

March 2, 1937.

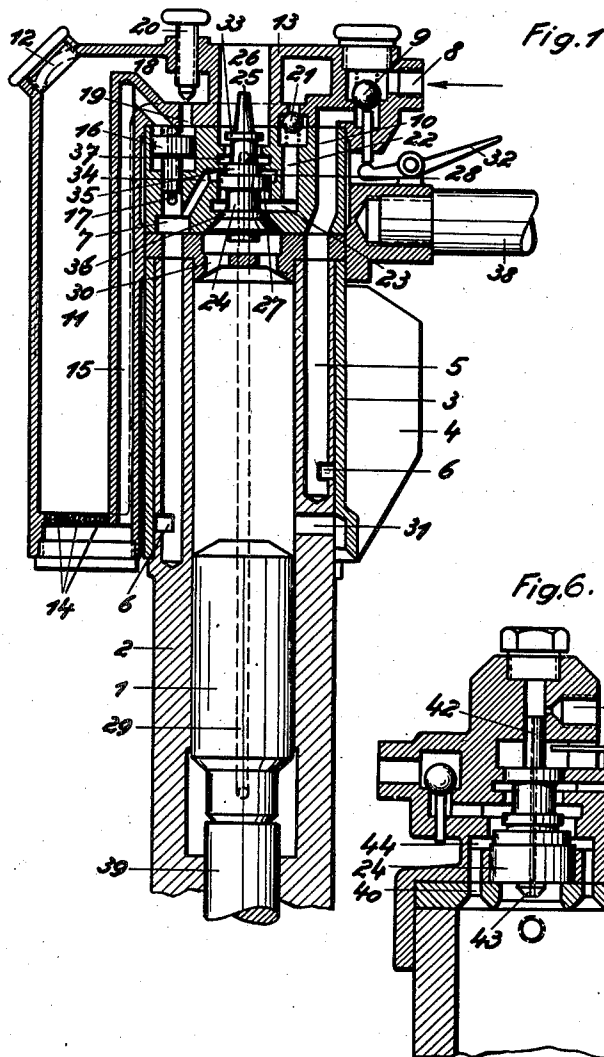
M. KIECKSEE

2,072,266

PERCUSSIVE TOOL DRIVEN BY AN INTERNAL COMBUSTION ENGINE

Filed Aug. 3, 1934

2 Sheets-Sheet 1



INVENTOR
MAX KIECKSEE
BY *Haseltine, Lake & Co.*
ATTORNEYS

March 2, 1937.

M. KIECKSEE

2,072,266

PERCUSSIVE TOOL DRIVEN BY AN INTERNAL COMBUSTION ENGINE

Filed Aug. 3, 1934

2 Sheets-Sheet 2

Fig. 2

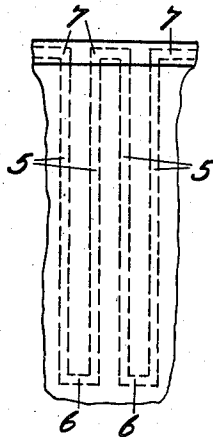


Fig. 4

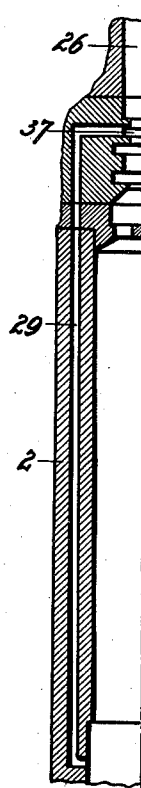
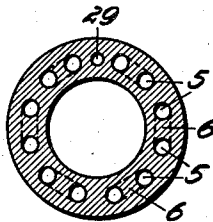


Fig. 5



Fig. 3



MAX KIECKSEE
INVENTOR
BY *Haseltine, Lake & Co.*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,072,266

PERCUSSIVE TOOL DRIVEN BY AN INTERNAL COMBUSTION ENGINE

Max Kiecksee, Wilmersdorf, Berlin, Germany, assignor to Knorr-Bremse Aktiengesellschaft, Lichtenberg, Berlin, Germany, a joint-stock company of Germany

Application August 3, 1934, Serial No. 738,195
In Austria July 5, 1934

12 Claims (Cl. 123—7)

This invention relates to percussive tools of the type which can be used for the most varied purposes, for example, as a stone borer, as a tamping tool in railway or road construction, for tearing up road surfaces (asphalted or cemented) and the like, and which can be driven by an internal combustion engine.

The object of the invention is to construct such a tool so that it can be started rapidly and reliably, without the aid of a starting crank or of a special starting motor.

The device according to the invention is so arranged that it starts with certainty when a current of compressed air or compressed oxygen is fed to it, which serves to so actuate a control member for the mixture of fuel and air that the overhung working piston is brought into the initial position ready for operation, and that while or directly before this takes place the mixture of fuel and air necessary for the operation of the device is supplied to the working space of the cylinder, the said mixture being compressed by the piston movement. Furthermore, the current of compressed air or compressed oxygen supplied to the device serves to gasify the liquid fuel if it is not, as is the case in a special constructional form of the device according to the invention, atomized into the cylinder, or hammer motor which also takes place under the influence of the current of pressure medium (compressed air or compressed oxygen). Also, the current of pressure medium serves to dilute the mixture of fuel and air by being mixed with the said mixture in a regulatable quantity; it also induces the return movement of the working piston upon completion of its working stroke, and finally serves to cool the working cylinder.

The device according to the invention is illustrated in the accompanying drawings, wherein:

Figure 1 represents a longitudinal section through an engine according to the invention, whose working piston is situated in its lowermost position and whose control member lies in its uppermost position.

Figure 2 is a diagrammatical illustration of the guide conduits for the current of pressure medium extending in the wall of the working cylinder.

Figure 3 is a cross-section through the working cylinder below the control member for the mixture of fuel and air.

Figure 4 is a longitudinal section through a portion of the working cylinder, showing the conduit which feeds to the working piston the pres-

sure medium which causes the said piston to carry out the idle movement.

Figure 5 is a fragmentary longitudinal section through a portion of the cylinder within the range of a regulating valve hereinafter more fully described.

Figure 6 represents the longitudinal section through a portion of another constructional example of the invention, wherein the control member serves as a pump and as atomizer for the liquid fuel.

The working piston 1 of the percussive tool is constructed as an overhung piston, which carries out its working movement under the combustion pressure of the ignited mixture of fuel and air and at the end of the stroke strikes against the head of a tool 39 (chisel, rock borer, track tamping tool or the like).

The working cylinder 2 which in working would be greatly heated by the explosions, is surrounded with a jacket 3 upon which cooling gills 4 are arranged. In the wall of the cylinder 2 there are longitudinal channels 5 which are so connected with each other by cross channels 6 at one (the lower) end, and by cross channels 7 at the other (upper) end, that they represent a continuous pipe or sinuous conduit system which, according to Figures 1 to 5 surrounds the upper part of the cylinder 2 exposed to heating by the explosions. The last cross channel 7 in the continuous run of the channels 5, 6 and 7 communicates with a space in which there is a regulating valve 16 made as a differential piston and controlling the lower mouthpiece of a conduit 17 surrounding the valve 16 and the upper mouthpiece of which is continuously in open communication with a channel 15 and a channel 19. The channel or conduit 19 may be throttled or entirely blocked by a set screw 20. The conduit 15 leads into the lower part of a sack-like fuel container or carburetor 11 arranged on the tool head on the side thereof facing the operator, and the filling of which container 11 takes place by a filling opening which can be closed by means of the screw cap 12. A partition near the bottom of the fuel container 11 is perforated with sieve-like holes 14 for the purpose hereinafter described. The upper part of the fuel container 11 is in open connection with the space 18 in which the fuel and air mixture collects. The space 18 is adapted to be placed in communication with a space 23 through a conduit 22 which is normally closed against the space 18 by a non-return valve 21. A conduit 34 branches from the

conduit 7 and leads to a space 28 which is arranged above the said space 23. The spaces 23 and 28 form constituent parts of a casing for a control member 24 having the form of a stepped piston valve, and which according to the form of construction shown by Figure 6 can at the same time serve as fuel pump. The control member 24 supervises, by means of the part 36 of valve body character, the connection between the space 23 and the combustion space of the cylinder 2 which by the bores 30 in the upper cylinder end, is in open communication with the control space under the action of the member 24; by means of the parts 27 and 35 it controls the connection between the conduit 34, and thus of the conduits 7 and 5 connected therewith, and a space 37 which, is by the part 33 of the control member 24, according to the position of the latter, brought into communication with an atmospheric exhaust opening 26, or is cut off from the same. A conduit 29 running in the wall of the cylinder 2 opens at its upper end into the space 37 and at its lower end into the said cylinder 2 in such a position that it cannot be covered by the working piston 1 even when this piston is at the lower extremity of its working stroke. In the wall of the cylinder 2 there is also an outlet opening 31 leading to atmosphere and which is left open by the working piston 1 when the same is immediately before the end of its working stroke. A neck piece 8 permits the connection of the internal combustion tool with a compressed medium pipe through which compressed air or compressed oxygen is supplied to the tool. The neck 8 is separated from a conduit 10 by a valve 9 which by means of the lever 32 can be opened against the pressure of a closing spring. The lever 32 is in the vicinity of one of the handles 38 by which the tool is manipulated. The conduit 10 leads into one of the conduits 5 in the wall of the cylinder 2.

The method of operation of the device is as follows:

If the tool is not working, the valve 9 is closed, the working piston 1 is—in the case of the free running piston of a percussive tool (stone borer, breaking up hammer, rammer, and the like)—in consequence of its own weight, in the lower position shown on the drawings. The control and inlet member 24 also takes up the lower position in which it places the space 23 in communication with the explosion space of the cylinder 2. The space 28 is in communication with the space 37, while the latter is cut off from the atmosphere opening 26 by the part 33 of the control member 24. The upper opening of the conduit 29 is in communication with the conduit 34, thus also with the conduits 7, 6, 5 and 10. The regulating valve 16 takes up its lowest position under the influence of its own weight and of the possible (low) pressure obtaining in the space 18 of any residual fuel and air mixture.

To put the apparatus into use, by means of the lever 32 the valve 9 is opened; compressed air or compressed oxygen flows through the neck 8, past the valve 9 through the conduit 10, into the first of the conduits 5, and runs through the connecting conduits 6 and 7 and thence through all the conduits 5 arranged around the cylinder 2, it then comes under the regulating valve 16 and raises this valve. At the same time it passes through the conduit 34 into the space 28, and on to the upper annular surface 27 of the control member 24, and holds this member 24 firmly in the lower position. Since the spaces 28 and 37

are in open communication at the bottom position of the control member 24, the compressed air passes also into the space 37 and through the conduit 29 to below the working piston 1. By the other path, opened by means of the raised regulating valve 16, it passes through the conduits 17 and 15 into the lower space of the carburettor 11 and is divided up into a number of part currents corresponding to the number of the bores 14, which currents pass through the liquid fuel in the container 11 and vaporize a portion thereof, and then mix with the evaporated fuel. The space 18 is consequently filled with a mixture of fuel and air under pressure. The lower face of the lower guiding attachment of the valve piston 16 is smaller than the upper face of the piston-like part of the valve piston 16. The valve piston is thus lifted by the compressed air, as the pressure on its upper side is at first smaller than on the lower face of the guiding attachment. The lower aperture of the bypass channel 17 is freed. The compressed air flows through the channel 17 into the channel 15 (Figure 1) which it can immediately do, as the mouth of the channel 17 is not blocked by the valve piston 16, as is the case with regard to the lower aperture when the valve piston 16 assumes a lower position. Owing to the throttling action of the channel 17, the pressure slowly rises in the channel 15, in the fuel-reservoir 11 and in the space 18. When it is so great that, multiplied with the relatively large area of the upper face of the valve piston 16, it produces a greater force than the (higher) pressures, multiplied with the smaller area of the lower face of the lower guiding attachment of the valve piston 16, the piston 16 is forced downwards and closes the lower mouthpiece of the channel 17. The pressure in the space 11 thus never becomes, owing to the surface difference between the upper face of the piston 16 and the small lower face of its lower guiding attachment, as great as in the channels 5, 6, and 7. The piston valve 16 consequently alternately rises and descends. The pressure developed in the space 18, when it has reached a particular value, corresponding to the ratio of the lower and upper faces of the regulating valve 16, thus closes the conduit 17 and prevents the flow of excessive quantities of compressed air into the carburettor 11. The prepared fuel mixture, which may be further mixed under certain circumstances with pure compressed air through the conduit 19 according to the position of the screw 20, opens the non-return valve 21, flows through the conduit 22 and the space 23, into the combustion space of the cylinder 2. This takes place simultaneously with the inflow of compressed air through the conduit 29 into the space below the piston 1; the piston 1 moved upwards by the compressed air closes the outlet opening 31 and compresses the fuel and air mixture which is above the said opening. The non-return valve 21 is thereby closed. When the compression of the fuel and air mixture has taken place to such an extent that the pressure exerted by it on the full passage surface of the valve 36 from below exceeds the pressure of the compressed air exerted from above on the annular surface 27 of the control member 24 in the space 28, the control member is thrown into its upper terminal position. In this it cuts off the connection between the space 23 and the explosion space of the cylinder 2 and also the connection between the spaces 28 and 37; the supply of compressed air to the space below the working piston 1, through the

conduit 29, ceases. The space 37 is connected with the free air space 26 and the lower space of the cylinder 2 is thereby relieved of air through the conduit 29. Ignition takes place in the known manner by means of a suitable sparking plug, the ignition current circuit being closed by the projection 25 on the control member 24, and the piston 1 is thrown violently by the pressure of the explosion downward onto the tool 38. As soon as it releases the exhaust opening 31, the gases of combustion flow out, the control member 24 takes up its lower position; fuel and air mixture passes out of the space 18 past the non-return valve 21, the conduit 22 and the space 23 into the cylinder 2, flushes the gases of combustion out of this, and the piston 1 is moved upwards by the compressed air reaching its lower side through the conduit 29 and compresses the fuel which is above it. The sealing surface 36 preserves the control member from fouling. The cycle of operations is repeated.

The form of construction shown in Figure 6 differs from that according to Figure 1 in that instead of prepared fuel and air mixture, liquid fuel is injected into the cylinder and the flushing of the products of combustion from the cylinder 2 takes place by compressed air which reaches the cylinder through the narrow annular gap 44 and the bores 40, and that the control member 24 serves as fuel pump and atomizer, liquid fuel which is supplied to the apparatus by the inlet 41 reaching the cylinder 2 through the bore 42 and the nozzle 43, during the upward movement of the control member 24. The scavenging air and the combustion air for the next ignition pass by the raised ball valve and the annular gap 44, and thence by the bore 40 into the cylinder. An upward cylindrical extension of the member 24 fits closely in a boring in the valve casing. By the upward movement of the control member 24 the ingress of fuel at 41 is cut off and the fuel which is in the upper part of the boring is driven through the bore 42 into the combustion space of the cylinder and finally atomized in the nozzle 43, simultaneously with the admission of compressed air through the bores 40. As soon as the control member touches the contact shown at the right hand side of Figure 6 ignition takes place, under which contact is the exhaust opening to the atmosphere.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A hammer motor of the character described, comprising the combination, with a cylinder having a bore and a working piston reciprocable in said bore, of a valve casing mounted on said cylinder and having a valve chest, channel means in the walls of the cylinder providing communications from the forward and rear ends of the cylinder to the valve chest, fuel channel means in the valve casing for connecting the valve chest with a liquid fuel supply, an exhaust port in said casing, gas channel means communicating with said valve chest and opening into the same for conducting elastic pressure medium containing oxygen to said valve chest from a compressed gas supply, further channel means communicating with said exhaust port and thereby with the atmosphere, operable control means interposed in the gas channel means serving to control admission of pressure medium into said valve chest, a piston valve reciprocable in and occupying said valve chest, said valve piston having a surface portion receiving pressure medium from said gas channel means so as to move said piston valve in

one direction, and a plurality of distinct means upon said valve piston serving as closure means individually supervising the communications of all of the channel means with the valve chest.

2. A hammer motor of the character described, comprising the combination, with a cylinder having a bore and a working piston reciprocable in said bore, of a valve casing mounted on said cylinder and having a valve chest terminating at one end in a seat opening into the cylinder bore, 5 channel means in the walls of the cylinder providing communications from the forward and rear ends of the cylinder to the valve chest, fuel channel means in the valve casing for connecting the valve chest with a liquid fuel supply, an exhaust port in said casing, gas channel means communicating with said valve chest and opening into the same for conducting elastic pressure medium containing oxygen to said valve chest from a compressed gas supply, further channel means 15 communicating with said exhaust port and thereby with the atmosphere, operable control means interposed in the gas channel means serving to control admission of pressure medium into said valve chest, a piston valve reciprocable in and occupying said valve chest, said valve piston having a portion engaging with said seat in closed position and having a surface portion receiving pressure medium from said gas channel means so as to move said piston valve in one direction, 30 a plurality of distinct means upon said valve piston serving as closure means individually supervising the communications of all of the channel means with the valve chest, and a projecting portion upon said valve piston adapted to engage with and operate an electric switch. 35

3. A hammer motor of the character described, comprising the combination, with a cylinder having a bore and a working piston reciprocable in said bore, of a valve casing mounted on said cylinder and having a valve chest, a carburettor having a fuel mixture inlet and an outlet, channel means in the walls of the cylinder providing communications from the forward and rear ends of the cylinder to the valve chest, fuel channel 45 means in the valve casing for connecting the valve chest with the fuel mixture outlet of the carburettor, an exhaust port in said casing, gas channel means communicating with said valve chest and opening into the same for conducting elastic pressure medium containing oxygen to said valve chest from a compressed gas supply, further channel means communicating with said exhaust port and thereby with the atmosphere, a movable regulating valve member interposed in said fuel channel means with a portion exposed to fuel mixture from said fuel mixture outlet of the carburettor and also interposed in the gas 50 channel means with another portion exposed to pressure medium from said gas channel means, communication means between the carburettor inlet and said gas channel means, said regulating valve member controlling and supervising the communication means between said carburettor inlet and said gas channel means, operable control means interposed in the gas channel means serving to control admission of pressure medium into said valve chest, a piston valve reciprocable in and occupying said valve chest, said valve piston having a surface portion receiving pressure medium from said gas channel means so as to move said piston valve in one direction, and a plurality of distinct means upon said valve piston serving as closure means individually supervising 75

the communications of all of the channel means with the valve chest.

4. A hammer motor according to claim 1, wherein the gas channel means extend into the walls of the cylinder from the valve casing in the form of a sinuous conduit system.

5. A hammer motor according to claim 1, wherein the gas channel means extend into the walls of the cylinder from the valve casing in the form of a sinuous conduit system, which consists of a large number of conduits in parallelism with the axis of the cylinder and cross conduits alternately connecting the parallel conduits at one end and then the other in pairs.

6. A hammer motor according to claim 1, wherein the valve chest opens into the cylinder bore and at the opening terminates in a valve seat, and the valve piston is provided with a portion rigid therewith engaging with said seat in one extreme position of the valve piston in order to seal off the valve chest from the cylinder bore during the explosion in said cylinder.

7. A hammer motor according to claim 1, wherein the various channel means communicating with the valve chest open into the same at different levels, and the plurality of distinct means upon the valve piston comprise a plurality of rigid portions individually closing said channel means in predetermined positions of said valve piston.

8. A hammer motor according to claim 1, wherein the valve casing has a bore interposed in the fuel channel means and terminating in a fuel nozzle, and one of the distinct means upon the valve piston comprises a rigid extension movable in said bore capable of closing said fuel channel means in a predetermined position of the valve piston, and wherein said valve piston is also provided with a portion adapted to engage with and operate an electric switch.

9. A hammer motor according to claim 3, wherein the carburettor comprises a vessel sus-

pended upon the upper portion of the device, the vessel having an introduction means in the upper portion thereof and a closure therefor, said vessel having adjacent to its lower end a perforated partition and at its lower end communication by the fuel channel means with the valve chest and thereby with the gas channel means communicating with the pressure medium supply.

10. A hammer motor according to claim 3, wherein the carburettor is provided with a fuel container formed with an opening communicating through the valve chest with the gas channel means communicating with the pressure medium supply, in order to cause secondary air to be admitted from said supply to fuel mixture in said container produced by the carburettor, and wherein a regulating screw extends to the mouth of said opening for regulating the flow of the secondary air to said container.

11. A hammer motor according to claim 3, wherein the carburettor is provided with a container for the fuel mixture mounted on the valve casing and formed with a channel means communicating with the valve chest, and wherein a non-return valve controls said channel means.

12. A hammer motor of the character described, comprising the combination, with a cylinder having a bore and a working piston reciprocable in said bore, of a valve casing mounted on said cylinder and having a valve chest, ports in said valve casing communicating with channel means within the same for controlling the admission of fuel and air to said cylinder, a control valve member reciprocably located in the valve chest within said casing capable of opening and closing said ports in predetermined positions of said control valve member and means communicating a pressure medium to the valve chest within said casing to propel said control valve member in one direction of movement.

MAX KIECKSEE.