G. BRADSHAW.

COOLING INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 12, 1921.

1,420,684.

Patented June 27, 1922.

2 SHEETS—SHEET 1.

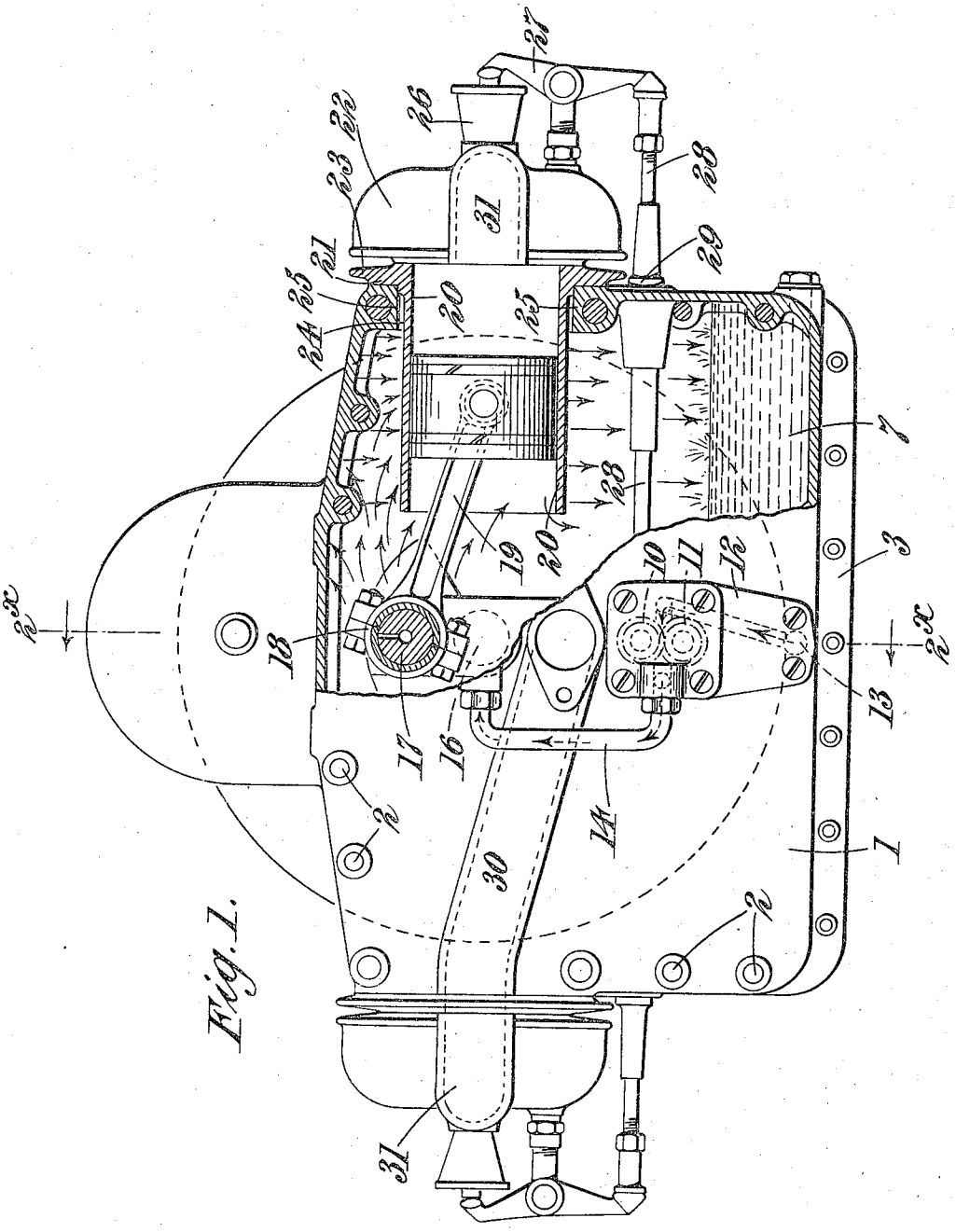


Fig. 1.

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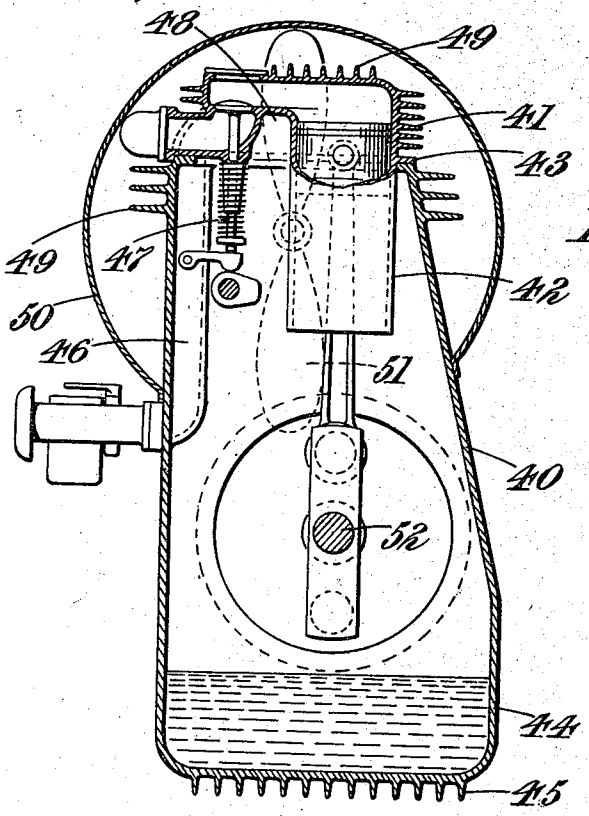


Fig. 3.

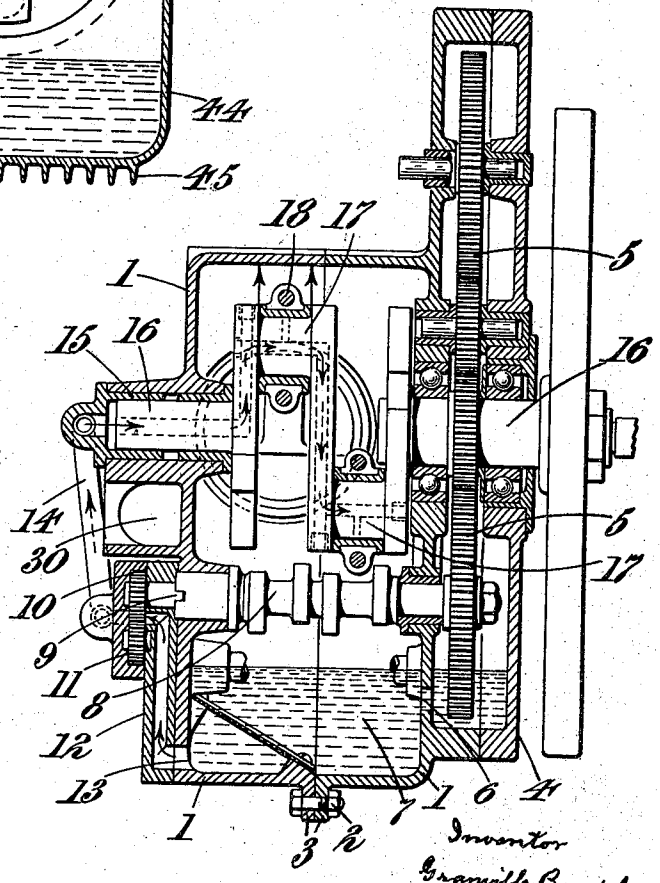


Fig. 2.

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UNITED STATES PATENT OFFICE.

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COOLING INTERNAL-COMBUSTION ENGINES.

1,420,684. Specification of Letters Patent. Patented June 27, 1922.

Application filed July 12, 1921. Serial No. 484,217.

To all whom it may concern:

Be it known that I, GRANVILLE BRADSHAW, a subject of the King of Great Britain and Ireland, residing at Darby House, Sunbury-on-Thames, Middlesex, England, have invented certain new and useful Improvements in Cooling Internal-Combustion Engines, of which the following is a specification.

My invention relates to the cooling of internal combustion engines and particularly of those in use on motor cycles, cars and the like, and of the so called air-cooled type, but it may also be applied to other types of engine either air or water-cooled.

Owing to the elaboration of wind and mud shields and like obstructions on modern motor cycles, radiation has more largely been relied upon lately for cooling than convection, which has previously been the practice.

Recent tests have brought to light the fact that approximately one half of the heat dissipated from an internal combustion engine is diffused by the crank case, although no practical effort has been made to develop the crank case as a cooling medium. According to this invention however, I provide a crank case of a size and form particularly suitable for this purpose, in conjunction with an oiling system adapted to assist the transportation of heat from one surface to another as will be explained. The crank case is of course made as efficient as possible from the radiation point of view, and may or may not follow the known practice of having cooling fins or ribs provided. Such fins are not in fact efficient unless subjected to a current or air not always available.

Advantages incidental to the use of this invention are evenly distributed cooling throughout, which tends to eliminate expansion difficulties, cooling of oil before circulation, cleanliness, pleasing smooth exterior appearance, reduction of noise, easy and simple construction, and cheapness, owing to highly efficient running. Provision is also made whereby the usual induction pipe union at the induction port end is dispensed with, with consequent simplicity and reduction of parts and weight; the induction pipe is also so placed as to be warmed.

According to this invention, an internal combustion engine is provided with a crank-case large enough to accommodate not only the usual crank shaft, connecting rods, etc., but also the whole or greater part of the cylinders, and the oil is so circulated or kept in motion that it acts as a vehicle for the heat generated in the cylinders and other hot parts, and passes from them to the walls of the crank case or a sump or chamber connected therewith, where it gives up its heat by conduction to the metal which in turn dissipates it either by radiation or radiation and convection (i. e. on the well known air cooled principle). For this purpose the crank case is preferably made with the largest possible external area. The junction between cylinders and crankcase may be about the combustion chamber, or lower down the cylinder, or actually at the cylinder head (where the cylinder is to be totally enclosed). The valves, if of overhead type, may be operated from a camshaft inside the crankcase, by push-rods working through glands in the crankcase, or may be of ordinary side type totally enclosed in the crank-case, as will be shown. Pump lubrication and oil distribution is preferably used, and if a separate oil-cooler is desired a secondary pump may be used to circulate the oil in the oil-cooling system. In a preferred form however, the oil is merely drawn from a sump, passed to one bearing of the crank-shaft which has ducts drilled through to the crank pins, where the big ends are lubricated and the oil is caused to fly out from the cranks on to the cylinders, inside and outside of them and on to any such parts as valves, as may be desired. It then drips or is flooded on to the crank case inner surface where it gives up heat taken from the cylinder, etc. Not only the crank case may be used thus to dissipate the heat, but if, for example, a gear box is employed it may be arranged that it is partially or wholly flooded with the oil, the chief object being to increase the effective radiating area of the whole machine as much as is practicable. Another feature of my invention is the construction of the crank case with induction pipes cast in its walls so that when the cylinders are in correct position the induction valve ports register with the end of the pipes, no joint being necessary other than the usual holding down devices of the cylinders or cylinder heads. If side valves are used, the construction of the improved engine allows of efficient cooling of a most difficult but essential part namely, the recess formed between the valve chamber and the

cylinder wall or combustion chamber. These points, however, will be better understood with the aid of the accompanying drawing, on which:—

Figure 1 is a view of a cylindrical horizontal engine, partly broken away.

Figure 2 is a section of the same on the line 2× of Figure 1.

Figure 3 is a section of an engine I have designed having four vertical cylinders and side-by-side valves, according to an alternative form of the invention. The first engine is of a type convenient for motorcycle use, the second for automobile use, but this of course is immaterial to the features of the invention.

In Figures 1 and 2 a cylinder engine is shown with crank case 1, made in two halves and bolted together by nuts and bolts, 2, through flanges, 3, where necessary, an oil-proof joint being obtained if necessary by the use of any usual device such as a gasket. Cast integral with the crank case is the timing gear case, 4, with timing pinions, 5. A passage 6 connects the crankcase with the timing case below oil level, so that the bases of both form in effect one large reservoir or sump for the oil shown at 7. The cam shaft 8 is bushed at either end, in the walls of the crankcase, and drives at one end preferably through a dog 9, carried by one pinion 10 of a gear-wheel oil pump of which 11 is the following pinion. The pump is housed in a separate casting 12 in two parts fastened on to the outside of the crankcase in any convenient manner oil ducts being drilled or formed in the casting 12 registering with a hole 13 in the sump at the bottom and connected to an oil pipe 14 at the discharge side, which leads the oil, forced by the pump, up to the crankshaft and bearing 15. As shown, the oil enters the crankshaft 16 axially through an oil drill, but if this is impossible owing for example to the use of a starting handle applied to the end of the crankshaft 16, any method such as a circumferential groove or other well known device may be used. The oil is forced through drills in the crankshaft 16, to the crankpins 17. Up to this point the system resembles a well known system of ordinary forced lubrication, but according to this invention, the big end 18 of the connecting rod 19 is made a loose fit between the crankwebs, so that oil may spray out of each side of the bearing as indicated by the arrows, centrifugal force being the cause of this although the pressure exerted by the pump may be contributary.

I do not wish to be confined to this precise system of oil distribution, since many well known methods are adaptable and even splash lubrication might be relied upon, although positively forced circulation is preferred.

The cylinders of the engine comprise barrels 20 with flanges or shoulders 21 forming a shallow spigot joint with the crankcase, and heads 22. One cooling fin 23 is shown in this form, conveniently formed as an extension of flange 21 although more may be used, and the cylinder head 22 may have them also if required. It will be noted that an annular recess 24 has been shown between the shoulder 25 of the crankcase and the barrel 20. This was arrived at as the result of experiment, it being found that a thick joint of large contact area such as would otherwise exist was undesirable. As it is shown, oil can convey heat from high up the barrel 20 and keep an even temperature there. The spigot joint between the flange 21 and shoulder 25 is preferably tightened up hot by tightening the nuts and bolts 2 which clamp the crankcase together at that part thereof, good contact of the parts being conductive to better conduction of the heat from the inside outwards. The crank case near the cylinders may thus be made responsible for an appreciable loss of heat by direct conduction and subsequent radiation. The cylinder heads 22 may be jointed to the barrels 20 in any usual manner and holding down bolts provided (not shown) as usual. The engine is shown for simplicity with only inlet valves 26, with rockers 27 and push rods 28 working through glands 29 in the crank case wall off the camshaft 8. The camshaft will be seen to be in an excellent situation where lubrication is concerned.

The whole object of the construction above described is to place the cylinder barrel 20 where it can be constantly subjected to a flood of oil, both outside and inside, and since it is almost entirely enclosed in the crankcase this object is achieved. The sprays of oil from the big ends of the connecting rods form in effect a constant circulation over the hot parts of heat transporting medium, which then falls back on to the cooler crankcase walls, which cool it, so that when it ultimately comes into re-circulation it can take over another charge, as it were, of heat.

A feature of the invention is to be seen in the induction pipe 30, which is cast in the crankcase wall, and is so arranged that the induction port or a prolongation of it 31 cast on the cylinder head 22 registers correctly with it when the head is in position and is of course as gas tight a fit as the cylinder head joint itself. An advantage of this device is the elimination of the difficulties arising out of uneven expansion, often to be found in engines of the opposed type. Also, the oil, in warming the induction pipe and mixture, itself becomes cooled.

In Figure 3 is shown as alternative form a vertical engine. In this form, more cooling fins are provided, both on the cylinder head and crankcase.

The crankcase 40 is as before extended

far up the cylinder barrel 42 which in this case is integral with the cylinder head 41. A flange 43 extends partially around the cylinder to form a means of attachment with the crankcase 40 and the cylinder is also attached thereto on the valve side by lug or other means.

The crankcase is provided with a capacious base 44 with cooling flanges 45 if desired to assist in the cooling of the oil. The induction pipe 46 is as before cast with the crankcase and registers with a port in the cylinder block. In this engine all the external valve gear 47, including the spring, and that part of the stem projecting from the guide, are enclosed in the crankcase and are thus freely lubricated and noise is minimized. A feature of the arrangement is the efficient cooling of the valve chamber and that part of it which merges into the combustion head at 48 in the drawing which is exposed to the flow of oil (which circulates in the manner previously described) thus overcoming what was previously a serious difficulty in design. As stated, external cooling fins 49 may be used on crankcase and cylinder and a cowl 50 may be used to facilitate convection cooling in conjunction with a driven fan 51.

I claim—

1. In combination in an internal combustion engine, a crank shaft case enlarged to substantially enclose an engine cylinder, thereby providing greatly increased heat dissipating surface, an engine cylinder extended sufficiently within said casing to expose to the interior of said casing a part of the cylinder subject to the heat of explosion, and means for directing a moving film of cooling oil over said heated part of the cylinder whereby the heat of the cylinder is continuously and rapidly conducted away and the cylinder maintained at a lower temperature.

2. In combination in an internal combustion engine, a crank case adapted to receive and contain cooling oil, an engine cylinder extending within said case and spaced therefrom and having exposed to the interior of said case a part thereof which is subject to the heat of explosion, and means for maintaining over said heated surface a flowing film of cooling oil which flows from said cylinder into said crank case, whereby the heat of the cylinder is continually absorbed by the oil which conducts it into the crank case which absorbs it from the oil and dissipates it.

3. In combination in an internal combustion engine, a crank case enlarged to substantially enclose an engine cylinder, an engine cylinder extended sufficiently within said casing to expose to the interior of said casing a part of the cylinder subject to the heat of explosion, and a crank revolubly mounted in said casing and adapted to project upon said exposed cylinder surface a spray of oil, thereby cooling said heated part.

4. In combination in an internal combustion engine, a crank case enlarged to substantially enclose an engine cylinder, an engine cylinder extended sufficiently within said casing to expose to the interior of said casing a part of the cylinder subject to the heat of explosion, and means for simultaneously directing oil over said heated part to cool the same and over the inner face of said cylinder.

5. In combination in an internal combustion engine, a crank case enlarged to substantially enclose an engine cylinder, an engine cylinder extended sufficiently within said casing to expose to the interior of said casing a part of the cylinder subject to the heat of explosion, and a crank revolubly mounted in said casing and provided with oil passages and adapted to project upon said exposed cylinder surface a spray of oil.

GRANVILLE BRADSHAW.