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STARTING DEVICE FOR EXPLOSIVE ENGINES.

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A plan view of a wheel with a central hub and eight spokes. The spokes are labeled with 'd' and 'd'' at the hub and 'd³' and 'd¹' at the rim. The rim is labeled 'f' and 'D'.

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UNITED STATES PATENT OFFICE.

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STARTING DEVICE FOR EXPLOSIVE-ENGINES.

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To all whom it may concern:

Be it known that I, GILBERT N. McMILLAN, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Starting Devices for Explosive-Engines, of which the following is a specification.

This invention relates to hand-operated devices for starting internal-combustion or explosive gas-engines the pistons of which must ordinarily be moved manually to compress the explosive charge to effect the initial explosion and start the automatic operation of the engine. Such engines are ordinarily started by means of a crank, lever, or the like applied to the engine crank-shaft or other shaft driven by the engine. It happens not infrequently that the charge is fired prematurely, owing to one cause or another—such, for instance, as a faulty igniter or the overheating of the cylinder—thereby causing a reverse or backward rotation of the engine-shaft. Such backward rotation of the engine-shaft if imparted to the starting crank or device when the operator is exerting pressure thereon to effect the forward rotation of the engine-shaft is very liable to seriously injure the operator.

The objects of this invention are to provide a simple and desirable device by which the engine-shaft can be rotated forwardly to start the engine, but which is positively prevented from taking any part in the reverse rotation of the engine-shaft in the event of a premature explosion, and, further, to so construct the starting device that it will be thrown out of action by the forward rotation of the engine-shaft after the engine has been started.

In the accompanying drawings, Figure 1 is a longitudinal sectional elevation of an engine-starting device embodying the invention. Fig. 2 is a transverse section, on a reduced scale, of the clutch, showing one of the clutch members in elevation. Fig. 3 is a section, on a reduced scale, of the clutch, showing the clutch members in edge elevation. Fig. 4 is a transverse sectional elevation in line 4 4, Fig. 1, showing the ratchet mechanism for holding the starting-shaft from backward rotation.

Like letters of reference refer to like parts in the several figures.

A represents one end of a shaft, which may be the engine crank-shaft or other shaft driven by the engine and to which the starting device is coupled to start the engine.

B represents a manually-operated starting-shaft, which is provided at its outer end with a hand crank, lever, or other device C for turning it and is releasably coupled to the engine-shaft A by some means whereby the engine-shaft can be turned in one direction—forwardly—by the starting-shaft and is permitted to rotate backwardly and preferably forwardly also independently of the starting-shaft. The means shown for this purpose are constructed as follows: D represents a clutch disk or member which is connected to the inner end of the starting-shaft by a screw or stud d , on which it is free to revolve, and D' represents a complementary clutch disk or member which is slidable on the starting-shaft toward and from the other clutch member, but is held against rotation on the shaft, which for this purpose may be square or angular and passes through a correspondingly-shaped central hole in the clutch member D'. The clutch members are provided with interlocking projections d' d^2 , having inclined or rounded edges d^3 , which are yieldingly held interlocked or in operative relation by suitable springs e , arranged between and bearing at opposite ends against the sliding clutch member D' and a plate E, which is fixed on the starting-shaft. The pressure of the springs e and inclination of the edges of the interlocking projections of the clutch are so proportioned that they will remain interlocked and cause the engine-shaft to turn with the starting-shaft until the charge is compressed and the engine started, while a premature explosion and pressure acting to turn the engine-shaft backwardly will cause the separation of the clutch members, thus allowing the member D to turn rearwardly with the engine-shaft independently of the other clutch member. The clutch members and springs are inclosed by a suitable shell or casing f , secured to said plate E. The clutch member D is provided with a hollow hub or sleeve G, which loosely surrounds the engine-shaft A and is provided at its end with a

notch g , which when the starting-shaft is moved axially inward and turned forwardly engages a coupling stud or pin g' on the engine-shaft and causes the latter to turn also.

5 The notch has an inclined edge g^2 , against which the coupling-pin g' acts when the engine is started and the engine-shaft A turned forwardly to throw the sleeve G outward out of engagement with the coupling-pin. Other
10 clutches and coupling devices capable of the action described can be employed in place of those described.

The starting-shaft is free to turn forwardly, but is positively held from rotation in the opposite direction or rearwardly by suitable
15 means, which in the construction shown consist of a ratchet-wheel H, secured to the starting-shaft and provided with teeth which are engaged by pawls $h h'$, pivoted on a stationary support I, which may constitute a
20 part of the vehicle or other frame on which the engine is mounted. The disposal of the pawls is such that one is always in holding engagement with a tooth of the ratchet-
25 wheel, thus preventing any rearward movement of the latter.

The starting-shaft, which is square, is provided with a thimble or bushing k , which is externally cylindrical and capable of rotation in bearing-holes k' in the stationary
30 frame. The ratchet-wheel is fixed to this thimble k . This construction affords a bearing for the outer end of the starting-shaft and permits the latter to be moved longitudinally
35 to couple the clutch-sleeve G with and uncouple it from the engine-shaft without the ratchet-wheel partaking in the longitudinal movement of the shaft. The outward movement of the shaft is preferably limited by a
40 collar l , fixed thereon and adapted to strike the thimble. Holding means of other construction to prevent rearward rotation of the starting-shaft can be used.

The operation of the starting device is as follows: The operator pushes the starting-
45 shaft B, together with the parts carried thereby, inward and turns the hand-crank in a forward direction, as indicated by the arrows in Figs. 1 and 4, thereby engaging the
50 coupling-pin g' of the engine-shaft in the notch g of the clutch-sleeve G. The engine-shaft will be turned with the starting-shaft in the further forward rotation of the latter and the engine started. When the starting-
55 shaft is stopped or the speed of the engine-shaft is greater than that of the starting-shaft, the coupling-pin g' will pass out of the notch g in the clutch-sleeve and throw the
60 latter outward, and the engine-shaft will continue its forward movement independently of the starting-shaft. Should the engine fire prematurely or the engine-shaft be rotated for any reason in a rearward direction, the

starting-shaft and hand-crank cannot be turned back with the engine-shaft on account
65 of the engagement of the pawls $h h'$ with the ratchet-wheel H; but the clutch-disk D' will yield so as to disengage the clutch projections and permit the clutch member D and
70 engine-shaft to rotate rearwardly independently of the starting-shaft and crank. No rearward movement can be imparted to the starting-shaft, and the operator is absolutely protected against injury.

I claim as my invention—

1. The combination of an engine-shaft, a starting-shaft, means connecting said shafts and constructed to cause them to turn together in one direction and having a part
80 movable in a direction endwise of said starting-shaft to release the engine-shaft and allow it to rotate in the opposite direction independently of the starting-shaft, and means for positively holding the starting-shaft from rotation with the engine-shaft in said opposite
85 direction, substantially as set forth.

2. The combination of an engine-shaft, a starting-shaft, means connecting the engine and starting shafts and constructed to cause the former to turn with the latter in one direction and to release the engine-shaft and allow it to rotate in the opposite direction independently of the starting-shaft, means for positively holding the starting-shaft from rotation in said opposite direction, said starting-shaft being movable relative to said positive holding means to allow the independent rotation of the engine-shaft, substantially as set forth.

3. The combination of an engine-shaft, a starting-shaft, a clutch connecting said shafts and consisting of a member connected to each of said shafts and constructed to cause said shafts to turn together in one direction, means for positively holding the starting-shaft from rotation in the opposite direction, one of said clutch members being movable
105 endwise of the starting-shaft to release said engine-shaft and allow it to rotate independently in said opposite direction, substantially as set forth.

4. The combination of an engine-shaft, a starting-shaft rotatable in one direction, means for positively holding the starting-shaft from rotation in the opposite direction, a clutch member connected to said starting-shaft, a cooperating clutch member releasably coupled to said engine-shaft, and means for releasably holding said clutch members in driving relation, said starting-shaft being
120 movable endwise relative to said positive holding means to release said second clutch member from the engine-shaft, substantially as set forth.

5. The combination of an engine-shaft, a starting-shaft rotatable in one direction, an

operating-handle fixed thereto, a ratchet-and-pawl mechanism for positively holding the starting-shaft from rotation in the opposite direction, a clutch-disk which is connected
5 with said engine-shaft, a cooperating clutch-disk which turns with and is slidable on the starting-shaft to release said engine-shaft, and springs for yieldingly holding said clutch-

disks in driving relation, substantially as set forth.

Witness my hand this 29th day of November, 1904.

GILBERT N. McMILLAN.

Witnesses:

CHARLES W. PARKER,
EDWARD C. HARD.