

March 24, 1936.

N. HERZMARK

2,035,161

ENGINE STARTING DEVICE

Filed Feb. 4, 1931

2 Sheets-Sheet 1

Fig. 1.

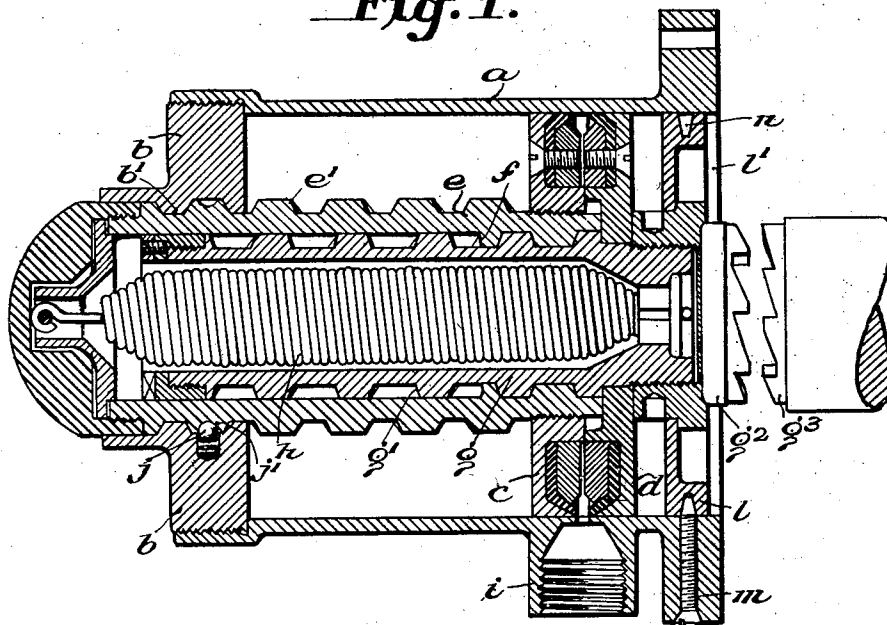
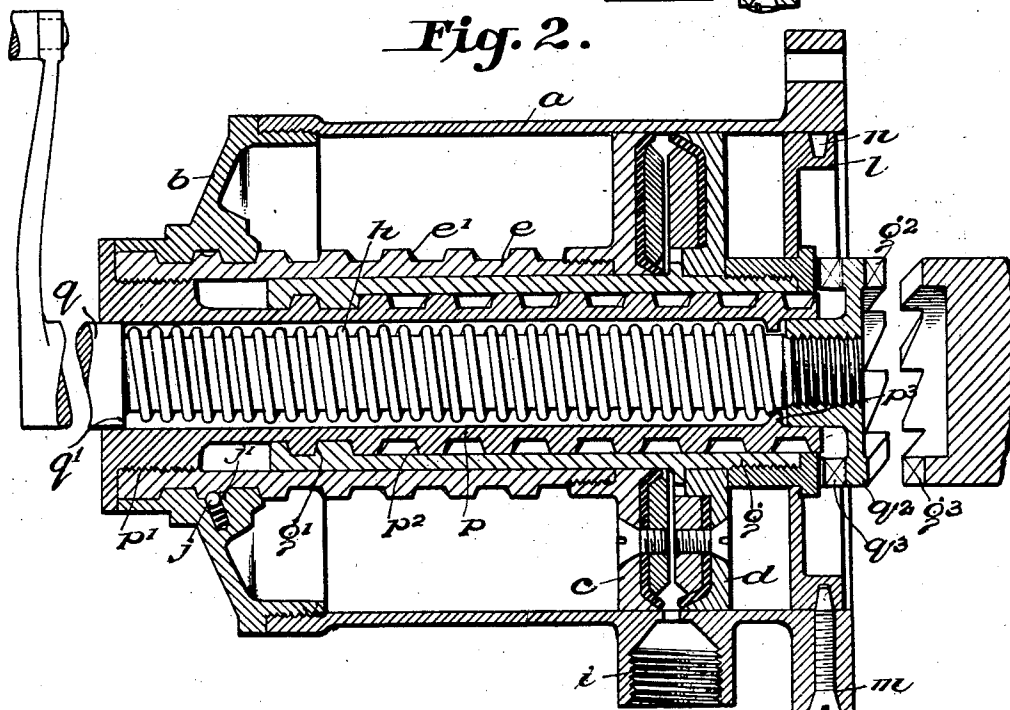


Fig. 2.



INVENTOR
Nicolas Herzmark.

BY *F. B. Smith.*
ATTORNEY

March 24, 1936.

N. HERZMARK

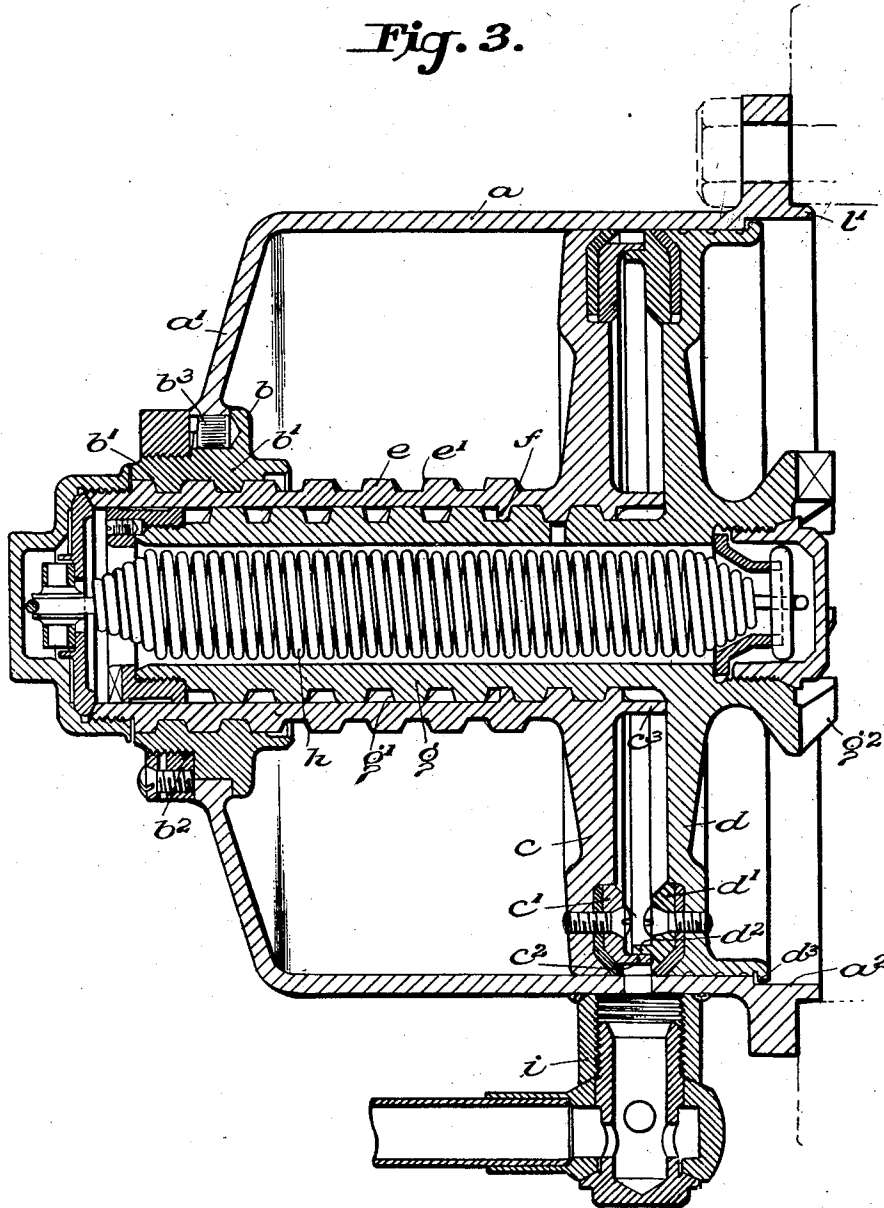
2,035,161

ENGINE STARTING DEVICE

Filed Feb. 4, 1931

2: Sheets-Sheet 2

Fig. 3.



INVENTOR
Nicolas Herzmark.
BY *F. B. Smith.*
ATTORNEY

UNITED STATES PATENT OFFICE

2,035,161

ENGINE STARTING DEVICE

Nicolas Herzmark, Paris, France

Application February 4, 1931, Serial No. 513,437

In France February 4, 1930

6 Claims. (Cl. 121—37)

This invention relates to starting devices for internal combustion engines.

One of the objects of the invention is to provide an engine starter of the fluid pressure type embodying novel means for producing engagement with and cranking of a member of the engine to be started.

A further object of the invention is to provide in a starting device of the foregoing character, novel means for converting an axially directed pressure into a rotation producing force whereby the axial movement of the driving member is translated to the engine cranking member.

A further object of the invention is to provide a novel starting mechanism of the type employing a plurality of power actuated piston members one of which operates to produce engagement between the starting mechanism and a member of the engine to be started and the other of which operates to impart a cranking torque to the engine engaging member.

Another object of the invention is to provide a piston driven starting mechanism of the foregoing character which makes it possible, by the use of a novel construction, to obtain a greater number of cranking turns of the starting mechanism without increasing the power stroke of the piston beyond that heretofore employed.

Another object of the invention is to provide a novel construction in a piston driven starting mechanism by the use of which it is possible to reduce the size and bulk of such a mechanism or for the same size to increase the maximum number of turns which the starter can make in a single starting operation.

Another object of the invention is to provide a novel arrangement of the component parts of the starter, which novel arrangement permits the interior parts to be readily withdrawn from the casing with a view to their inspection or replacement without it being necessary to disconnect the pipes or other parts leading to the starter.

Another object of the invention is to provide in a piston driven starter of the character above described, a novel construction whereby the piston or pistons are automatically positioned at the end of the starting operation in the proper location for most effective application of power at the beginning of the next engine starting operation.

Other objects and advantages to be derived from the use of the invention reside in the specific construction, combination and inter-relation of parts whereby a compact, efficient, and easily operated and maintained unit is produced, all of which objects and advantages will appear more clearly upon an inspection of the following specification, with reference to the accompanying drawings illustrating three embodiments of the

invention. It is to be expressly understood, however, that the said drawings are for the purpose of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings wherein like reference characters refer to like parts throughout the several views:

Fig. 1 is a longitudinal axial section through a device embodying the invention;

Fig. 2 is a similar sectional view of a second embodiment of the invention; and

Fig. 3 is a similar sectional view of a third embodiment of the invention.

Referring to Fig. 1, the starting mechanism constituting the embodiment of the invention therein shown comprises a casing *a* fixed by any suitable means upon the frame work or crank case of the engine to be started, the said casing being provided at its front end with an annular member *b* of which the interior surface *b*¹ is screw-threaded. In the interior of the casing *a*, which forms the fixed cylinder to which the air is admitted, are two pistons *c* and *d*. The piston *c*, which is the driving piston, is fast with a socket or sleeve *e*, the exterior surface *e*¹ of which is screw-threaded in such a manner as to be able to screw through the annular member *b* forming a quick-pitch nut. The other end of the sleeve *e* is also provided on its interior face with a nut *f*.

Means preferably employed for producing initial engagement with a member of the engine to be started comprises a second piston *d*, which is displaceable through only a limited stroke, is fixed upon an inner socket or sleeve *g*, also screw-threaded on its exterior surface *g*¹, and adapted to screw through the nut *f*. The sleeve *g* is also fitted with a coupling member *g*² having ratchet jaws and coming into engagement, at the time of starting, with the corresponding member *g*³ keyed upon the shaft of the motor to be started.

Means are provided for returning the pistons *c* and *d* after the operative stroke of the starter in order to restore the parts to position for the next operation. As shown in Fig. 1, the preferred means for producing such return operation comprises the use of a tension spring *h*, connecting the inner end of the sleeve *g* with the outer end of the sleeve *e*. A pipe connection *i* leading to the compressed air supply line is designed to admit the compressed air into the cylinder at a point between the two pistons *c* and *d*. A number of balls *j* are spring-pushed against the cup-seatings *j*¹ formed on the exterior surface of the sleeve *e*, so that this sleeve and consequently the piston *c*, experiences a certain resistance to their axial displacement at the beginning of such movement.

The working of the arrangement is as follows:

When compressed air is admitted between the pistons *c* and *d* by the operation of a suitable cock or valve, the piston *d*, which is entirely free, is displaced; the sleeve *g*, with which it is fast, screws through the nut *f* which for the moment is stationary. The jaw coupling *g*² comes into engagement with the coupling *g*³, and the piston *d* is thereupon stopped.

Under the force derived from the compressed air acting on the piston *c*, the balls *j* are now pushed back out of the cups *j*¹, and the piston *c* moves axially whilst revolving as the sleeve *e* screws through the nut formed by the member *b*. At the same time, the nut *f*, fast with the travelling and revolving sleeve *e*, causes the screw-threaded sleeve *g* to turn, which consequently imparts a movement of rotation to the coupling members *g*² and *g*³ and thence to the motor shaft.

It will be seen that when the sleeve *e* has made one complete turn and has consequently advanced one screw-pitch, the interior sleeve *g* has also performed one complete revolution relatively to the sleeve *e* and therefore has made two complete turns relatively to the fixed part *b*. This obviously on condition that the screw threads of the two sleeves *e* and *g* are of equal pitch but of opposite hand or direction.

The result of this arrangement is that the number of turns of the central sleeves *g* and therefore of the shaft to be started, is double that which would be obtained with a single screw-threaded sleeve.

In order to provide for dismantling the starter without having to disconnect the compressed air pipes, the inner cylinder head *l* of the starter is fixed to the cylinder barrel *a* by screws or the like *m* entering a groove *n*, and the outer end or annular member *b* is screwed into the said barrel. Consequently, when it is desired to withdraw from the barrel or casing all the members of the starter, it is sufficient to unscrew the screws *m* and the annular member *b*.

In the form of construction shown in Figure 2, the exterior sleeve *e* fast with the piston *c* is also made fast with a central sleeve *p* by means of a screw thread *p*¹. The sleeve *p* is provided with a screw thread *p*² upon its external surface. The piston *d* is fast with an intermediate sleeve *g* provided with a nut *g*¹, in which is engaged the thread *p*² of the sleeve *p*.

The spring *h* is formed as a compression spring fitted between a fixed collar *q*¹ on the shaft *q* and an abutment *p*³ on the interior of the central sleeve *p*. Upon the shaft *q* is mounted a double-jaw-clutch member *q*² which at rest is held in engagement with a jaw-clutch member *q*³ fast with the intermediate sleeve *g*.

This starter works in the following manner: Compressed air being admitted between the two pistons *c* and *d*, the piston *d* is the first to move, carrying with it the sleeve *g*, which rotates together with the piston, screwing along the thread *p*². The shaft *q* is also rotated by the intermediary of the engaged jaw-clutch members *q*² and *q*³, and after a limited movement of the shaft *q* the jaws *g*² come into contact with the jaw clutch member *g*³ on the motor shaft.

From this moment, the balls *j* are pushed back out of their recesses *j*¹ and the piston *c* begins to travel; the exterior sleeve *e* screws through the fixed nut *b* and as a result the central sleeve *p* fast with the exterior one is also rotated, whilst moving axially. In consequence, the sleeve *g* provided with the nut *g*¹ revolves further, mak-

ing two revolutions while the connected sleeves *e* *p* make one complete revolution, on the assumption obviously that the screw threads of the sleeves *e* and *p* are of equal pitch but of opposite hand.

When the rotation of the motor shaft by the jaw clutches *q*² and *g*³ is completed, the whole is brought back to the initial position by the spring *h*.

To start up the motor by hand, the pressure exerted manually on the shaft *q*, whilst turning, has for effect to separate the jaw-clutch members *q*² and *g*³ and to bring into engagement the jaws *g*² and *g*³. The starting then takes place as usual.

The dismantling of the starter is effected in the same manner as that which has been described for the starter illustrated in Figure 1.

In the embodiment shown in Fig. 3, the casing *a* is provided with two pistons *c* *d* and an annular member *b* forming a nut for the screwed sleeve *e*, and a nut *f* for the screwed sleeve *g* which nut is integral with the revoluble sleeve *e*. The two sleeves *e* *g* with screw-threads *e*¹ *g*¹ are shown integral with the respective pistons *c* *d*, and the nut *b*¹ is secured in the centre of a dished outer end *a*¹ of the casing *a*, by means of a nut *b*², dowel pins *b*³ being spaced around the periphery of the nut to anchor it to the casing. The pistons *c* *d* are fitted with packing leathers or similar elastic members, as in the aforesaid prior specification, and the rings *c*¹ *d*¹ holding the packing in position are formed with concentric flanges *c*² *d*² which enter telescopically one within the other in the position illustrated. The rings *c*¹ *d*¹ are secured in position upon the packing leathers by means, for example, of screws entering the pistons.

In this embodiment the air or gas under pressure admitted by way of the connection *i*, has only the narrow outer annular areas of the pistons upon which to act until the flanges *c*² *d*² are separated by the initial movement of the piston *d*. The engagement of the coupling member *g*² with the corresponding member on the motor shaft therefore takes place gently and without damage to the coupling jaws.

The piston *d* is formed with a lip *d*³ travelling in a counterbore *a*² at the rear end of the casing, so as to limit the axial movement of the piston *d*. The piston *c* is also shown provided with a concentric flange *c*³ which abuts against the pinion *d* in the normal position shown, under the tension of the spring *h* connecting the opposite ends of the screw-threaded sleeves. By the provision of the flanges *c*² *d*² and *c*³, the correct movements of the pistons are ensured and the outer space between the pistons must register with the inlet *i* for the admission of the compressed air or gas.

The sleeves *e* *g* are formed with screw threads *e*¹ *g*¹ of equal pitch but of opposite hand, so that the rotary movement imparted to the coupling member *g*² is double that of the exterior sleeve *e* and piston *c*.

The invention is not limited to the forms of construction which have been described but can be carried out with all modifications based on the same principle, the arrangement comprising more than two screws, if desired. Such a starter can likewise be combined with an air compressor mounted on the same axis and driven by the motor shaft. For this purpose, the rear end of the starter casing or cylinder barrel, as shown in the drawings, is provided with a centering por-

tion or register 1¹ in which the extremity of the compressor casing can be located in alignment with the starter and the motor shaft.

Instead of compressed air to separate the pistons, gas under pressure may be employed, and such gas may be obtained from a storage tank or directly from an explosion (such as that of a cartridge) conveyed into the inlet i.

Likewise other changes which will now suggest themselves to those skilled in the art may be made in the form, details of construction and arrangement of the parts without departing from the scope of the invention as disclosed herein, and reference is therefore to be had to the appended claims for a definition of such scope.

What is claimed is:

1. In a starter for an engine having a starting jaw; a piston coaxial with said jaw; a cylinder cooperating with the piston, said cylinder constituting a permanent installed part of said engine; an end plate slidable throughout the length of the cylinder and adapted to normally close one end thereof; fastening means for normally securing the end plate in fixed position adjacent one end of said cylinder and operable to permit removal of said end plate; a starter jaw automatically engageable with the engine jaw; a second end plate adapted to normally close the other end of the cylinder; fastening means for normally securing the second end plate to said cylinder and operable to permit removal of said end plate; and means for imposing several turns on the starter jaw from a single stroke of the piston, said last named means including a sleeve driven by said piston and threadedly engaging said second named end plate; said piston, sleeve and end plates being removable through one end of said cylinder without disturbing the position of the cylinder with respect to the engines on which said cylinder is mounted.

2. A starter comprising a cylinder, a piston mounted to reciprocate therein, an axially movable and rotatable shaft extending through the cylinder and terminating in a clutch element engageable with a member of the engine to be started, helical members adapted to drivably connect said piston and clutch element, and a spring compressible between a shoulder on said shaft and an abutment on one of said helical members for returning said piston to its initial position.

3. A starter comprising a cylinder; an apertured end plate adapted to normally close one end thereof; fastening means for normally securing the end plate in fixed position adjacent one end of said cylinder and operable to permit removal of said end plate; a piston mounted to reciprocate in said cylinder; an axially movable and rotatable shaft extending through the apertured end plate and into the cylinder and adapted to convert the axial movement of said piston into a rotary cranking action applied to a member of the engine to be started; helical means adapted to drivably connect said piston and said shaft, said helical means including an externally threaded sleeve movable axially with said piston and rotarily with said shaft; cooperating threads on said shaft with said sleeve; cooperating threads on the inner surface of the aperture in the end plate and cooperating with the externally threaded sleeve; means for mounting said cylinder permanently in position on the engine prior to installing said piston and sleeve therein, said piston,

sleeve, and end plate being insertable within said cylinder as a unit after the permanent installation of said cylinder; a second end plate slidable throughout the length of the cylinder and adapted to normally close the other end of said cylinder; fastening means for normally securing said second named end plate in fixed position and operable to permit removal of said end plate when it is desired to remove the piston, sleeve and end plates from the cylinder.

4. In a device of the class described, in combination, an axially movable driving member, a driven member, a pair of concentric screw-threaded sleeves having screw-threads of opposite hand, said sleeves being rotatable in response to axial movement of said driving member, and an intermediate sleeve for transmitting the rotary movement of said first named sleeves to said driven member.

5. In a device of the class described, a substantially cylindrical casing, a piston movable axially of said casing, a sleeve movable axially of said casing and connected to said piston to be driven thereby, said piston and sleeve being readily removable through an end of said casing, means for introducing fluid under pressure into said casing to move said piston and sleeve therein, said means including a part formed on the exterior of said casing for attachment of a fluid conducting member, a closure plate for each end of said cylindrical casing, and said closure plates being relatively disposed so that both may be withdrawn with the piston and sleeve from one end of said cylindrical casing without disconnecting said fluid conducting member; engaging and cooperating threads on said sleeve and on one of said closure plates to cause rotation of said sleeve as it moves axially of the casing, a clutch element engageable with a member of the engine to be started, and means connecting the sleeve and clutch element to effect rotation of said clutch element by the rotation of said sleeve.

6. An engine starter comprising a fixed cylindrical casing; a stationary apertured closure member at one end of said casing, the walls defining said aperture being threaded; a pair of opposed pistons reciprocable within said casing; means for introducing fluid under pressure between the pistons to move the pistons in opposite directions; an outer sleeve within said cylindrical casing having an external thread adapted to engage the thread of the stationary apertured closure member and to be rotated thereby, said sleeve being directly connected to one of said pistons and being protrusible in part from said casing through the apertured closure member; a second sleeve within the outer sleeve and connected to said outer sleeve to move therewith, said second sleeve being externally threaded; a third sleeve intermediate said outer and second named sleeves and being externally threaded to engage the threads of said second named sleeve and to be rotated thereby, said third named sleeve being secured directly to the other of said pistons; and a clutch element secured to one end of said third named sleeve and engageable with a clutch element of the engine to be started, whereby the rotation of said outer and second named sleeves is imparted to the third named sleeve and to the engine.

NICOLAS HERZMARK.