No. 704,618. Patented July 15, 1902.

C. F. COPE.

STARTING DEVICE FOR EXPLOSIVE ENGINES.

(Application filed Dec. 17, 1900.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.

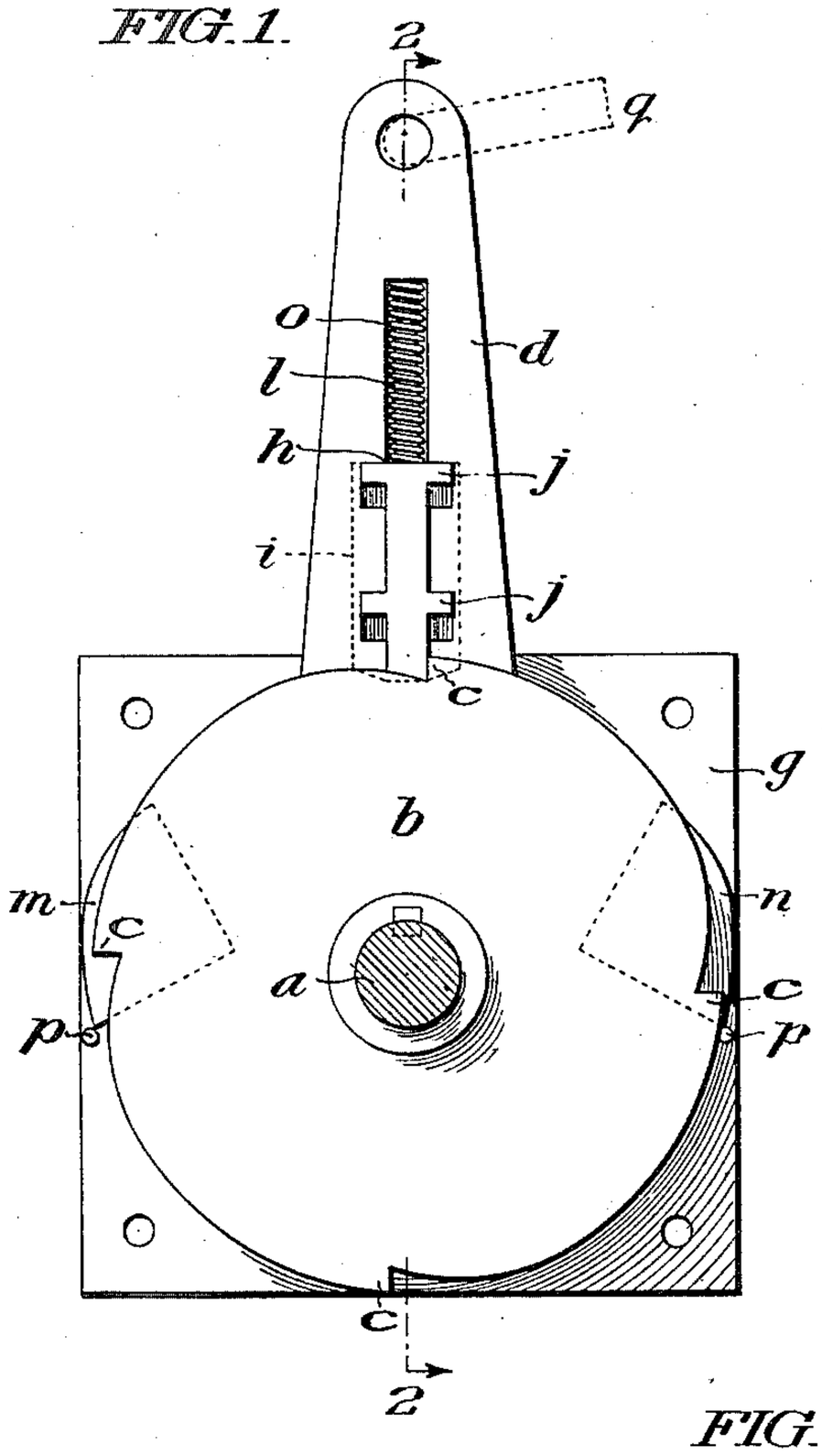


FIG. 2.

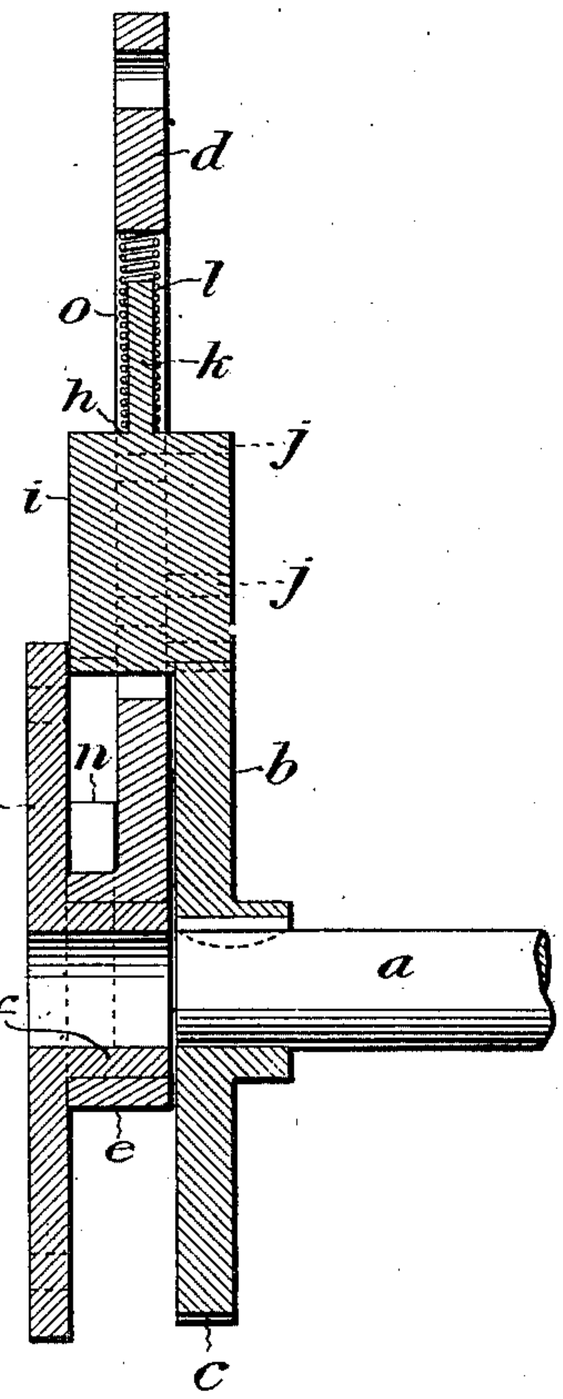
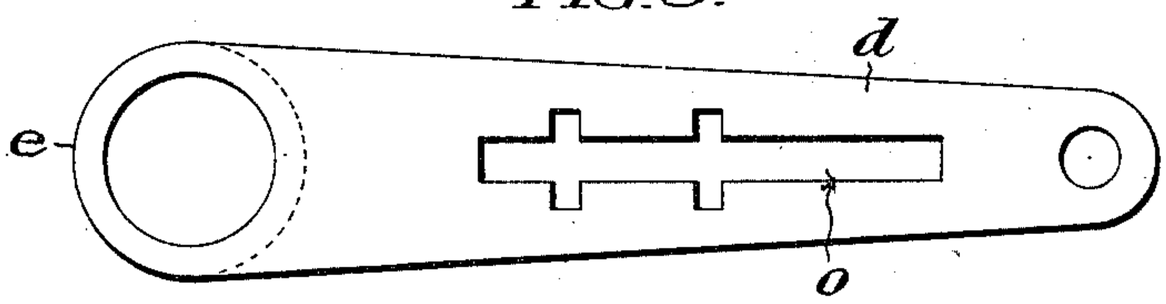


FIG. 3.



C. F. Cope,
INVENTOR:
By his attorneys,
Wm C. Strawbridge
F. Norman Dixon.

WITNESSES:
Arthur E. Paige.
Thos. K. Lancaster

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FIG. 4.

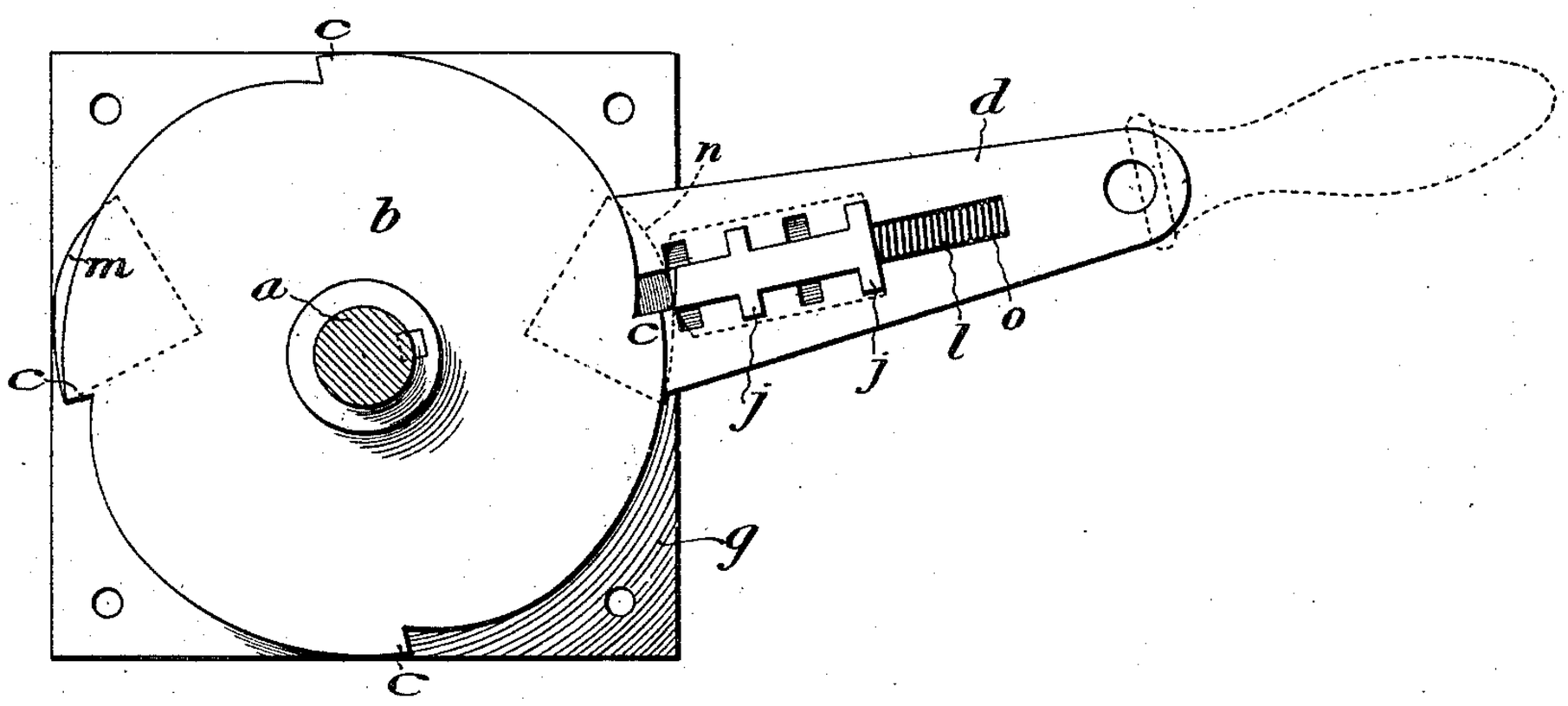
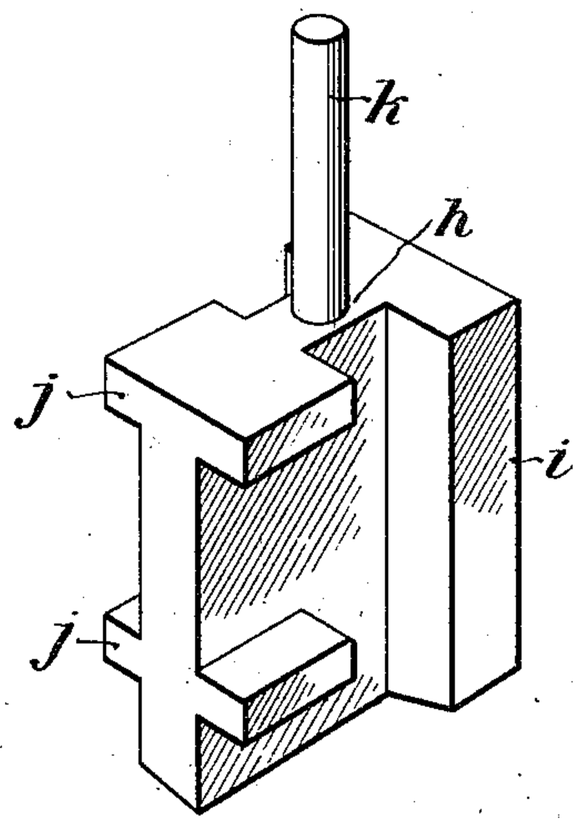


FIG. 5.



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UNITED STATES PATENT OFFICE.

CALEB F. COPE, OF PHILADELPHIA, PENNSYLVANIA.

STARTING DEVICE FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 704,618, dated July 15, 1902.

Application filed December 17, 1900. Serial No. 40,196. (No model.)

To all whom it may concern:

Be it known that I, CALEB F. COPE, a citizen of the United States, residing in the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

In the management of an explosive engine, as is well known, when it is desired to set it in operation, it is necessary to manually rotate one of the moving parts to occasion the compression of the gas and its automatic ignition.

Inasmuch as, in the set of the parts of such engines, it is usual for the ignition of the explosive charge to occur in advance of the completion of the compression stroke of the piston, it sometimes occurs that when such explosion takes place it occasions the driving of the engine in a reverse direction, and accident to the operator is liable to occur, as well as breakage of the crank arm and ratchet usually employed in rotating the shaft to start the engine.

It is the object of my invention to provide an improved mechanism through which may be effected the rotation of a part or shaft of the engine to bring about the compression and ignition of the charge, of such construction as to become automatically freed from the shaft or ratchet wheel so soon as the engine starts its operation.

In the accompanying drawings I show, and herein I describe, a good form of a convenient embodiment of my invention, the particular subject-matter claimed as novel being hereinafter definitely specified.

In the accompanying drawings,

Figure 1 is a view in front elevation of an apparatus embodying my invention.

Figure 2 is a vertical sectional elevation of the same on the dotted line 2 2 of Figure 1.

Figure 3 is a plan of the crank arm.

Figure 4 is a view in front elevation of the parts shown in Figure 1, the parts, however, occupying a different position from that therein depicted.

Figure 5 is a view in perspective of the pawl detached from the crank arm.

Similar letters of reference indicate corresponding parts.

In the accompanying drawings,

a is a rotatable shaft of an explosive engine upon which is mounted a ratchet wheel *b*, having the ratchet teeth *c*, said wheel being keyed to said shaft so as to positively rotate therewith.

The term "ratchet wheel" as employed in the specification and claims is intended to cover any kindred structure operative, for the purpose of this apparatus, to the same result as the ratchet wheel, even though such structure be not technically a ratchet wheel.

d is a crank arm suitably journaled for rotative movement upon an axis preferably coincident with that of the shaft.

Any convenient means may be resorted to for the mounting and support of said crank arm, but I prefer to provide it at its inner end with a collar *e*, encircling a hub *f*, upon the face of a supporting plate *g*, adapted to be attached by screws, to any convenient portion of the support framework or connections of the engine.

The provision of the fixed plate and hub avoids the friction and wear on the parts which would be incident to a running bearing constituted by mounting said arm on a rotating shaft.

The plate is, in the embodiment of my invention illustrated, so located with respect to the ratchet and shaft that a slight interspace exists between the opposing side faces of the ratchet wheel and crank arm.

The crank arm is provided with a pawl adapted to move longitudinally with respect to it, said pawl overhanging the edge of the ratchet wheel and being constantly pressed towards it by a suitable spring.

In the preferred embodiment of my invention, I form said pawl *h*, as shown particularly in Figure 5, as a slide block, having at its rear the lateral extension *i*, and at its front the laterally extending noses *j*.

In the body of the crank arm, I form a longitudinally extending slot *o*, with four marginal notches or recesses matching in size and disposition the noses *j*, and to apply said pawl to the crank arm I introduce the front portion of the pawl through the slot, the noses *j* passing through the marginal notches, and then move said pawl longitudinally of said slot; the pawl thereupon, by reason of

its rear lateral extension *i* engaging against one face of the crank arm, and its noses *j* engaging against the other face of said arm, while its central body remains within the longitudinal slot, becomes self-retaining in position in said crank arm.

An advantage of this construction and arrangement is that the crank arm is made as a single integral member and the pawl as an independent integral member and no small parts requiring to be fitted and attached and liable to wear loose are present.

The pawl is provided with an upwardly extending stud *k* upon which is disposed a spiral spring *l*, the lower end of which bears against the upper face of the body of the pawl while its upper end bears against the end wall of the slot *o*.

m n are a pair of cam trips or plates, applied conveniently to the face of the plate *g*, and one at each side portion thereof, said cam trips being preferably formed integral with the said plate.

The cam trips exist in a common plane, which is in parallelism with the plane of the ratchet wheel, so that while the front projection of the pawl overhangs the ratchet wheel, its rear projection overhangs, that is to say, is in the same plane with, the cam faces.

The cam faces of the cam trips *m n*, which are preferably counterparts of each other, are outwardly curved or bellied, the inner ends of said faces,—being the ends nearest the central position of the crank arm, to-wit, the position indicated in Figure 1,—existing at a point closer to the axis of the shaft *a* and hub *f* than is any part of the circumferential face of the ratchet wheel, while the outer end portions of said faces occupy positions at greater radial distances from the axis of said shaft *a* than are the crests of the teeth of said wheel.

The pawl, by reason of being pressed downward by the spiral spring, constantly bears against either the ratchet wheel or one of the cams, and these are of such size and location that it cannot in the operation of the machine be caused to descend to a position in which its noses come into registry with the lateral notches of the slot *o*.

The pawl, therefore, is positively retained in its position of engagement in the arm.

The operation of my apparatus will be readily understood.

It being necessary in starting the engine to rotate to the right the shaft *a* on which is mounted the ratchet wheel *b*, the crank arm is set so that its pawl is engaged behind one of the ratchet teeth.

The crank arm is then shifted to the right until the pawl by contact of its rear extension *i* with the cam *n* is lifted out of engagement with said tooth.

The crank arm is then, if necessary, carried back until its pawl springs into engagement with the next ratchet tooth, and is then moved to the right, and said first named operation thus repeated several times, if necessary, according to the number and radial distribution of the teeth, to bring about the desired compression and explosion.

So soon as the explosion takes place and the shaft *a* is thereby given a rapid motion of rotation, the ratchet wheel *b*, of course, participates therein, and drags the crank arm around with it. Before, however, said crank arm completes more than a fraction of a circle, its pawl, encountering the cam *m* or the cam *n*, as the case may be, is lifted out of engagement with the wheel and said crank arm, being freed from said wheel, comes to rest.

The danger of accident to the operator and machine from violent rotation of the crank arm, is, therefore, overcome, as the operating device is automatically freed almost at the very instant that the rapid movement begins.

My improved apparatus may be applied and employed in any desired manner in connection with explosive engines, and the crank arm may if desired instead of being thrown or rotated by direct manual operation, be arranged to be thrown through the agency of an applied link *q* adapted to be manipulated by the foot or hand from a distant point, as indicated in dotted lines in Figure 1.

The crank arm being mounted, for movement through its arc, in permanent relation with respect to the ratchet wheel *b*, and not necessarily removed from its position after each starting operation of the machine, renders the apparatus very much more convenient in operation than devices of a somewhat kindred character heretofore constructed, inasmuch as in the employment of my device the crank arm may be, through the link *q* or other connection, controlled by the hand or foot of the driver of an automobile for instance, (for which my apparatus is especially designed,) without any occasion for his leaving his seat, thus dispensing with the necessity for dismounting and visiting the shaft *a* each time the machine is to be started.

The fact that the arm is thus mounted in permanent relation to the wheel *b*, furthermore, avoids the necessity for any detached parts which are liable to be mislaid or overlooked.

The ratchet wheel may, of course, have any desired number of teeth, but I prefer to employ but four, as shown, by reason of the fact that the arrangement of said teeth on the margin of the wheel bears a relation to the phases or positions of the piston in the piston chamber, and by the observation of said teeth and their position I am able to determine the position of the piston in the cylinder and the amount of movement of the shaft *a* required before the occurrence of the explosion.

As will be understood, my arrangement very thoroughly protects the machine from damage as a result of what is known as "backfiring," or sudden reversal of the engine from any other cause.

On the other hand, my arrangement precludes the annoying rattling of the pawl which occurs in some constructions of apparatus of this general character, in the operation of which the teeth of the ratchet wheel passing beneath the pawl occasion its rapid oscillation and consequent rattling.

In my improved construction, as will be understood, when the engine is started in the right direction, the crank arm passing to the right carries the pawl over the cam trip *n*, and said pawl is thereupon elevated and held clear of the teeth of the wheel.

Any usual stop devices may be employed to limit the right or left hand movement of the crank arm, so that it will not carry the pawl past the respective cam faces *m n*.

Stop devices of this kind may, if desired, be applied as studs *p*, projecting from the face of the plate *g*, as shown in Figure 1.

The term "fixed" as applied in the claims to the trips, is by no means used in an absolute sense as excluding for instance structural arrangement permitting slight adjustment or movement upon or with respect to the face of the plate *g*,—but in a relative sense as expressing the condition of their being normally maintained in their respective positions as distinguished from rotating for instance with the ratchet wheel.

Having thus described my invention, I claim—

1. In combination with a rotatable shaft of an explosive engine, a ratchet wheel, a device rotatable with respect to said wheel and adapted to be moved by the operator, a pawl mounted on said device and adapted to engage with said wheel, and two fixed trips arranged to be encountered by the pawl and located at different points in its path of movement, substantially as set forth.

2. In an explosive engine, in combination, a rotatable shaft, a ratchet wheel mounted thereon, two fixed cam surfaces arranged in proximity thereto, a crank arm, and a pawl mounted on said arm and free for sliding movement longitudinally thereof, and having one portion which overhangs the ratchet wheel and another portion which overhangs the cam surfaces, substantially as set forth.

3. In an explosive engine, in combination, a rotatable shaft, a ratchet wheel mounted on said shaft, a cam trip in adjacency thereto, a crank arm mounted for rotation in adjacency to said ratchet wheel, a slot formed in said crank arm, a pawl mounted in said slot and having a portion which overhangs the ratchet wheel and another portion which overhangs the cam trip, substantially as set forth.

4. In an explosive engine, in combination, a rotatable shaft, a ratchet wheel mounted thereon, a plate supported in adjacency thereto and provided with two fixed cam trips, a crank arm mounted free for rotation on said plate, a longitudinally extending slot with lateral notches formed in said crank arm, a pawl mounted in said slot, and having a lateral extension on one face, and lateral noses on the other face of the arm, substantially as set forth.

5. In an explosive engine, in combination, a rotatable shaft, a ratchet wheel mounted thereon, a plate supported in adjacency thereto and provided with two fixed cam trips, a crank arm mounted on said plate free for rotation, a longitudinally extending slot with lateral notches formed in said crank arm, a pawl mounted in said slot and having a lateral extension on one face, and lateral noses on the other face, of the arm, and a spring mounted on said arm, and bearing against the pawl, substantially as set forth.

6. In combination, in an explosive engine, a rotatable shaft, a ratchet wheel, a trip, a rotatable device having a slot with a lateral recess or extension, a pawl mounted in said slot and having a lateral extension on one face of said rotatable device, and a laterally extending projection or nose on the other face of said rotatable device, said pawl working in association with said ratchet wheel and said trip, substantially as set forth.

7. In combination with a rotatable shaft of an explosive engine, a ratchet wheel, a crank arm, a device mounted on said crank arm and adapted to engage with the ratchet wheel, and a pair of trips having curved acting faces eccentric with respect to the ratchet wheel, substantially as set forth.

8. In an explosive engine, a rotatable shaft, a ratchet wheel mounted on said shaft, a support independent of said shaft, a pawl carrying device mounted on said support and free for rotative movement on an axis coincident with that of the wheel, a pawl mounted on said pawl carrying device and adapted to engage said ratchet, and a fixed trip adapted to be encountered by said pawl to elevate it out of engagement with the ratchet upon the reverse rotation thereof, substantially as set forth.

9. In an explosive engine, a rotatable shaft, a ratchet wheel mounted on said shaft, an independent support, a pawl-carrying arm mounted on said support and free for rotative movement in an axis coincident with that of the wheel, a pawl mounted on said arm and adapted to engage said ratchet, a fixed trip adapted to be encountered by said pawl to elevate it out of engagement with the ratchet upon the reverse rotation thereof, and a link connected to said arm and extending to a point in the vicinity of the operator's station, substantially as set forth.

In testimony that I claim the foregoing as my invention I have hereunto signed my name this 14th day of December, A. D. 1900.

CALEB F. COPE.

In presence of—
THOS. K. LANCASTER,
S. SALOME BROOKE.