June 5, 1951 G. LEVESQUE DU ROSTU 2,555,451

ENGINE STARTING DEVICE

Filed March 29, 1946 2 Sheets-Sheet 1

Fig. 2.

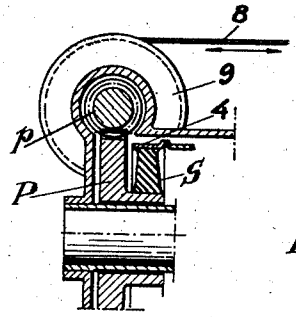


Fig. 1.

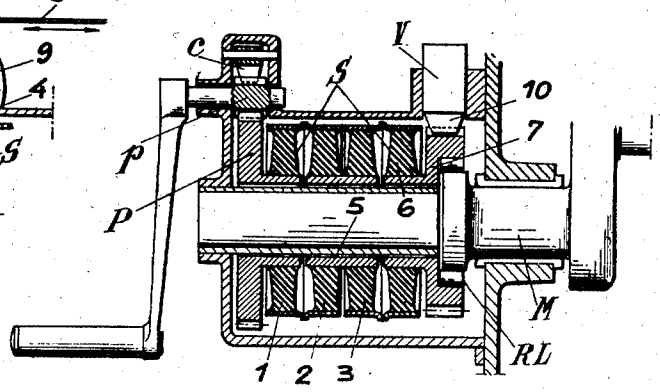


Fig. 3.

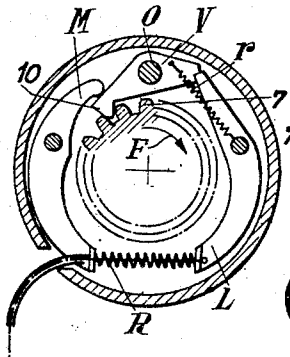


Fig. 4.

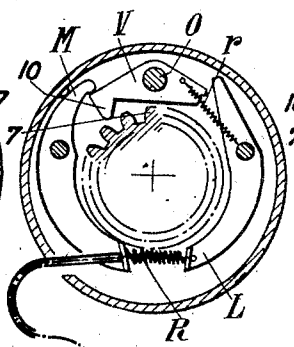
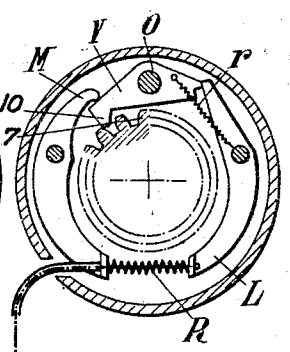
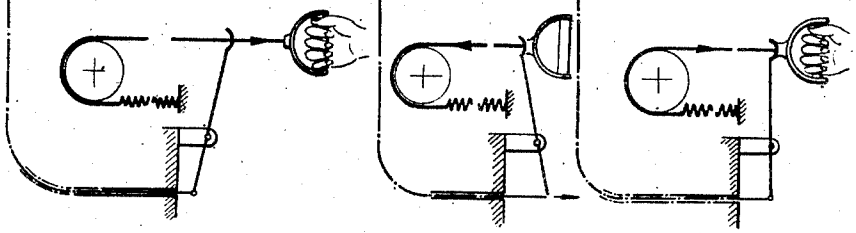


Fig. 5.





Inventor
G. Levesque du Rostu
By Glascock Downing Seibold
Attys.

June 5, 1951 G. LEVESQUE DU ROSTU 2,555,451

ENGINE STARTING DEVICE

Filed March 29, 1946

2 Sheets-Sheet 2

Fig. 6.

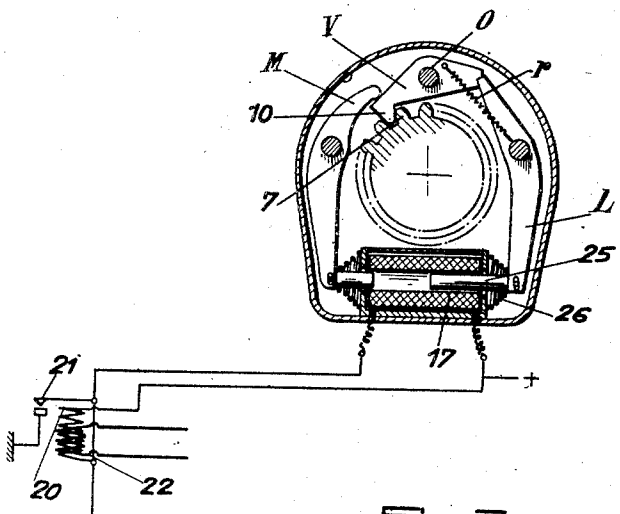
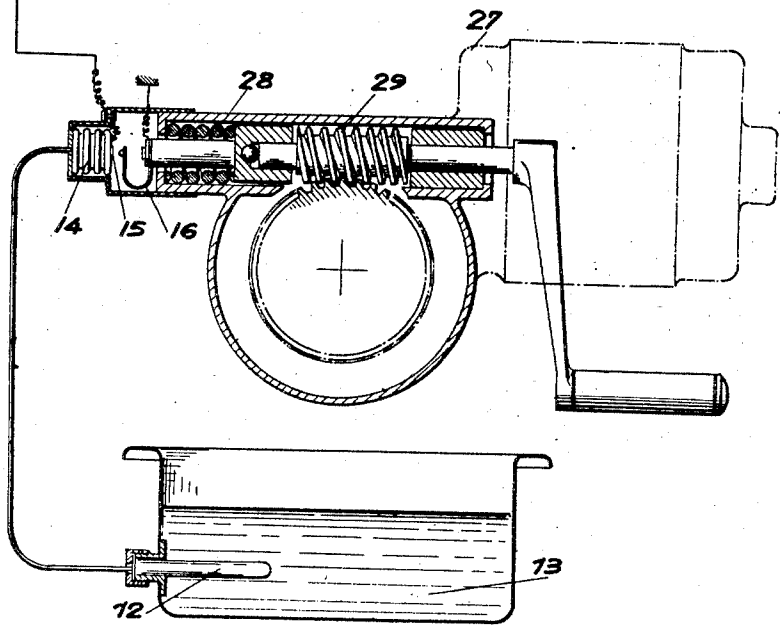


Fig. 7.



Inventor

G. Levesque du Rostu

By Hasco ck Downing Rebh
Attys

Patented June 5, 1951

2,555,451

UNITED STATES PATENT OFFICE

2,555,451

ENGINE STARTING DEVICE

Georges Levesque du Rostu, Paris, France, assignor to Societe Anonyme Andre Citroen, Paris, France

Application March 29, 1946, Serial No. 658,084
In France February 27, 1945

Section 1, Public Law 690, August 8, 1946
Patent expires February 27, 1965

5 Claims. (Cl. 185—37)

1

The subject-matter of this invention is a starting device for combustion engines and more generally a device suitable for all such purposes as involve the use of means comparable to those which are necessary for starting internal combustion engines.

It is well known that for the purpose of starting an engine the shaft thereof must be rotated at a definite speed; with this end in view it has already been proposed to replace crank starting by an electric or a momentum starting gear.

The device according to this invention is more efficient than a momentum starting gear and is more satisfactory in operation than an electric starting gear.

The starting device proposed operates on the basis of elastic accumulation, the element selected being rubber. It consists primarily of a plurality of rubber rings connected in a series, one end ring of the series being attached to the locking device and the other end ring to a device for the winding up of the rubber ring system. Moreover, the end ring located on the locked side is provided with some suitable coupling means for connection with the engine or machine to be driven.

The winding up of the rubber ring system is effected either by means of a crank to be operatively connected with a pinion meshing with a gear wheel rigid with one end rubber ring, or from a distance through a ratchet gear with a return spring, this enabling to set the pinion into rotation by alternating actions exerted upon an operating cable, or with the aid of an electric motor. The instantaneous power necessary for such winding up is far less than the power involved by direct starting.

One manner in which this invention can be carried into effect will now be described more specifically, reference being had to the appended drawing in which:

Figure 1 is a diagrammatical view of the starting device;

Figure 2 illustrates the embodiment of a worm gear wind-up device.

Figures 3, 4 and 5 illustrate the locking system in three different positions, together with the embodiment of a release system useful in the case of remote operation of the wind-up device.

Figure 6 shows diagrammatically the electrically controlled release device, while Figure 7 illustrates an arrangement providing for automatic release as soon as the torque is sufficient to start the engine, together with the electric relay involved by that arrangement.

2

The device is composed of a number of molded rubber rings S (Fig. 1) vulcanized on metal armatures. Said rings are connected in a series, that is, the first ring 1 is connected with the second ring 2 through the outer armature 4, the second ring with the third ring 3 through the inner armature 5, and so on; the first ring is attached to a wind-up device; as shown in Fig. 1 the latter consists of a gear wheel P driven by a pinion p retained in one direction by a pawl c. The last rubber ring 6 of the series is attached to a disc 7 normally locked by a latch V. The coupling with the engine M to be started is obtained in the example illustrated by a unidirectional clutch with wedging rollers RL.

In Figs. 3, 4 and 5 in which a locking system is illustrated in a somewhat less diagrammatical manner than in Fig. 1 the latch V is pivoted on a pin O and provided with a return spring r. A keeper L is designed to hold the latch in its locking position. A lever M urged by a spring R is designed to bring back the latch into its locking position.

The operation is as follows:

The device being locked, the rubber ring system is wound up either with the aid of a crank as shown in Fig. 1 or from a distance by means of a cable 8 wound on a drum 9 provided with some ratchet one-way coupling and with a return spring, whereby the pinion p can be driven by alternating pulls exerted on the operating cable (Fig. 2) or again with the aid of an electric motor.

After a certain number of revolutions the rings are sufficiently stressed and the device is released.

The part 7 to be locked has gear teeth cut at the periphery thereof with an angle of pressure of say 20°. The nose 10 of latch V is also shaped as a gear tooth with a rounded end. Upon a torque being exerted in the direction shown by the arrow F in Fig. 3, a disengaging force is set up by reason of the angle of pressure amounting to 20°. It will be appreciated easily that with a given coefficient of friction the said disengaging force depends on the position of the pivot O of latch V with respect to the tangent to the circle through the point of contact of the latch with one tooth on the part to be locked. Care is to be taken that the said disengaging force shall always be positive, while on the other hand it shall be small to allow the latch keeper L being displaced by a comparatively slight force.

Not only does the fulfilment of the above con-

dition provide for an easy release, but also wear at the points of escapement of keeper L and latch V is reduced to a minimum. In addition, as soon as the said points of escapement are passed, the latch V is cammed away by the release force. As a result of the rounded shape of the latch nose end (or of the teeth on the part to be locked) the releasing force increases rapidly in proportion as the latch is moved away. Since that force is considerably larger than the one necessary to rock the latch, the bending stress upon the tooth is removed almost instantaneously. Every danger of breakage or wear is thus avoided.

During the recoil of the rubber rings the latch is kept disengaged by spring *r*, and the engine to be started is driven through some clutch that can be thrown out of gear automatically as soon as the engine is started, such as a claw clutch, a pawl-and-ratchet coupling, a one-way wedging roller coupling. The latter arrangement is the one illustrated.

At the end of the recoil the latch is re-engaged as shown in Fig. 5, spring R then acting upon latch V through lever M.

The release system can be controlled in any suitable manner; however, an arrangement which can be used where the device is wound up by hand from a distance (Fig. 2) is shown diagrammatically by way of example in Figs. 3, 4 and 5 in three different positions, viz.: the locked position, the released position and the first stage of the locking process.

The release mechanism can also be combined with the clutch pedal. This would afford the advantage of compelling the driver to throw the engine out of gear to allow same being started, which is desirable, especially by cold weather, in order to decrease resistance to motion.

Fig. 6 illustrates an electric release device that can advantageously be combined with the automatic switch shown in Fig. 7. The spring R is replaced by an electro-magnet 17 whose core 25 actuates the keeper L against the action of a spring 26. The use of this arrangement makes it possible to limit the stress on the rubber rings to a value just sufficient for starting the engine irrespective of the temperature of the latter. Effectively, it is well known that the energy necessary for starting an engine is the more considerable as the temperature of the latter is lower. Practically, with a given engine and a given starting device, to every particular temperature there corresponds a definite torque.

In the arrangement shown in Fig. 7 the torque finds its measurement in the compression of a spring 28 that absorbs the reaction of the torque upon the worm spindle 25. It would as well be possible to use the axial reaction of a pair of helical gear wheels or the tangential reaction upon one amongst the three elements of a planetary gear.

Temperature is given e. g. by the expansion of a liquid enclosed in a capsule 12 immersed in the oil sump 13 of the engine. The said expansion is transmitted to a deformable capsule 14 that carries a contact 15 located opposite a rod 16 which undergoes a displacement which is proportional to the torque. It will be understood easily that in such conditions the distance between the contacts is the smaller as the temperature is higher; consequently, contact will also be established at a value of the torque which is the smaller as the temperature is higher.

The outline of a small electric motor is drawn in chain lines in Fig. 7, it being obvious that the elastic accumulation starting device can also be wound up electrically. The use of such an arrangement, while retaining all the advantages of the conventional electric starting (simplification of the operations to be performed by the driver), provides for much more powerful startings by a starting device and above all with a battery of much less power. The gain in weight is a considerable one. Moreover, with an exhausted battery, the engine can still be started powerfully owing to the possibility of winding up by hand.

Where the arrangement used is the one shown in Fig. 7 release takes place as soon as the contacts bear upon each other; this results in a sudden drop in the torque, while the contacts move away from each other; consequently, the electromagnet shown in Fig. 6 would release the latch before the recoil has come to an end, so that said latch would ride over the teeth on the part to be locked. The electric relay shown is designed to avoid that inconvenience. The operation is as follows: the engagement of the contacts visible in Fig. 7 with each other produces the grounding of the release electro-magnet 17 (Fig. 6) and at the same time that of the winding of relay 20 by which a contact-carrying strip 21 is attracted which provides for an additional grounding of the first circuit. The result is that the current goes on flowing through the release electromagnet and through the winding of the relay. It is necessary that the opening of said circuit should take place as soon as the engine has started, or as soon as a new starting is attempted if the first one should prove unsuccessful. For that purpose, a stripping winding 22 is provided on the relay through which an electric current, for instance that of the battery loading circuit, as soon as the generator switch-in speed is reached, or that of the wind-up motor circuit, should the engine have failed to start and a new starting be attempted. The flowing of any one of the said currents will be effective to release the relay and consequently to lock the starting device.

What I claim as my invention and desire to secure by Letters Patent is:

1. A device for the starting of engines and for all such purposes as involve the development of considerable power in a very short time, consisting of a wind-up device, a locking device, a plurality of rubber rings, means connecting said rings in a series so that the total angle of twist of the several rings is equal to the sum of the angles of twist of the individual rings, the first ring in the series being rigid with the wind-up device and the last ring with the locking device, and means to couple the locking device with the driven part.

2. A device for the starting of engines consisting of a gear wheel, a plurality of deformable elastic rings arranged in a series, the first ring being connected at the outer portion thereof with the next ring and at its inner portion with said gear wheel, a source of power, a pawl retained pinion driven by said source of power and meshing with said gear wheel, a normally locked disc the last ring in the series being connected at its outer portion with the last ring but one and being rigid with said normally locked disc which, upon release, will drive the part to be driven and means connecting the rings two by two, alternatively at their inner portion and outer portion.

3. A device for the starting of engines consisting of a gear wheel, a ratchet gear, a return spring, a motor, a normally locked disc, a plu-

rality of deformable elastic rings arranged in a series, the first ring being connected at the outer portion thereof with the next ring and at its inner portion with said gear wheel actuated through the medium of said ratchet gear and of a return spring through said motor, the last ring in the series being connected at its outer armature with the last ring but one and being rigid with said normally locked disc which, upon release, will drive the part to be driven and means connecting the rings two by two, alternatively at their inner portion and outer portion.

4. A device for the starting of engines consisting of a gear wheel, a pinion, a pawl, a source of power, a disc, actuating means, a plurality of elastic rings arranged in a series, the first ring being connected at the outer portion thereof with the next ring and at its inner portion with a gear wheel driven by said pinion retained in one direction by a pawl and actuated by a source of power, the last ring in the series being connected at its outer portion with the last ring but one and being rigid with said disc, means connecting the rings two by two, alternatively at their inner portion and outer portion, the said disc being formed at the periphery thereof with teeth having an angle of pressure of about 20°, a latch in the shape of a gear tooth with a rounded crest coacting with said teeth and adapted to oscillate about its median axis by the action of said actuating means acting upon either end thereof in combination with the action of calibrated springs.

5. A device for the starting of engines consisting of a gear wheel, a pinion, a pawl, a source of power, a disc, electromagnet cores, levers operable by said cores, a plurality of elastic rings arranged in a series, the first ring being connected at the outer portion thereof with the next ring and at its inner portion with said gear wheel driven by a pinion retained in one direction by said pawl and actuated by said source of power, the last ring in the series being connected at its outer portion with the last ring but one and being rigid with said disc means connecting the rings two by two, alternatively at their inner portion and outer portion, said disc being formed at the periphery thereof with teeth having an angle of pressure of about 20°, a latch in the shape of a gear tooth with a rounded crest adapted to oscillate about its median axis by the action upon either end thereof of said levers actuated by said electromagnet cores against the action of a calibrated spring.

GEORGES LEVESQUE DU ROSTU.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
440,482	Lee	Nov. 11, 1890
774,525	Mack	Nov. 8, 1904
1,135,694	Keeler	Apr. 13, 1915
1,184,961	Johnston	May 30, 1916
1,216,416	Chalmers	Feb. 20, 1917
2,203,342	Sloman	June 4, 1940

FOREIGN PATENTS

Number	Country	Date
591,023	Germany	Apr. 26, 1934