

Aug. 23, 1949.

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2,479,593

INTERNAL-COMBUSTION PERCUSSION TOOL CONTROL

Filed Sept. 4, 1945

2 Sheets-Sheet 1

Fig. 1

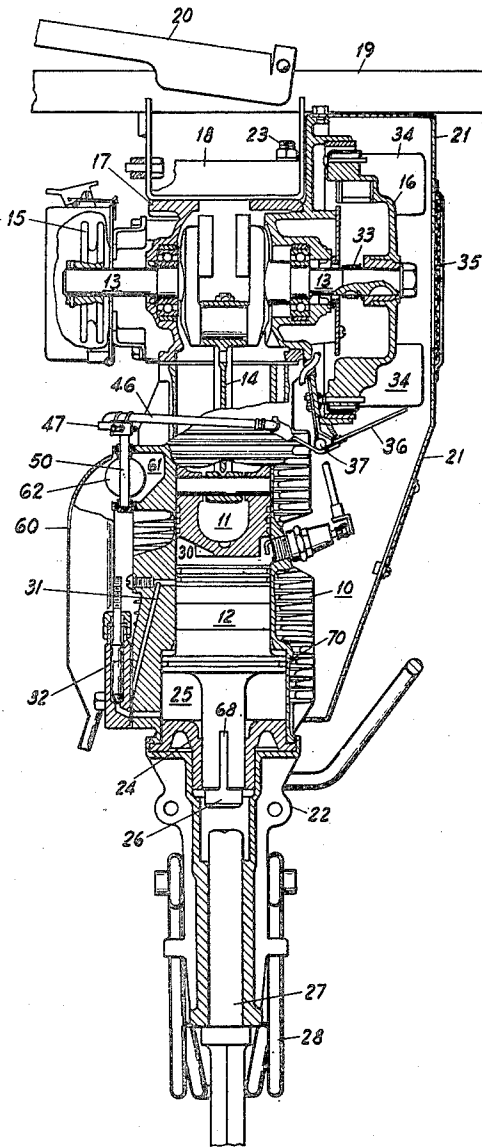
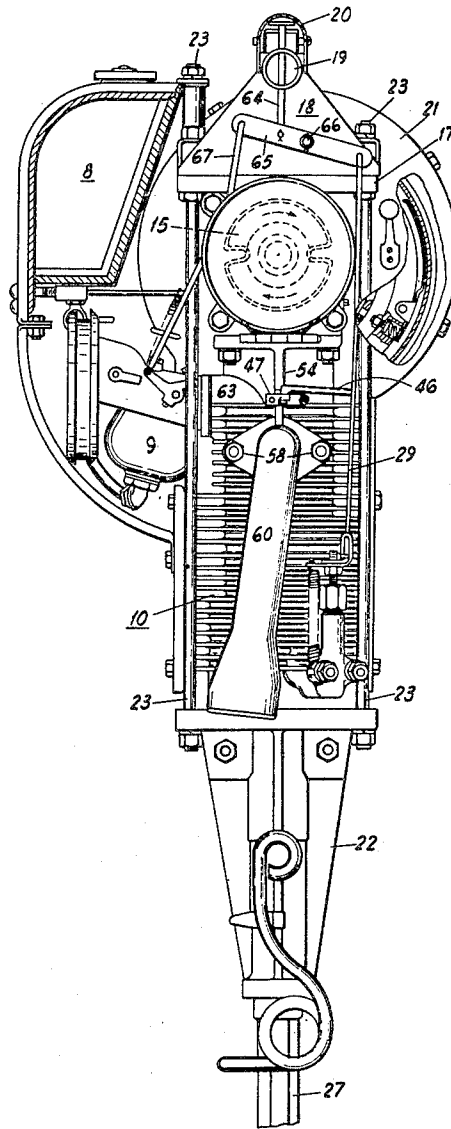


Fig. 2



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Fig. 4

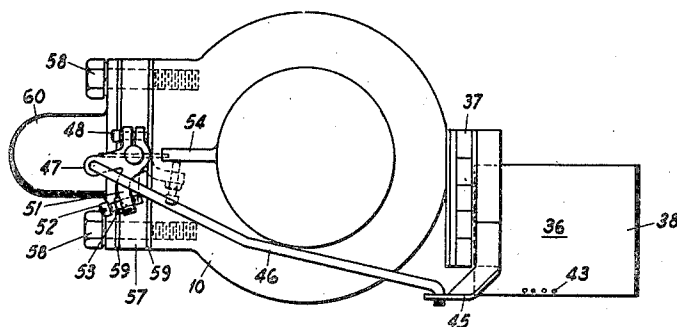


Fig. 3

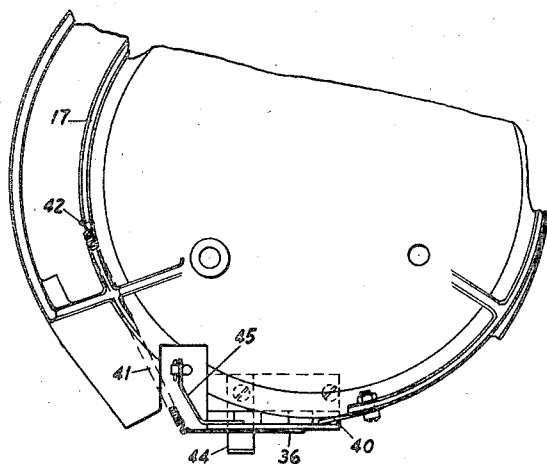
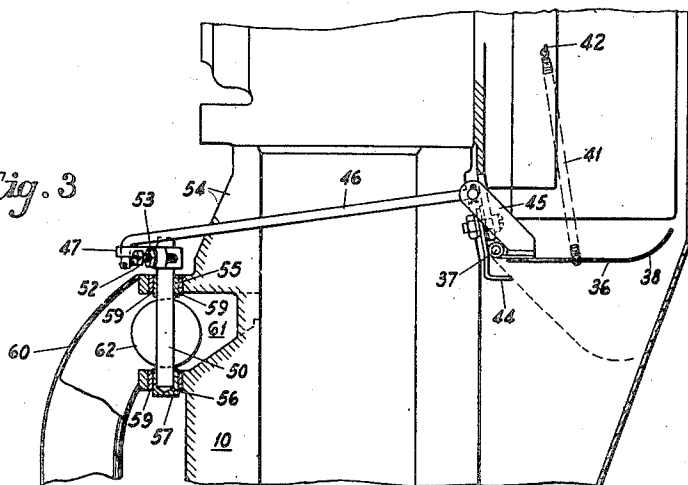


Fig. 5

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2,479,593

INTERNAL-COMBUSTION PERCUSSION
TOOL CONTROL

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Application September 4, 1945, Serial No. 614,321

14 Claims. (Cl. 123-7)

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This invention relates generally to the control of the maximum speed of an internal combustion engine percussion tool and more particularly to the control of the flow of the exhaust gases from an internal combustion engine percussion tool to regulate the top speed of the idling timing piston and maintain work producing reciprocation of the working percussion piston.

This invention may be advantageously employed on internal combustion engines such as used for gasoline hammers which have a captive piston and a free percussion piston operable from the same energy source. In engines of this character there is very little load on the crank shaft of the captive piston, usually a magneto and a motor cooling fan. This light load permits the captive piston to over speed, or to reciprocate faster than the percussion piston, causing them to get out of step. When the pistons are out of step the percussion piston fails to operate on successive explosions making the device useless as a percussion tool.

A centrifugal speed device has heretofore been incorporated on the ignition breaker point cam to hold the breaker points open when the speed of the captive piston becomes greater than a predetermined value to eliminate the ignition spark in the motor until the speed of the captive piston is reduced. When the proper speed is attained the captive and percussion pistons again function normally until the captive piston again races out of step with the percussion piston. During the excessive speed periods the device ceases to function, which is undesirable.

A second mode of controlling the speed of the captive piston is to provide a centrifugal governor arranged to actuate an air vane in the carburetor input to check the flow of fuel or gas input to the carburetor. This reduces the speed of the captive piston by lowering the fuel input and the blow of the percussion piston is likewise reduced, which make this mode of speed control undesirable.

A third mode of controlling the speed of the captive piston is obtained by the provision of a speed governor arranged to apply a brake effective on the crank shaft to retain the captive and percussion pistons in step. This mode requires the expenditure of energy in the form of friction, and the brake mechanism is not only subjected to wear but it is sensitive and requires frequent adjustment, making it disadvantageous for this use, notwithstanding the fact that it is believed to be superior to that of the first two modes of speed control.

The principal object of this invention is the

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provision of a simplified device for controlling the speed of an engine which does not have the disadvantages of the above mentioned controls.

Another object is the provision of a speed control for internal combustion engines that does not interfere with the ignition and fuel supply, nor apply a frictional load on the engine.

Another object is the provision of a speed control for a captive piston of a gas hammer without decreasing the number of power strokes or the energy delivered to the percussion piston.

Another object is the provision of a simple and economical speed control structure for internal combustion engines which is not subjected to wear nor requires frequent adjustment.

Another object is the provision of an internal combustion engine speed control device that is sensitive in operation to maintain the proper speed of the engine.

Another object is the provision of means effective by the speed of the engine for controlling the flow of exhaust gases to regulate the speed of the internal combustion engine.

Another object is the provision of an internal combustion engine speed control device arranged to regulate the flow of the exhaust gases, commensurate with the speed of the engine to maintain the speed within predetermined limits.

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

In the accompanying drawing a practical embodiment illustrating the principles of the invention is shown, wherein:

Fig. 1 is a sectional view of a gasoline hammer provided with a speed control device comprising this invention.

Fig. 2 is a side view of the hammer shown in Fig. 1.

Fig. 3 is an enlarged view of the speed control structure shown in Fig. 1, with parts of the hammer broken away.

Fig. 4 is a plan view of the structure shown in Fig. 3.

Fig. 5 is a side view of the structure shown in Fig. 3.

The present invention provides a speed control of the internal combustion engine by regulating the flow of the exhaust gases. If the exhaust is completely shut off the engine will stop. If the exhaust is partially closed the engine speed is correspondingly decreased. Thus, a speed governor arranged to vary the flow of the exhaust gases is enabled to regulate the speed of the engine. Any type of governor actuated by the speed of the motor may be employed to regulate

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the flow of the exhaust gases. However, the gas hammer used to illustrate a practical embodiment of the principles of this invention is provided with a cooling fan, the stream of air from which may be advantageously employed as a source of energy which is commensurate with the speed of the engine and thus provide an excellent source for actuating a fluid operated governor. The fluid actuated governor is simple to construct and is readily adaptable to the gas hammer and is therefore particularly advantageous to this invention and represents an important object thereof.

Referring to the drawings, Figs. 1 and 2 show a sectional and elevational view, respectively, of a gas hammer comprising a cylinder 10 having a captive piston 11 and a percussion piston 12 arranged to operate therein. The captive piston 11 is operably connected with the balanced crank shaft 13 by the connecting rod 14. One end of the crank shaft 13 is provided with a covered starting pulley 15 and the other end carries a fly wheel 16. The crank case head 17 is attached to the upper end of the cylinder 10 and is adapted to carry the crank shaft bearings and other stationary parts of the gas hammer, such as the bracket 18 on which is mounted the handle 19 with its throttle lever 20 and the housing 21 which encloses the fly wheel 16, the fuel tank 8, and carburetor 9, as shown in Fig. 2.

The nose casting 22 is clamped to the lower end of the cylinder 10 by four tie bolts 23 fastened to the bracket 18 and which extend the full length of the crank case head 17 and the cylinder 10. The nose casting 22 is bored to receive the hammer piston guide 24 which extends into and fits the bore of the differential chamber 25, and is provided with a flange clamped between the end of the cylinder and the nose casting, as shown in Fig. 1.

The free or percussion hammer piston 12 has a depending stem or striking member 26 extending through the hammer piston guide 24 and arranged to strike the top of the tool 27 slidably supported in the nose casting 22 and retained by the spring catch 28.

The percussion piston 12 is a differential piston and the combustion end controls the port leading from the combustion chamber 30 through the valve controlled passageway 31 to the chamber 25 for supplying products of combustion to return the free or percussion hammer piston 12. The valve 32 which controls the passageway 31 is actuated through a reach rod 29 by the hand throttle lever 20 that also controls the supply of gasoline to the carburetor 9.

The fly wheel 16 is hollow and encloses the magneto and breaker points but are not shown. However, the breaker arm cam is shown on the crank shaft at 33. A series of short fan blades 34 are secured to the outer face of the fly wheel 16 adjacent its perimeter. The vortex formed by the fan blades is disposed adjacent to the screened opening 35 in the housing 21 which surrounds the fan and tapers downwardly to the bottom of the cylinder 10, and partially covers the same on three sides, causing the air to be discharged transversely across the cylinder 10 to cool it.

Owing to the fact that this fan is driven by the crank shaft the flow of air developed thereby is proportional to the speed of operation of the captive piston 11.

An air vane 36 is hinged at 37 to crank case head 17 and is permitted to extend out into the

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path of the stream of air produced by the fan blades 34. The vane 36 is sufficiently large to be moved by the stream of air but does not completely close the duct formed by the housing 21.

The end of the vane is preferably turned upwardly as indicated at 38 to make it equally effective when substantially fully extended. The vane is normally retained against the upper stop 40 by means of the helical spring 41 which is attached to a cotter key 42 in the crank case head 17, as in Fig. 5. The lower end of the spring may be hooked in one of a series of holes 43 along the edge of the vane to vary the load pressure effective on the vane for a given spring, as shown in Fig. 4. A lower stop 44 is provided to prevent the vane 36 from extending any further than the position shown in dotted lines in Fig. 3.

An upwardly extending arm 45 is secured to the vane 36 and has one end of the operating rod 46 pivotally connected thereto. The other end of the rod 46 is pivotally connected to the crank arm 47 which may be clamped by the screw 48 in any desired position on the outer end of the shaft 50. The crank arm 47 is provided with an outwardly extending lug 51 having a tapped hole to receive the stop screw 52 which may be set and then locked by the nut 53. When the vane 36 strikes the lower stop 44 the stop screw 52 may be adjusted to strike the stop 54 on the cylinder 10 as indicated in dotted lines in Fig. 4.

The shaft 50 is journaled in the aligned bearings 55 and 56 in the washer 57 that is clamped by the bolts 58 between the gaskets 59 and with the exhaust pipe 60 to the exhaust port 61 of the cylinder 10. The lower bearing 56 is a stop bearing which is not open to the under side of the washer 57. The shape of the exhaust port 61, the mating end of the exhaust pipe 60 and the washer 57 are circular. Thus the washer 57 may be added to the side of the cylinder 10 without difficulty as it has the same shape as the gaskets 59.

The intermediate portion of the shaft 50 has the circular disc butterfly valve 62 attached thereto which, when in the full line positions shown in Figs. 3 and 4, permits full and uninhibited flow of the exhaust gases from the combustion chamber 30 to the exhaust pipe. When in this position the vane 36 is in its normal position against the upper stop 40.

In operation the carburetor 9 is adjusted to permit the engine to run at an idling speed. A pull rope is wound around the starting pulley 15 and pulled to rotate the crank shaft 13 and reciprocate the captive piston 11. The magneto supplies the spark and the engine operates at idling speed with only the captive piston 11 working. The forced draft created by the fan blades 34 at idling speed is insufficient to move the vane 36. The gas is fed from the carburetor 9 to the intake manifold 63 to the cylinder 10 where it is compressed in the crank case, and is then admitted through an inlet port to the combustion chamber. The downward stroke of the captive piston 11 compresses the gas charge and it is fired before dead center and exhausted through the port 61 to the exhaust pipe.

When the throttle 20 is depressed the rod 64 rotates the lever 65 on its pivot 66 and pulls the bypass control valve rod 29 up and pushes the carburetor throttle rod 67 down to admit more fuel to the engine. The valve rod 29 lifts the valve 32 to admit a portion of the products of combustion to the percussion chamber 25, thereby

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raising the percussion piston 12. Upon the next ignition the burning gases force the percussion piston 12 down causing it to strike the tool 27 on this power stroke. After the piston 12 passes the port to the passageway 31 another charge of products of combustion is admitted to the percussion chamber 25 to return the piston 12 after it has struck the tool 27. The cycle of operation repeats as rapidly as the percussion piston 12 can operate due to its weight, friction, power of combustion and exhaust pressure return. The gases from the chamber 25 are discharged through the multiple slots 68 before the percussion piston reaches the top of the stroke. The percussion piston has differential sections and the chamber space therebetween is open to the atmosphere by the ports 70 in the side of the cylinder 10 which permits the air to freely pass therethrough but is cut off by the large diameter portion of the piston just prior to it reaching the top of the stroke to provide a cushioning action that prevents contact between the piston and the cylinders.

As the fuel is increased the speed and power of the hammer is also increased. The size of the vane 36, the calibration and adjustment of the spring 41 permits the vane 36 to swing downwardly on its pivot when the speed of the captive piston 11 is about to raceway from synchronous operation with the percussion piston. The air stream produced by the fan is sufficient to force the vane 36 down, causing the butterfly valve to partially close the exhaust of the engine, thereby choking the flow of the products of combustion from the combustion chamber 30. As the exhaust passage decreases the speed of the engine decreases and the captive and percussion pistons are maintained in step or in synchronism. If the butterfly valve 62 was permitted to shut off substantially all flow of the products of combustion the engine will stop completely. However, in operation, the vane moves up and down through a limited arc and the pistons are constantly retained in synchronism and the hammer does not over speed. The lower stop 44 on the adjustable screw stop 52 may be adjusted to provide a minimum exhaust opening which is sufficient to insure the reduction of speed of the captive piston but will not stop the engine.

This invention thus permits the full supply of gasoline for every stroke of the piston, hence the blow of the percussion piston is not greatly interfered with, and there is a positive and strong blow for every cycle which is an important advantage of this invention. Some source of energy commensurate with the speed of the captive piston must be employed to regulate the exhaust cutoff. The air stream affords an excellent source of energy for this control and is employed to illustrate the principle of this invention because it is not apt to get out of adjustment and the control is positive.

I claim:

1. In a control for an idling piston and a working percussion piston in an internal combustion engine, the combination of a combustion chamber having intake and exhaust and arranged to be supplied with fuel where it is ignited and burned and then exhausted in timed sequence to operate said pistons, means arranged to vary the exhaust opening commensurate with the speed of the pistons to maintain work producing reciprocation of the working percussion piston.

2. In a control for an idling piston and a working percussion piston in an internal com-

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bustion engine, the combination of a valve arranged to restrict the exhaust passage from the engine, means to yieldably hold the valve in its open position, and means operating commensurate with the speed of the engine to regulate the operation of the valve and maintain work producing reciprocation of the working piston.

3. In a control for an idling piston and a working percussion piston in a two cycle internal combustion engine, the combination of means for supplying a constant amount of fuel to the engine to operate said pistons, a valve arranged to restrict the flow of the exhaust products of combustion from the engine, calibrated spring means to normally hold the valve in its open position, and means operable commensurate with the speed of the engine to regulate the position of the valve and maintain work producing reciprocation of the working piston.

4. The structure of claim 3 characterized in that said last mentioned means includes an air governor, the operation of which is determined by the speed of the engine.

5. In a control for an idling piston and a working percussion piston in an internal combustion engine, the combination of means arranged to restrict the flow of the exhaust gases from the engine, spring means to normally maintain said means in its unrestricted position, fan means operated by said idling piston and arranged to produce a stream of air the force of which is commensurate with the speed of the engine, and means responsive to pre-determined limits of the force of the air stream for regulating the restricting means to maintain work producing reciprocation of the working percussion piston.

6. The structure of claim 5 characterized in that said control means is a hinged vane partially blocking the air stream.

7. In a control for an idling piston and a working percussion piston in a two cycle internal combustion engine, the combination of a valve arranged to restrict the flow of the exhaust gases from the engine, a rod connected at one end to said valve for actuating the same, a fan driven by said idling piston to produce an air stream, a passage for directing the stream of air produced by the fan, a vane pivotally supported in the passage for movement commensurate with the force of the stream of air produced by the fan and arranged to operate the rod to operate the valve and maintain work producing reciprocation of the working percussion piston, and spring means to normally hold the vane and the valve in their normal or open position.

8. The structure of claim 7, which also includes means to limit the movement of the vane in both directions.

9. The structure of claim 7, which also includes a stop on said valve to limit the restriction of the flow exhaust gases.

10. The structure of claim 7, which also includes means to vary said spring means to regulate the limit of the speed of operation of the engine.

11. In a control for an idling timing piston and a working percussion piston in an internal combustion engine, the combination of a common source of burning fuel energy for operating both pistons simultaneously to produce useful work, and means to restrict the flow of the exhaust gases of the burning fuel to maintain work producing reciprocation of the working percussion piston.

12. In a control for an idling timing piston

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and a working percussion piston in an internal combustion engine, the combination of a common source of burning fuel energy for operating both pistons simultaneously to produce useful work, a valve arranged to restrict the flow of the exhaust gases of the burning fuel, means to yieldably hold the valve in its open position, and means operating commensurate with the speed of the engine to regulate the operation of the valve and maintain work producing reciprocation of the working percussion piston.

13. In an internal combustion percussion tool, the combination of a casing having a combustion chamber, an idling timing piston and a working percussion piston therein operated by a common source of energy to produce useful work, an air stream produced by the operation of the idling timing piston the force of which is commensurate with the speed of the idling timing piston, means arranged to restrict the flow of exhaust gases discharged from the combustion chamber, and means responsive to the force of the air stream for regulating the restricting means to maintain work producing reciprocation of the working percussion piston.

14. In an internal combustion percussion tool,

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the combination of a casing having a combustion chamber with independent inlet and exhaust ports, an idling timing piston and a working piston in the combustion chamber and operated by a common source of energy to produce useful work, a fan operated by the idling timing piston to produce a stream of air the force of which is commensurate with the speed of the idling piston, a valve arranged to restrict the flow of gases from the exhaust port, and a vane arranged to operate the valve and mounted in the path of the air stream, said vane being movable in response to the force of the air stream to regulate the valve and maintain work producing reciprocation of the working piston.

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