

March 3, 1942.

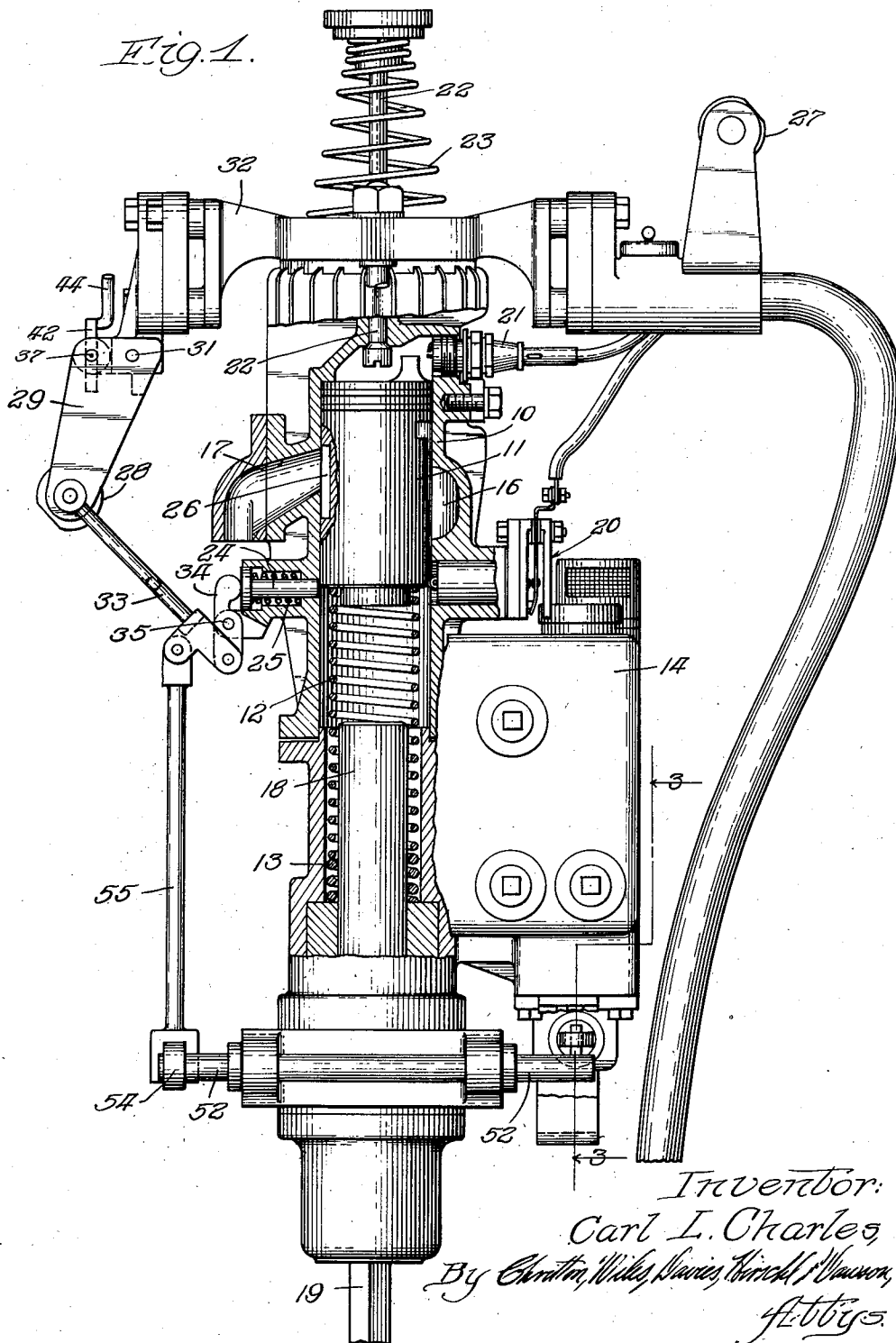
C. L. CHARLES

2,275,285

INTERNAL COMBUSTION PERCUSSIVE HAMMER

Filed Jan. 15, 1940

3 Sheets-Sheet 1



March 3, 1942.

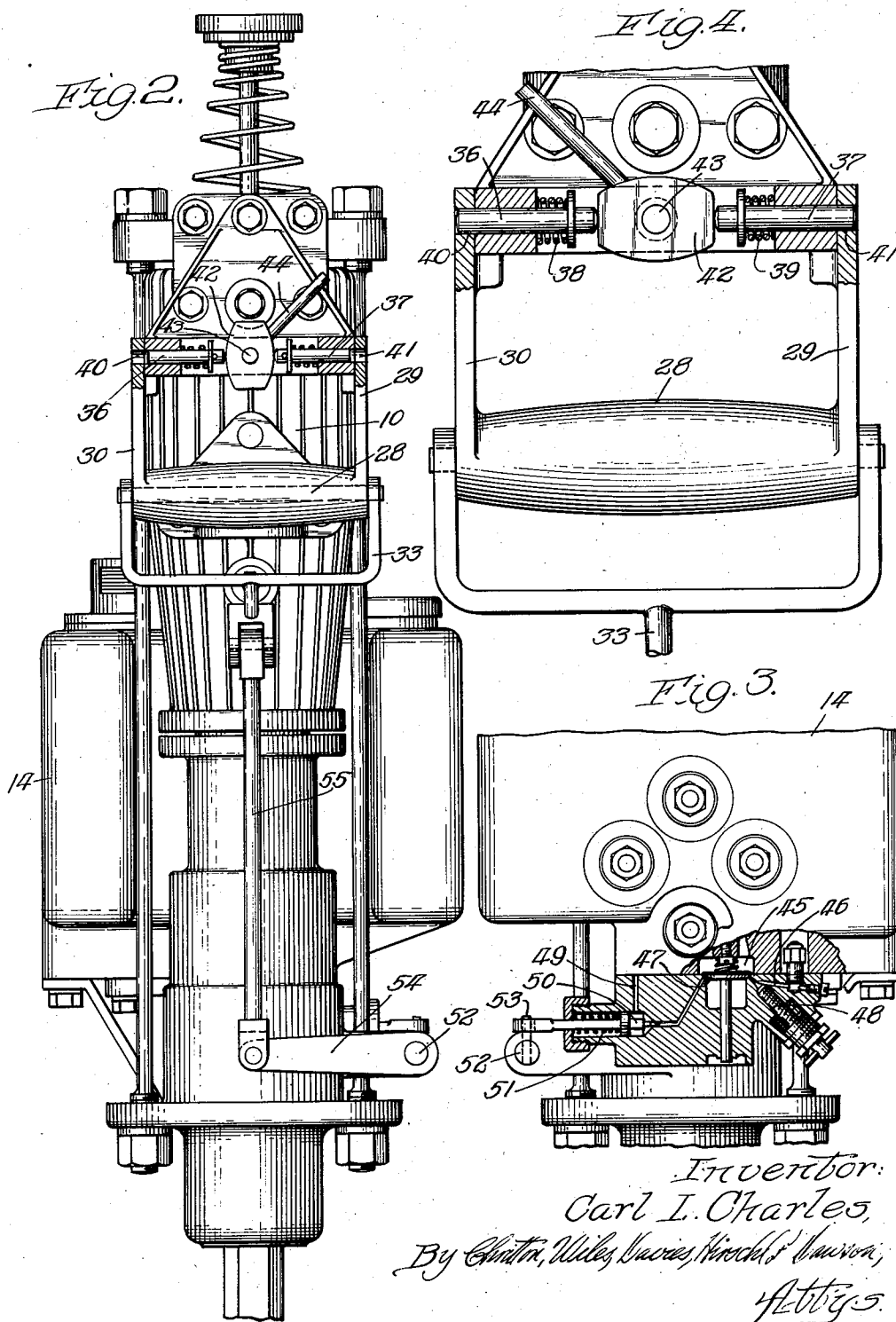
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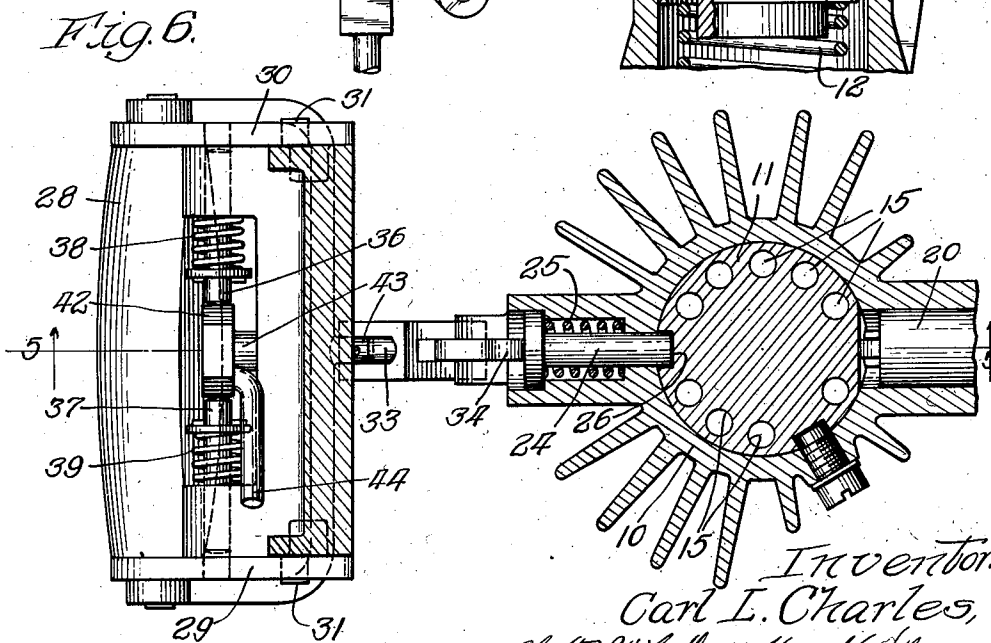
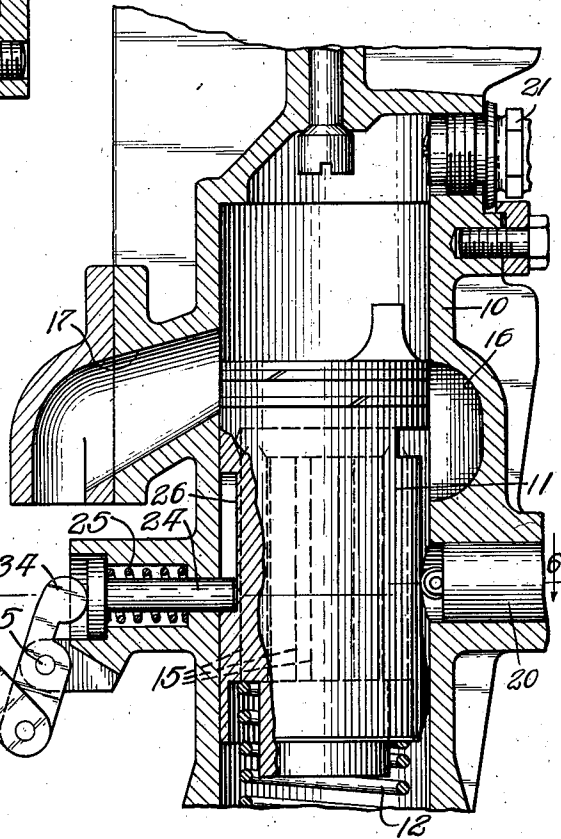
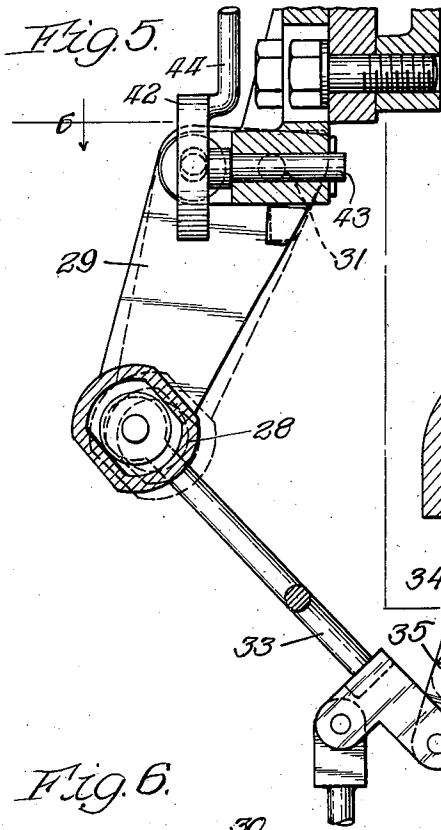
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INTERNAL COMBUSTION PERCUSSIVE HAMMER

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,275,285

INTERNAL COMBUSTION PERCUSSIVE
HAMMER

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Application January 15, 1940; Serial No. 313,975

5 Claims. (Cl. 123—7)

This invention relates to an internal combustion percussive hammer, and more particularly to control apparatus therefor.

This application is a continuation-in-part of my co-pending application, Serial No. 262,016, filed March 15, 1939, now abandoned.

One feature of this invention is that it provides improved means for subduing the reciprocation of the piston of an internal combustion hammer; another feature of the invention is that it is adapted to stop and hold the piston in such a position in the cylinder that the hammer will restart automatically upon release of the piston; yet another feature of this invention is that the piston is stopped at a point in its reciprocation where it is moving relatively slowly, so that strain on the stopping and holding mechanism is minimized; a further feature of this invention is that the stopping and holding means operates on the latching principle; still another feature is that the piston is stopped at a position such that the exhaust port is at least partially uncovered, whereby relatively rapid initial acceleration of the piston may be effected when the holding means is released; another feature of this invention is that the charge adapted to be fired upon release of the holding means is enriched; other features and advantages of this invention will be apparent from the following specification and the drawings, in which:

Figure 1 is an elevation, partly in section, of an internal combustion percussive hammer of the free piston type embodying my invention; Figure 2 is a side elevation of the same hammer, at right angles to the previous view; Figure 3 is a fragmentary detailed view, partly in section, of the fuel supply means, along the line 3—3 of Figure 1; Figure 4 is an enlarged fragmentary view, partly in section, of the movable lifting handle and associated parts; Figure 5 is a fragmentary vertical sectional view of the upper part of the hammer, along the line 5—5 of Figure 6; and Figure 6 is a horizontal sectional view along the line 6—6 of Figure 5.

As has been heretofore set out in my Patent 2,125,013, issued July 26, 1938, internal combustion percussive hammers, particularly of the free piston type wherein the piston return is by a spring, have many problems and difficulties peculiar to themselves. One problem is that of subduing the reciprocation of the piston when the hammer is lifted from working position and held in the air by the operator, as when he desires to move from one place to another in order to start the tool working in another spot. When

the hammer is lifted the entire force of the downward movement and impact of the piston, as a result of explosion of the combustible charge thereabove, must be absorbed within the body and frame of the hammer itself. Where the hammer has a desired power when in working position, this force is frequently destructive in effect when the hammer is lifted, even though various means are used to cushion to some extent the impact. The average workman or operator, however, will not throw the ignition switch to stop the hammer before he lifts it, since in the type of hammer heretofore used this would involve subsequently removing the hands from working position on the handles, leaning the hammer against his thighs, and operating a starting rod to restart the working reciprocations of the piston.

The present invention obviates this objection in prior hammers, other than that shown in my above-mentioned patent, by providing means readily operable by the workman for latching the piston at a desired predetermined point in its movement. This stops reciprocation of the piston, and enables the hammer to be moved to a new working point without the terrific vibration and strain resulting when the hammer is lifted while working; yet the arrangement is such that a fresh charge is retained above the piston, and the hammer will restart automatically when the piston is unlatched.

Moreover, this method of subduing the reciprocation, by latching the piston at a point near the lower end of its stroke, provides further problems and difficulties. If the return spring must start upward movement of the piston against not only its frictional and inertial resistance, but also against the resistance of a charge being compressed, the acceleration of the piston is so slow that proper compressing of the charge thereabove frequently cannot be effected. Failure to do this, of course, causes the hammer to fail to restart automatically, and destroys the usefulness of this particular form of subduing means.

I have overcome this difficulty, however, by so constructing and arranging the parts as to stop and hold the piston in such a position in the cylinder that the exhaust port is at least partially uncovered, preferably to the extent of a quarter of an inch or more. With this arrangement there is no compressive resistance to uphold movement of the piston, when the holding means is released, until the piston has closed the exhaust port; and this permits relatively rapid

initial acceleration of the piston. I have found that if the early acceleration is rapid there will be a continued build-up in velocity and the desired compression of the charge will be effected.

If the piston is held down in latched position for a minute or two before it is desired to restart the hammer there is some decrease in temperature within the cylinder, and some leaning of the charge by loss of fuel vapor through the partially open exhaust port. This results in the charge held above the piston sometimes being too lean to ignite even when properly compressed where the hammer has been kept inoperative for more than a minute.

I have overcome this difficulty by providing means for enriching the charge held above the piston when the hammer is stopped temporarily. This means is operative upon movement of the same means which effects operation of the piston latch; and supplies more than the normal amount of fuel to the air delivered to the space above the piston just before it stops.

In the particular embodiment of the invention illustrated herewith an internal combustion percussive hammer is shown as comprising a cylinder 10 which is generally in vertical position when the hammer is working. This cylinder has a piston 11 freely reciprocable therein. The piston operates on the two-stroke cycle principle, being driven downwardly each time it reaches the top of the cylinder by the explosion of a combustible charge, such as gasoline vapor and air; and the return movement of the piston, after it has delivered its blow to the tool, is effected by spring means here shown as a piston spring 12 and a cushion spring 13. The general construction and operation of internal combustion percussive hammers of this type is known in the art, but it is believed that a brief description thereof is proper here.

Means for forming the combustible charge is provided, here shown as including a tank 14 containing gasoline adapted to be vaporized and mixed with air by carbureting means, and thereafter to be delivered to the space beneath the piston when it is at the upper part of its stroke, as shown in Figure 1. During downward movement of the piston 11 the charge in the sub-piston space is partially compressed, and when the piston has reached the bottom of its stroke, or substantially so, the charge is transferred (through holes 15 in the piston and the transfer passage 16 in the wall of the cylinder) to the space above the piston. At the same time, the piston being at a position even lower than that shown in Figure 5 with the exhaust port completely open, burned gases leave the cylinder by the exhaust opening 17.

Downward movement of the piston terminates when it strikes the anvil 18, the impact being delivered therethrough to a tool in the bottom of the hammer, here indicated as 19. Impact of the piston with the anvil causes the piston to rebound, and the spring means then acts to return the piston to the upper end of its stroke, this movement compressing the fresh charge thereabove. As the piston approaches the top of its movement, timing means, here indicated in general as 20, causes a spark to jump the terminals of the spark plug 21. This ignites the charge and drives the piston down on its next power stroke, the cycle of operation just described then being repeated. This is, the piston reciprocates in the cylinder on the principle of a two-stroke cycle internal combustion

engine, and on each cycle delivers a blow to the tool to accomplish the desired work. In the commercial embodiments of such hammers there are in the neighborhood of fifteen hundred blows or impacts per minute when the hammer is working.

Starting means for the hammer is provided in the form of a longitudinally reciprocable starting rod 22. During operation of the hammer this starting rod is maintained in the position shown in the figures by the spring 23. When it is desired to start the hammer, speaking with respect to initial starting thereof, the body of the hammer is supported in any convenient way, as by leaning it against the thighs of the workman, and the starting rod is then manually pumped up and down a few times to effect several reciprocations of the piston. These draw in and compress a charge and effect the first explosion thereof, the hammer thereafter continuing operation. This starting means requires considerable energy for its operation, since the piston return spring means frequently has a static compression, at the bottom of the piston stroke, of one hundred pounds or more. The workman handling the hammer does not like to use this starting means any oftener than necessary, therefore, and will not stop the hammer to move it short distances, as from one tie to the next in tamping railroad ballast, if it must be restarted by this starting rod.

The present invention, however, provides means for latching the piston in a depressed position with a fresh unexploded charge above it. The hammer can then be moved a short distance and then conveniently restarted merely by unlatching the piston. When the piston is released the springs effect compression and firing of the charge above the piston, and the hammer resumes operation without any effort on the part of the operator. Moreover, the means for operating the piston holding means is preferably so arranged as to be automatic upon lifting of the hammer, so that the mere act of lifting the hammer from one position and then placing it in a new working position automatically stops its motor operation and then restarts such operation when the tool is in place again.

The latching means is here shown as a plunger 24 mounted in the wall of the cylinder 10 for longitudinal sliding movement. While the hammer is working the latch plunger is normally biased toward and retained in its outer position, as shown in Figure 1, by the spring 25. When it is desired to stop the piston temporarily, however, the plunger 24 is moved inwardly to project into the cylinder in the position shown in Figures 5 and 6. As it moves into the cylinder it moves into the longitudinal slot 26 in the piston 11, upward movement of the piston being arrested at the desired point by engagement of the plunger 24 with the shoulder at the bottom of this slot. This latches the piston in the position shown in Figure 5 until such time as the plunger is permitted to return to outer position.

The arrangement is such that the latch plunger can never interpose resistance to the movement of the piston on its power stroke. During the early part of the power stroke any attempt to move the latch plunger in merely brings it into engagement with the piston below the slot 26. As soon as the lower shoulder of the slot has passed the plunger, however, the plunger can

move into the cylinder; but the length of the slot 26 is such that the piston can complete its full power stroke without hindrance. When the piston starts on its return movement, however, it travels only a short distance, until the lower shoulder of the slot abuts the bottom of the latch plunger. The piston will be held in this desired position, of course, as long as the latch means remains in the position shown in Figure 5; and will be released when the latch means is permitted to return to its normal outer position.

It is desirable, in order to have the minimum strain on the latch means and the maximum compressive effect on the charge after release of the piston, to stop the piston at a position only a short distance from the lower end of its stroke. It is preferable not to stop the piston at the absolute bottom of its stroke, since then both the exhaust and transfer ports are wide open, and it would be impossible to maintain a fresh charge above the piston for any reasonable period. I have found that if the piston is permitted to move up until the intake port is closed, or nearly closed, and is then stopped before the exhaust port is completely closed best restarting will be secured. When the piston is stopped in the position shown in Figure 5 it can move about a quarter of an inch (upon release of the holding means) before it must do compressive work, by reason of the sealing ring, on the charge thereabove; and this enables relatively rapid initial acceleration of the piston and the creation of momentum in the piston before compressive work must be done. This results in a velocity of the piston, as it nears the top of its stroke, much higher than would be the case if it were started from a position where the exhaust port also was completely closed.

The hammer is provided with two working handles 27 and 28. The workman operating the hammer uses these handles for lifting the hammer, applying pressure to it during working, holding it in the desired position on the work, etc. One of these handles, as 28, is movable with respect to the hammer, and has means connected to it for effecting the desired operation of the latch plunger 24.

The side pieces or brackets 29 and 30 in connection with the handle 28 are pivotally mounted at 31 on a yoke 32 at the top of the cylinder. A rod 33, bifurcated at its upper end, is pivotally connected to the lower end of a short lever 34 fulcrumed at 35, the upper end of this lever bearing against the outer end of the latch plunger 24. If rotation of the handle 28 about the point 31 is unrestrained, as is normally the case, lifting of the hammer by this handle automatically causes movement of the handle from the position shown in dotted lines in Figure 5 to the position shown in full lines; and this moves the lever 34 about its fulcrum point 35 to effect inward or latching movement of the plunger 24. When the hammer is placed in its new working position and the workman leans on the handle to put downward force on the tool additional to the mere weight of the hammer, the handle 28 automatically returns to the position shown in dotted lines in Figure 5. This unlatches the piston and causes restarting of the hammer. Even though the hammer is not lifted the workman can, of course, consciously rotate the handle 28 about the pivot point 31 to effect temporary stoppage of its operation.

In order to prevent the automatic stopping of the hammer when it is lifted momentarily, means

is provided for locking the handle in lower position. This means is here shown as a pair of locking pins 36 and 37, normally biased inwardly in inoperative position by the springs 38 and 39. When the pins are in inoperative position the handle 28 is free to pivot about the point 31; but when they are moved outwardly against the springs their ends move into the holes 40 and 41, respectively, in the side brackets 30 and 29. In this position the handle is, of course, locked from movement with respect to the hammer. Means for moving the pins to and maintaining them in locking position is here shown as a cam 42, pivotally mounted at 43, and provided with an operating lever 44. When the lever is thrown to one side, as shown in Figure 2, the handle is free to move; when the lever 44 is thrown to the other side, as shown in Figure 4, the handle 28 is locked against movement.

As has been mentioned heretofore, I also provide means for enriching the charge held above the piston when it is temporarily latched down. The carbureting part of the charge-forming means (best shown in Figure 3) is provided with a passage 45 through which air is drawn into the cylinder 10. Means for supplying the necessary normal amount of gasoline vapor to the inflowing air is provided, here being shown as a channel or drilling 46 terminating in a port opening into the channel 45 at one part of the seat for the valve 47. This port is supplied with gasoline from the tank 14; and the rate of flow, and thus the normal richness of the mixture, is regulated by the rotatable needle valve 48.

I provide additional gasoline supplying means in the form of a channel or drill tube 49, opening into the gasoline tank at one end and terminating at the other end in a port also located in the seat for the valve 47. This passageway 49 is normally closed by a needle valve 50, biased inwardly by the spring 51.

Means is provided for moving the valve 50 out against the pressure of the spring 51 to open the passage 49 when it is desired to supply more than the normal amount of gasoline to the inflowing air to enrich it; that is, to provide a mixture which has a higher gasoline to air ratio than normal. A cross shaft 52 is provided with an upwardly extending arm 53 engaging the outer end of the valve 50, so that counter-clockwise (speaking with respect to Figure 3) rotation of this shaft effects outward or opening movement of the valve 50. In order to effect the desired rotation of the shaft 52 it is provided at its other end with an arm 54 pivotally connected to an upwardly extending rod 55. This rod is in turn pivotally connected to the heretofore described rod 33, movable upon movement of the handle 28 with respect to the hammer.

It will be thus seen that upward movement of the handle 28 actuates both the latching means and the means for enriching the combustible charge. Moreover, the connecting linkage is preferably so adjusted that opening of the enriching valve 50 is effected at the very first upward movement of the handle 28, before the latching plunger 24 has gotten into latching position. With this arrangement, no matter how fast a workman picks up the hammer the charge held above the piston will be an enriched one, since with a hammer operating in the neighborhood of fifteen hundred strokes per minute it is only necessary that the enriching valve open a very small fraction of a second, in the neighborhood of forty thousandths of a second, before the piston is

latched. The provision of an enriched charge above the piston when it is temporarily latched down insures proper restarting even though some of the mixture should be lost through the exhaust opening.

While I have described and claimed certain embodiments of my invention it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. An internal combustion percussive hammer of the character described, including: a cylinder; a piston reciprocable therein on the two-stroke cycle principle; a tool adapted to receive impacts from the piston when the hammer is working; means for holding the piston in a position near the lower end of its stroke; and means for enriching the charge adapted to be fired upon release of the holding means.

2. A hammer of the character claimed in claim 1, including a handle mounted on the hammer and movable with respect thereto, and wherein movement of the handle actuates both the holding means and the enriching means.

3. An internal combustion percussive hammer of the character described, including: a cylinder

having an exhaust opening; a piston reciprocable therein on the two-stroke cycle principle and adapted to be driven downwardly by the explosion of a combustible charge thereabove, the piston uncovering the exhaust opening at the lower end of its stroke; a spring operatively connected to the piston for returning it to the upper end of the cylinder; a tool adapted to receive impacts from the piston when the hammer is working; means for holding the piston in a position near the lower end of its stroke with the spring under strain and the exhaust opening at least partially uncovered, whereby rapid initial acceleration of the piston is effected by the spring upon release of the holding means; and means also actuated by the movement rendering the holding means effective for enriching the charge delivered to the space above the piston.

4. A hammer of the character claimed in claim 1, wherein the enriching means includes a normally closed fuel supply port additional to the normal fuel supply port and means for opening the normally closed port to effect the enriching.

5. A hammer of the character claimed in claim 3, wherein the enriching means includes a normally closed fuel supply port additional to the normal fuel supply port and means for opening the normally closed port to effect the enriching.

CARL L. CHARLES.