Nov. 8, 1955 R. K. A. WIIG 2,722,928

ENGINE OPERATED PORTABLE WOOD FELLING SAW

Filed April 7, 1950 3 Sheets-Sheet 1

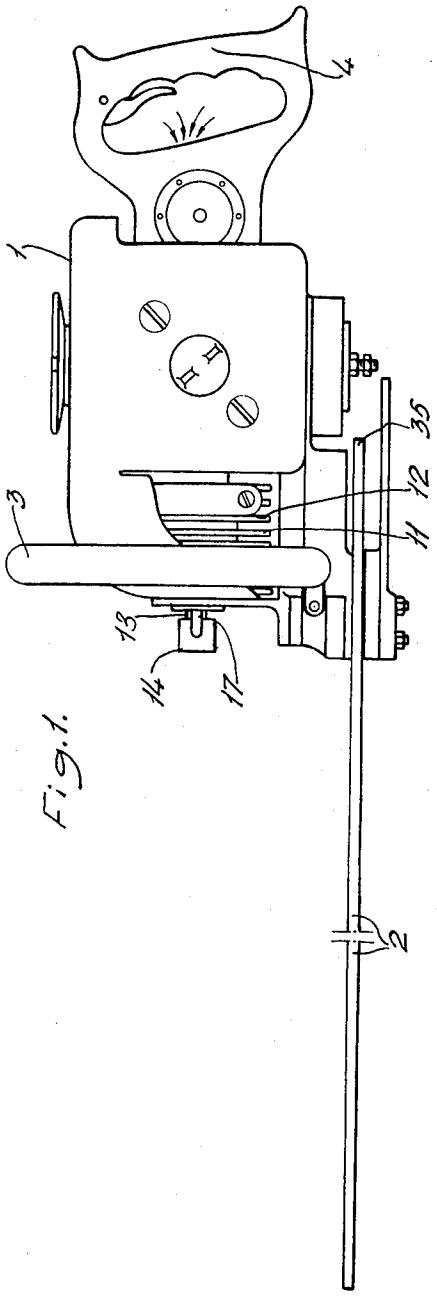

Fig. 1.

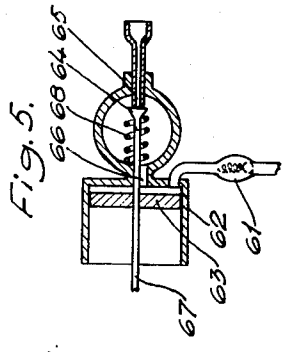

Fig. 5.

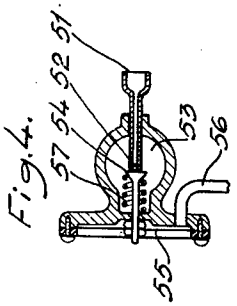

Fig. 4.

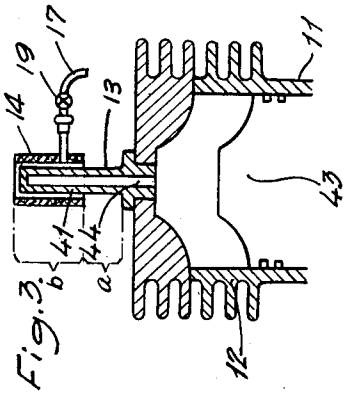

Fig. 3.

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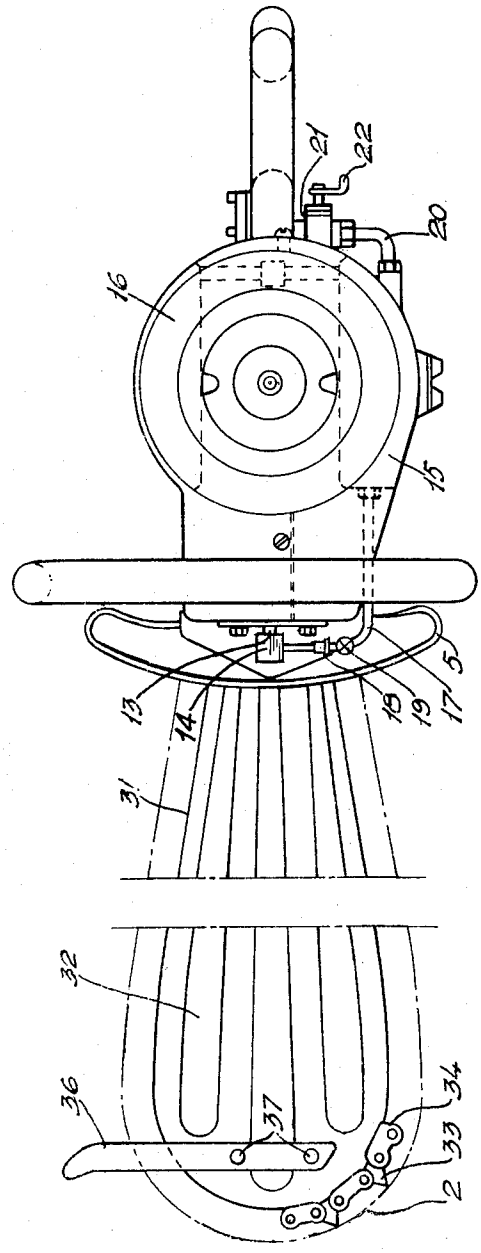

Fig. 2.

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Fig. 6.

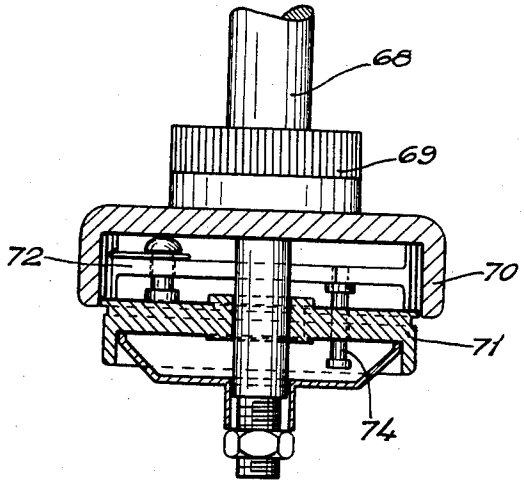
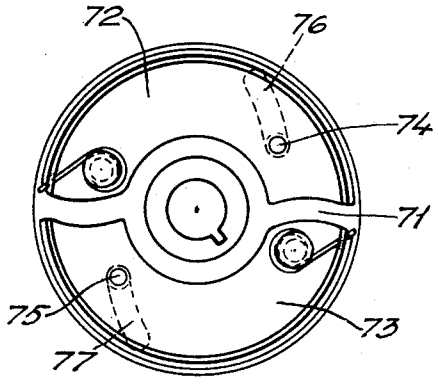


Fig. 7.



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ENGINE OPERATED PORTABLE WOOD FELLING SAW

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4 Claims. (Cl. 123—145)

The present invention refers to a portable wood felling saw, which is considerably lighter in weight than those known so far. There is especially aimed at a motor saw of the type comprising an endless chain equipped with saw teeth and guided along the periphery of a guide plate (centre plate), and a driving motor for the saw chain. As in use such saws are to be carried from place to place in rough terrain and to be held with the hands during the sawing operation, it is of greatest importance to reduce the weight to a minimum. In spite of many years of experiments, however, it has not been possible to reduce the weight sufficiently. Thus, the lightest motor saws of the said type known so far have a weight of more than 16 kg. For motor saws there have hitherto been used small internal-combustion engines of normally 1–4 H. P., and exclusively of the type carburetor motors with electric ignition. To render motors of this kind light enough for practical use, it has been necessary to construct them for a high number of revolutions, for which reason it has been impossible to utilize the ordinary diesel or hot bulb principle because a feature of the last-mentioned types of motor is that the fuel is injected by means of the pump at the moment of ignition, and the valves of these pumps do not function at the high number of revolutions required for the saw motors and the motors of hand implements. Therefore, it has never been thought possible to use motors of other types than such having carburetors and electric ignition. In this connection no importance has been attached to the fact that an internal-combustion engine with self-ignition has been used for model aircrafts, because in that case it has only been the matter of a motor at which the load is constant, the time of operation only some seconds and the thermal efficiency without importance. That such an aircraft motor can be caused to function satisfactorily without special control members for determining the moment of explosion has been considered to lack significance for ordinary service motors. There has not been thought of the possibility to utilize such a motor for driving motor saws or other hand implements exposed to a highly varying load from idling to maximum load and working continuously for a time up to several hours.

According to the present invention, the electric ignition system and the fuel pump system are removed, and the motor is either provided with a hot bulb of special design or is constructed with an adjustable compression chamber. As it is here presumed that the hot bulb principle has advantages over the diesel principle, the description will substantially comprise the principle first mentioned. Furthermore, the motor is provided with different means for securing a smooth and satisfactory run under the varying and partly difficult circumstances to which engine operated hand implements are subjected. By replacing a hot bulb system for the electric ignition system, the weight of the motor is reduced by about 30%. Besides, this gives greater liberty at the construction of the other part of the implement. Thus, in motor saws according to the invention the motor cylinder may be

mounted at advantage in the longitudinal direction of the saw plate, which has been impossible in the motor saws used so far, and which renders less vibrations in the handle of the saw.

According to the present invention, the fuel is sucked in together with the air which is necessary for the explosion. This fuel-air mixture is compressed and caused to explode by contact with the hot bulb.

It might be evident that special means are necessary to prevent too early ignition after some time of operation and at varying piston velocity. Experiments have shown that correct ignition can be secured by connecting the combustion chamber of the hot bulb with the cylinder by a channel or concaveness, the length and/or the cross section of which causes that a certain gas compression, for instance the compression necessary to give an explosion at a certain temperature, is obtained a moment later in the hot bulb or the cylinder. During the operation of the motor both the cylinder and the channel are cooled from outside, and the hot bulb will have a sufficiently uniform temperature, to which the moment of ignition is adjusted.

To keep the hot bulb at a uniform temperature and prevent it from being cooled together with the channel, it has appeared necessary to screen it. For this purpose there is preferably used a jacket of asbestos, covering the outer portion of the hot bulb. Said jacket may be removed when the motor has been completely heated or it may be mounted permanently, in doing which the start heat is supplied to the channel. At the latter process it might be thought that the start is rendered more difficult by too early ignition, but at this time the cylinder is cold and the motor is unloaded. The screening described above is also of importance thereby that the hot bulb keeps the temperature necessary for starting some time after the motor has been started. In motors for motor saws it is necessary to have overpressure in the tank for the liquid fuel, because it means a great advantage that the implement may be placed in different positions during the work without requiring special manual operations to prevent the fuel from leaking out through the supply hole of the tank or to secure uniform supply of fuel to the motor.

However, this overpressure involves the drawback that the fuel supply has to be opened and closed at the starting, and at the stopping respectively, of the motor. According to the present invention this drawback is avoided by a device, whereby the overpressure of the motor is conducted through a channel against a membrane or a piston acting on a valve, which, when the motor is out of operation, rests against the nozzle opening with the aid of a spring pressure and closes said opening. At the starting of the motor, the varying pressure of the crankcase causes the piston or membrane to perform a movement which is transmitted to the valve, so that the fuel nozzle is opened. This arrangement also acts as an automatic speed control for the motor. It has turned out, namely, that when the channel is of a certain length and a comparatively small cross section, an increasing number of revolutions reduces the average pressure on the pressure side of the membrane with the result that the valve connected with the membrane or the piston strives to guide the fuel nozzle.

An automatic speed control is also obtainable by transmitting the crankcase pressure through a channel provided with a pressure valve to a piston placed in a cylinder, which piston is provided with a valve closing the nozzle opening by spring pressure in the position of rest. When a pressure arises in the channel, the piston is moved so that the nozzle is opened. If due to increased revolution of the motor the pressure exceeds a certain maximum, a rod having one end connected to the piston

and the other end to the air throttle lever effects a choking of the fuel-air mixture.

If the diesel principle is followed, the compression chamber must have possibilities of expanding responsively to rising cylinder temperature. This is suitably obtained for instance by means of an internally threaded channel with comparatively large diameter leading from the compression chamber, in which a sealing screw may be tightened or loosened.

The main feature of a motor saw according to the invention is that the driving motor is a high speed mixture-compressing combustion motor with hot bulb or self-ignition.

To furthermore reduce the weight of the motor saw, the guide plate of the saw chain is constructed with longitudinally extending grooves and as thin as possible. By providing the plate with such grooves it is possible to make it essentially thinner than it must be, if it is made plane.

An embodiment of a motor saw according to the invention and a driving motor pertaining thereto are shown diagrammatically by way of example in the accompanying drawings, in which

Fig. 1 shows the motor saw viewed from the side and Fig. 2 is a plan view of the same. Fig. 3 shows on a larger scale a section through the compression end of the cylinder. Fig. 4 is a section through a fuel control device, likewise on a larger scale, and Fig. 5 is a corresponding construction of a modified embodiment of the control device. Fig. 6 shows a longitudinal section through a safety clutch between the motor and the saw chain, and Fig. 7 shows a clutch part viewed from above.

According to Figs. 1 and 2, the numeral **1** designates the motor proper while **2** is the saw chain which in Fig. 1 is indicated diagrammatically only. **3** is a bow mounted at the end of the motor facing the saw chain and **4** a handle at the rear end of the motor. **5** is a cross piece intended to rest against a tree during the sawing.

The motor proper comprises the cylinder **11** with cooling flanges **12** and piston **43**. **13** designates a tube projecting from the cylinder and communicating internally with the compression end of the cylinder. The outer end of tube **13** is closed to constitute a tubular hot bulb or ignition chamber and the outer portion *b* of the tube is enclosed by an open tubular jacket **14**, preferably of asbestos as previously explained, to retain the heat from the combustion in the engine cylinder. **15** is a fuel tank located on one side of the motor, while **16** is a fuel tank on the other side thereof. The two tanks are interconnected in some appropriate manner. **17** is a pipe leading from the fuel tank **15** to a fuel nozzle **18**, by the aid of which a flame can be directed towards the outer portion *b* of the tube **13**. **19** is a valve for controlling the fuel supply to the nozzle **18**.

20 is the real fuel supply pipe of the motor and leads to a carburetor **21**. **22** is a handle of a member controlling the fuel supply. The carburetor **21** and the member **22** are located on opposite sides of the motor adjacent the handle **4**, so that the member **22** is operable by one finger of the hand holding the handle **4**. **31** is a so-called guide plate, i. e. an elongated plate serving as guidance for the saw chain. According to the invention the guide plate **31** is made with longitudinal grooves **32**. This involves the advantage that the guide plate is stiff even if made essentially thinner than is necessary to obtain sufficient stiffness in a plane plate. **33** designates a saw tooth located on a chain link **34**. The chain links **34** together form an endless chain, which is disposed along the periphery of the guide plate **31** and which at **35** is laid around a chain wheel not shown here, said chain wheel being driven by the motor. **36** is an arm, which by means of bolts **37** or the like is exchangeably fixed to the guide plate at the outer end thereof. The arm extends approximately in the plane of the guide plate and perpendicularly to the longitudinal direction thereof, and serves as support against that side of a tree to be cut, which is opposite to the side against which the saw is resting. It is of importance that this arm is exchangeable, while otherwise the saw would not be usable for cutting trees of larger diameter than the length of the guide plate.

The construction of the motor proper will be described in the following text with special reference to Figs. 3, 4 and 5. As shown in Fig. 3, the compression end of the motor cylinder is adapted with an ignition chamber **44** constituted by the interior of tube **13** mounted at its outer end, which tube protrudes from the cylinder and is screwed into the cylinder head.

The volume of the ignition chamber is suitably dimensioned for determining the motor compression. The diameter of the channel connecting this chamber with the motor cylinder **11** is suitably dimensioned for determining the ignition moment thereby that the portion *a* in Fig. 3 adjacent the motor cylinder is kept cooled with the aid of an air stream from the cooling fan of the motor, while the outer portion *b* is not cooled, such portion preferably being insulated by means of the absestos jacket **14** previously referred to and hence will remain hot on account of the explosions. As mentioned before, the portion *b* is heated by means of a flame at the starting.

To allow disposition of the motor saw in all planes without any special operations or adjustments, the motor works up a pressure in the tank and the fuel is conducted from the same through a rubber hose, the free end of which is provided with a weight. Further, the fuel is passed on through the pipe **51** to the nozzle **52**, the outlet of which into the inlet chamber **53** is closed by the valve **54**, see Fig. 4. When the motor piston compresses the air in the crankcase, this pressure is transmitted to the membrane **55** through the channel **56**, and the valve **54** admits the fuel to the inlet chamber **53**. The spring **57** urges back the valve **54** and closes the fuel nozzle. When the motor has started running, the membrane will give the valve a suitable opening. If the motor is non-loaded, thereby obtaining a higher number of revolutions, there will be formed so much turbulence in the pipe or the channel **56** connecting the crankcase with the membrane housing, that the spring **57** overcomes the pressure exerted by the membrane, the valve **54** will close the fuel supply and the number of revolutions of the motor will fall. Thus, this membrane will act as a speed control. When the motor has run for a time at full load, for instance at felling or cutting, it will be very hot, but because of its piston velocity no pre-ignition will take place.

However, in case the motor is to run slowly, there will be a risk of pre-ignition until the cylinder has cooled down. This can be prevented by choking the pipe sucking in the fuel-air mixture.

Fig. 5 shows how such a choking is effected automatically. In the figure, **61** designates a pipe or channel leading from the crankcase to a cylinder **62**, in which a piston **63** is working. The said piston carries a valve head **64** for the fuel supply pipe **65**. A narrow channel **66** is arranged in the wall between the cylinder **62** and the air supply pipe. On its opposite side, the piston **63** furthermore carries a rod **67** connected to the lever of a throttle (not shown in the drawing) in the air supply pipe. This device functions in such a manner that at the start of the motor the piston **63** first opens the fuel nozzle **65**, whereupon it automatically controls the fuel-air supply to the motor. This automatic control is obtained thereby that supply of air through the channel **61** increases with rising number of revolutions, so that the piston **63** is moved to the left. If the number of revolutions decreases, the pressure to the right of the piston will fall because the air leaks out through the channel **66**.

It is of great importance that the saw chain is dis-

connected from the motor if clamped by the tree. For this purpose, some saws use the so-called centrifugal coupling, which operates in such a manner, that the chain is connected when the motor reaches a suitable number of revolutions and is disconnected when the motor is over-loaded or the speed is reduced intentionally. A coupling of this kind demands exact adjustment to prevent wear on the lamellae and besides they are dangerous if the number of revolutions of the motor increases when carried by the cutter between the trees or if the gas control is actuated by a twig or the like, so that the chain is engaged when the cutter is unprepared therefor.

According to the present safety means, accidents are prevented but advantage is taken of the centrifugal force, the motor never being over-loaded or stopped, and no exact adjustment of the coupling is necessary. Besides, one movement of the hand is sufficient to secure that the chain is not connected at all.

The safety connector according to the invention is seen from Figs. 6 and 7. The motor shaft **68** carries a toothed wheel **69** which is rotatably journalled in ball bearings and is in mesh with a drive wheel for the saw chain. The wheel **69** is connected to a case **70**, into which is inserted a keyed-up clutch disk **71**. The clutch disk is provided with two pivotally journalled cheeks **72** and **73**, which, at a certain number of revolutions of the shaft **68** and against spring-action, are swung out towards the inner wall of the case **70** by the centrifugal force, whereby through friction they bring the said case, the wheel **69** and consequently also the saw chain to partake in the rotation.

The cheeks **72** and **73** are provided with pins **74** and **75** respectively, which at the movement of the cheeks are displaceable in elongated grooves **76** and **77** respectively in the disk **71**. The cheeks are lockable, i. e. they may be prevented from swinging out, for instance by pushing on a conical jacket **78**, which is journalled on the shaft **68** and is preferably arranged so as to lock the cheeks when the motor saw is set down on the ground or some other place. The jacket **78** prevents the pins **74** and **75** from sliding in their grooves, whereby the cheeks **72** and **73** are prevented from frictionally engaging the inner side of the case **70**. Accordingly, the clutch makes it possible by a single movement of the hand to secure non-connection of the saw chain. The clutch according to the invention requires no exact adjustment, as there is a considerable air gap between the cheeks and the inner side of the case **70**.

The motor saw described above starts easily, is reliable and very easy to operate. At the same time it is well up to the purpose, which is of great importance under different working conditions. It should also be mentioned that the saw according to the invention is considerably less expensive to manufacture than the previous motor saws of similar type.

Having now described by invention, what I claim as new and desire to secure by Letters Patent is:

1. In a saw motor of the single cylinder internal combustion type having a crankcase, an intake chamber and a hot bulb for ignition adapted to be connected in driving relation with a saw chain of the endless type, the plane of which is parallel to the motor cylinder, said hot bulb comprising an elongated tubular chamber dimensioned to determine the moment of ignition of the compressed combustible mixture, said chamber being closed at its outer end and having its inner end in communication with said motor cylinder, the inner end portion of said tubular chamber adjacent said motor cylinder being air cooled and the outer end portion of said tubular chamber being non-cooled.

2. A saw motor as defined in claim 1 and which further includes an insulating jacket surrounding the outer end portion only of said tubular chamber.

3. A saw motor as defined in claim 2 and which further includes means for heating the portion of said tubular chamber surrounded by said jacket when said motor is started.

4. A saw motor as defined in claim 3 wherein the heating means for the portion of said tubular chamber surrounded by said jacket is comprised of a fuel supply nozzle communicating with the interior of said jacket.

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