Dec. 12, 1961 F. N. BARD ET AL 3,012,549

INTERNAL COMBUSTION DEVICE

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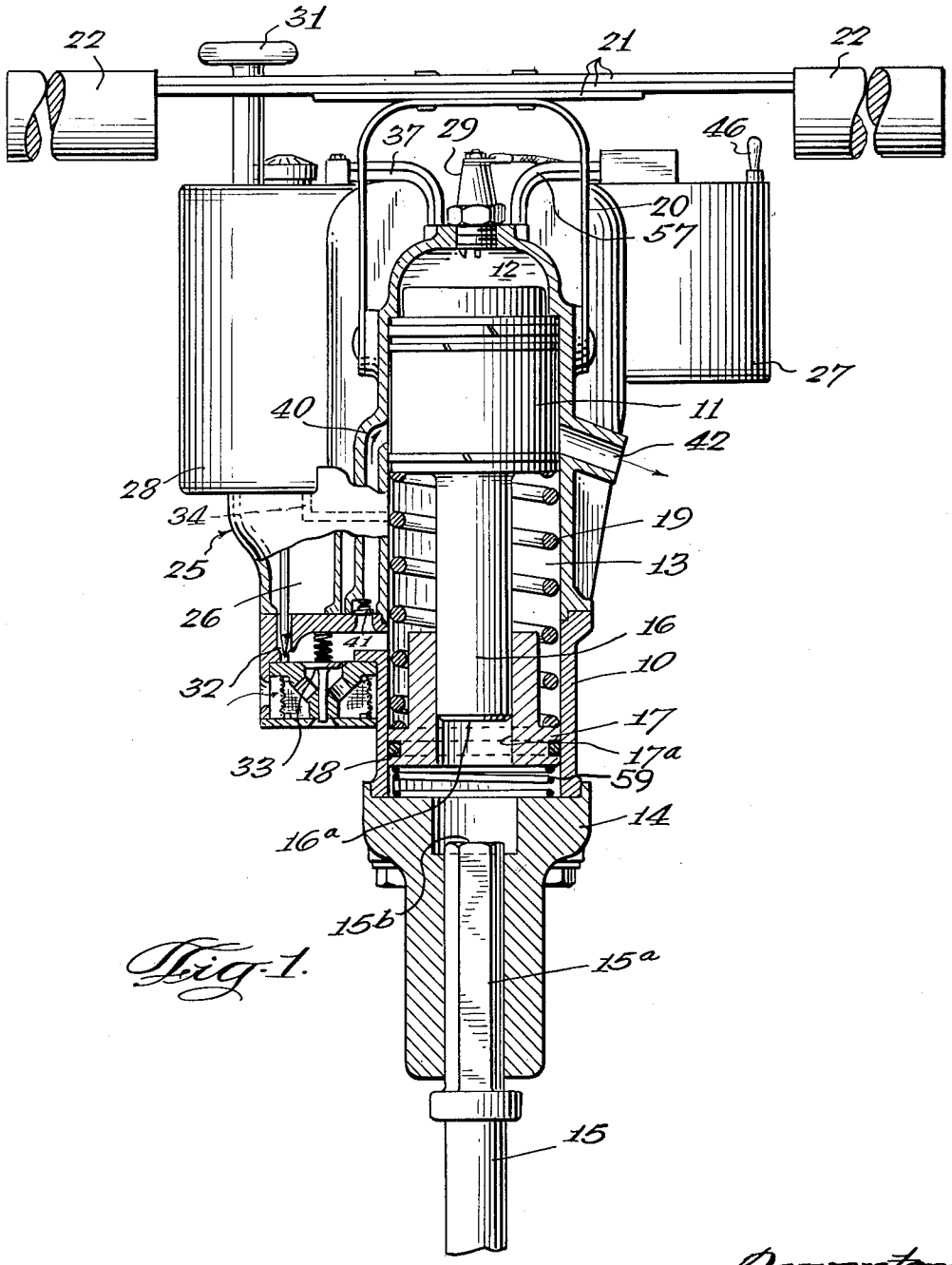

Fig. 1.

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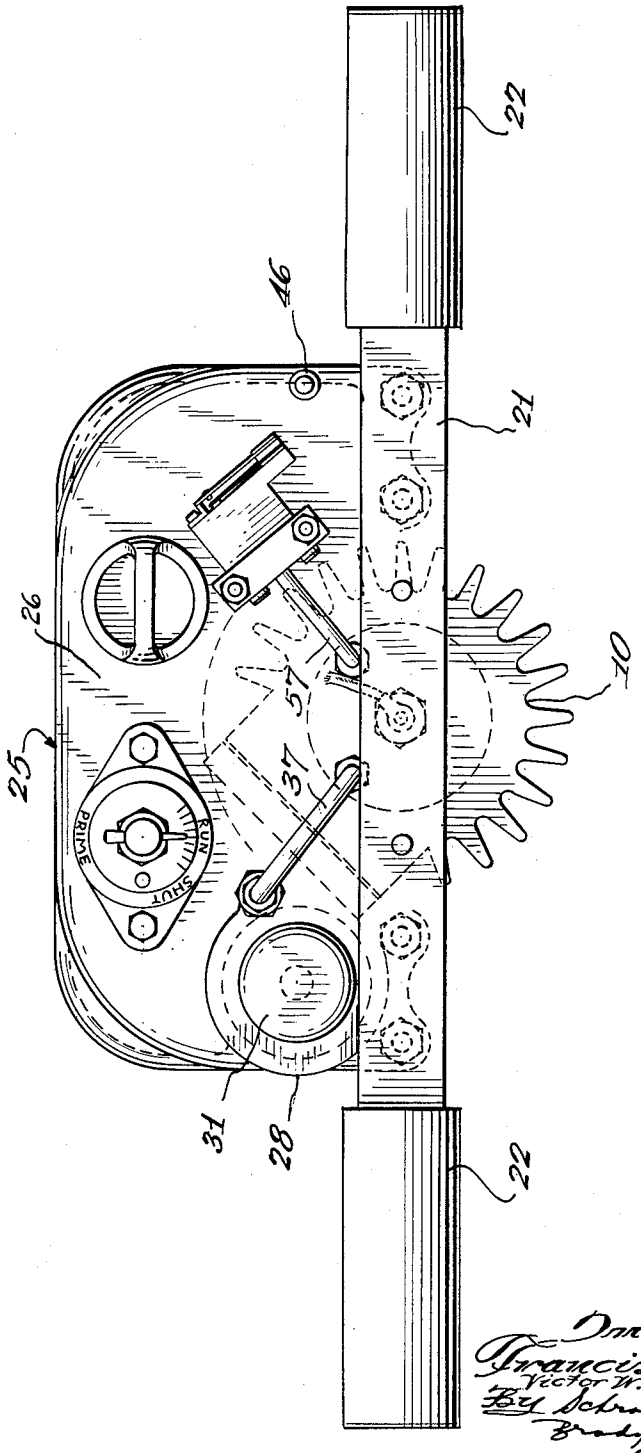
Fig. 2.



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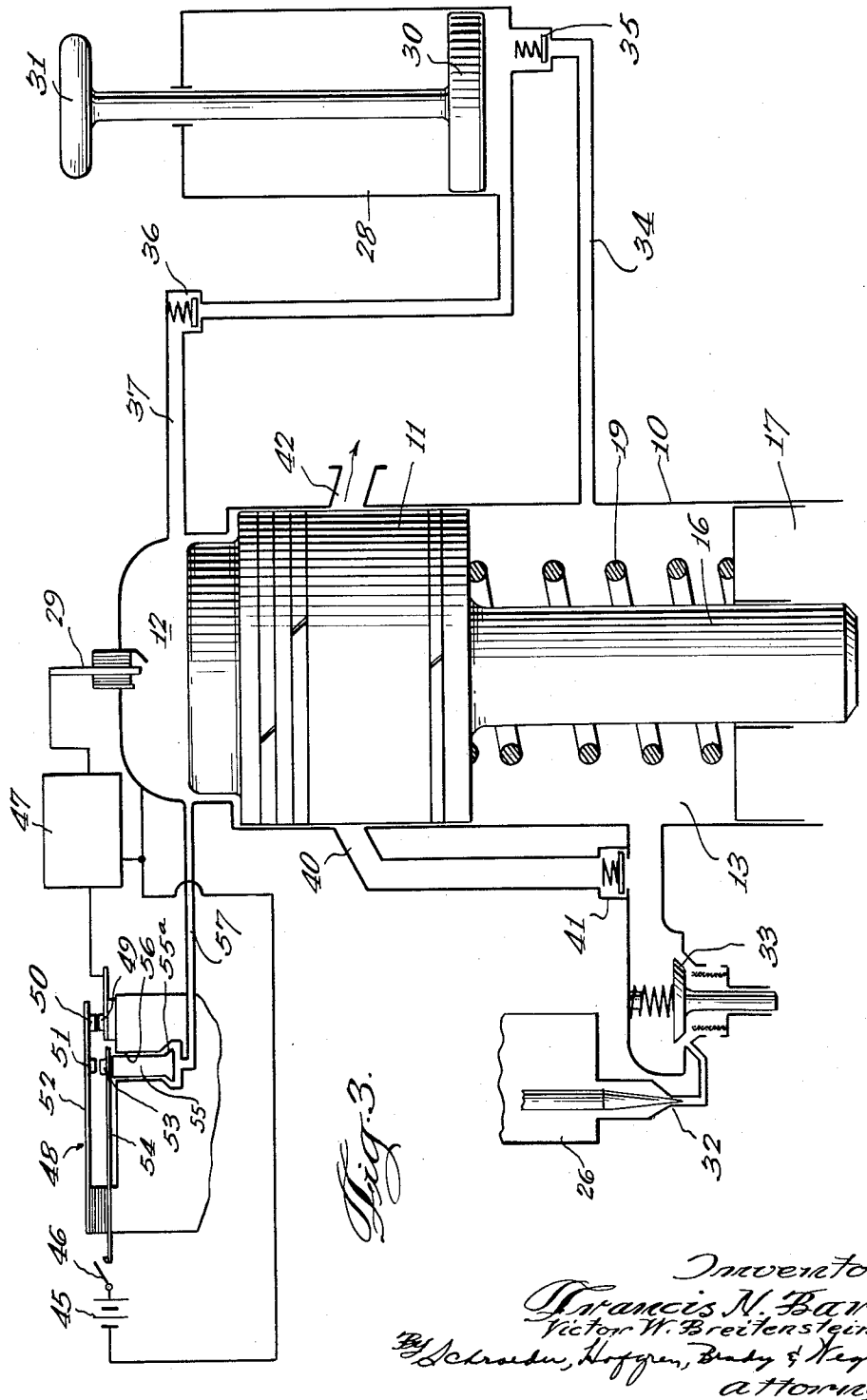

Fig. 3.

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INTERNAL COMBUSTION DEVICE

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This invention is concerned with an internal combustion percussive device and more particularly with improvements associated with a free piston engine in a percussive device.

Internal combustion percussive devices are used extensively to break up concrete, drill holes, tamp earth, cut asphalt and other similar operations. It is a general object of this invention to provide an improved internal combustion percussive device which is easier to start and easier to handle than devices which have heretofore been known.

One feature of the invention is the provision of such a device including a cylinder, a piston freely movable therein, a source of fuel and a starting device having an inlet connected to be supplied with a fuel-air mixture and an outlet connected directly to the cylinder. Another feature is that the starting device includes a piston which may be readily operated to inject a fuel-air mixture into the cylinder to start the engine, without need for depressing the piston of the engine.

Still another feature is the provision of an ignition system including a normally open ignition circuit and means responsive to the pressure in the combustion chamber for closing the ignition circuit and further means responsive to increased pressure in the combustion chamber upon firing to break the ignition circuit.

Yet a further feature is that the piston has a striking portion extending downwardly therefrom for striking the top of a standard tool, and a bushing in the cylinder receives the striking portion of the piston and seals the lower end of the cylinder.

Another feature is that the device is provided with handles and resilient spring means for mounting the handles on the cylinder.

Further features and advantages of the invention will readily be apparent from the following specification and from the drawings, in which:

FIGURE 1 is a fragmentary side view, partly in elevation and partly in section of a device embodying the invention;

FIGURE 2 is a top plan view thereof; and

FIGURE 3 is a schematic drawing of the device, illustrating the operation.

Referring first to FIGURES 1 and 2, a cylinder **10** has a piston **11** freely movable therein and provides an upper or combustion chamber **12** above the piston and a lower or fuel and air mixing chamber **13** below the piston. The lower end of the cylinder **10** is closed by a removable tool holding and guiding member **14** which carries a tool **15**, the portion **15***a* of the tool extending through the guide member and presenting a striking surface **15***b* to the interior of the cylinder. Extending downwardly from the main body portion of piston **11** is a stem or tail portion **16**, slidably received in the bore **17***a* of piston tail bushing **17** removably carried within the cylinder. A seal **18**, as an O-ring of resilient material, is inserted between bushing **18** and the inner wall of the cylinder. A coil piston spring **19** is interposed between the piston **11** and the bushing **17**, urging the piston toward an upper or compression position, as shown in the drawing; and a cushion spring **59** is provided between bushing **17** and tool guide **14**.

The tail portion **16** of piston **11** has a close sliding fit in bushing **17**, and together with seal **18**, seals the lower end of cylinder **10**. This permits the use of a standard tool **15** with a hexagonal shank (this being the usual type of tool commercially available) without need for a seal between the tool shank and the tool guide **14**.

A housing **25** outside the cylinder and extending part way therearound provides a fuel tank **26**, an ignition compartment **27** and the cylinder **28** of a starting device. A spark plug **29** is mounted in the top of the cylinder and extends into combustion chamber **12** for igniting the fuel. A U-shaped bracket **20** secured to the cylinder has mounted thereon resilient leaf spring elements **21** which extend transversely of the device and have handle or gripping portions **22** at their outer extremities.

Turning now more particularly to FIGURE 3, the starting of the engine and operation of the ignition system will be described. Cylinder **28** of the starting device is provided with a piston **30** having a push rod extending upwardly therefrom and terminating in an operating handle **31**. Piston **30** is first depressed to exhaust air from cylinder **28**, then as the piston **30** is pulled up, gasoline from fuel tank **26** is drawn through adjustable needle valve **32** and past check valve **33**, mixing with filtered air which is simultaneously drawn in through check valve **33**, providing a fuel-air mixture in chamber **13**. The fuel-air mixture is drawn through inlet passage **34** and check valve **35** into cylinder **28**. When piston **30** is pushed down again the fuel-air mixture in cylinder **28** is forced through check valve **36** and outlet passage **37** into combustion chamber **12**.

The ignition system operates (as will be more fully described later) to provide a spark, igniting the fuel in the combustion chamber and driving the piston downwardly. On the downstroke of piston **11** the fuel-air mixture in mixing chamber **13** is compressed until the piston clears intake port **40** whereupon the fuel is forced through check valve **41** into combustion chamber **12**. At the same time the waste gases are expelled through exhaust port **42**. At the end of the downstroke, when the piston is at its lower or exhaust position, the lower face **16***a* of the piston stem strikes the upper surface **15***b* of the tool directly, performing the desired work. Any accompanying downward movement of the bushing **17** is cushioned by spring **59**. On the return stroke of piston **11**, primarily effected by return spring **19**, the fuel-air mixture in combustion chamber **12** is compressed and fresh charges of gasoline and air are drawn through needle valve **32** and check valve **33** to mix in chamber **13**, the engine operating on the two-cycle principle. Check valve **41** may be eliminated if desired, as the major portion of the compression in chamber **12** occurs after piston **11** has closed intake port **40**.

The ignition system includes a suitable source of voltage, as battery **45**, a manual ignition switch **46** and a high voltage ignition coil **47** which is in turn connected with the spark plug **29**. An ignition timer switch assembly indicated generally as **48** is connected in series with battery **45** and switch **46** in the low voltage portion of the ignition circuit. The timer switch assembly **48** includes a fixed contact **49**, a pair of movable contacts **50** and **51** mounted on a flexible leaf member **52**, and a contact **53** mounted on flexible leaf member **54**. A piston **55** is movable in a cylinder **56** which is connected through passageway **57** with the combustion chamber **12**.

As the pressure increases in combustion chamber **12**, due either to the operation of the starting device or to the upward movement of piston **11**, the piston **55** is forced upwardly closing normally open contacts **53** and **51**, thus completing the primary circuit for ignition coil **47** and providing the necessary high voltage at spark plug

29. When the fuel-air mixture in combustion chamber 12 ignites, the force of the explosion causes piston 55 to move farther upwardly forcing contact 50 away from fixed contact 49, breaking the ignition circuit. The shoulder 55*a* on piston 55 engages the wall of the cylinder 56 stopping the upward movement of the piston. This timed operation of the ignition system prevents ignition of the next charge of fuel which is forced into combustion chamber 12 on the downward movement of piston 11.

The piston 30 of the starting device is forced to its upper position during operation of the hammer by the pressure developed in the fuel mixing chamber 13. Thus, the primer cylinder 28 is normally filled with a fuel-air mixture. When the hammer stops, either intentionally or accidentally, it may be easily restarted within a short time by merely pushing piston 30 down to inject a fresh fuel charge into combustion chamber 12, increasing the pressure therein and actuating the spark to re-initiate engine operation.

The use of a single integral body casting 25 for the fuel and air supply means, the starting device and the ignition means is of considerable advantage in providing an assembly which withstands the vibration present in a device of this type. As a further advantage of enabling fuel regulating, ignition and starting controls to be placed conveniently to the operator, and with a minimum of outside connections.

While we have shown and described certain embodiments of our 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.

We claim:

1. A free running internal combustion device of the two-cycle type, comprising: a cylinder; a piston movable in said cylinder between a compression position and an exhaust position, and dividing the cylinder into a combustion chamber and mixing chamber; a spring urging said piston toward the compression position; means for supplying fuel and air to said mixing chamber; a fuel connection between said mixing chamber and said combustion chamber, said connection opening into the combustion chamber through a port closed by said piston when in the compression position; a starting device separate from said fuel connection, comprising a cylinder and a piston manually movable therein, this cylinder having an inlet connected to said fuel mixing chamber and an outlet connected directly to said combustion chamber at a point above said piston when in compression position; means for firing fuel in said combustion chamber including a normally open ignition circuit; means responsive to pressure in said combustion chamber for closing said ignition circuit; and a second means responsive to increased pressure in said combustion chamber to break said ignition circuit.

2. A free running internal combustion engine, comprising: a cylinder; a piston movable in said cylinder, said cylinder providing a combustion chamber above said piston; a source of fuel and air; a fuel connection between said source of fuel and said combustion chamber; a starting device separate from said fuel connection comprising a cylinder and a piston manually movable therein, this cylinder having an inlet connected to said source of fuel and air and an outlet connected to said combustion chamber; means for firing fuel in said combustion chamber including a normally open ignition circuit; means responsive to pressure in said combustion chamber for closing said ignition circuit; and a second means responsive to increased pressure in said combustion chamber to break said ignition circuit.

3. An internal combustion percussive device of the character described, comprising: a cylinder; a piston freely movable in said cylinder and defining a combustion chamber therein; means for supplying fuel and air to said combustion chamber; means for firing fuel in said combustion chamber including a normally open ignition circuit; means responsive to combustion supporting pressure in said combustion chamber for closing said ignition circuit to provide continuous ignition; and a second means responsive to the increased pressure of combustion in said combustion chamber to break said ignition circuit.

4. An internal combustion percussive device of the character described, comprising: a cylinder; a piston freely movable in said cylinder and defining a combustion chamber therein; means for supplying fuel and air to said combustion chamber; means for firing fuel in said combustion chamber, including a normally open ignition circuit; a fixed contact in said ignition circuit; a first movable member having a first contact in engagement with said fixed contact and having a second contact; a second movable member having a contact for engagement with the second contact of said first member; and a second piston responsive to pressure in the combustion chamber of said cylinder for closing the contact on said second member with the second contact on said first member to complete said ignition circuit, and responsive to increased pressure in said combustion chamber to separate the first contact on said first member from said fixed contact to break said ignition circuit.

5. Apparatus of the character claimed in claim 1, wherein the starting device and fuel igniting means are in a single assembly member attached to the cylinder.

6. An internal combustion percussive device of the character described, comprising: a cylinder; a tool having a striking surface exposed to said cylinder; a piston freely movable in said cylinder and having a reduced striking portion extending therefrom, for striking engagement with said striking surface; a bushing in said cylinder receiving the striking portion of said piston; and sealing means between said bushing and cylinder.

7. An internal combustion percussive device of the character described, comprising: a cylinder; a tool having a striking surface exposed to said cylinder; a piston freely movable in said cylinder and having a reduced stem portion extending therefrom with a striking surface for striking said tool; and a bushing movable in said cylinder adjacent said tool and having a bore receiving the stem portion of the piston and guiding the movement thereof.

8. An internal combustion percussive device of the character described, comprising: a cylinder; a tool carried by the device and having a striking surface; a piston freely movable in said cylinder and having a reduced striking portion extending therefrom, for striking engagement with said striking surface; a bushing movable in said cylinder for closely receiving said reduced striking portion of the piston; a cushion spring for said bushing; and means for sealing said bushing to said cylinder.

9. A free running free piston, internal combustion device of the character described, comprising: a cylinder; a piston movable in said cylinder, dividing the cylinder into an upper combustion chamber and a lower fuel mixing and pressure pumping chamber; a piston return spring urging said piston to an upper position in said cylinder; a source of fuel connected with said lower chamber; a source of air for mixing with said fuel, connected with said lower chamber; a fuel connection between said lower chamber and an intake port in said upper chamber, said intake port being blocked by said piston in its upper position; and a starting device separate from said fuel connection, including a cylinder with a piston manually movable therein, the starting device cylinder having an inlet connected with said mixing chamber and an outlet connected directly with said combustion chamber through a port above said piston when in its upper position, the pressure developed on the fuel-air mixture in said lower fuel mixing and pressure pumping chamber during oper-

ation of said device filling the cylinder of said starting device with a fuel-air mixture.

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