Oct. 16, 1951 H. W. TREVASKIS 2,571,312

SWASH PLATE PUMP

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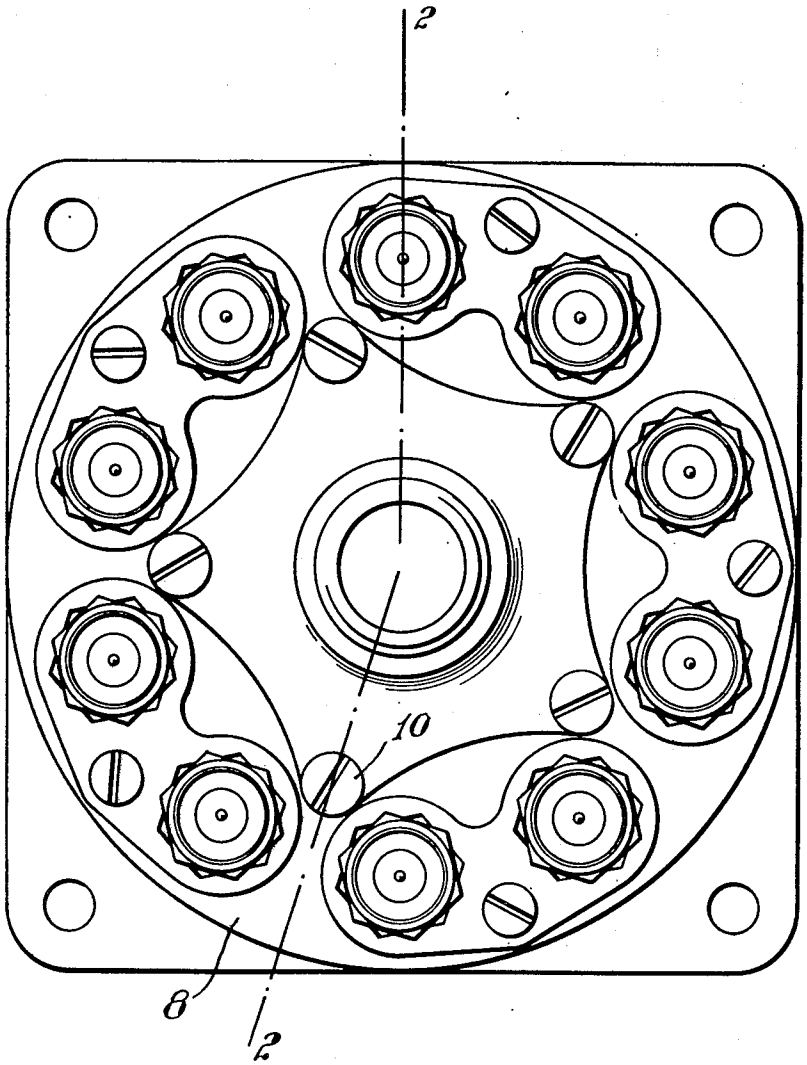
Fig. 1.



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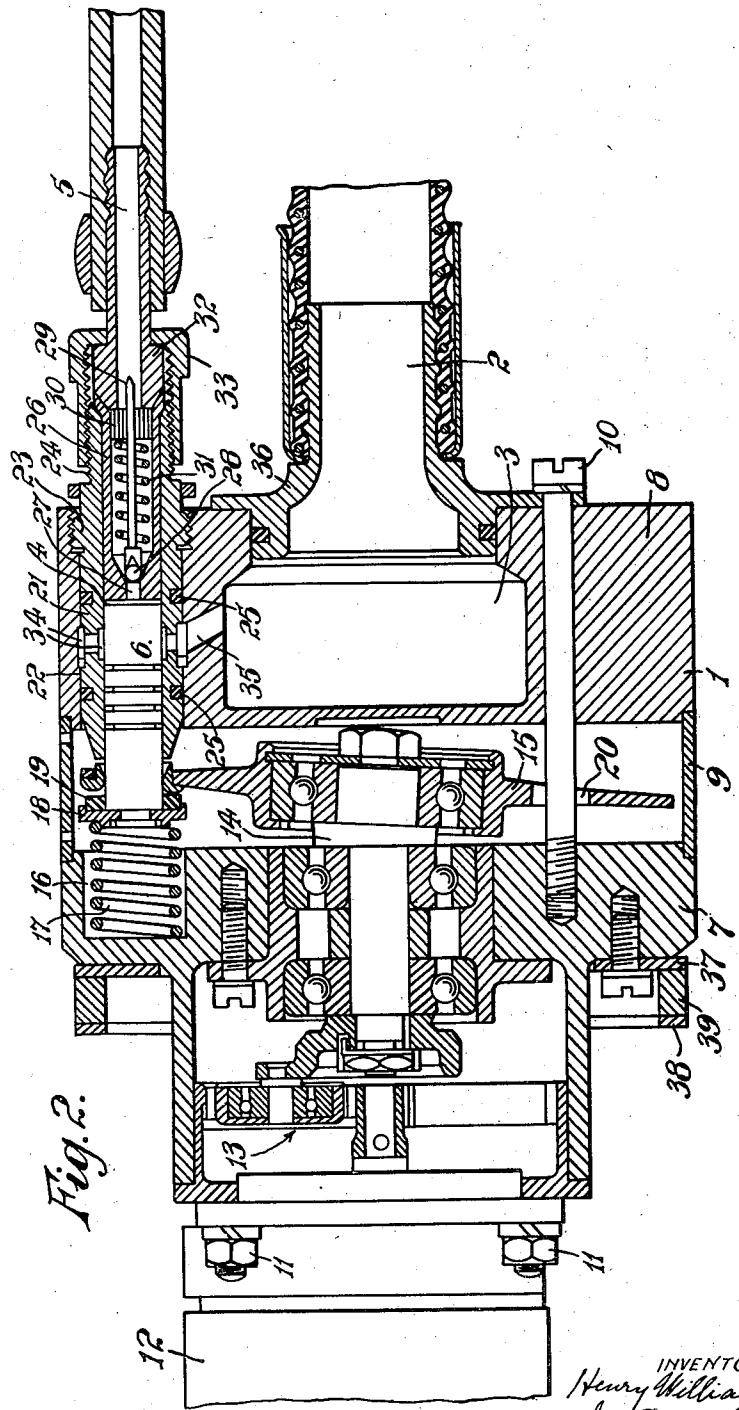

Fig. 2.

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SWASH PLATE PUMP

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3 Claims. (Cl. 103—37)

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The present invention relates to improvements in swash plate pumps particularly in pumps suitable for aircraft.

Swash plate pumps are known in which the pump plungers are actuated by a swash plate during the delivery stroke and by a spring during the non-delivery stroke. It is however not possible to adjust the amount of liquid delivered per stroke by such pumps except by changing the speed of the swash plate mechanism. Such pumps cannot therefore be suitably modified to act as multi-delivery pumps for de-icing liquid when variable quantities are required for propellers, wings, and other parts. It is also not readily possible to prevent known swash plate pumps from operating at excess pressures.

It is the object of this invention to provide a swash plate pump in which the delivery can be adjusted whilst maintaining a constant speed of swash plate mechanism. It is a further object of the invention to provide a swash plate pump which does not permit the delivery pressure to exceed a pre-determined amount. It is a still further object of the invention to provide a multi-delivery pump which is compact and relatively noiseless and of which the deliveries from the separate cylinders can be adjusted whilst the swash plate mechanism is driven at a constant speed.

According to the invention a swash plate pump for the delivery of liquids under pressure is provided with a pump plunger which is actuated by a spring during the delivery stroke and by a swash plate against the action of the spring during the return stroke.

The variation in pump delivery according to the invention is effected by adjusting the cylinder capacity and not by changing the spring strength. This adjustment can readily be effected by means external of the pump.

One embodiment of a pump in accordance with the invention is illustrated in the accompanying drawings wherein Figure 1 is an end view of the pump, and Figure 2 is a section on the line 2—2 of Fig. 1.

The pump comprises a cylindrical casing 1 having a central inlet 2 for de-icing or other fluid communicating with a chamber 3 supplying fluid to ten axially disposed cylinders 4 spaced adjacent the periphery of the casing, from which the fluid is pumped to ten individual outlets 5 by pistons 6 reciprocating in the cylinders. The pistons are spring-operated on the pumping stroke while the return stroke is effected by a swash-plate mechanism driven by an electric motor.

The casing comprises two cylindrical end portions, hereinafter identified as the driving portion 7 and the feed portion 8, spaced axially from each other by a spacing ring 9 seating in annular recesses formed in the adjacent peripheral edges of the two portions, the end portions and ring being held together by five bolts 10 passing through holes in the feed portion and engaging in threaded sockets in the other portion.

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The driving portion is provided with attachment means 11 for an electric motor indicated diagrammatically at 12 from which a drive is taken through epicyclic reduction gearing 13 mounted in the casing to a swash-plate 14 which is arranged to rotate in the cylindrical space bounded by the spacing ring and the opposing faces of the two end portions and to oscillate a driving member 15. Ten axially disposed equidistant cylindrical holes 16 are provided in the driving portion of the casing on a pitch circle near its periphery, and in each of these holes is positioned a helical spring 17, the ends of which are located between the base of the hole and a seating disc 18 fixed to a transverse face of the corresponding piston. On the opposite face of the disc is fixed a rubber ring 19 which receives the thrust of the driving member, and also serves to absorb shock if for any reason the piston and member do not move together.

Each piston passes through one of ten holes 20 in the driving member and makes a fluid-tight fit in the bore of a cylindrical insert 21 fitting into a cavity 22 extending parallel to the axis of rotation of the swash plate in the feed portion of the casing and having a threaded portion 23 of larger diameter engaging with a corresponding threaded portion of the cavity. The position of the insert in the cavity is then made adjustable axially for a purpose hereinafter described, and means are provided for locking the insert in any desired position. Extending from the threaded portion of the insert is a sleeve-like portion 24 of smaller diameter having an external thread. Sealing rings 25 are provided in the periphery of the insert on either side of the fluid inlet groove referred to below.

Also making a fluid-tight fit in the bore of the insert is a hollow cylindrical non-return valve member 26 having a central hole 27 in the end thereof adjacent the working face of the piston. This hole is normally closed by a ball 28 carried in a ball holder on the end of the rod 29 centrally located in the interior of the valve member by means of a plug 30 through which it passes and urged against the hole by a spring 31 located between the ball holder and the plug. The outer

peripheral surface of the plug is slotted axially to allow fluid to flow between the plug and the wall of the cavity.

On the side of the plug remote from the ball is a pipe connector **32** comprising a cylindrical portion with a partially tapered end face adapted to mate with a flared portion of the valve member and to form a seating for the plug and an extension of reduced diameter to which a rubber pipe for carrying fluid may be connected.

The external face of the flared portion of the valve member seats on a complementary face formed on the sleeve-like portion of the cylindrical insert whereby the member is located, and the said member and pipe connector are held in position by a collar **33** which slips over the reduced diameter portion of said connector and is in screw-threaded engagement with the external thread on said sleeve-like portion of the insert. Removal of the pipe connector and valve member from the pump can therefore be effected very simply if required.

Fluid connection between the bore of the insert and the chamber in the feed portion of the casing is provided by internal and external annular grooves **34** formed in the wall of the insert and connected by equally spaced radial holes. The position of the grooves is such that the outer groove registers with a hole **35** drilled through the wall of the central chamber, ten such holes being provided, one for each cylinder.

The chamber in the feed portion has a circular hole in the end wall in which is inserted a member **36** having a portion of reduced diameter to which a pipe connecting the chamber with a tank of de-icing fluid may be attached. Preferably the pipe connection to the tank is made through a coupling provided with a filter such as is described in British Patent 632,412.

Means for resiliently mounting the pump and motor is provided by a metal ring **37** bolted to the drive portion of the casing which is connected to a suitably drilled mounting plate **38** by a rubber ring **39** bonded to the metal ring and to the plate.

In operation the swash-plate is rotated by the motor at a high speed, e. g. 1500 revolutions per minute, and as each piston is moved by the swash-plate and driving member against the pressure of the spring it uncovers a portion of the internal annular groove in the corresponding insert and allows fluid to flow in from the central chamber. On the reverse stroke of the piston, which takes place under the action of the spring, the groove is covered and fluid trapped in the bore of the insert is forced through the non-return valve into the delivery pipe. The volume of fluid so displaced at each stroke depends on the axial travel of the piston after the cut-off point at which it seals the groove, and can be regulated by screwing the insert in or out and thus changing the position of the groove relative to the piston.

Since the travel of the piston on the working stroke is effected by spring action, if a back pressure is set up in a delivery line which exceeds the force exerted by the spring the cylinder concerned will cut out without affecting the action of the pump as a whole, thus safeguarding the distributor connected to that line.

Having described my invention, what I claim is:

1. A swash plate pump comprising a plurality of pump cylinders arranged with their centers on a common pitch circle and with their axes substantially parallel, each cylinder having an individual outlet, a spring loaded check valve for said outlet, plungers one for each said cylinder, each said cylinder having an inlet orifice positioned within the limits of the stroke of the delivery end of its respective plunger to be alternately opened and closed by the reciprocation of said plunger, said cylinders being individually adjustable in an axial direction relative to the stroke of the plunger, a non-rotatable driving member engaging said plungers, a swash plate engaging said driving member and rotatable relatively thereto to oscillate said driving member and withdraw said respective plungers in a direction away from said outlet, and springs, one for each said plunger, to move said plungers in a forward stroke toward said outlet.

2. A swash plate pump comprising a casing, pump cylinders arranged with their centers in a common pitch circle within said casing and with their axes substantially parallel, each cylinder having an outlet, a spring loaded check valve for said outlet, plungers, one for each cylinder, each having a flange outside of said cylinder, a spring for each plunger acting to force said plunger into its respective cylinder in a forward stroke, a common supply conduit, each cylinder having an inlet orifice from said common supply conduit opening within the limits of the stroke of the delivery end of its respective plunger in position to be alternately opened and closed by the reciprocation of said plunger, each cylinder being individually adjustable longitudinally in the direction of its axis relatively to the stroke of its plunger, a non-rotatable driving member engaging said flange in position to withdraw said plungers against the action of said spring, a swash plate engaging said driving member and rotatable relatively thereto to oscillate said driving member.

3. The swash plate pump of claim 2 in which said cylinders have a screw threaded engagement with said casing to permit individual longitudinal adjustments of said cylinders.

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