

Aug. 17, 1954

N. C. McKELVY

2,686,501

IGNITION SPEED CUTOUT FOR INTERNAL-COMBUSTION PERCUSSION TOOLS

Filed Oct. 25, 1950

Fig. 1

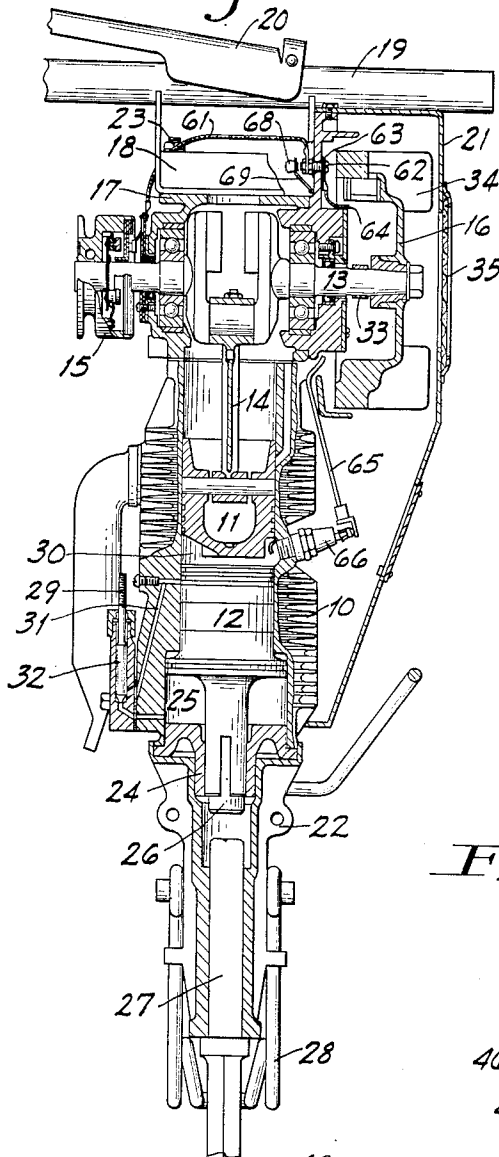


Fig. 2

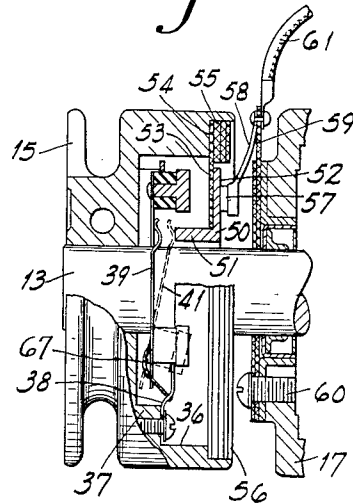


Fig. 4

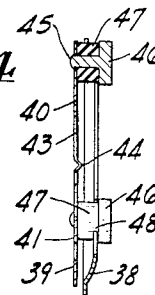


Fig. 3

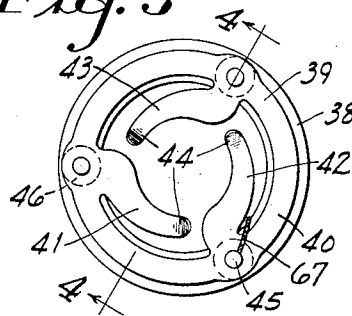
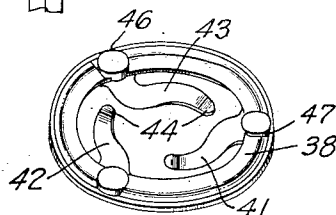


Fig. 5



INVENTOR.
Neville C. McKelvy
BY
William D. Crosthwaite
His Attorney.

UNITED STATES PATENT OFFICE

2,686,501

IGNITION SPEED CUTOFF FOR INTERNAL-COMBUSTION PERCUSSION TOOLS

Neville C. McKelvy, Blairsville, Pa., assignor to
Syntron Company, Homer City, Pa., a corporation of Delaware

Application October 25, 1950, Serial No. 192,121

5 Claims. (Cl. 123—7)

1

This invention relates generally to the control of the operation of an internal combustion percussion tool and more particularly to a centrifugal switch means actuated by the speed of the timing piston to make the ignition circuit ineffective and thereby regulate the frequency of the reciprocation of the working piston, preventing the timing piston from racing away from the operation of the working piston.

Internal combustion percussion tools employing a captive timing piston and a slave working piston are provided with an ignition system which initiates the combustion of fuel in the chamber of the reciprocating percussion tool. The control of the ignition system and the supply and discharge of products of combustion from the combustion chamber of the reciprocating tool are functions controlled by the timing piston. The load on the timing piston is therefore comparatively small as its only function is to control the operation of the percussion tool and to generate the ignition and ignite the spark and actuate the valves of the ports for the admission of fuel to the combustion chamber where the energy is employed to operate the timing piston and the working piston for the purpose of producing useful work. The speed of operation of the working piston may be regulated by the control of the speed of the timing piston. Frequently the timing piston may speed up and get out of step with the operation of the working piston causing the latter to cease operation and prevent it from delivering useful work. When the working piston gets out of step with the timing piston, it fails to operate on successive explosions making the tool useless as a percussive tool. Different types of speed devices have been employed for controlling, checking or otherwise retarding the excessive speed of the captive piston of percussive tools of this character. One method of producing this result is by the use of a throttle control, however such a mode necessitates the continued operation of a captive piston until it has reduced the speed sufficiently to supply gases to return the working piston in time and again function as a percussion tool.

Another mode for controlling the speed of a captive piston is by the provision of a centrifugal governor arranged to actuate an air vane which actuates the carburetor to check the inward flow of the fuel to the engine. This reduces the speed of the captive piston by lowering the supply of fuel as in the first mentioned mode. However, such a mode reduces the power input to the working piston thereby operating the tool inefficiently, making such modes an undesirable speed control.

2

Another mode of controlling the speed of the captive piston is by use of a speed governor arranged to apply a centrifugal brake on the crankshaft of the captive piston. This mode requires expenditure of energy in the form of friction and the brake mechanism is not only subjected to wear, but is very sensitive and requires frequent adjustment making this mode disadvantageous.

Another mode for controlling the speed of the captive piston is by the use of means correlated with the speed of the captive piston arranged to control the flow of exhaust gases from the internal combustion chamber thereby regulating the speed of the operation of the tool. This mode of control produces a contaminated mixture of fuel in the combustion chamber causing a reduction of power to the tool making it an undesirable control.

Another mode of control is the provision of a manually operated brake which is effective on the crankshaft of the captive piston which represents a very simple and immediately effective mode of quickly reducing the speed of the captive piston but it requires skill on the part of the operator.

The principal object of this invention is the provision of a centrifugal switch mounted on the rotary crankshaft and thus actuated by the speed of the timing piston which switch, when closed by centrifugal force created by a predetermined excess speed of the timing piston, short-circuits the ignition circuit making it ineffective. The timing piston must exceed a predetermined speed to close the switch and be reduced to a lower speed to open the switch to properly regulate the frequency of the reciprocation of the working piston to operate within work-producing limits of the working piston.

Another object is the provision of a centrifugal switch actuated by the speed of the timing piston to close a circuit and, thus, ground the ignition circuit making it ineffective when the timing piston exceeds a predetermined speed for the purpose of regulating the reciprocating frequency of the working piston to within work-producing limits.

Another object is the provision of a speed control for an internal combustion percussion tool including a centrifugal switch actuated by an upper limit of speed of the timing piston to make the ignition circuit ineffective and which when cut out will require the timing piston to reduce in speed materially below the upper limit of speed to insure good operation of the working piston.

Other objects and advantages appear hereinafter in the following description and claims.

The accompanying drawings show for the purpose of exemplification without limiting the invention and claims thereto, certain practical embodiments of the invention wherein:

Fig. 1 is the sectional view of the internal combustion percussion tool having an ignition speed cutout switch comprising this invention.

Fig. 2 is an enlarged detail view, a portion of which is in section, illustrating the centrifugal cutout switch.

Fig. 3 is an enlarged plan view of the actuating member of the cutout switch.

Fig. 4 is an enlarged detail sectional view of the actuating member of the cutout switch shown in Figs. 1 and 2.

Fig. 5 is a perspective view of the cutout switch.

The present invention provides a centrifugal ignition cutout switch to control the speed of the timing piston of an internal combustion percussion hand tool. This hand tool is operated from the vertical to the horizontal position and may be employed as a hammer, a drill, a ballast tamper, a concrete buster or for performing similar useful work. This hand tool is completely self-contained as it does not require the use of a supplementary apparatus in its operation.

Referring to the drawing, the internal combusive percussive tool comprises a cylinder 10 having a timing piston 11 and the percussion working piston 12 arranged to operate therein. The timing piston 11 is operatively connected with the balanced crankshaft 13 by means of the connecting rod 14. One end of the crankshaft 13 is provided with a starting pulley 15 enclosed by a hinged lid and the other end carries a flywheel 16 having fan blades for the purpose of supplying a stream of air to cool the internal combustion tool. A crankcase head 17 is attached to the upper end of the cylinder 10 and is adapted to carry the aligned crankshaft bearings and other stationary parts of the gas hammer, such as the bracket 18 on which is mounted a handle 19 with the fuel throttle lever 20 together with the housing 21 which encloses the flywheel 16, the fuel tank 8 and the carburetor 9. All of these parts are secured to the crankcase 17 or the cylinder 10 and provide a relatively small and compact and unitary tool.

The nose casting 22 is bolted to the lower end of the cylinder 10 by means of the four tie bolts 23 which are fastened at their upper ends through the bracket 18 and which extend the full length of the crankcase head 17 and cylinder 10. The casting 22 supports the working piston guide 24 which extends into and fits the bore of the differential chamber 25 of the cylinder 10 and is provided with a flange clamped between the end of the cylinder and the nose casting as shown at the lower end of Fig. 1.

The percussive working piston 12 has a depending stem 26 with a striking portion extending through the guide 24 and is arranged to strike the top of the tool 27 which is slidably supported within predetermined limits in the bore of the nose casting 22 and is retained by the spring latching member 28.

The percussive working piston 12 is a differential piston and the smaller end of this piston, which operates in the combustion chamber, controls the port leading from the combustion chamber 30 through the valve control passageway 31 to the chamber 25 at the other end of the working piston for supplying products of combustion under pressure which are effective against the larger end of the working piston 12 for returning

the same. The valve 32 in the passageway 31 is actuated by means of the reach rod 29 pivotally connected to the handle throttle lever 20 mounted on the handle 19, which throttle also controls the operation of the carburetor in supplying fuel to the engine.

The flywheel 16 is hollow and encloses a magnet and breaker points for the purpose of supplying the ignition of the internal combustion tool. These points are not shown, but the breaker arm cam is shown on the crankshaft at 33. The fan blades 34 are attached to the outer face of the flywheel 16 adjacent its perimeter and they form a vortex which is disposed adjacent the screened opening 35 in the housing 21 that surrounds the fan and tapers downwardly to around the lower end of the cylinder 10 partially covering the same and causing the air stream generated by the fan to flow transversely around the cylinder 10 between the cooling fins.

The starting pulley 15 is hollowed out as indicated at 36 and is provided with a series of three lugs 37 on which is mounted a frame in the form of the ring 38 of the centrifugally actuating switch member 39 as shown in Figs. 3 and 4 and comprises a circular stamping having an outer annular integral ring 40 with three equally spaced inwardly disposed arms 41, 42 and 43. Each arm extends radially inwardly from the annular ring 40 and then progresses arcuately and terminates in a switch point 44. At the base of each arm the annular ring 40 is provided with the hole for receiving the pins 45 that are made integral with the buttons 46 which are weights. The pins 45 on which the buttons 46 are mounted pass through the collars of a flexible elastomer material such as rubber, as indicated at 47. The flexible collars 47 are in turn fitted into inwardly open slots 48 in the stiff ring 38 which function as fulcrums for the arms. Each of the buttons or weight members 46 are arranged to rock outwardly toward the periphery of the frame 38 when the switch is rotated at a speed sufficient to make the centrifugal force of the weights overcome the flexibility of the spring ring 40 of the switch member 39 with a snap action. The slots 48 merely function as fulcrum guides for holding the flexible collars 47.

As shown in Figs. 1 and 2 the arms 41, 42 and 43 are lying in a plane substantially normal to the axis of the shaft 13 when the device is at rest or at a speed lower than 2300 to 2700 R. P. M. and the switch points 44 are out of contact. When the speed of the shaft 13 and the captive piston operating the same becomes greater than 2300 to 2700 R. P. M. the button weights 46 rock outwardly thereby flexing the ring 40 to move the arms 41, 42 and 43 inwardly so that their respective contact engaging tips 44 will become in engagement with the end of the metal collector ring 50. Considerable greater force is required to flex the annular spring 40 and move the arms into contact than is required to restore the spring 40 to its normal position. Thus the switch closes at a lower speed than that required to open the same.

The metal collecting ring 50 has a cylindrical section 51 and a flange 52. The cylindrical portion 51 extends through an opening in the insulating disk 53 and the flange 52 is in flat engagement with the surface of the insulating disk 53. The insulating disk 53 is set on the offset or step 54 in the chamber 36 of the starting pulley and is provided with a plurality of insulating rings 55, all of which are held in fixed position

on the shoulder 54 by means of an outer fastening ring 56. The exposed face of the flange 52 of the metal collector ring is engaged by the carbon brush 57 urged by a spring in the brush holder 58 attached to the insulating ring 59 mounted by the screws 60 to the housing 17. The brush 57, the spring and brush holder 58 are connected by the wire 61 to the bolt 62 which is supported in an insulating sleeve 63 mounted on the casing 17 and has another conductor 64 leading to the magneto, thence from the magneto the ignition circuit is supplied by the wire 65 to the spark plug 66 as shown in Fig. 1. When the speed urges the button weights out and flexes the arms to close their contacts this ignition circuit becomes grounded through the wire 67.

A manual stop paralleling the switch 39 is likewise provided by means of the insulated button 68 which is mounted on the end of a spring 69 and secured directly to the housing 17. By manually depressing the button 65 to engage the bolt 62, the magneto and the ignition circuit thereby become shorted. This switch is employed to stop the internal combustion chamber by merely shorting out the ignition system.

The centrifugal switch 39 merely shorts out the ignition switch and is in multiple with the manually controlled switch 68. However it operates as a function of the centrifugal force of the button weights 46.

Every time the ignition is restored, a very much harder than usual blow is obtained due to the excess or big charge of fuel that has collected in the combustion chamber during the time that the ignition is off. This produces a very shattering blow every so often which assists greatly in breaking concrete, stone, paving, or whatever is being broken.

The ring 40 is grounded through the wire 68 to the ring 38 fastened to the starter pulley and the button weights 43 are capable of swinging their arms so that the contact tips 44 engage the end of the cylindrical portion of the metal collecting ring and thus short out the ignition system at a speed from 2300 to 2700 R. P. M. However, the mounting of the button weights 46 on the ring 40, which is supported by the rubber sleeves 47, provides a delayed action and will not let the spring members 41, 42 and 43 retract from the collecting ring 50 until the speed of the captive piston and the shaft 13 are reduced to approximately 1600 R. P. M. The captive piston quickly responds to a reduction in speed when the ignition is shorted, but as soon as it reaches approximately 1600, the fingers 41, 42 and 43 become disengaged from the collector ring, and the ignition system again functions to supply ignition for the burning of the fuel in the combustion chamber which causes the working piston to operate and be returned by the flow of exhaust gases from the combustion chamber to the opposite side of the working piston.

By selecting the ring 40 to resist flexure until the speed of the shaft of the captive piston reaches 2300 to 2700 R. P. M. before shorting out the ignition circuit and not permitting the circuit to open until the speed is reduced to 1600 R. P. M. provides a differential that furnishes a wide operating range for the working piston. The internal combustion percussion tool merely sounds like it is missing a few cycles when the switch is operating. It takes a very little time to bring the speed down from 2700 to 1600 R. P. M. and full power is assured of every blow made by the combustion of fuel.

While, for clarity of explanation, certain preferred embodiments of this invention have been shown and described, it is to be understood that this invention is capable of different modifications, and changes in the construction and arrangement may be made therein and certain parts may be employed with conjoint use of other parts and without departing from the spirit and scope of this invention.

I claim:

1. An internal combustion percussion tool comprising a casing having a combustion chamber, an ignition circuit initiating combustion of fuel in said chamber, a timing piston reciprocable in said chamber to control the operation of said ignition circuit, a tool-actuating working piston reciprocable in said chamber and operated by the combustion of fuel, and a centrifugal switch means actuated by the speed of the timing piston to make said ignition circuit ineffective when the timing piston exceeds a predetermined speed and to restore the ignition circuit at a materially lower speed to regulate the frequency of reciprocation of the working piston to within work producing limits.

2. An internal combustion percussion tool comprising a casing having a combustion chamber, an ignition circuit initiating combustion of fuel in said chamber, a timing piston reciprocable in said chamber to control the operation of said ignition circuit, a tool-actuating working piston reciprocable in said chamber and operated by the combustion of fuel, and a centrifugal switch means actuated by the speed of the timing piston to ground said ignition circuit making it ineffective when the timing piston exceeds a predetermined speed and to restore the ignition circuit at a materially lower speed to regulate the frequency of reciprocation of the working piston to within work producing limits.

3. An internal combustion percussion tool comprising a casing having a combustion chamber, an ignition circuit initiating combustion of fuel in said chamber, a timing piston reciprocable in said chamber to control the operation of said ignition circuit, a tool-actuating working piston reciprocable in said chamber and operated by the combustion of fuel, and a centrifugal switch means actuated by an upper limit of speed of the timing piston to make said ignition circuit ineffective, said switch means maintaining the ignition circuit ineffective at an upper limit of speed and holding the same until the speed of the timing piston has reduced materially below the upper limit of speed when the ignition circuit became ineffective.

4. An internal combustion percussion tool comprising a casing having a combustion chamber, an ignition circuit initiating combustion of fuel in said chamber, a timing piston reciprocable in said chamber to control the operation of said ignition circuit, a tool-actuating working piston reciprocable in said chamber and operated by the combustion of fuel, and a centrifugal switch actuated by a speed of from 2300 to 2700 R. P. M. of the timing piston to ground the ignition circuit making it ineffective, said switch means maintaining the ignition circuit ineffective until the speed of the timing piston has reduced to a speed of approximately 1600 R. P. M.

5. An internal combustion percussion tool comprising a casing having a combustion chamber, an ignition circuit initiating combustion of fuel in said chamber, a timing piston reciprocable in said chamber to control the operation of said

ignition circuit, a tool actuated working piston reciprocable in said chamber and operated by the combustion fuel, a rotary shaft operated by said timing piston, a ring carried by said rotary shaft, a socket in said ring, an elastomer member in said socket, a metallic contact arm means movably carried by said elastomer member and extending in spaced relation from the axis of rotation of said shaft, and an insulated connecting ring mounted to be engaged by said contact arm means when the rotary speed of the shaft is effective to rock the same and move said arm means to make said ignition circuit ineffective when the timing piston exceeds the predetermined speed and to restore the ignition circuit at a materially lower speed for the purpose of regulating the frequency of reciprocation of the working piston to within work producing limits.

References Cited in the file of this patent

UNITED STATES PATENTS

	Number	Name	Date
5	970,794	Carlson	Sept. 20, 1910
	1,390,376	Oglesby	Sept. 13, 1921
	1,722,117	Suter	July 23, 1929
	1,764,055	Schylander	June 17, 1930
	2,152,287	Scott	Mar. 28, 1939
10	2,480,879	Rice, Jr.	Sept. 6, 1949
	2,522,550	Weyandt	Sept. 19, 1950
	2,551,988	Weyandt	May 8, 1951
	2,616,682	Greenhut	Nov. 4, 1952

FOREIGN PATENTS

	Number	Country	Date
15	298,641	Great Britain	July 4, 1929