teeth placed as near as possible to the said clutch claw, which driving members are of such a profile that the part carrying the clutch claw is displaced along its axis in order to render it possible to put it into engagement without adjustment.

2. A friction brake acting on a normally fixed spur gear renders possible a certain amount of slip in the event of too violent a starting operation or an excessive resistance.

3. The axle of the crank for controlling the rotation of the starter members is placed as near as possible to the engine which is to be started, that is to say, between this latter and the case of the starter proper, the said axle being arranged radially or non-radially in an inclined position or a non-inclined position with regard to the generatrix of the starter.

4. The angular velocity of the crank is increased by means of gears which are arranged in an internal case, and can be easily changed according to the muscular power of the person attending to the starting operation.

5. The arrangement according to the invention permits of the provision without difficulty of a supplementary reversing gear which renders it possible to manipulate the crank always in the same direction to the right in order to be able to start any kind of engine, whether it runs in a clockwise or a counter-clockwise direction.

6. A modification for producing the reversing action consists in placing the bevel gear wheel, either in front of or behind the driven bevel wheel, according to the direction of rotation required.

7. The crank effecting the rotation can be actuated by any desired suitable means, and may for example, be actuated either from the exterior of an aircraft to which the engine is fitted or from the interior of the cabin of the said aircraft.

8. The arrangement of the aggregate may, as hereinafter described, be such that the principal driving member is supported either by one or by two ball bearings, and that the double axial pinion and the speed reducing gear are capable of being centered and supported either by two ball bearings or by a single one.

It is to be understood that different arrangements of the parts herein described are indicated by way of example only and that modifications of the said arrangements or of the details thereof may be effected without departing from the scope of the invention.

In order to facilitate the comprehension of the invention some preferred constructional forms are illustrated by way of example in the accompanying drawings, in which:

Figures 1, 2 and 3 show diagrammatically in longitudinal section three different constructional forms of the apparatus according to the invention, in which for the sake of clearness only one of three planet wheels are shown.

Fig. 3*a* is an enlarged sectional detail of the multiple disc clutch shown in Fig. 1,

Figures 4 and 5 show the positions of the bevel gear wheel in the front and at the back respectively for producing the reversal of the direction of rotation of the clutch claw,

Figures 6 and 7 show an arrangement for effecting the said reversal by means of a supplementary pinion arranged in the speed increasing gear box,

Figures 8 and 9 illustrate in detail the sleeve section having the camming teeth and clutch claw and its development showing the recesses therein.

Figures 10, 11 and 12 show the sleeve-like end of the main operating member and its camming teeth in section, in development and in end view respectively,

Figure 13 is a longitudinal section showing one method of assembling the clutch parts, wherein the claw itself forms a slide,

Figure 14 shows a modification in which the advancement of the claw is effected by means of a rack,

Figure 15 shows another modification in which the bevel gear wheel, which is larger than the supporting bearing, passes above the latter, and

Figure 16 is a modification in which the advancement of the claw is produced by a slide which is manipulated by an eccentric cam member.

Figure 17 is a transverse section taken at right angles to the axis of the starting mechanism as shown in the arrangement of the three planet gears,

Figure 18 is an enlarged perspective detail showing the cooperative engagement of the teeth on the sleeve sections,

Figure 19 is a perspective view of one of said sleeve sections, and

Figure 20 is a perspective view of the other of said sections.

In the position of the aggregate shown in Fig-

ure 1, the fly wheel 1 which has previously been set in rapid rotation, transmits its kinetic energy to the speed reducing pinions 2, 3, and thence to the pinions 4, 5. The sun gear 6 carried with the pinion 5 engages with three planet wheels 7 which mesh in turn with the fixed ring gear 8 and transmit the motion, which has been reduced in speed, to the sleeve section of the main operating member 12 by means of the three crank studs 11 on which the said three planet wheels 7 are fixed. The camming teeth 15 of the sleeve section shown in detail in Figs. 8 and 9 and the camming teeth 16 shown in detail in Figures 10 and 11 drive the sleeve section carrying the claw 17, which is pushed forward by the collar 19 actuated by the eccentric lever 20 and the control lever 21, and is thus brought into engagement with the opposite claw of the engine. The camming teeth 15 and 16 have the object of suppressing all regulation of the assembling of the starter on the engine which is to be started. This result is due to the fact that, when the starter is running and is put into engagement with the engine, the camming teeth 16 have a great resistance to overcome for starting the engine and, due to the inclination of the teeth 15, the latter tend to push the teeth 16 outward, thus engaging the claw 17 completely with the claw of the engine M to be started whatever is the adjustment distance between the engine and the starter; it is thus obvious that this distance does not need to be exact and that however the engagement of the claws of the engine and of the starter will be complete. In other words as will be noted from Figures 19, 20 and 21, teeth 15 and 16 are inclined in two opposite directions in such a manner that, when the starter turns, the teeth 16 tend to be pushed towards the engine to be started, whatever is the direction of rotation of said starter and engine; thus the starter can be used in the same way for starting engines turning in one direction or in the other. These teeth constitute an arrangement for eliminating adjustments of the starter after same is mounted on an engine and allowing however simultaneously a complete arrangement of claw 17 with the corresponding claw of the engine. The camming action of the inclined teeth 16 and 15 forces the claw 17 to remain in contact with the claw of the engine M until this latter being started pushes back the claw 17 which is then drawn back by the spring 18. The fixed spur gear 8 is braked by a multiple disc brake including alternately arranged annular plates 9 respectively splined as at 9' to the casing and ring gear 8 and held in place by a retaining ring 10' and a conical spring washer of the Belleville type 10 which keeps the brake stationary so long as the force is not too great. At the moment of starting the shock effect resulting from the engagement of the claw 17 of the apparatus with the claw of the engine M will thus be moderated by the action of the friction brake 9.

The fly wheel 1 is set in rotation by means of an external shaft 26 which is provided with grooves or with a polygonal end for driving purposes and is integral with the pinion 23 engaging with the small pinion 22 which is carried on the same shaft as bevel pinion 14 which latter in turn engages with and transmits motion to the bevel gear wheel 13. This wheel 13 is capable of being fixed either at the right or at the left-hand side of the pinion 14. The sleeve-like part of the main operating member 12 is supported on the one hand by the bearing 25 arranged at its end and, on the other hand, by the bearing 24 situated approximately at the middle part.

In Fig. 2, which shows a modification of the constructional form shown in Fig. 1, the bearing 24 is situated at the end opposite to the bearing 25 and is centered on the camming teeth 15 of the sleeve-like part of the main operating member.

In Fig. 3, which shows a further modification of the constructional form shown in Fig. 1, the main operating member 12 is supported only by the bearing 24 which is situated approximately at its middle part, the three planet wheels which gear with the fixed ring gear 8 are automatically centered, as are also the member 12 and the double speed reducing pinion 4, 5, which latter is only supported by a single bearing 24'.

Fig. 4 shows more in detail the arrangement of the bevel wheel 13 which is maintained in place by the bearing 24, by the nut 29 and the interposition of a liner 27, the notches of which situated at the end engage with the teeth of the bevel wheel and drive the member 12 by means of internal grooves 28.

In Fig. 5 the liner 27 and the bevel gear wheel 13 have been reversed in order to drive the engine clutch claw in the reverse direction.

In Fig. 6 the two speed increasing pinions 23 and 22 drive the claw of the starter towards the right. If the claw has to turn to the left, it will be necessary to separate the pinions 22 and 23 and to interpose between them a toothed reversing pinion 30, as has been shown in Fig. 7.

Figs. 8 and 9 show in detail the sleeve-like clutch jaw provided with recesses 31 and carrying the clutch claw 17.

Figs. 10, 11, and 12 show the sleeve-like part of the main operating member provided with the clutch jaws 15 separated by the spaces 32.

In Fig. 13 the eccentric cam 20 engages in a channel 17^1 provided on the clutch claw which latter itself forms a slide.

In Fig. 14 the advancement of the claw is effected by means of the rack 33 controlled by the shaft 34.

In Fig. 15 the bevel gear wheel 13 is larger than the supporting bearing 24 which is thus situated at the interior of this crown.

Fig. 16 shows a modification of the device for advancing the claw, the movement being effected by means of the slide 19 and the eccentric cam 20.

I claim,

A mechanical starter for internal combustion engines including in combination, a housing, a rotatable fly wheel, an engine engaging member, a planetary gearing interposed between the fly wheel and the engine engaging member and including planet wheels and a normally fixed ring gear wheel, a driven sleeve unitary with the engine engaging member, said sleeve being spring biased to normal position and manually movable to engine engaging position, a driving sleeve drivably connected to the said planetary gear train, said sleeve members being formed with coacting camming teeth on adjacent ends thereof, and a multiple disc brake capable of allowing a slip to take place in case of too violent a starting operation or excessive resistance and interposed between the said ring gear wheel and the said housing.

LÉON GÉRARD.