

July 25, 1950

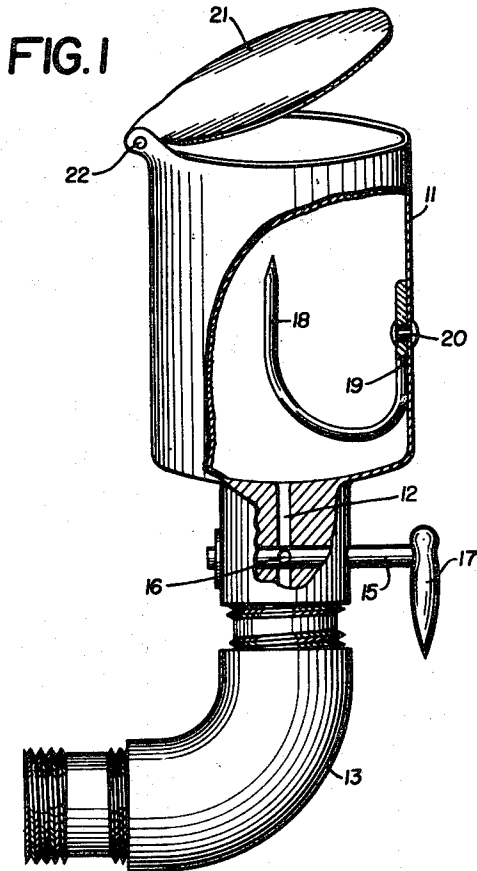
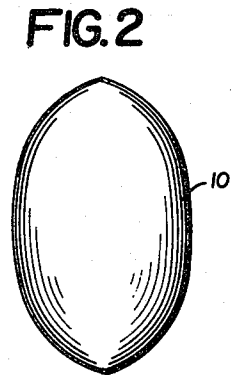
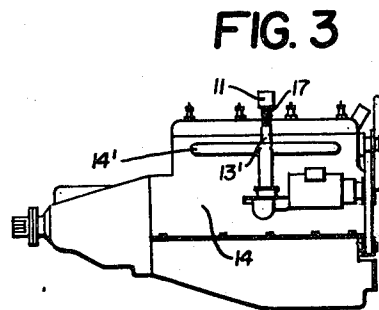
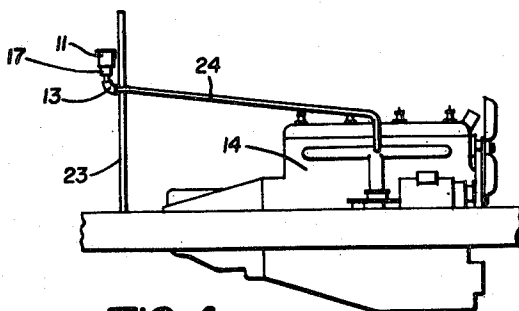
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2,516,787

STARTING OF INTERNAL-COMBUSTION ENGINE

Filed June 16, 1948

3 Sheets-Sheet 1



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STARTING OF INTERNAL-COMBUSTION ENGINE

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FIG. 5

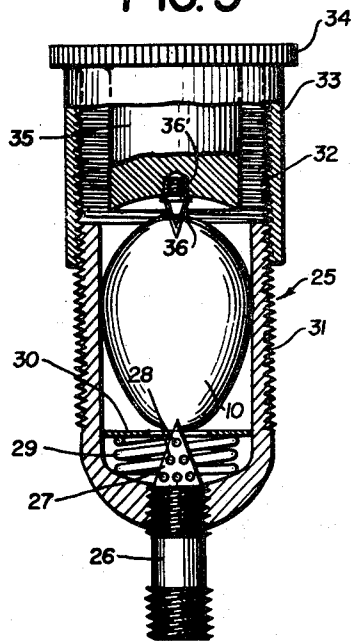


FIG. 6

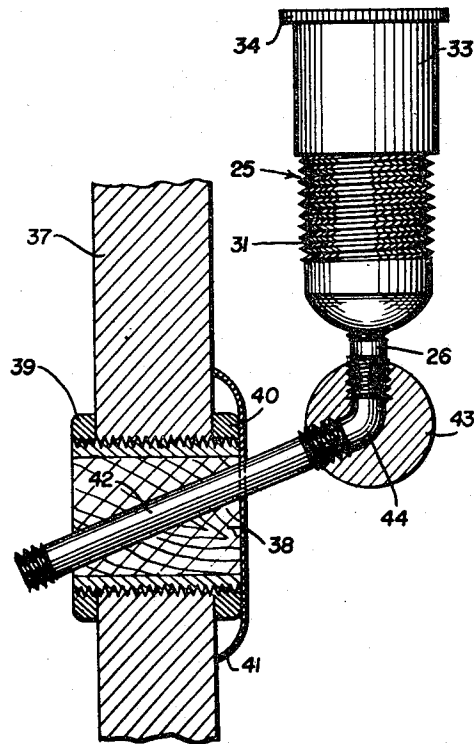
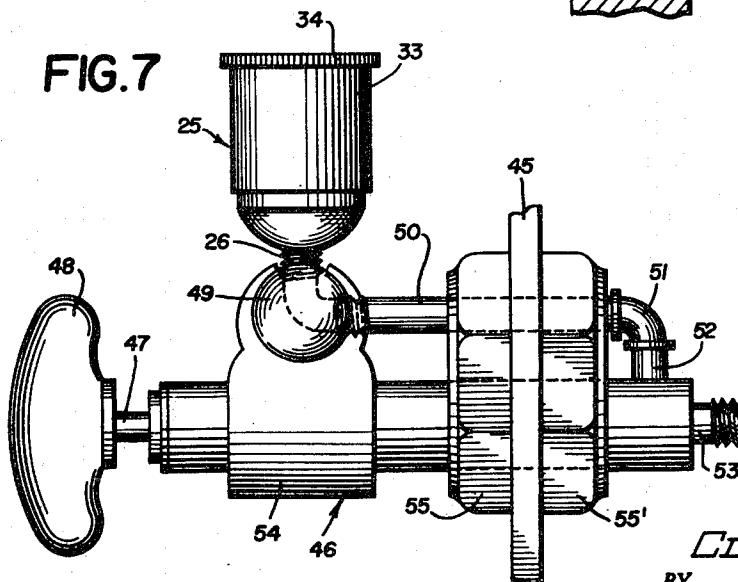


FIG. 7



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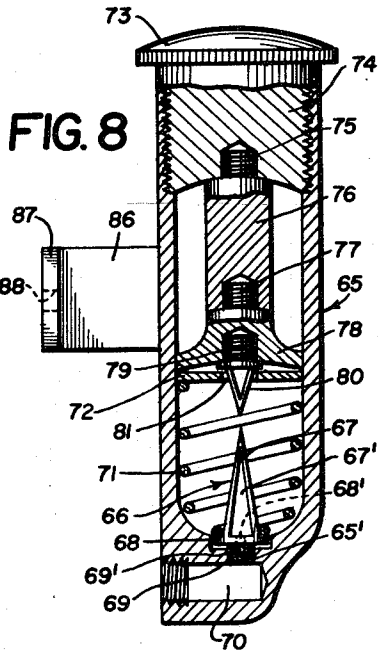
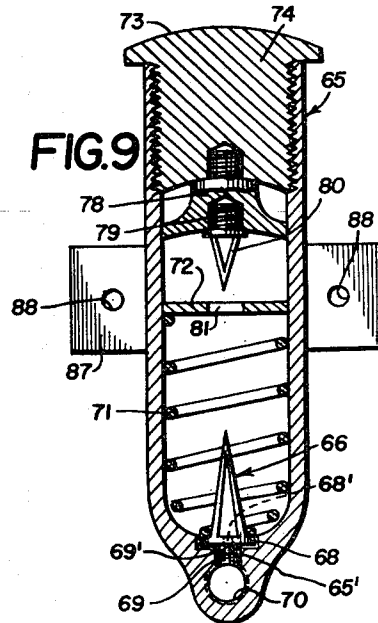
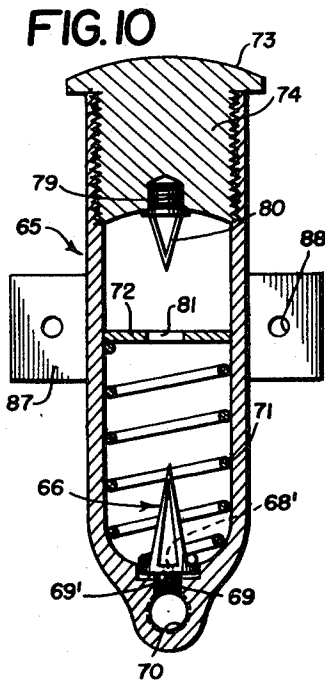
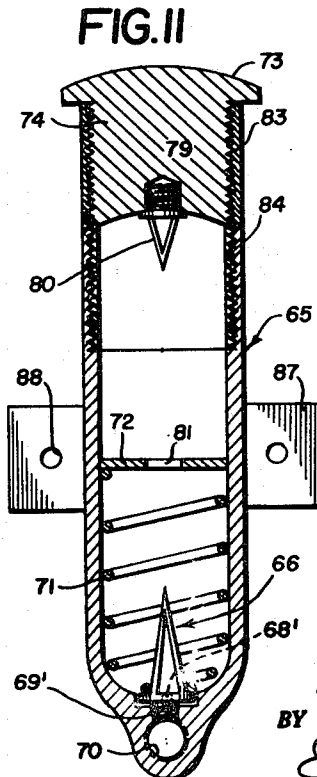
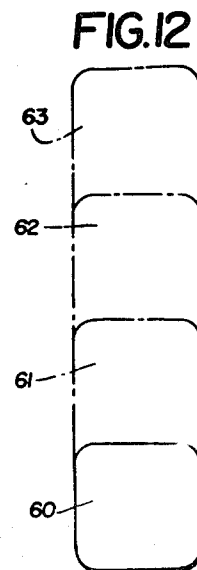
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STARTING OF INTERNAL-COMBUSTION ENGINE

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,516,787

STARTING OF INTERNAL-COMBUSTION  
ENGINES

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Application June 16, 1948, Serial No. 33,365

8 Claims. (Cl. 123—187.5)

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This invention relates to the starting of internal combustion engines in cold weather. The starting of automobile and airplane engines under low temperature conditions has long presented a problem. Many years ago automobile engines were equipped with primer cups connected to the engine into which cups gasoline was poured and thence conducted to the cylinders to prime the latter for expediting the starting of the engine. For the past decade or more it has not been customary to equip automobile engines with such cups.

The problem of starting automobile and airplane engines under frigid conditions, especially at temperature substantially below zero, has remained a source of considerable trouble and annoyance. Fluid suitable for quickly starting internal combustion engines in frigid weather, at temperature as low as  $-40^{\circ}$  F. has been available on the market for several years. Such fluid contains ethyl ether as its major component. One mode of application of the fluid to the engine has been through a pump mounted on the dash, and connected to a tank containing the starting or priming fluid, for impelling the fluid through a suitable connection to the intake manifold of the engine. Another method involves the use of a spray gun for injecting fluid from a supply tank through a hole in the manifold of a Diesel engine or through the air filter of a gasoline engine.

The foregoing methods of starting internal combustion engines in cold weather involve storing substantial quantities of the starting or priming fluid in a supply tank or container, as, for example, a gallon can or a three-pint can, from which fluid is transferred to a smaller can connected to the pump or spray gun. The fluid remaining in the opened gallon or three-pint can creates a storage hazard; while the can connected to the pump or spray gun also stores fluid for repeated use.

The present invention obviates the hazards incident to the prior practice in the storage of the inflammable and explosive starting or priming fluid. The invention provides a charge of starting fluid, sufficient for one starting of the engine, in a flexible container which is discarded after a single use. More specifically, it provides a charge of starting or priming fluid in a capsule of gelatinous material. It further provides for the prompt and effective injection of the fluid into the engine by merely rupturing the capsule.

Other features and advantages of the inven-

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tion will be hereinafter described and claimed. In the accompanying drawings:

Fig. 1 is a view in side elevation, partly in longitudinal section and partly broken away, showing an embodiment of a cup adapted for connection to the engine and for disrupting the capsule containing priming-fluid, in accordance with my invention.

Fig. 2 is a view in elevation, on an enlarged scale, showing a priming-fluid capsule.

Fig. 3 is a view in side elevation of an internal combustion engine with the cup of Fig. 1 connected thereto.

Fig. 4 is a view similar to Fig. 3, but showing the capsule-receiving cup mounted on the dashboard of an automobile or other vehicle and connected to the intake-manifold of the engine.

Fig. 5 is a view in vertical section of an alternative embodiment of capsule-receiving cup.

Fig. 6 is a view in side elevation, with parts in vertical section, showing means for mounting a capsule-receiving cup on a vehicle dashboard.

Fig. 7 is a side elevational view showing a capsule-receiving cup mounted on a pump on a dashboard.

Fig. 8 is a view in vertical section of another modification of a capsule-receiving cup having provisions for readily adapting it for receiving capsules of different sizes.

Fig. 9 is a view similar to Fig. 8, showing the cup of Fig. 8 in condition for receiving a capsule of larger size.

Figs. 10 and 11 are similar views showing said cup conditioned for receiving capsules of still larger sizes.

Fig. 12 is a diagrammatic view showing a series of capsules of different sizes which may be placed in the respective cups of Figs. 8-11, inclusive.

Referring to the drawings, the capsule shell shown in Fig. 2 is formed of gelatinous material, such as a suitably plasticized commercial gelatin solution. Said gelatin solution may be the conventional one of gelatin, glycerin, and water, the glycerin acting as a plasticizer of the gelatin. I have found that the conventional plasticized gelatin capsule shells employed for the marketing of bath oils are particularly well adapted to serve as containers for the starting or priming fluid.

As previously noted, the major constituent of effective cold-weather starting or priming fluid on the market is ethyl ether, which is highly volatile and combustible. I have taken conventional oil bath capsules, replaced their oil bath content

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by conventional ethyl ether starting fluid, and, after resealing the capsules, subjected them to abnormally high temperatures as well as to temperatures abnormally low. My tests showed that the capsules retained their elasticity and preserved the starting fluid effectively and without leakage, despite the abnormal temperatures to which they were subjected.

In accordance with my invention, a quantity of priming or starting fluid, sufficient for one starting of an internal combustion engine, is sealed within a capsule shell of suitable plastic material such as above referred to. One way in which the charge of priming fluid may be discharged into the engine is shown in Fig. 1, wherein a primer cup 11 communicates through passage 12 and a suitable pipe fitting 13 with the interior of an internal combustion engine 14 (Fig. 3). As shown in Fig. 3, the pipe 13 may conveniently be connected to a pipe section 13', which in turn is fitted into a threaded hole provided in the intake manifold 14' or any other desired portion of the engine 14 for communicating with the interior of one or more of the cylinders. A rotatable valve 15 is provided with an opening 16 movable into and out of registry with the passage 12, and carries on its outer end a suitable handle 17. In the position shown in Fig. 1, the passage 12 is blocked by said valve 15. The weight of the handle 17 normally maintains said valve in that position.

Extending upwardly in the cup 11 is a needle or puncturing tool 18 for rupturing the plastic capsule when the latter is inserted in the cup. Said puncturing tool 18 may be mounted in any suitable way in said cup. As shown in Fig. 1, it may conveniently have a curved or bowed extension 19, attached to the side of the cup by a rivet 20. The cup 11 is provided with a cover 21, pivoted at 22, which cover may be of well-known type, continuously biased to closed position by a suitable spring (not shown) extending about the pivot 22.

In the operation of the cup arrangement shown in Fig. 1, the handle 17 is operated to rotate the valve 15 to open communication between the cup and the pipe fitting 13 by way of the passage 12. The cover 21 is then opened and the capsule containing the priming fluid is inserted by hand into the cup. During the insertion of the capsule, its lower end encounters the tool 18 and is punctured thereby in the further downward movement of said capsule. As soon as the capsule is fully inserted the operator withdraws his hand, and the cover 21 is closed. The highly volatile priming fluid, released from the punctured capsule, proceeds downwardly through passage 12 and fitting 13 into the intake manifold or other portion of the engine so that the latter may be quickly started. Prior to starting of the engine, the handle 17 is operated to restore the valve 15 to the closed position shown in Fig. 1. The ruptured capsule may be withdrawn from the tool 18 and discarded at any convenient time after discharge of its contents.

As shown in Fig. 4, the cup 11 may be mounted on the dashboard 23 of an automobile, airplane, or motor boat, through a pipe 24 extending from the fitting 13 to the intake manifold of the engine 14.

In Fig. 5 I have shown a modified embodiment, wherein a primer cup 25 has a pipe fitting 26, threaded through a hole in the bottom of the cup. The top 27 of said fitting 26 is cone shaped to provide a tool for puncturing a capsule. Also said

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top has perforations 28 which provide communication between the interior of the cup and the interior of the pipe fitting 26. Said fitting 26 is connected by suitable piping to the intake manifold of the engine, as in Fig. 3 or 4, for example.

Surrounding the top portion 27 of said fitting is a spring 29, seated at its lower end in the bottom of the cup and bearing at its upper end against a washer 30.

The exterior of the cup 25 is threaded, as shown at 31, for cooperation with interior screw threads 32 on the skirt or flange 33 of a cover 34. Projecting downwardly from said cover is a boss or extension 35, which, as the cover is screwed downwardly on the cup, presses downwardly upon the upper end of a capsule 10 to force the lower end of said capsule on to the point of the puncturing cone 27. The cover 34 may be knurled, as shown, to facilitate turning thereof by hand.

A piercing element 36 projects downwardly from the cover boss 35, and may be suitably attached thereto, as by a screw-threaded extension 36' of said piercing element.

In the operation of the cup shown in Fig. 5, the capsule 10 is inserted with its lower end resting upon the washer 30. The cover 34 is then applied, and is rotated so as to move downwardly on the cup. The downwardly extending element 36 of said cover acts upon the upper end of the capsule to force the latter downwardly, compressing the spring 29, and bringing the lower end of the capsule against the tip of the cone 27. As the downward movement of the cover 34 continues, the capsule is punctured at both its upper and lower ends. Puncturing of the capsule at both ends is found desirable, in the Fig. 5 arrangement, to insure that the capsule is thoroughly drained under the vacuum applied to the interior of the tightly closed receptacle 25 during the operation of the engine. In the cranking of the engine by the starter the fluid contents of the capsule pass quickly therefrom into the engine, with resultant prompt starting of the latter.

After the engine has been started, the cover 34 may be unscrewed from the primer cup 25. As the cover is unscrewed the washer 30 is raised by the spring 29, and projects the punctured capsule upwardly so that the operator may readily remove it from the cup.

In Fig. 6 there is illustrated a convenient form of means for mounting the primer cup on a dashboard 37. Such mounting means comprises a block 38, of wood or other suitable material, extending through and threaded in an opening in said dashboard. Said block may be held in place by nuts 39 and 40 threaded on its opposite ends and engaging opposite sides of the dashboard 37. A cover 41 of metal or other desired material may be applied over the front end of said block, as shown.

The block 38 has bored therethrough a downwardly inclined opening through which extends a pipe 42, threaded at opposite ends. At one end of said pipe is threaded into a fitting 43 having a curved passageway 44, into the upper end of which passageway there is threaded the lower end of the previously mentioned fitting 26. It will, of course, be understood that at its lower end the pipe 42 is connected through other piping (such as pipe 24 in Fig. 4) to the intake manifold or other part of the engine. Thus the priming fluid released from a capsule in the cup 25 passes downwardly through fittings 26 and 43, pipe 42, and connected piping to the engine to be started. The

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block 38 provides an effective support for the pipe 42, fittings 43 and 26, and cup 25.

In the arrangement shown in Fig. 7, there is mounted on the dash 45 a pump 46 of conventional design, operated by a plunger 47 through a knob 48 readily grasped by the operator. The fitting 26 of primer cup 25 is threaded into a fitting 49 (similar to fitting 43 in Fig. 6) and communicating with a pipe 50 threaded into said fitting. At its further end, said pipe communicates through an elbow 51 and pipe section 52 with the interior of the pump. The latter, in turn, communicates, through conduit 53 and piping connected thereto, with the intake manifold or other portion of the engine to be started. The fitting 49 may, as shown, be mounted in a suitable clamp 54 fastened to the pump casing. The pipe 50 may extend through aligned openings in the dash 45 and in suitable nuts 55, 55' threaded on the pump for clamping the same firmly to the dash.

In the operation of the embodiment illustrated in Fig. 7, the operator inserts a capsule in the primer cup 25, closes the cover 34, and then operates the pump plunger 47. The priming fluid thus is pumped from the cup 25, through pipe 51 and conduit 53, to the engine. This arrangement is particularly useful in installations where the engine is at the same or a higher level than the dashboard, as in airplanes.

Since different sizes of engines may require different amounts of starting fluid, the single-use capsules may be made in correspondingly different sizes. For instance, in Fig. 12, there is indicated diagrammatically at 60 a capsule suitable for starting an engine of a light automobile. Capsule 61, shown as twice the size of capsule 60, may be used to start an engine of larger size, as for a heavier automobile or a truck. Capsule 62, three times the size of capsule 60, may be employed to start a still larger engine. The capsule 63, four times the size of capsule 60, may be used for an aeroplane engine. It will, of course, be understood that the capsule sizes may be varied as desired, in accordance with the amounts of fluid required for starting different engines.

In Figs. 8-11, I have shown a further embodiment of a primer cup or capsule receptacle, arranged to accommodate readily different sizes of capsules. In Fig. 8, the cup or receptacle 65 includes a lower puncturing tool 66, which may conveniently comprise a conical member 67 extending outwardly from a base member 68. The end of said cone opposite said base member 63 forms a piercing projection. Below said projection said cone is open to the interior of the receptacle 65 through one or more openings 67' in said cone.

The base 68 has an extension 69, externally threaded for engagement with a correspondingly threaded opening in the lower wall portion 65' of the receptacle 65. Said extension 69 is hollow and communicates by way of a hole 68' in the base 68 with the space above said base. Thus, when the capsule is pressed downwardly upon the point formed by the upper end of the cone 67, and is punctured by the latter, the fluid contents of said capsule pass through the opening or openings 67' in said cone, and thence through the opening 68' and the interior of the extension 69, into a communicating passageway 70. It will of course be understood that said passageway 70 is placed in communication with the intake manifold of an engine, by suitable piping.

The base or flange 68 forms a seat for the lower

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end of a coil spring 71, the upper end of which spring supports a washer 72.

To insure drainage of the fluid from the interior of the receptacle 65 when the base 68 does not closely fit the side walls of the receptacle 65 above the bottom wall portion 65', one or more drainage openings, such as shown at 69', may be provided in the extension 69 as shown. Said openings provide communication between the lower interior portion of receptacle 65 and the hollow interior of the extension 69, so that any fluid in the lowermost part of said receptacle adjacent the flange 68 may drain out through said openings 69'.

The cover 73 for the receptacle 65 has a downwardly extending boss or plunger portion 74, exteriorly threaded for engagement with interior threads in the upper portion of the receptacle. Said plunger has a threaded hole therein, which, in Fig. 8, receives the threaded end 75 of a plunger extension 76. The latter, in turn has a threaded hole adapted to receive the threaded end 77 of a further extension or spacer 78.

The spacer 78 also is provided with a threaded hole in its lower end, receiving the threaded extension 79 of an upper puncturing tool 80. Said puncturing tool 80 may conveniently be of the same construction as described above with respect to the puncturing tool 66. When no capsule is in the receptacle 65, and the cover 73 is screwed completely into said receptacle, the parts above-described assume the position shown in Fig. 8, wherein the upper puncturing tool 80 extends through an opening 81 in the washer 72.

When the receptacle 65 in Fig. 8 is to be used for starting the engine to which it is connected, the cover 73 is unscrewed, and removed from the receptacle. The extensions 76 and 78, and tool 80, being secured to said cover, are of course removed with it. A capsule, such as shown at 60, is then inserted into said receptacle so that the lower end of said capsule rests upon the washer 72. The unitary assembly of the cover 73, extensions 76 and 78, and tool 80, is then inserted and the cover is screwed downwardly into the receptacle. The tool 80 engages the upper end of the capsule and forces the latter downwardly, against the action of the spring 71, bringing the lower end of the capsule against the lower puncturing tool 66, which then projects through the opening 81 in the lowered washer 72. As the downward movement of the cover 73 and tool 80 continues, the upper and lower ends of the capsule are punctured by the tools 80 and 66, and the volatile contents pass from the capsule to the engine by way of the hollow interior of the threaded extension 69, and the passageway 70.

If a capsule of larger size, such as the capsule 61, is to be used, the intermediate extension 76 is detached from the cover plunger 74, and the extension or spacer 78 is attached directly to said cover plunger, as shown in Fig. 9. The upper puncturing tool 80 is now spaced appropriately from the lower tool 66 for puncturing said larger capsule as the cover 73 is screwed downwardly into the receptacle.

When a still larger capsule, such as capsule 62, is to be inserted in the receptacle, the extension or spacer 78 is removed, and the end 79 of the tool 80 is screwed directly into the cover plunger 74, as shown in Fig. 10.

For using a capsule of further increased size, such as capsule 63, an extension or adapter sleeve 83 is employed. This sleeve has an upper portion interiorly threaded for cooperation with the

exterior threads on the cover plunger 74, and a lower portion 84 exteriorly threaded to cooperate with the interior threads in the upper part of the receptacle 55. When said capsule of further increased size is to be used, the cover 73 and attached plunger 80 are removed from the receptacle, and the downward extension 84 of the sleeve 83 is screwed into the receptacle, as shown in Fig. 11. Then, after insertion of the capsule, the cover 73, with tool 80 directly attached thereto, is screwed downwardly into the upper portion of said sleeve 83. During said downward movement of the cover 73, the upper and lower tools 80 and 86 effect puncturing of the corresponding ends of the capsule.

For conveniently mounting the receptacle 55 on the dashboard of an automobile, the receptacle may have formed integrally therewith a bracket 86 having laterally-extending flanges 17, 87 provided with holes 88 for the passage of bolts or screws.

In addition to the advantages of the various features of my invention hereinbefore referred to, it will be noted that the capsules lend themselves readily to speedy filling by conventional automatic machinery.

When desired the capsules may be conveniently packed in sleeves of cardboard or other suitable material, open at their ends, whereby the cross-sectional diameter of the capsules may be preserved despite pronounced increase in temperature and the capsules may be readily fitted into primer cups having substantially the same diameter.

Where the volatile fluid contents of the capsule, as in the case of an ethyl ether starting fluid, are heavier than air, the fluid contents readily pass under the influence of gravity from the punctured capsule into the engine manifold. In the event that it is desired to admit air to the receptacle, as where the engine manifold is at a higher level than the receptacle for the capsule, and a pump is employed as in Fig. 7, it will be apparent that an air inlet valve of any suitable or conventional type may be provided in a side wall of the receptacle for admitting air hereto while at the same time preventing the escape of fluid from the receptacle to the external atmosphere.

The upper puncturing tool 36 for the receptacle 25, in Fig. 5, may if desired be of the same construction as that of the puncturing tool 66.

The terms and expressions which I have employed are used as terms of description and not of limitation, and I have no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereon, but recognize that various modifications are possible within the scope of the invention claimed.

I claim:

1. In combination, a charge of priming fluid or an internal combustion engine, and a single-use gelatinous capsule containing said charge.

2. In combination, a charge of priming fluid of

higher volatility than gasoline, and a single-use gelatinous capsule containing said charge.

3. In combination, a charge of priming fluid the major component of which is ethyl ether, and a single-use gelatinous capsule containing said charge.

4. In combination, a primer cup having an opening for the discharge of priming fluid to an internal combustion engine, a gelatinous capsule containing a charge of priming fluid and positioned in said cup, and a piercing element in said cup engageable with the lower end of said capsule for rupturing the latter.

5. A primer cup for internal combustion engines, said cup having a chamber for communication with said engine and adapted to receive a priming-fluid capsule, a piercing element in said cup adapted to engage the lower end of said capsule, a cover movable into and out of said cup, a piercing element attachable to said cover for engaging the upper end of said capsule, and means comprising an adapter element movable with respect to said last mentioned piercing element and insertible into said cup for varying the distance of said last mentioned piercing element from the first mentioned piercing element to accommodate capsules of varying sizes.

6. A primer cup for internal combustion engines, said cup having a chamber for communication with said engine and adapted to receive a priming-fluid capsule, a piercing element in said cup adapted to engage the lower end of said capsule, a cover movable into and out of said cup, an adapter sleeve insertible into said cup and having an upper portion for receiving said cover, and a piercing element carried by said cover for engaging the upper end of said capsule.

7. In combination, a charge of priming fluid containing ethyl ether, and a single-use gelatinous capsule containing said charge.

8. In combination, a primer cup having an opening for the discharge of priming fluid to an internal combustion engine, a gelatinous capsule containing a charge of priming fluid and positionable in said cup, and means in said cup for rupturing said capsule.

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