Jan. 22, 1924. 1,481,597

A. FORSTER

LIQUID FUEL SPRAYER

Filed Feb. 4, 1921

FIG. 1.

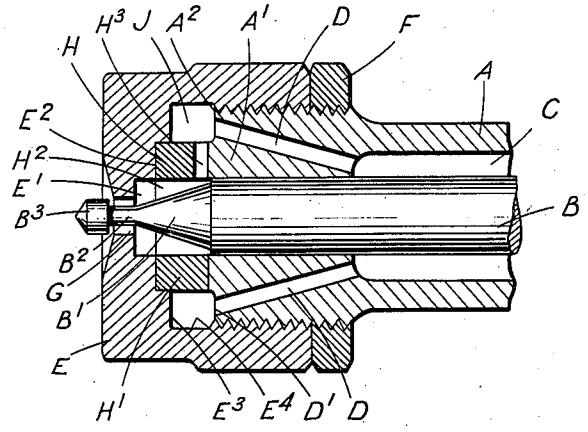



FIG. 2.

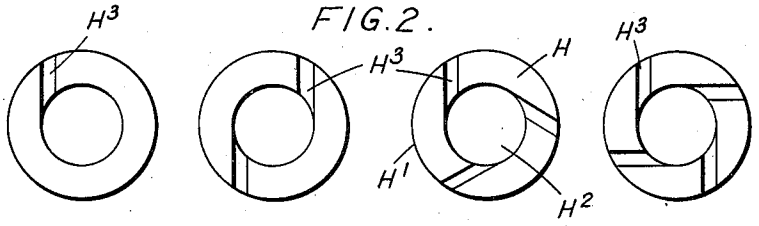
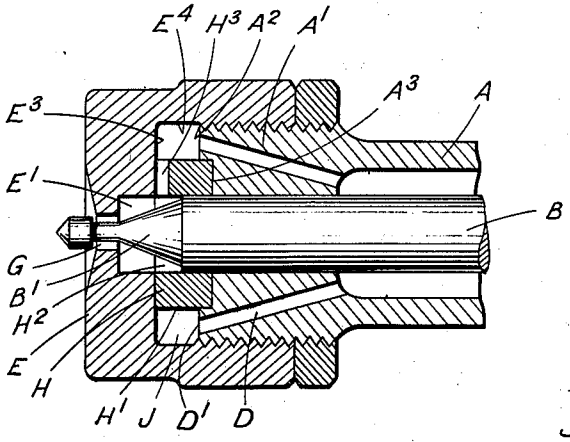



FIG. 3.




Inventor.
Andrew Forster,
By Watson, Cole, Moore & Grindle,
Attorneys.

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# UNITED STATES PATENT OFFICE.

ANDREW FORSTER, OF COWES, ISLE OF WIGHT, ENGLAND, ASSIGNOR TO J. SAMUEL WHITE & COMPANY LIMITED, OF EAST COWES, ISLE OF WIGHT, ENGLAND.

## LIQUID-FUEL SPRAYER.

Application filed February 4, 1921. Serial No. 442,517.

*To all whom it may concern:*

Be it known that I, ANDREW FORSTER, a subject of the King of England, and residing at Cowes, Isle of Wight, England, have invented certain new and useful Improvements in Liquid-Fuel Sprayers, of which the following is a specification.

This invention relates to liquid fuel sprayers and more particularly to sprayers possessing a central valve spindle with a conical end which extends into the sprayer nozzle, and has for its object to modify certain existing constructions so as to provide a sprayer which has a high efficiency and enables the fuel to be sprayed at high velocity while employing a lower delivery pressure than is usual with known constructions.

In a form of sprayer previously in use a series of tangentially arranged grooves were provided through which the liquid fuel passed into a central chamber from which the delivery orifice led. In this case the path followed by the fuel has to turn substantially at right angles where the fuel enters the tangential grooves and consequently velocity is lost and a higher pressure is required for delivering the fuel than might otherwise be needed. In a later modification of this type of sprayer a separate plate in which are tangential slots is employed the fuel passing from the end of an annular chamber into the slots wherein the direction of flow is turned at right angles the fuel subsequently issuing from the inner ends of the slots into a central chamber whence it passes as spray through the delivery orifice. By means of the present improvements this change in the direction of flow as the fuel enters the tangential grooves or slots is avoided so that the resistance thereby offered to the free flow of fuel is materially decreased and consequently less pressure is required to deliver the fuel through the sprayer. The improved construction also provides means whereby the sprayer may be adjusted in a simple manner so as to vary the quantity of fuel delivered by it.

According to this invention an annular chamber is formed between the end of the body of the sprayer and a removable end cap into which chamber the fuel is delivered under pressure. An annular plate lies between the opposed faces of the body and the cap, the outer periphery of this plate forming the inner wall of the annular chamber. In the plate are one or more grooves or holes which are disposed tangentially with respect to a central chamber of which the hole within the plate forms part. These grooves or holes are designed straight so as to give the maximum possible velocity, and to keep down the pressure. The outer ends of the grooves or holes open through the outer periphery of the plate into the annular chamber. Thus the path followed by the fuel as it flows through the sprayer is deflected in the annular chamber whence the fuel can flow straight through the tangential passages and consequently the resistance to the flow is decreased. Conveniently the annular plate lies partly in a recess formed either in the inner face of the cap or in the end of the body of the sprayer the depth of this recess being such that a substantial portion of the outer periphery of the plate projects beyond the recess so as to form the inner wall of the annular chamber. A series of interchangeable annular plates is provided each plate having one or more tangential grooves or holes in it but the number of these grooves or holes varying in each plate. The amount of fuel delivered by the sprayer can therefore be determined and varied in accordance with the number of holes or grooves in the plate which is inserted in the sprayer. Conveniently one or more tangential grooves are formed in one face of each annular plate the groove or grooves being constructed and arranged so that when the plate is in position between the end of the body of the sprayer and the cap one or more passages will be formed which lead from the inner side of the annular chamber into the central chamber whence the fuel passes to the delivery orifice. The recess whether formed in the inner face of the end cap or in the end of the body is of such depth that one side of the plate is sunk into the recess to an extent which is not less than the depth of the groove or grooves formed in the opposite face of the plate. Thus if the plate is incorrectly placed in position the passages in it will be closed and the mistake will be at once apparent.

The invention may be carried out in practice in various ways but the accompanying drawings illustrate by way of example

alternative constructions that may be adopted. In these drawings,

Figure 1 is a longitudinal sectional elevation of the end portion of a fuel sprayer constructed in accordance with the present invention.

Figure 2 illustrates in plan a series of interchangeable grooved plates adapted to be employed in the improved sprayer.

Figure 3 is a sectional elevation similar to Figure 1 but showing an alternative construction.

Like letters indicate like parts throughout the drawings.

The body A of the sprayer of which only the end is shown in the drawings is of known construction with a valve spindle B passing longitudinally through it, a hollow space C being formed around the spindle into which the liquid fuel is forced by suitable means. From the end of this fuel space C a series of diverging passages D run through the end portion A′ of the body of the sprayer these passages terminating in orifices D′ situated in the end face of the sprayer body. In the construction shown in Figure 1 a shallow annular recess $A^2$ is formed in the outer part of the end face of the body and the orifices D′ lie in this recess. A cap E is screwed on to the end portion A′ of the sprayer body and is fixed in place by a lock nut F or otherwise. At the centre of this cap is the delivery orifice G which is provided with a seating for a conical valve B′ formed on the end of the spindle B. The length of the cone forming this valve may vary and at its apex it is provided with a cylindrical prolongation $B^2$ on the end of which is an enlargement $B^3$ which lies beyond the delivery opening G and serves to spread the fuel passing through this opening.

In the inner face of the cap E immediately around the opening G there is formed a recess E′ which constitutes part of a central chamber into which the fuel is delivered before it passes through the delivery passage G. Around this recess E′ there is formed in the face of the cap E an annular recess $E^2$ of less depth than the recess E′ and in this recess lies an annular plate H. This plate is of such thickness that when in position part of its outer periphery is sunk into the recess $E^2$ while the remainder of this periphery as at H′ constitutes the inner wall of an annular chamber J whose other walls are respectively formed by the annular recess $A^2$ in the end face of the sprayer body A and the sides $E^3$ and $E^4$ of the interior angle of the cap E. The hole $H^2$ in the centre of the plate H is conveniently of the same diameter as the passage through which the valve spindle B passes and also the recess E′ in the cap E and these parts constitute a central chamber into which the fuel is delivered through grooves $H^3$ formed in one face of the plate H. These grooves $H^3$ as shown in Figure 2 run tangentially from the central hole $H^2$ right out to and through the periphery H′ of the plate so that when the grooved face of the plate is held by the cap E against the face of the end portion A′ of the sprayer body tangential fuel passages are formed which lead from the inner wall H′ of the annular chamber J into the central chamber $H^2$.

The fuel passes through the space C in the valve body A in the direction of the axis of the latter and thence through the diverging passages D into the annular chamber J in which the direction of flow is changed and the fuel then flows inwardly through the tangential passages $H^3$ into the central chamber $H^2$. The change in the direction of flow thus takes place in the annular chamber J without serious obstruction so that less pressure is required to force fuel through the sprayer than when the change in direction occurs actually in the ends of tangential grooves or slots as in previous constructions of sprayers.

A series of interchangeable plates H are provided as shown in Figure 2 each plate having a different number of tangential grooves $H^3$ the number conveniently ranging from 1 to 4 and these grooves being disposed as shown in Figure 2. Thus if the sprayer is to deliver a lesser quantity of fuel a plate H is inserted having say only one or perhaps two grooves, but on the other hand, if a greater quantity of fuel is to be delivered a plate having say four grooves may be used. In order to prevent the plate from being wrongly placed in the sprayer the recess $E^2$ in the inner face of the cap E in which one side of the plate H lies is made of such depth that if the plate is placed in the cap the wrong way round with the grooved face against the face of the cap then the ends of the grooves $H^3$ will be completely closed by the side wall of the recess $E^2$. As there will thus be no passage through the sprayer the mistake can be readily ascertained when the sprayer is tested to see that the passages are clear.

In the modified construction shown in Figure 3, in place of the recess in which one side of the plate H lies being formed in the cap E, this recess is formed as at $A^3$ in the face of the end portion A′ of the body of the sprayer. The outer annular part $A^2$ of this end face in which are the orifices D′ at the ends of the passages D then projects beyond the inner part of the face. The grooved face of the plate H is placed against the inner face $E^3$ of the cap which is formed flat around the recess E′. The ends of the tangential grooves $H^3$ lead, however, as before from the annular

chamber J through the inner wall of this chamber which is formed by the periphery H′ of the plate H.

In the construction shown in Figure 1 it is preferable to form the valve cone B′ on the end of the spindle B of greater length than in the construction shown in Figure 3 since in the construction shown in Figure 1 the grooves $H^3$ lead the fuel into the inner end of the central chamber $H^2$. On the other hand, in the construction shown in Figure 3 the grooves $H^3$ deliver the fuel into the central chamber nearer to the delivery passage G, the central chamber in this case being formed to a considerable extent by the recess E′ which is made of greater depth than in the construction shown in Figure 1.

The details of construction may be modified as required in accordance with the construction of sprayer to which the invention is applied. The thickness of each plate H may vary for example in accordance with the dimensions that it is required to give to the annular chamber J. Also in place of grooves $H^3$ in the face of each plate tangential holes may be drilled through the plate, these holes being arranged so that they will lead from the outer periphery of the plate which forms the inner wall of the annular chamber J into the central hole $A^2$ in the plate. The annular chamber J may be formed in various ways and the outer wall $E^4$ may be curved if desired so as to merge into the wall $E^3$ in order to facilitate the change in the direction of the flow of the fuel which takes place in this chamber.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a liquid fuel sprayer the combination of a hollow cylindrical sprayer body having a closed end with a circular flat end surface, a cap on the end of the sprayer body, an annular plate of less outside diameter than that of the end of the sprayer body disposed and carried between it and the cap so that an annular space is formed in advance of the closed end of the sprayer body and the cap, between the sprayer body and the hole in the centre of the annular plate constituting a mixing chamber, a plurality of passages formed in the annular plate and extending tangentially from the central opening therein to and through the outer periphery of the plate and serving for the flow of fuel from the annular chamber, a plurality of passages extending from the hollow interior of the sprayer body through the closed end thereof into the annular chamber and serving for the delivery of fuel into this chamber, and a central orifice leading through the end cap from the mixing chamber and serving as a nozzle for the sprayer as set forth.

2. In a liquid fuel sprayer the combination of a hollow cylindrical sprayer body having a closed end with a circular flat end surface, a cap on the end of the sprayer body, an annular plate of less diameter than the end of the sprayer body disposed and carried between it and the cap so that an annular space is formed in advance of the closed end of the sprayer body and between it and the cap, the hole in the centre of the annular plate constituting a mixing chamber, a plurality of grooves formed in one face of the plate forming in conjunction with the flat surface against which the plate is held, a series of passages extending tangentially from the central opening in the plate to and through the outer periphery of the plate and serving for the flow of fuel from the annular chamber, a plurality of passages extending from the hollow interior of the sprayer body through the closed end thereof into the annular chamber and serving for the delivery of fuel into this chamber, and a central orifice leading through the end cap from the mixing chamber and serving as a nozzle for the sprayer as set forth.

3. In a liquid fuel sprayer the combination of a sprayer body, a cap mounted on the end of the sprayer body so that the inner face of the cap is opposed to the end face of the body, a recess formed in one of these opposed faces, an annular plate carried between the sprayer body and the cap and disposed with a part of its thickness in the recess in one of these opposed faces the central opening in the plate constituting a mixing chamber while that portion of the outer periphery of the plate which does not lie within the recess forms the inner wall of an annular chamber comprised between the cap and the end of the sprayer body, a plurality of passages formed in the annular plate and extending tangentially from the central opening therein to and through the outer periphery of the plate and serving for the flow of fuel from the annular chamber, a plurality of passages extending through the end of the body of the sprayer into the annular chamber and serving for the delivery of fuel into this chamber, and a central orifice leading through the end cap from the mixing chamber and constituting a nozzle for the sprayer as set forth.

4. In a liquid fuel sprayer the combination of a hollow cylindrical sprayer body having a closed end with a flat circular end surface, a cap on the end of the sprayer body, an annular plate of less diameter than the end of the sprayer body disposed and carried between it and the cap so that an annular space is formed in advance of the closed end of the sprayer body and between the sprayer body and the cap, the hole in the centre of the annular plate constituting

a mixing chamber, a plurality of passages formed in the annular plate and extending tangentially from the central opening therein to and through the outer periphery of the plate and serving for the flow of fuel from the annular chamber, a plurality of passages extending from the hollow interior of the sprayer body through the closed end thereof into the annular chamber and serving for the delivery of fuel into this chamber, a central orifice leading through the end cap from the mixing chamber and serving as a nozzle for the sprayer, and a valve carried on a spindle extending through the closed end of the sprayer body into the mixing chamber and nozzle opening as set forth.

5. In a liquid fuel sprayer the combination of a sprayer body, a cap mounted on the end of the sprayer body so that the inner face of the cap is opposed to the end face of the body, a recess formed in one of these opposed faces, an annular plate carried between the sprayer body and the cap and disposed with a part of its thickness in the recess in one of these opposed faces the central opening in the plate constituting a mixing chamber while that portion of the outer periphery of the plate which does not lie within the recess forms the inner wall of an annular chamber comprised between the cap and the end of the sprayer body, a plurality of grooves so formed in one face of the annular plate that with the part against which the face of this plate lies the grooves will constitute passages extending tangentially from the central opening in the plate to and through the outer periphery of the plate and serving for the flow of fuel from the annular chamber, a plurality of passages extending through the end of the body of the sprayer into the annular chamber and serving for the delivery of fuel into this chamber, and a central orifice leading through the end cap from the mixing chamber and constituting a nozzle for the sprayer as set forth.

6. In a liquid fuel sprayer the combination of a sprayer body, a cap mounted on the end of the sprayer body so that the inner face of the cap is opposed to the end face of the body, a recess formed in one of these opposed faces, an annular plate carried between the sprayer body and the cap and disposed with a part of its thickness in the recess in one of these opposed faces the central opening in the plate constituting a mixing chamber while that portion of the outer periphery of the plate which does not lie within the recess forms the inner wall of an annular chamber comprised between the cap and the end of the sprayer body, a plurality of straight grooves so formed in one face of the annular plate that with the part against which the face of this plate lies the grooves will constitute passages extending tangentially from the central opening in the plate to and through the outer periphery of the plate and serving for the flow of fuel from the annular chamber, a plurality of passages extending through the end of the body of the sprayer into the annular chamber and serving for the delivery of fuel into this chamber, a central orifice leading through the end cap from the mixing chamber and constituting a nozzle for the sprayer, and a valve carried on a spindle extending through the body of the sprayer into the mixing chamber and nozzle opening as set forth.

In testimony whereof I have signed my name to this specification.

ANDREW FORSTER.