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PUMPING SYSTEM
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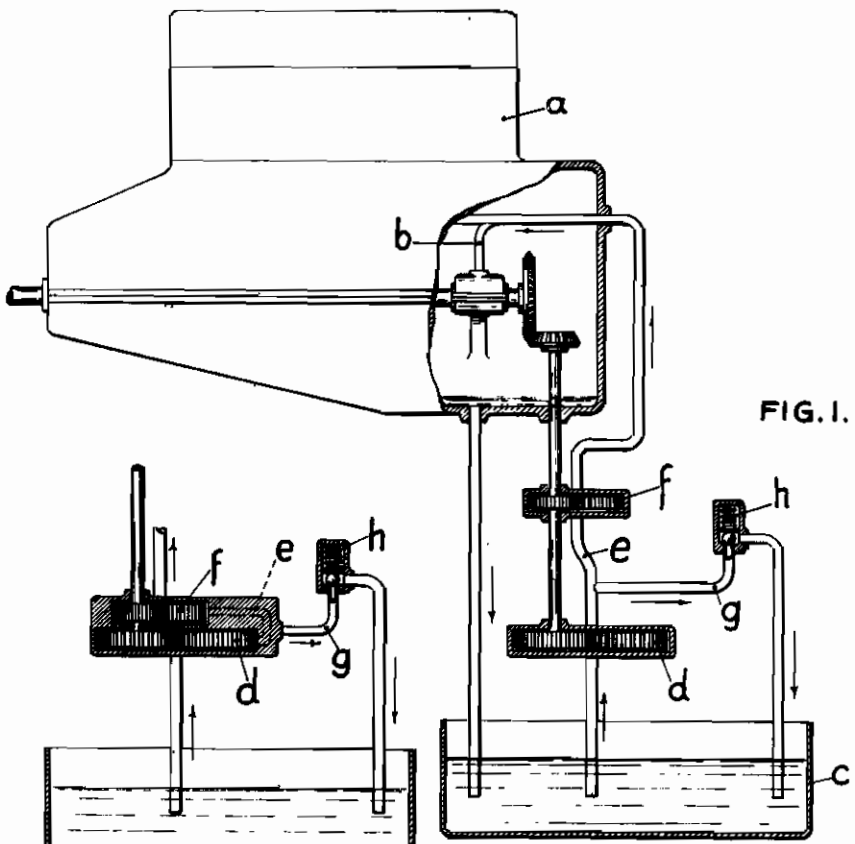

FIG. 1.

FIG. 2.

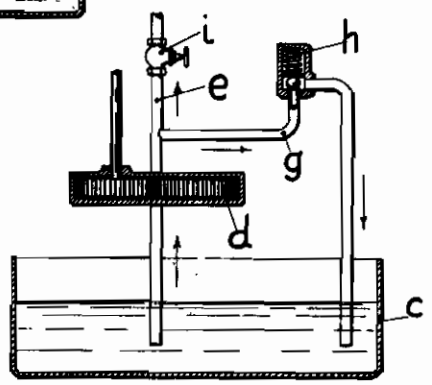

FIG. 3.

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PUMPING SYSTEM

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This invention relates to a pumping system and particularly to such a system for pumping a lubricant to various parts of an internal combustion engine.

An object of this invention is the provision of a novel pumping system constituting an improvement of those now known to the art.

Another object of this invention is the provision of a novel and improved pumping system for supplying a lubricant to internal combustion engines.

A further object of this invention is the provision of an improved pumping system capable of delivering a steady flow of fluid irrespective of changes of pressure on the lubricant in the sump.

A specific object of this invention is the provision of a pumping system utilizing gear or similar pumps for supplying lubrication to an airplane engine at constant volume despite variations in aeroplane altitude.

Further objects and advantages of this invention will be apparent from consideration of the specification and as illustrated by the accompanying drawings of possible embodiments of the invention, in which drawings:

Fig. 1 is a more or less diagrammatic view of one form of my novel pumping system;

Fig. 2 is a partial view similar to Fig. 1, illustrating a modified form of pump; and

Fig. 3 is another partial view similar to Fig. 1, illustrating a third modification of my invention.

The pumping system illustrated in Fig. 1 is shown as applied to the lubrication of an internal combustion engine which is adapted to be suitably positioned in an aeroplane (not shown). The engine, diagrammatically indicated by the reference character *a*, has a plurality of points to be lubricated as *b*. The lubricating oil is supplied from a reservoir or sump c.

Certain pumps, especially gear pumps, have the unfavorable characteristic that their delivery volume drops rapidly with the reduction of the air pressure upon the lubricant in the sump. This is particularly objectionable in the case of airplane motors, due to the substantial reduction in pressure at higher altitudes. The means to be presently described overcomes this disadvantage.

A pump illustrated as a gear pump *d* lifts the lubricant from the sump c and by means of the conduit *e* supplies it to the necessary lubricating points b. A second pump *f* is placed in the connecting line *e* above the pump *d*. These pumps are indicated as of relatively different size for reasons which will be later apparent. The pumps *d* and *f* may be driven by any suitable means, but as illustrated in Fig. 1, they may be conveniently driven by a single shaft driven in turn by the aeroplane engine *a*.

A conduit *g* communicating with the conduit *e* between the pumps *d* and *f* leads back to the sump c. A normally closed relief valve *h* interposed in the conduit *g* is adapted to normally prevent passage of fluid through the said conduit. The valve *h* is illustrated as a spring and ball valve which upon occurrence of a predetermined pressure on the delivery side of the pump *d* will open to permit passage of fluid to the conduit *g*.

If desired a conduit may be provided, as illustrated, for returning the engine oil from the engine back to the sump.

The operation of the above described pumping system is as follows: The pump *d* has a greater capacity than is necessary for supplying lubricant to the points *b* at ordinary sea leavel atmosphere pressure. The pump *e* will, however, restrict the flow of fluid from pump *d* to the point *b* and if the pump *d* attempts to deliver too much fluid through the pump *f* the pressure on the delivery side of the pump *d* will rise, open the valve *h* and thereby release the excess lubricant and return the latter to the sump *c*, through conduit *g*.

As the aeroplane rises to higher altitudes, the pump *d* will be unable to supply as much lubricant as formerly due to the decrease in atmospheric pressure upon the sump. As the pump *d* however was originally built to have a much greater capacity than necessary even at the highest altitudes it will still be able to deliver sufficient lubricant to the engine through pump *f*. At the lower altitudes where the full capacity of the pump *d* is not utilized, no excess oil is delivered to the engine as it is returned through conduit *g* and valve *h* to the sump *c*.

It will accordingly be seen from the above disclosed operation that just sufficient lubrication will always be supplied to the necessary engine parts. By the use of gear pumps as illustrated, the flow will be constant and by use of a metering device such as the gear pump *f* which is unaffected by excess pressure on its delivery sides in conjunction with the by-pass valve *h*, the amount of lubricant supplied to the parts *b* will remain constant whatever the altitude of the aeroplane.

The pumping system illustrated in Fig. 2 is identical in principle with that of Fig. 1 but in

this modification the pumps *d* and *f* have been combined in a unitary structure.

In the system illustrated in Fig. 3, instead of a pump as the metering device, a throttle *i* is used. In this form of the invention therefore, only one pump is necessary. The throttle *i* can readily be designed to permit passage of the required quantity of fuel only, the remainder being returned to the sump through relief valve *h* and conduit *g*.

Many modifications of my invention will be apparent to those skilled in the art. The type of pump illustrated, while admirably adapted for the described purpose can be replaced by other known suitable pumps. Furthermore the type of control valve *h* is unimportant, it being within the scope of this invention that the valve *h* be variably adjusted by means responsive to atmospheric pressure. Such means might take the form of a metal bellows or any other suitable pressure responsive means known to the art.

The pumping system has been illustrated as wholly without the motor structure. Obviously this need not be the case, but on the other hand the various elements of the system may be positioned in any suitable desired position.

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