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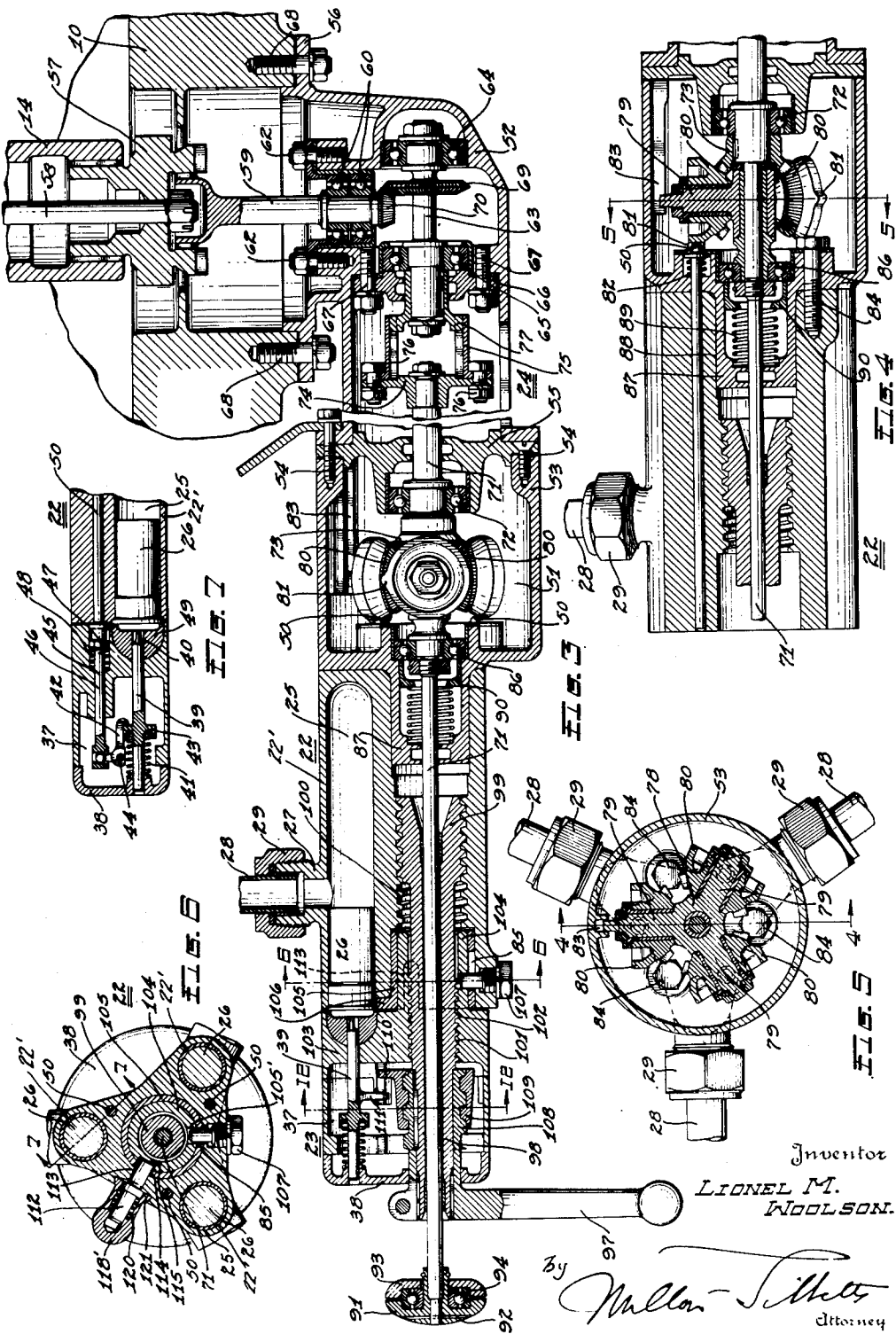
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INTERNAL COMBUSTION ENGINE

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## INTERNAL COMBUSTION ENGINE

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This invention relates to internal combustion engines, and more particularly to starting devices.

An object of the invention is to provide a starting device for internal combustion engines in which cartridges are exploded to cause reciprocation of the pistons and consequent compression of the fuel charges.

Another object of my invention is to provide a cartridge starter for internal combustion engines which can be actuated initially by a manual manipulation and then automatically.

Another object of the invention is to provide a starter for internal combustion engines in which cartridges are fired into a plurality of cylinders to reciprocate the pistons.

A further object of my invention is to provide a cartridge starter for engines which can be readily adjusted to remove and insert cartridges.

A still further object of my invention is to provide a cartridge starter for internal combustion engines in which a breech member, an ejector member and the firing pin are actuated simultaneously by manipulation of a single means.

Another object of my invention is to provide a cartridge starter for internal combustion engines with an indicator so that the timing of the firing can be accurately determined with reference to the position of the engine pistons.

Still another object of my invention is to provide a cartridge starter device for internal combustion engines in which cartridges can be fired into cylinders in synchronized relation with the pistons through mechanism actuated by the crankshaft of the engine.

Another object of my invention is to provide a cartridge starter for internal combustion engines with a novel form of firing mechanism.

A still further object of my invention is to provide a cartridge starter device for internal combustion engines with an ejector mechanism which is actuated with the breech to partially withdraw a cartridge from the barrel.

A further object of the invention is to pro-

vide a gun starter device for internal combustion engines in which cocking mechanism is set through movement of the breech.

Other objects of the invention will appear from the following description taken in connection with the drawings, which form a part of this specification, and in which:

Fig. 1 is an end elevation of an internal combustion engine with the gun starter secured in operative relation therewith;

Fig. 2 is a fragmentary sectional view of one of the engine cylinders showing the gun starter connection thereto;

Fig. 3 is a sectional view of the gun starter and a portion of the engine taken on line 3—3 of Fig. 1;

Fig. 4 is a fragmentary sectional view of the gun starter taken on line 4—4 of Fig. 5;

Fig. 5 is a sectional view of the starter taken on line 5—5 of Fig. 4;

Fig. 6 is a sectional view of the starter taken on line 6—6 of Fig. 3;

Fig. 7 is a sectional view of the starter taken on line 7—7 of Fig. 6;

Fig. 8 is fragmentary elevational view of an end of the breech member showing the ejector actuating groove;

Fig. 9 is another fragmentary elevational view of one end of the breech member showing the groove for causing helical reciprocation;

Fig. 10 is a sectional view taken on line 10—10 of Fig. 8;

Fig. 11 is an end elevation of the starter;

Fig. 12 is a sectional view of the starter taken on line 12—12 of Fig. 3.

Referring to the drawings by characters of reference, 10 represents the crankcase of an internal combustion engine from which nine cylinders extend radially, the engine illustrated being of the four cycle type in which fuel is ignited in the cylinders 11 through heat of compression pressure.

The cylinders and their associated mechanism are similar, and a description of one will suffice. A piston 12 reciprocates in the cylinder 11 and a connecting rod 13 extends therefrom to the crankshaft 14. The head of the cylinder is provided with a neck 16 having a single passage 15 extending there-

through for the inlet and the exhaust, and a valve 17 controlling flow through the passage is opened and closed by suitable cam operated mechanism 18 in a conventional manner. A fuel injecting mechanism 19 is arranged in communication with the cylinder, and is actuated through mechanism 20 operated from the crankshaft in desired sequence. The valve is open continuously during the exhaust and intake strokes and closed during the compression and working strokes, air is drawn in during the suction stroke, then compressed, fuel is injected during the compression stroke and after combustion occurs, the exhaust is expelled from the passage through which the air was taken in. The fuel conduits 21 lead to the injection mechanisms from a suitable reservoir.

This invention concerns the starting of an internal combustion engine, and while adapted to a Diesel engine it is capable of use with engines in which combustion is caused through other means of ignition. The starter mechanism is in the form of a gun wherein cartridges are fired and the resulting gases conducted to the cylinders so that the pistons are reciprocated sufficiently to develop compression in the cylinders capable of producing functioning of the engine. While the starter can be used with a single cylinder, I prefer that it be formed in multiple and connected with a plurality of cylinders when associated with an engine of the Diesel type.

The starter structure includes a barrel section indicated generally at 22, a breech section indicated generally at 23, and a connecting section between the barrel section and the crankcase indicated generally at 24. The breech section is preferably formed as a forging having three radially equally spaced and longitudinally extending barrels 22' each having a chamber 25 therein adapted to receive a cartridge 26. Each of the barrels is provided with an outlet 27 through which extends a passage communicating with the associated chamber. A conduit 28 is secured to each of the outlets 27 by means of a nut 29, and each conduit extends to a cylinder of the engine. With the engine illustrated, the firing order is 1, 3, 5, 7, 9, 2, 4, 6, 8, and a conduit is associated with cylinders 6, 7, and 8. The heads of those cylinders with which the conduits communicate are provided with an aperture 30 for the reception of a connector consisting of a section 32 which screws into the section 31, the conduit 28 being connected with the section 32 by means of a nut 33. The sections 31 and 32 are provided with a passage communicating with the associated conduit 28, and a valve element 34 normally closes the inner end of the passage in the section 31. The valve is held in such position by a coil spring 35 which engages an enlarged portion of the

section 32 and with a cap 36 fixed to the valve stem which extends through the section 32.

It will thus be seen that the gas which flows through the conduits 28 from the chambers 25 when a cartridge is exploded will force the valves 34 open, against the action of the springs 35, so that the interior of the combustion chamber of the cylinders are in open communication with the associated barrel chamber 25.

The breech section consists of a forging conforming in contour to the barrel section and formed with three radial longitudinally extending enlargements 37 which are each adapted to contain a cartridge firing pin, a trigger, and a portion of the releasing mechanism therefor. The breech member includes an end wall 38 which incloses the open end of the main forging. Each firing pin 39 is reciprocally mounted in apertures formed in the breech block and the end cover plate and is provided with a reduced end 40 which is adapted to be forced against the end of the cartridge in the associated barrel chamber by the coil spring 41, when the trigger 42 is released from engagement with the projection 43 formed on the firing pin, with a force sufficient to cause explosion of the charge of powder therein. It will be understood that the mechanism just described is arranged in each of the breech enlargements.

Each trigger is pivotally mounted upon a shaft 44 carried by the walls of the associated firing pin chamber, and is rocked to engage or release the pin through means of a rod 45 reciprocated in a passage 46 extending longitudinally of the breech. Such passages are enlarged at the end portion of the breech forging for the reception of a nut 47 which is screwed upon the end of the rod 45 and for a coil spring 48 which normally tends to press the rod outwardly of the passage and in a direction causing the associated trigger to secure the pin in a cocked position. It will be understood that mechanism such as that just described is arranged within each of the three firing pin chambers and that there is an insert 49 seated in a recess in the end of the breech members adjacent each of the firing pins which serve as clamping means for the rim of the cartridges to maintain them tightly within the chamber of the associated barrel. The barrel section of the gun starter is drilled longitudinally for the reception of rods 50 which are reciprocated to actuate the trigger operating rod and which extend into a chamber 51 forming one end of the connector section 24 for association with actuating mechanism.

Mechanism is associated in a relation with the pin actuating rods 50 which can be first manually actuated and then automatically actuated to cause a movement that will release the firing pins in sequence of the en-

gine operation such that the cartridges will be exploded and the resulting expanding gas will move into the associated engine cylinders after the pistons have started a down-stroke.

The connecting section 24 is formed of two casings 52 and 53 which are secured together by bolts 54 in axially aligned relation, there being a partition wall 55 arranged intermediate the two casings. The casing 52 is secured over an opening in the end of the engine casing and is fixed to the casing by studs 68 which pass through a flange 56 projecting beyond the opening, in alignment with the crankshaft 14. The crankshaft has splined thereto a starter jaw 57 which is secured in position by the rod 58 and a shaft 59 is splined to the starter jaw, such shaft being carried by a pair of bearings 60 which are held within the casing 52 and supported by flanges formed interiorly thereof, such bearings being secured in position by retainers 61 and studs 62. A countershaft 63 is rotatably mounted in the casing 52 and is arranged to extend at right angles to the stub shaft 59, being supported by bearings 64 and 65 which are mounted and secured to walls interior of the casing. The bearing 65 is secured in position by a keeper 66 and studs 67. The countershaft 63 extends in axial alignment with the central portion of the barrel and the breech sections, and has keyed thereto a bevel gear 69 arranged to mesh with a gear 70, secured to the end of the stub shaft 59.

A shaft 71 extends through the partition 55 and is mounted in a bearing 72 carried thereby, one end of the shaft having secured thereto the beveled gear 73 and the other end of the shaft having a plate 74 attached thereto. This plate supports an extension 75 which is secured thereto by nuts 76, the extension being provided with a plurality of grooves which are adapted to receive arms projecting from the drive member 77 which is keyed to the countershaft 63. The drive connector 75 extends longitudinally of the casing 52 in a manner such that it can be reciprocated axially relative to the drive member 77.

A spider 78 is arranged within the chamber 51 in the casing 53 and is provided with a hub portion from which radially project three equally spaced stub shafts 79 upon each of which is rotatably mounted a bevelled gear 80 arranged to mesh with the gear 73 on the shaft 71. These gear members 80 are rotating in a plane transversely to that in which the gear 73 rotates, and are each formed with a peripheral flange upon which is a cam lobe 81, such cam lobes being rotatable in a plane such that they will engage against the projecting end of the rods 50 and thereby cause them to move in a direction which will cause the rods 45 to release the firing pin trigger,

overcoming the tension of the springs 48 and 82 normally tending to project the rods 50 into the chamber 51. The end of one of the stub shafts 79 is of such length that it engages a guide-way 83 arranged to extend longitudinally in the chamber 51, such guide-way and shaft extension thereby preventing rotation of the spider and at the same time permitting longitudinal axial movement thereof.

The casing 53 is secured in axial alignment with the barrel section by cap screws 54. The shaft 71 projects through the hub of the spider 78 and provides a bearing and support therefor within the casing 53, and also extends axially through the barrel and breech members. The casing 53 has a projecting reduced portion 87 which extends into a passage 88 formed at the end of the barrel section in order to strengthen its connection with the barrel member and carries the bearing 86 and a coil spring 89 which normally exerts a pressure against a bearing block 90 sufficient to maintain the spider 78 and the shaft 71 in a position such that the cams 81 will not contact with the rods 50 when they are rotated.

The rod 71 projects beyond the end of the breech member and is provided with a sectional handle having one portion 91 secured thereto by the pin 92 and another portion 93 loosely mounted with respect thereto, the bearing 94 being interposed between the two sections of the handle. That portion of the handle which is fixed to the rod 71 is provided with a marking, such as an arrow 95, arranged to align with lines on the cover plate 38 of the breech member to indicate when the pistons in the cylinders 6, 7, and 8, are at top compression stroke.

The shaft 71 is rotated at one half crankshaft speed, and the gears 80 will likewise rotate in the same manner. The gears are related with the firing mechanism so that when the arrow registers with one of the lines, a cam lobe will be in position to actuate the trigger to fire the cartridge into the cylinder so indicated. As the piston in such cylinder is at top center, the cartridge charge will move the same downwardly in the cylinder thereby turning over the crankshaft.

When the gun is to be positioned for firing cartridges into the cylinders the handle section 92 is rotated by turning the crankshaft until the arrow registers with one of the marks at the end of the breech member and is then pulled outwardly which will move the spider structure axially in the chamber 51, causing a cam 81 to move its associated rod 50 in a direction to cause movement of the rod 45 releasing the trigger 42, whereupon the coil spring 41 will exert sufficient pressure against the firing pin to cause it to engage the cartridge with such force that it will explode the charge therein, and the expanding gas

will cause the piston to move inwardly of the associated engine cylinder and rotate the crankshaft. By holding the handle of the rod 71 in such extended position, the cams 81 which are now rotated by the crankshaft are in a plane such that they will actuate their associated firing pin releasing mechanism. In this manner, while the first cartridge is fired by manual movement of the rod 71, the second and third cartridges will be fired automatically through rotation of the crankshaft, providing the mechanism is held manually so that the cams 81 will contact with the pin releasing mechanism as they rotate. The cartridges will be fired into the cylinders in numerical sequence, and the device can be set to fire first in any one of cylinders 6, 7, or 8. If the cylinder 7 is fired into first, then cylinders 8 and 6 will be next fired into in order, while if cylinder 8 is first fired into then cylinders 6 and 7 will in order be next fired into.

A cylindrical member 98, bored axially to permit the rod 71 to extend therethrough, is arranged to extend axially within the hub of the breech and barrel members, the end portion 99 thereof being formed with an external right-hand worm thread to engage with a similar internal thread 100 formed in the wall of the bore 88 which extends through the hub of the barrel member. Another portion of the member 98 is provided with a left hand external worm thread 101 which engages a similar internal thread 102 formed in the wall of the bore which extends axially through the breech member end wall 103. The wall 103 of the breech member is formed with a reduced central extension 104 which projects into an enlarged end of the bore in the barrel hub, and an ejector sleeve 105 is arranged intermediate the reduced breech portion 104 and the barrel, the ejector having flanges 106 provided with grooves which are adapted to seat a portion of the rims of the cartridges.

The breech extension 104 is provided with a slot 105' extending therethrough, the base portion of which extends longitudinally and terminates in an angularly extending portion, there being a cap screw 107, which is screwed through a recess in the barrel section and which has a reduced unthreaded end projecting through a slot 85 in the ejector sleeve and into a slot 105 in the extension 104. The cap screw 107 is stationary so that when the lever 97 is rotated manually, it will rotate the member 98 which is keyed thereto and such rotation will be imparted to the breech member 23 to a degree equal to the movement caused by the left and right hand threads 100 and 101 so that with a slight turning movement of the lever 97, the breech member will be reciprocated in a multiplied degree.

Due to the engagement of the cap screw

107 in the slot 105' the breech will first move rearwardly a short distance and then continue the rearward movement in a helical direction such that when the lever 97 has turned the breech so that the cap screw 107 lies in the opposite end of the slot 105' from which it started, the radial portions of the breech member will lie in alignment with the grooved portions of the barrel and will thus permit extraction and renewal of cartridges with respect to the bores 25 in the barrel section. Upon turning of the handle in reverse direction the mechanism will return over the same path.

Likewise when the handle 97 is turned in a direction to cause the breech to move away from the barrel section, the sleeve member 108, provided with external worm threads, and which member is keyed to the member 98, will cause reciprocation of the ring 109 which is screwed thereon, such ring having a flanged end portion 110 which will engage with a projection 111 on the firing pins and move the pins into a position such that the triggers 42 will drop over the shoulders 43 and thereby cock the firing pin for the next explosive operation of the gun. The pin extensions extend through grooves found in the breech member which prevent rotation thereof.

It will be seen that this cocking ring member 109 will actuate all of the pins in a similar manner when the breech is backed away from the end of the barrel by turning of the lever 97.

As before stated, the ejector member 105 is reciprocated by means of the movement of the breech member. In order to accomplish such motion of the ejector member, I provide the breech member with a recess 115 into which the pin 112 projects, such pin extending through a longitudinally extending slot 113 in the barrel member and through a circular aperture 114 in the ejector member. It will be seen that movement of the pin 112 will cause a movement of the ejector and that the pin 112 can be moved longitudinally with respect to the barrel. When the breech member is in closed relation with the barrel member, the cartridges will be clamped against the ejector flanges 106 in which position the pin 112 will extend into the recess 115 as indicated in Fig. 8. Upon the straight longitudinal movement of the breech member when reciprocated adjacent the barrel, the pin 112 will remain stationary and the breech extension will move with respect thereto, so that when in its outermost position of such movement the pin 112 will move in the recess 115 toward the top of the angular wall 116. When the helical movement of the breech member commences, as the breech member is being moved outwardly, the wall 116 will rotate with respect to the pin 115 and cause it to move rearwardly of the barrel member and in the slot therein carrying

the ejector therewith, this movement of the pin being a maximum distance corresponding to the angle at which the wall 116 extends with respect to the wall 117. When the breech extension has reached its outermost position with respect to the barrel member, the pin 112 will be in a position adjacent the base wall 118 of the recess. When in this position, the pin knob 118' can be manipulated to reciprocate the ejector member as the pin is free to move in the recess 115 along the wall 118, so that in this manner the ejector can be moved manually to place cartridges in their final position in the barrel chamber and without interfering with the movement of the breech member or without being effected thereby.

When the ejector has been moved to a position such that the cartridges are in their final position within the barrel chambers, the pin 112 will be at the right hand end of the wall 118, so that as the breech is helically returned toward the barrel member, the pin will ride upon the surface 119 sloping upwardly from the base of the recess and terminating in the wall 116 which conforms to the periphery of the breech extension and will ride thereacross back into the portion of the recess 115 opposite the wall 118. Whereupon, the straight movement of the breech member will again locate the pin in its position as shown in Fig. 8. When the ejector has not been returned by the manual means, and the breech member is in its rearmost position, the pin 112 which lies adjacent the wall 118 at the end of the wall 116 will be engaged by the wall 117 and will be moved toward the barrel member in this manner by the breech extension, the rotation thereof finally placing the pin 112 in the position from which it started as shown in Fig. 8.

A coil spring 120 is associated with the button 118' which button is fixed to slide in a groove 121 in the barrel so that the pin can move outwardly as it rides over the angular wall 119 and will normally be held in the bottom of the recess 115 thereby, and furthermore the end of the pin 112 is bevelled to permit the sliding movement when contacting with the angular wall 119.

It will thus be seen that the ejector is moved away from the barrel member by movement of the breech member, but not to as great an extent, and that when the breech member is in its rearmost position from the barrel member that the ejector member can be moved to place the cartridges in their final firing position within the barrel member, and also that the ejector member can be returned automatically to such position if desired.

Although the invention has been described in connection with a specific embodiment, the principles involved are susceptible of numerous other applications which will readily oc-

cur to persons skilled in the art. The invention is therefore to be limited only as indicated by the scope of the appended claims.

What I claim is:

1. In a gun starter device for internal combustion engines, a barrel member having a cartridge receiving chamber, a breech member aligned with the barrel, said breech member having an interior chamber, a firing pin reciprocable in the breech chamber and adapted to fire a cartridge in the barrel chamber when released, a trigger in the breech chamber adapted to hold the firing pin in retracted position, means in said breech chamber urging said firing pin into extended firing position, trigger release means extending through said barrel and into said breech chamber, and engine actuated means associated with the release means beyond the barrel to cause a pin releasing movement thereof.

2. In a gun starter device for internal combustion engines, a barrel member having a cartridge receiving chamber, a breech member aligned with the barrel, said breech member having a chamber, a firing pin reciprocable in said breech chamber and carried in alignment with the barrel chamber, a spring in the breech chamber urging said pin into extended firing position, a trigger in said chamber holding the pin in retracted position, manually operable mechanism for initially releasing the trigger from the pin, and engine operated means for actuating the releasing mechanism.

3. In a gun starter device for internal combustion engines, a barrel member having a cartridge receiving chamber, a chambered breech member aligning with the barrel member, a firing pin reciprocably mounted in the chamber breech member, said pin having an intermediate shoulder, a coil spring intermediate a wall of the breech member and the pin shoulder urging the pin into firing position, a trigger member pivoted in the breech chamber for engaging the pin shoulder and maintaining the pin in retracted position, trigger rocking means extending through the barrel member, and cam means engageable with the projecting portion of the trigger rocking means, said cam means being operable either by hand or by the engine.

4. In a gun starter device for internal combustion engines, a barrel member having a cartridge receiving chamber, a breech member movable axially relative to the barrel member, a spring actuated firing pin carried by the breech member, a firing pin trigger mechanism carried by the breech member, a reciprocable trigger actuating rod carried by the breech member, a reciprocable rod carried by the barrel member for actuating the rod in the breech member, and means for actuating the rod in the barrel member.

5. In a gun starter device for internal com-

bustion engines, a barrel member having a cartridge receiving chamber, a breech member, a spring actuated firing pin carried by the breech member, a pivoted trigger member  
 5 for holding the firing pin in retracted position, a rod extending through the barrel and breech members for rocking the trigger to release the firing pin, and spring means for normally maintaining the rod in a position  
 10 permitting the trigger to hold the firing pin in retracted position.

6. In combination with an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers each communicating  
 15 with the interior of an engine cylinder, means for firing a cartridge in each of the chambers, said means being operated manually to fire one of the cartridges, and engine driven means for firing the other cartridges.

7. In combination with cylinders and the crankshaft of an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers, means connecting each of  
 25 said barrel chambers with the interior of an engine cylinder, and means for firing a cartridge in each of the barrel chambers, said means being actuated manually to fire the first cartridge and then being actuated from  
 30 the engine crankshaft to fire the other cartridges.

8. In combination with cylinders and a rotating element of an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers communicating with the interior  
 35 of cylinders, and mechanism comprising relatively movable sections for firing cartridges in the barrel chambers actuated by the rotating element of the engine, and manual means for shifting one of the sections of said mechanism into either an effective or  
 40 ineffective cartridge firing position with an adjacent section of the mechanism.

9. In combination with cylinders and a rotating element of an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers communicating with the interior  
 50 of cylinders, cartridge firing mechanism associated to be actuated through movement imparted from the rotating engine element, means for automatically disengaging portions of the firing mechanism, and manually operated means for maintaining  
 55 the disengageable portions of said mechanism in relation for firing the cartridges.

10. In combination with cylinders and a rotating element of an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers communicating with the interior of cylinders, and cartridge  
 60 firing mechanism including reciprocable elements and rotatable elements for actuating the reciprocable elements, said rotatable elements being driven from the engine rotating element and movable into and from actuating  
 65 relation with the reciprocable elements.

11. In combination with cylinders and the crankshaft of an internal combustion engine, a gun starter device comprising a barrel having a plurality of chambers each adapted to receive a cartridge, a connection between each  
 70 of the chambers and a cylinder for the passage of exploding powder from the cartridges, a spring actuated firing pin associated with each of the chambers, a trigger for retaining each firing pin in retracted position, reciprocable rods for releasing the triggers  
 75 from the pins, and actuating mechanism for the rods connected for rotation by the crankshaft, said mechanism including spider and rotated cams rotatably mounted on the spider, said spider being movable to cause the  
 80 cams to actuate the rods.

12. In combination with cylinders and the crankshaft of an internal combustion engine, a gun starter device comprising a barrel having a plurality of chambers each adapted to receive a cartridge, a connection between each barrel chamber and the interior of a cylinder  
 90 for the passage of exploding powder, a spring actuated firing pin associated with each of the chambers, triggers for retaining the pins in retracted position, reciprocable rods for actuating the triggers to release the pins, a casing securing the barrel to the engine, and mechanism in the casing for transmitting motion from the crankshaft to actuate  
 95 the rods in desired sequence, said mechanism including an axially movable spider and gear driven cams carried by the spider, said spider being manually movable into a plane in which the cams will actuate the rods.

13. In a gun starter device for internal combustion engines, a barrel member provided with spaced longitudinally extending chambers, said barrel member having an axially extending aperture therethrough, an  
 100 ejector sleeve extending into the aperture at one end of the chamber, said ejector having flanges for engaging the rim of cartridges adapted to be inserted into the chambers of said barrel member, a breech member arranged in axial aligned relation with said barrel and ejector, and manually operable means for reciprocating said breech and said  
 105 ejector simultaneously.

14. In a gun starter device for internal combustion engines, a barrel member provided with a plurality of longitudinally extending chambers, a breech member associated with one end of the barrel member, and means extending axially through said members  
 110 for reciprocating said breech member relative to said barrel member whereby cartridges can be inserted and removed from the chambers.

15. In a gun starter device for internal combustion engines, a barrel member having a plurality of spaced longitudinally extending chambers, a breech member associated with one end of the barrel member and manually rotatable means extending axially of said members and associated therewith to cause reciprocation of the breech member relative to said barrel member whereby cartridges can be inserted and removed from the chambers.

16. In a gun starter device for internal combustion engines, a barrel member having a plurality of spaced longitudinally extending chambers, a breech member associated with one end of the barrel member and manually rotatable means extending axially of said members and associated therewith to cause helical reciprocation of the breech member relative to said barrel member whereby cartridges can be inserted and removed from the chambers.

17. In a gun starter device for internal combustion engines, a barrel member provided with a plurality of longitudinally extending chambers adapted to be connected with cylinders of the engine, said barrel having an axially extending threaded hub, a breech member in axial alignment with the barrel member, said breech member having an axial threaded hub portion, and a rotatable member extending through said barrel and breech members, said rotatable member having threads cooperating with the threaded hubs of said barrel and breech members for causing a helical motion of the breech member relative to the barrel member to close the chambers and to allow insertion and removal of cartridges.

18. In a gun starter device for internal combustion engines, a barrel member having a plurality of chambers adapted to be arranged in open communication with some of the engine cylinders, said barrel member having an axially extending right-hand helical thread, a breech member associated with one end of the barrel member, said breech member having an axially extending left-hand helical thread, and a rotatable member extending axially through the barrel and breech member, said rotatable member being provided with right and left hand helical threads adapted to be associated with the axial threads in the barrel and breech members, to cause a helical movement of the breech member at a faster rate than the rotational movement thereof, the movement of said breech member opening and closing the chambers in the barrel member.

19. In a gun starter device for internal combustion engines, a barrel member provided with a plurality of chambers adapted to be connected with the engine cylinders, a breech member associated with one end of the barrel member, and a rotatable means for

causing the breech member to move an axial, predetermined distance relative to the adjacent end of the barrel member, and to move in a helical direction beyond the axial, predetermined distance, the movement of said breech member relative to the barrel member opening and closing the chambers.

20. In a gun starter device for internal combustion engines, a barrel member having a plurality of longitudinally extending chambers adapted to be placed in communication with engine cylinders, a breech member having a reduced end portion telescoped by the barrel member, said reduced breech portion being provided with a groove therein extending longitudinally and then angularly in a direction toward the end thereof, a pin member secured to the barrel and projecting into the groove in the breech reduced portion, and means for causing said breech member to reciprocate relative to the barrel member, the relation of the pin causing the breech member not reciprocated to move in an axial direction and then in a helical direction, the movement of said breech member relative to the barrel member opening and closing the chambers.

21. In combination with an internal combustion engine, a gun starter device comprising axially arranged sections, breech mechanisms in one of the sections, cartridge receiving chambers in another of the sections, conduit means for connecting the chambers with the engine cylinders, and a drive mechanism in another of the sections, the drive containing section being secured to the engine casing and functioning in driving relation with the engine crankshaft, means extending through the barrel section reciprocated by the driving mechanism, and means within the breech section actuated by the reciprocating means extending through the barrel section for causing explosion of the cartridges placed within the chambers.

22. In a gun starter for internal combustion engines, a barrel member having chambers for the reception of cartridges, a breech member reciprocable axially relative to the barrel member, rotatable means for reciprocating the breech member, firing pins carried by the breech member, triggers for retaining the pins in retracted position, springs arranged to move the pins into firing contact with cartridges in the barrel chambers when the triggers are released, and means actuated by movement of the breech reciprocating member for moving the pins into retracted position.

23. In a gun starter for internal combustion engines, a barrel member having chambers for the reception of cartridges, a breech member, firing pins carried by the breech member, triggers for retaining the pins in retracted position, rotating means for reciprocating the breech member, and a re-

reciprocable sleeve in the breech member for moving the firing pins into retracted position, said sleeve being actuated by the rotating breech moving means.

24. In a gun starter for internal combustion engines, a barrel member having chambers for the reception of cartridges, a breech member, spring operated firing pins in the breech member arranged to engage the cartridges in the barrel chambers when released, triggers in the breech member for retaining the pins in retracted position, means for reciprocating the breech member, a sleeve for moving the pins to retracted position when the breech member is moved from the barrel member, and a worm on the breech reciprocating member for reciprocating the sleeve with the breech member.

25. In a gun starter for internal combustion engines, a barrel having chambers adapted to contain cartridges, a breech member, firing pins carried by the breech member and reciprocated therein, said pins having a lateral extension, springs for moving the pins to fire the cartridges, a sleeve in the breech member for engaging the pin extensions, a single means for reciprocating the breech member and the sleeve within the breech member, and triggers for retaining the pins in a retracted position into which they are moved by the sleeve.

26. In a gun starter device for internal combustion engines, a barrel having chambers adapted to contain cartridges, a breech member, reciprocable firing pins in the breech member, springs for moving the pins into contact with the cartridges in the barrel chambers, triggers for retaining the pins in retracted position, a manually rotated member for causing reciprocation of the breech member, said member having a worm gear thereon, and a reciprocable sleeve guided within the breech member to reciprocate axially therein and to move the pins into position for engagement by the triggers, said sleeve being actuated by the worm gear on the rotatable breech reciprocating member.

27. In combination with an internal combustion engine, a gun starter device comprising a barrel having a plurality of cartridge receiving chambers connected with certain of the engine cylinders, mechanism for firing the cartridges when the pistons in the associated cylinders are moving away from the head, said mechanism being connected and driven by the engine crankshaft, manual means for placing the mechanism into firing relation, and means on the starter for indicating when the pistons in the cylinders receiving the cartridge explosion are at top center.

28. In combination with an internal combustion engine of the reciprocating piston type, a gun starter device comprising a barrel having a plurality of cartridge receiving

chambers connected with certain of the engine cylinders, a breech member, engine driven mechanism for causing firing of certain of the cartridges, a portion of the mechanism extending through the chambers and adapted to be moved manually into effective position, and means on the breech member and the extended mechanism for indicating when the pistons in the cylinders which receive the cartridge explosions are at top center.

29. In combination with an internal combustion engine, a gun starter device comprising a barrel member having a plurality of chambers adapted to contain a cartridge, mechanism for causing explosion of the cartridges in the chambers in a predetermined sequence and timed with the down stroke of the piston in the cylinder with which the associated chambers are connected, and means associated with the mechanism for determining the position of the pistons in the cylinders associated with the barrel chambers.

30. In combination with an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers connected with engine cylinders, a manually operable mechanism for causing an explosion of a cartridge in one of the barrel chambers, a driving connection between the engine crankshaft and said mechanism for actuating the mechanism to fire the cartridges in the other barrel chambers, and a hand grip associated with the manually operable mechanism.

31. In a gun starter device for internal combustion engines, a barrel member provided with spaced longitudinally extending cartridge receiving chambers, a breech member adapted to be reciprocated relative to the barrel member, an ejector element for partially withdrawing the cartridges from the barrel member, and means associated with the barrel and breech members causing the ejector element to move with the breech member.

32. In a gun starter device for internal combustion engines, a barrel member provided with spaced longitudinally extending cartridge receiving chambers, a breech member adapted to be reciprocated in a direct and a helical axial direction relative to the barrel member, an ejector element against which the cartridge rims engage when inserted in the barrel chambers, and means associated with the barrel and breech members causing the ejector to reciprocate in a direct axial direction with the breech member in its reciprocal movement.

33. In a gun starter device for internal combustion engines, a barrel member provided with spaced longitudinally extending cartridge receiving chambers, a breech member partially telescoping within one end of the barrel member, an ejector sleeve member intermediate the telescoping portions of said breech and barrel members, means for recip-

roccating the breech member in a straight and helical direction, and means associated with the barrel and breech members for reciprocating said ejector sleeve.

5 34. In a gun starter device for internal combustion engines, a barrel member having spaced longitudinally extending chambers, a breech member adapted to be moved axially with respect to the barrel member, an ejector member, and means causing the ejector member to reciprocate automatically during a portion of and with the breech member reciprocation.

15 35. In a gun starter device for internal combustion engines, a barrel member having spaced longitudinally extending chambers, a breech member adapted to be moved axially with respect to the barrel member, an ejector member, means causing simultaneous movement of the ejector with the breech during a portion of its reciprocation, and manually operable means for reciprocating the ejector when the breech member is in fully extended position.

25 36. In combination with an internal combustion engine, a gun starter device comprising a plurality of cartridge receiving chambers each in communication with different engine cylinders, firing mechanism for the cartridges in the chambers, engine actuated means for releasing the firing mechanisms automatically in a definite order and in synchronized relation with the position of the pistons in the associated cylinders, and manual means for retaining the releasing means in operative position, said manual means being operative to cause the releasing means to effect actuation of each of the firing mechanisms.

40 37. In a gun starter device for internal combustion engines, the barrel member having a chamber into which a cartridge is inserted and exploded whereby the exhaust gases escape therein, a conduit leading from the chamber to the cylinder of the engine, a firing pin for engaging a cartridge in said chamber, a trigger associated in operative relation with said pin exteriorly and independently of said barrel member, trigger release mechanism extending through the barrel member, and mechanism adapted to actuate the release mechanism.

55 38. In a gun starter device for internal combustion engines, a barrel member having a chamber in which a cartridge is inserted and exploded so that the exhaust gases pass into the chamber, a breech member aligned with the barrel enclosing one end thereof, a spring actuated firing pin carried by the breech member, a trigger carried by the breech member for controlling the pin, trigger actuated mechanism extending through the barrel, and engine actuated means for operating the mechanism to cause release of the pin.

39. In combination with an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers communicating with different cylinders of the engine, mechanisms for firing the cartridges into the barrel chambers, and engine driven means, including a plural cam member, for actuating said mechanisms, said cam member being manually adjustable to actuate said mechanisms in sequence starting with any one.

40. In combination with an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers communicating with different cylinders of the engine, mechanisms for firing the cartridges into the barrel chambers, engine driven means, including a plural cam member, for actuating said mechanisms, said cam member being manually adjustable to actuate said mechanisms in sequence starting with any one, and manually operable means for retaining the plural cam member in operative relation with said mechanisms.

41. In combination with an internal combustion engine, a gun starter device comprising a barrel member having a plurality of cartridge receiving chambers communicating with different cylinders of the engine, individual mechanisms for firing cartridges in the several barrel chambers, and manually operable means including a plural cam for selectively operating said mechanisms.

In testimony whereof I affix my signature.  
LIONEL M. WOOLSON.

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**CERTIFICATE OF CORRECTION.****Patent No. 1,903,079.****March 28, 1933.****LIONEL M. WOOLSON.**

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, line 95, claim 2, before "chamber" insert "breech"; and line 105, claim 3, for "chamber" read "chambered"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D. 1933.

**M. J. Moore.**

(Seal)

**Acting Commissioner of Patents.**