Oct. 4, 1960 R. S. BEVANS 2,955,028

FUEL SYSTEMS FOR COMPRESSION IGNITION ENGINES

Filed Oct. 17, 1955 3 Sheets-Sheet 1

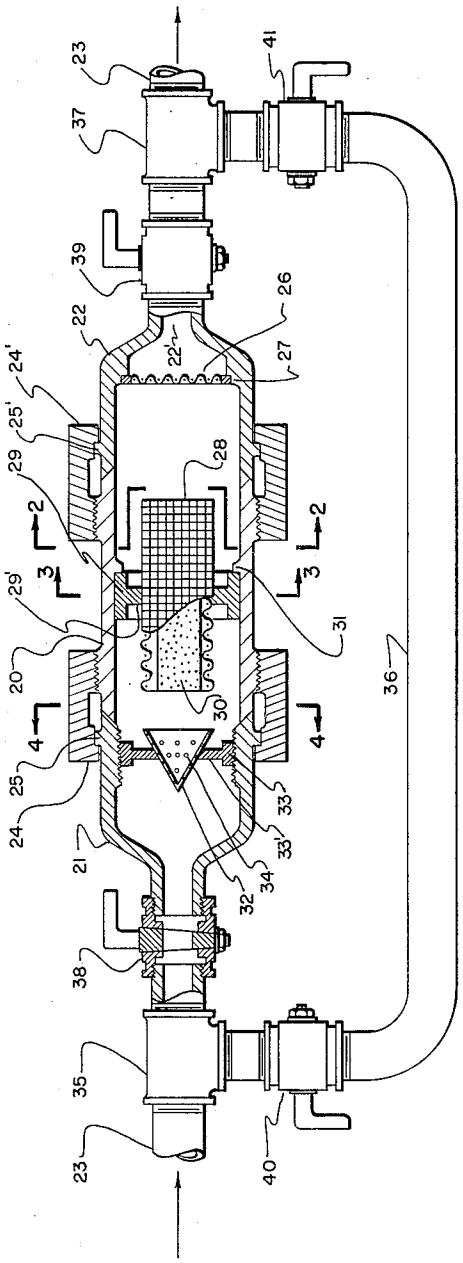


FIGURE 1

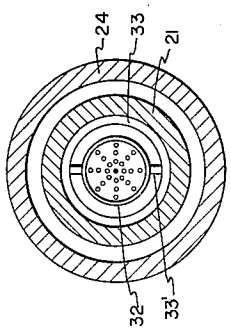


FIGURE 4

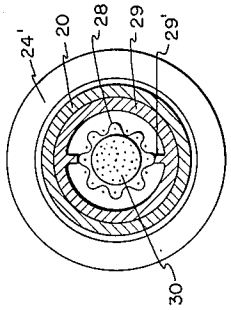


FIGURE 3

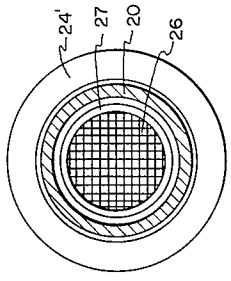


FIGURE 2

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FUEL SYSTEMS FOR COMPRESSION IGNITION ENGINES

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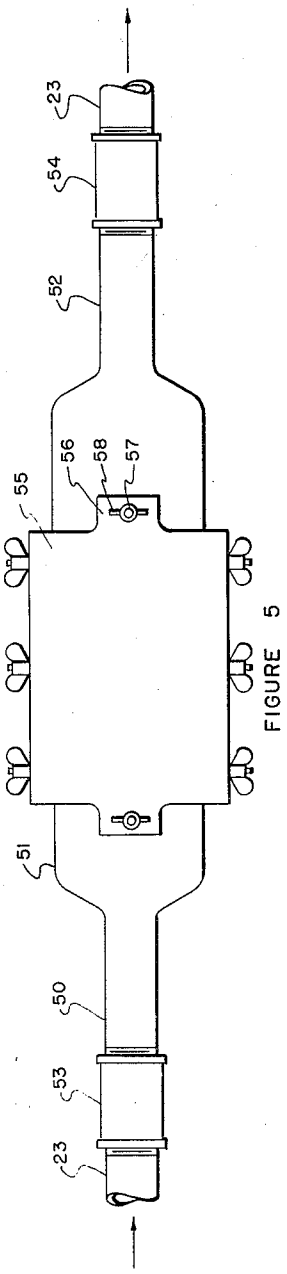


FIGURE 5

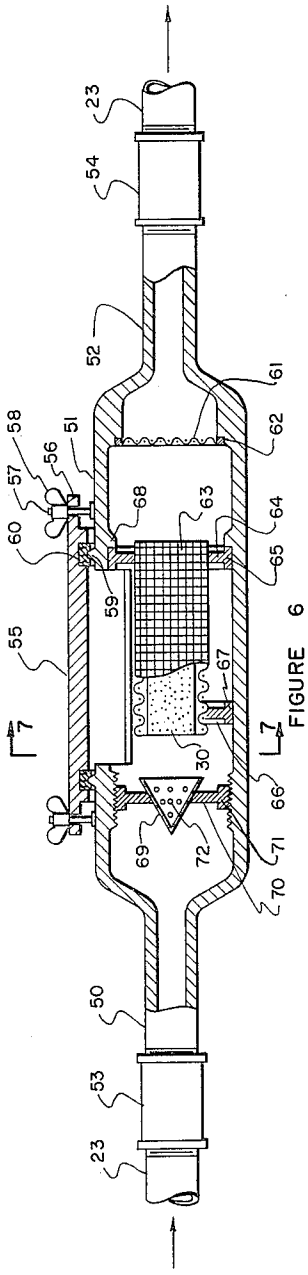


FIGURE 6

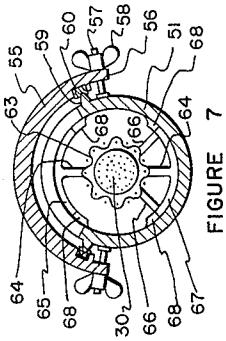


FIGURE 7

FUEL SYSTEMS FOR COMPRESSION IGNITION ENGINES

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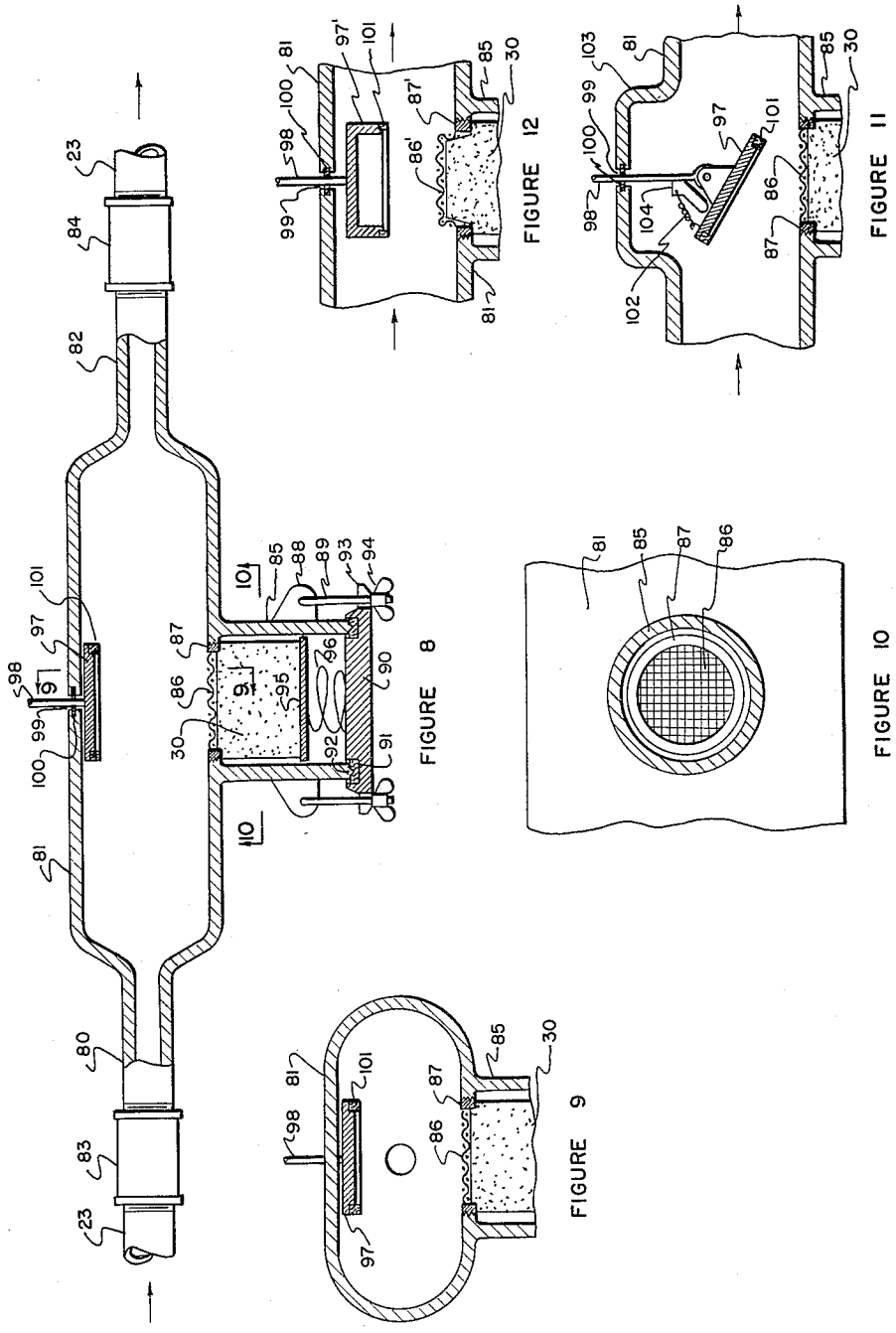


FIGURE 8

FIGURE 12

FIGURE 11

FIGURE 10

FIGURE 9

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2,955,028

FUEL SYSTEMS FOR COMPRESSION IGNITION ENGINES

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3 Claims. (Cl. 44—2)

This invention is concerned with fuel systems of compression ignition engines and in particular is directed to improved fuel systems having a means for contacting the fuel with a solid dispersion of finely divided metal.

In my co-pending continuation-in-part application, S.N. 448,160, filed August 5, 1954, now U.S. Patent 2,720,869, has been described an improved method for operating compression ignition engines wherein the fuel employed is contacted with a solid dispersion of finely divided alkali metal whereby the metal is released and suspended into the fuel prior to injection into the combustion chamber so as to increase the cetane number and combustion characteristics of the fuel. In connection with the contact of the fuel with the solid dispersion is the problem of providing a suitable means for effecting such contact efficiently.

It is therefore an object of this invention to provide a means for contacting a solid dispersion of finely divided metal with the fuel in the fuel system of a compression ignition engine. Another object is to provide an improved fuel system for compression ignition engines. A particular object is to provide a means for effecting the contact of the fuel with a solid dispersion of the finely divided metal. These and other objects will be apparent from the discussion hereinafter.

In its broadest aspects, the present invention comprises a fuel treating container adapted to support therein a solid dispersion of finely divided metal which has an inlet and an outlet through which the fuel employed will pass and contact the solid dispersion, and which has a means for preventing the solid dispersion from entering the outlet while still permitting the finely divided metal which is released to do so.

In general, the containers of this invention are inserted and form a part of the fuel system at some point between the fuel tank and the discharge port or ports of the injectors of compression ignition engines. That is, they can be connected to the fuel line at a point between the fuel supply pump and the injector pump, between the injector pump and the discharge ports of the injectors or between the fuel tank and the fuel supply pump by simple means such as self-sealing couplings. It is preferred, however, that the container be inserted in the fuel system at a point between the fuel supply pump and the injector pump to minimize hold-up of fuel containing the metal particles and to avoid compression of the fuel in the dispersion container which would thereby decrease the efficiency of injection into the combustion chamber. A further criterion of choice of the location of the container in the fuel system is that the lines subsequent to the container do not have constrictions smaller than about 0.04 inch although the injector orifices themselves may be as small as 0.002 inch. Line constrictions smaller than this size should be avoided in order to eliminate plugging.

The invention is best described with reference to the attached drawings wherein:

Figure 1 is a cross section of one type container of this invention.

Figure 2 is a detail in section of the outlet portion of the container described in Figure 1, taken on lines 2—2.

Figure 3 is a detail in section of the center portion of the container depicted in Figure 1, taken on lines 3—3, showing a basket in which the solid dispersion is inserted.

Figure 4 is a detail in section of the inlet portion showing a deflector which is employed in the container of Figure 1, taken along lines 4—4.

Figure 5 is a top plan view of a second embodiment of a container of this invention.

Figure 6 is a longitudinal sectional elevation of the second type container.

Figure 7 is a cross section of the central portion of the container depicted in Figure 5, taken along the lines 7—7.

Figure 8 is a longitudinal sectional elevation of a third embodiment of this invention.

Figure 9 is a cross section of the central portion of the third container taken along the lines 9—9.

Figure 10 is a cutaway view looking from the top of the container depicted in Figure 8, along the lines 10—10.

Figure 11 is a cutaway view of an alternate closing means for sealing off the fuel from contact with the solid dispersion when employing the container depicted in Figure 8.

Figure 12 is a cutaway view of still another alternate closing means for sealing off the fuel from contact with the solid dispersion when the dispersion protrudes into the stream of flow of the fuel.

The drawings depict three different types of containers which can be employed for contacting solid dispersions of finely divided metal with the fuel in the fuel system of a compression ignition engine.

Referring to the embodiment illustrated in Figure 1, in its simplest form it comprises a housing **20**, a constricted inlet portion **21**, a constricted outlet portion **22**, and a means for inserting the solid dispersion into the housing **20**. The container is attached and forms an integral part of the fuel system by connecting it to the fuel line **23** of the fuel system by suitable means. The means for inserting the solid dispersion into the container comprises a nut **24** which bears against raised surface **25** on inlet portion **21** and is threaded to engage a threaded portion of housing **20** at one end, and at the opposite end of housing **20** is a second nut **24'** bearing against raised surface **25'** on outlet portion **22** having a threaded portion which engages with a threaded portion on housing **20** in the opposite direction to that of previously described nut **24**. Thus, mating surfaces of housing **20** and inlet and outlet constricted portions **21** and **22** bear against each other when the nuts **24** and **24'** are secured. Employing two diametrically opposed engaging systems such as depicted provides a means wherein, when both nuts **24** and **24'** are disengaged from housing **20**, the housing can be removed for insertion of the solid dispersion therein.

The flow of the fuel will pass from constricted inlet portion **21** through housing **20** and constricted outlet portion **22**. The container has inserted in constricted outlet portion **22** a foraminous or porous material **26** supported by ring support **27** which will engage the inner surface of constricted outlet portion **22**. As shown, the foraminous material **26** is positioned in constricted outlet portion **22** by a snug fit. It can however be threaded therein. The foraminous material **26** prevents large pieces of the solid dispersion from passing into discharge port **22'**, but is of size to permit the finely divided metal particles to pass therethrough.

Within the housing 20 there is provided a basket 28 constructed of foraminous material which is supported within housing 20 by means of ring member 29 and basket brackets 29'. The solid dispersion 30 is shown in position in the basket 28. The basket 28 is positioned in the housing 20 by means of ring member 29 which engages the inner surface of housing 20 and contacts raised support surface 31 of housing 20. As shown, the basket 28 is open at the end first contacting the fuel, however, it can have a foraminous closing portion at that end which can be pivotally attached or secured by suitable means.

In the constricted inlet portion 21 there is shown a conical deflector 32 supported by means of deflector brackets 33' and deflector ring 33 which is threadably engaged with the inner surface of constricted inlet portion 21. The deflector 32 is perforated with holes 34. The deflector 32 serves to disperse and agitate the stream uniformly in the housing 20 for uniform contact of the fuel with the solid dispersion. As noted, it can be positioned laterally with respect to basket 28 by means of the threaded portion in housing 20. Depending upon the control of erosion of the finely divided metal required and the fuel employed, the apparatus has, as shown, the modification of a by-pass system. This system comprises a T-joint 35 which joins the fuel line 23 to the constricted inlet portion 21 and connects to by-pass line 36, the other end of which is connected to one leg of T-joint 37 which in turn connects to constricted outlet portion 22 and fuel line 23. Constricted inlet portion 21 and outlet portion 22 have inserted therein valves 38 and 39 respectively. Likewise, by-pass line 36 in proximity to T-joints 35 and 37 has inserted therein valves 40 and 41 respectively. Thus, when it is not necessary to contact the fuel with the solid dispersion, valves 38 and 39 can be closed and valves 40 and 41 opened. These valves can be operated manually or, for trucks and the like, by suitable means connecting to the cab convenient for the operator or by automatic control through a suitable mechanism such as one based upon temperature of the engine or compression. The by-pass system can be employed as a partial by-pass, that is, the valves 38, 39, 40 and 41 are adjusted so that a portion of the fuel flows over the solid dispersion and the remainder does not, but the two are mixed at T-joint 37 and passed into fuel line 23. Such an arrangement serves the purpose of additional control of the concentration of the finely divided metal in the fuel going to the injectors.

Thus, in the operation of the above described embodiment the nuts 24 and 24' are disengaged and housing 20 is removed. The solid dispersion 30 is placed in the basket 28. The housing 20 containing the basket 28 is then reinserted into position and the nuts 24 and 24' are tightened to form a continuous flow chamber of the inlet portion 21, housing 20, and outlet portion 22. The valves 38, 39, 40 and 41 are adjusted to the amount of contact desired and the system is then ready for operation.

Referring to Figure 2, there is shown therein the positioning and shape of the foraminous material 26 in housing 20 along with screen support 27 and engaging nut 24'. Figure 3 shows the position of basket 28, housing 20 and engaging nut 24'. The support for basket 28 comprising brackets 29' and ring member 29 is shown in contact with housing 20. It is to be understood that more than two brackets 29' can be employed if desired. Figure 4 depicts in more detail deflector 32 in position in the constricted inlet portion 21 supported by deflector supports 33', and deflector ring 33. Here, also, the deflector can be supported by more than two deflector supports 33'.

It is to be understood that the deflector 32, basket 28, and foraminous material 26 need not all be used in the above described container. For example, the solid dispersion 30 can be placed into the housing 20 resting on its inner surface with or without deflector 32 and without the use of basket 28. In such an arrangement, the foraminous screen 26 is the only member which prevents the solid dispersion from passing into the outlet port 22'. Likewise, it is not necessary that the second engaging means 24' be employed since the dispersion can be inserted by distorting the fuel lines when disengaging only nut 24. It is preferred, however, to employ the apparatus including both nuts 24 and 24' with foraminous screen 26, basket 28, and deflector 32 included in the container as shown, since more efficient dismantling and contact of the solid dispersion is obtained.

Referring now to Figures 5, 6, and 7, another embodiment of this invention of a container is depicted which in this instance has a direct external means for inserting the solid dispersion without disturbing the alignment of the fuel system or requiring the removal of a whole segment of the container. Basically, it comprises a constricted inlet portion 50, a housing 51, a constricted outlet portion 52 and a means for entry into the housing 51 for inserting the solid dispersion therein. As shown the container is inserted in the fuel line 23 by means of couplings 53 and 54 which connect respectively constricted inlet portion 50 to line 23 and constricted outlet portion 52 to line 23. The means for entry into the housing 51 comprises a lid 55 having extensions 56 through which can pass bolts 57, these being pivotally attached to housing 51. Nuts 58 are provided which engage bolts 57, thus allowing sealing of the housing 51. Referring particularly to Figure 6, this embodiment of the invention is shown in more detail illustrating particularly the sealing means for forming a good seal of the lid 55 on the housing 51 along with other elements contained in housing 51. The sealing means comprises a knife edge 59 on housing 51 which is adapted to contact gasket 60 when wing nuts 58 are placed in tension. Within the housing 51, in close proximity to constricted outlet portion 52, is a foraminous material or screen 61 supported by a retainer 62 which contacts the inner surface of the housing 51 and is snug fit therein. There is also shown a foraminous basket 63 supported in its right hand portion by basket brackets 64 which are attached to basket retainer ring 65. At the left hand of basket 63 there are also second basket brackets 66 which support basket 63 and are attached to a second basket retainer 67. The basket 63 is positioned in the housing 51 by contact against raised surface 68 on the inner surface of housing 51. The solid dispersion 30 is shown in position in the basket 63.

Also shown within the housing 51 is deflector 69 which is supported by deflector brackets 70 which are attached to deflector support ring 71. The ring 71 is threaded into the housing 51. However, other means of securing the deflector can be employed. The deflector 69 also has a plurality of holes 72 for further deflection and distribution of the fuel stream over the solid dispersion.

Referring to Figure 7, there is shown in more detail the relative positions of the housing 51; lid 55; the side securing device for lid 55 including the bolts 57; the lid extension 56, and the side gasket 60 which contacts raised knife edge 59 of housing 51. This figure further demonstrates the positioning of the basket 63 with the first support bracket 64 and support ring 65 engaging raised surface 68 of housing 51. Also shown are the second support brackets 66 and support ring 67. It is to be noted that the support rings 65 and 67 are segments of a ring which contact the inner surface of housing 51 and fit into the raised surface 68 of housing 51.

The Figures 5, 6 and 7 depict a particularly preferred embodiment of this second container of this invention. It is to be understood, however, that the basket 63 and deflector 69 need not be employed and thus the solid dispersion 30 can be merely inserted into the housing 51. Alternatively, the deflector 69 can be employed without the basket 63, again merely placing the solid dispersion in the housing 51. Likewise, a by-pass or partial by-pass of the fuel over the dispersion can be employed as shown in Figure 1 and described previously.

A still third and more preferred embodiment of the

present invention comprises the container shown in Figure 8. This container comprises as its basic elements a constricted inlet portion **80**, a housing **81**, a constricted outlet portion **82** and a means for continuously providing a constant surface of the solid dispersion for contact with the fuel. The constricted inlet portion **80** is connected with the fuel line **23** by a suitable coupling **83** and likewise the constricted outlet portion **82** is connected to the fuel line **23** by a suitable coupling **84**. The means for continuously providing a constant surface for contact of the solid dispersion with the fuel comprises an extended housing **85** laterally attached to housing **81** in which the solid dispersion **30** is placed, and at or near the juncture or extremity in contact with the flow of the fuel, is attached a foraminous material **86** supported by a retainer **87** which is threaded and secured thereby in extended housing **85**. Extended housing **85** also has lateral extension brackets **88** to which are attached bolts **89**. A lid **90** is provided which has recessed portions adapted to receive gasket **91** which, when in the closed position, contacts knife edges **92** which are formed as a part of extended housing **85**. The lid **90** is secured in position on extended housing **85** bearing on knife edges **92** by means of extended portions **93** adapted to receive bolts **89** and which serve as a bearing surface when wing nuts **94** are tightened. In order to maintain the solid dispersion in intimate contact with the foraminous screen **86**, a retaining member **95** is employed which is maintained in contact with the solid dispersion **30** by means of resilient member **96**. Resilient member **96** is attached to the inner surface of lid **90** and in compression provides a force whereby plate **95** pushes against the solid dispersion **30** and continually moves away from lid **90** as the solid dispersion is consumed. A particular advantage of this resilient attachment is that due to the variations in pressure of the fuel, the solid dispersion is retained in contact with the foraminous material and if desired, the apparatus can be positioned on any axis, that is, so that the extended housing **85** can be horizontal, to the right or left; can be vertical, up or down; or in any intermediate direction.

To facilitate the use of this embodiment of the present invention there is provided a closing member **97** actuated by handle **98** which extends through housing **81** through a hole **99** which has recessed therein gasket **100** to prevent leakage of fuel. Closing member **97** has gasket **101** attached to its lower surface to facilitate sealing when in contact with the inner surface of housing **81** over foraminous material **86**. Employing closing member **97** permits sealing off the solid dispersion from contact with the fuel in those instances where such contact is not required. The closing member **97** actuated by handle **98** can be operated manually or, for trucks and the like, by suitable means connecting to the cab of the vehicle for access by the operator, or automatically by temperature control of ignition quality of the fuel. Thus, the employment of closing member **97** has the advantage of an internal mechanism for bypassing contact of the solid dispersion with the fuel thereby requiring lesser space and more efficient control. It is to be understood however, that if further desired, a bypass line such as that employed in Figure 1 can be employed to achieve a partial bypass of the fuel over the dispersion. Closing member **97** also permits removal of lid **90** for insertion of more solid dispersion without interrupting operation of the engine.

In operation, the lid **90** is removed and the solid dispersion **30** is inserted into the extended housing **85**. Then the lid is replaced and secured by tightening nuts **94**. With the closing member **97** in the open position, the apparatus is ready for operation.

Figure 9 is a partial cutaway of the internal portion of housing **81** showing in particular the shape of the housing in this portion of the apparatus. Figure 10 depicts the shape of the extended housing **85** including the foraminous material **86** in position.

Referring now to Figure 11 there is depicted there an alternative form of this embodiment in which closing member **97** is pivotally attached to actuating handle **98** by suitable means and a resilient member **102** is secured to the left extremity of closing member **97** and on handle member **98**. The housing **81** is modified to include the chamber **103** as a recess in which the mechanism of the closing member will move into when in the open position. A sealing means is provided similar to that depicted in Figure 8. Attached to handle **98** is also provided a stop **104** which prevents closing member **97** from assuming more than about a 45° angle from the axis of flow of the fuel. The size of the stop **104** can be adjusted so as to provide the angle of deflection desired. Employing this mechanism provides a means whereby closing member **97** also serves as a deflector to obtain more efficient contact of the fuel with the solid dispersion and better mixing of the released metal particles with the fuel while still providing an efficient means of sealing off the solid dispersion from contact with the fuel when moved downwardly. Other means of deflection of the fuel can be employed such as movable vane members in housing **81** upstream from the point of contact of the fuel and the solid dispersion.

In Figure 12 is shown an alternative embodiment of the closing means and the foraminous material which retains the solid dispersion in contact with the fuel. Here the solid dispersion **30** will protrude into the fuel stream by contacting foraminous member **86'** which here is of cylindrical shape. The closing member **97'** is of a shape to encompass the foraminous member **86'** so that gasket **101**, when in the closed position will contact the inner surface of housing **81** in close proximity to the screen member **86'**. In this instance the solid dispersion will protrude into the chamber of housing **81**, preferably between ¼ to ½ the depth of the housing **81**.

In the employment of the apparatus depicted in Figures 1 through 4, and 5 through 7, the void cross sectional areas through which the fuel passes will be between about ½ to 3 times the cross sectional area of the fuel line **23**. For best operation with regard to the flow of the fuel and time of contact of the fuel with the solid dispersion, it is preferable that the void cross sectional area be between about the cross sectional area of the fuel line and 1½ times thereof. As noted above foraminous materials are employed in certain elements in all embodiments of this invention. These foraminous materials can be screens, sintered metal plates, or the like which prevent large segments of the dispersion from passing into the fuel line **23** but which will permit the finely divided metal particles to pass therein. Thus these foraminous materials should have an opening at least as large as the largest diameter of the finely divided metal particles. For best operation it is preferred that the openings be between about 3 to 15 times as large as the major diameter of the largest particle of the finely divided metal. In general, the openings can be between about 3 to 20 times as large as the largest diameter of the finely divided metal.

As depicted in the drawings, the geometry of the chamber surrounded by housing **81** is rectangular with rounded edges, and extended housing **85** is cylindrical. It is to be understood that the geometry of these enclosures can be varied, for example, to result in cubical sections or any other modified form which will serve the functions set forth hereinbefore. Similarly, the same is true for the apparatus depicted in Figure 1 and the apparatus depicted in Figures 5 and 6. It is preferred, however, that for the apparatus depicted in Figures 1, 5, and 6 the geometry be essentially circular for easier manufacture and adaptation to the fuel system of combustion ignition engines.

It is to be understood that the three basic type apparatus depicted in the figures and described above can be further modified without departing from the spirit and

scope of the present invention. It is intended here only to depict three particular embodiments of the apparatus.

It will be evident that only minor modifications need be made to the fuel systems of commercial compression ignition engines or diesel engines in order to employ the containers of this invention. For example, in those engines wherein an excess of the fuel is employed for cooling the injector and this excess is recycled to the fuel tank, the recycle line can have a takeoff line to the dispersion container with its discharge side connecting to the fuel line between the fuel tank and the pump. By means of a T-valve or the like at the connection of the recycle and takeoff lines, recycle to the fuel tank can be stopped when the metal is to be eroded into the fuel, thus avoiding unnecessary buildup in metal concentration. Alternatively, the recycle line can be returned to the fuel tank and coiled therein for heat transmission of the fuel passing therethrough and then connecting to the fuel line between the fuel tank and the pump. That is, the recycled fuel can be cooled by the fuel in the fuel tank instead of employing other external cooling means, and in this operation the fuel containing some alkali metal is not mixed with the fuel in the fuel tank to result in buildup of metal concentration in the fuel. In those engines where there is no recycle the dispersion container is connected to the fuel line and forms an integral, continuous part of the fuel system. These and other simple modifications of compression ignition fuel systems will be evident to those skilled in the art.

As mentioned above, the apparatus of this invention is to be employed for contacting solid dispersions of finely divided metal with the fuel in compression ignition engines. These solid dispersions comprise a mixture of finely divided metal uniformly distributed in a solid dispersion medium. The metals preferably employed are the alkali metals, particularly sodium. Briefly, these solid dispersions comprise the metal in concentration between about 10 to 85 percent by weight dispersed in solid materials which are essentially inert or non-reactive with the metal and substantially soluble in the fuel employed. The solid hydrocarbons, particularly those having a melting point above 70° C., are particularly suitable. In many instances, because of varying climatic conditions and handling of the solid dispersion, it is desirable that it meet particular physical characteristics. Among such characteristics are that it be a solid which is dimensionally stable, will not flow when subjected to a wide temperature range of about −50 to +70° C., nor will it lose its shape by applying a slight pressure thereto. In order to meet these particular physical characteristics, these dispersions are modified by incorporating certain modifying agents such as liquids, semi-solids, and greases. Solids which are different from the dispersing medium employed can also be used. The liquid hydrocarbons have been found to be particularly siutable as modifiers. The particle size of the alkali metal can be varied over wide limits from very minute particles up to about 1000 microns in size. It is particularly preferred that particle size of the alkali metals average not greater than about 20 microns since these sizes have been shown to be most effective.

These solid dispersions have been described more completely in my co-pending application, S.N. 448,160. Likewise, it is described therein that the shape of the solid dispersion can be modified considerably; that is, it can be cubical, cylindrical, circular, a hollow cylinder, or a solid having an irregular surface which will impart greater surface area per unit mass. Thus, in this connection it will be evident that the baskets **28** and **63**, and extended housing **85** depicted in the drawings can assume various shapes to accommodate the shape of the solid dispersion, whether it be as a single piece or in many pieces. In the particular apparatus depicted in Figures 8, 9, and 10, it is preferred to employ a cylindrical solid dispersion of the finely divided metal.

To demonstrate the employment of the apparatus of this invention it will be described in the following example.

A solid dispersion of 200 parts of sodium of particle size averaging 9 microns with a range of between 1 to 20 microns in 200 parts of paraffin wax is employed. A CFR diesel engine has inserted in the fuel line between the fuel tank and the pump the container depicted in Figure 8 which forms a part of the fuel system. The lid **90** is removed, and the solid dispersion is inserted in extended housing **85**. The lid **90** is then replaced with plate **95** holding the solid dispersion securely against the foraminous screen **86**. Closing member **97** is maintained in the open position. A diesel fuel straight run from Gulf Coastal petroleum having a cetane number of 33 is charged to the fuel tank, and the engine is started in the normal manner. The fuel passing over the dispersion by erosion and solution of the dispersion medium contains 0.05 percent by weight of sodium. The cetane number of this fuel by the ASTM method (D613) is raised to 75.

In similar manner the other apparatus depicted in Figures 1 and 6 can be employed as described above.

Many advantages are achieved employing the apparatus of the present invention. These apparatus provide simple and effective means for contacting solid dispersions of finely divided alkali metal with the fuel where, by erosion and solution of the dispersion medium, the finely divided alkali metal is released and suspended into the fuel thereby increasing its cetane number and combustion characteristics. The apparatus are simple, compact, and provide ready means for insertion of the alkali metal dispersion into the fuel system. Likewise, each apparatus is provided with a means for bypassing the solid dispersion when contact between the fuel and the dispersion is not required. Ordinarily the contact is made, depending upon the fuel employed, when the engine is first started, i.e., while cold, thereby improving ignition of the cold temperature starting due to the presence of the alkali metal. After running the engine for a short period the improved benefits of the alkali metal may not be required and the fuel system can be cut out in order to bypass the dispersion. Likewise, contact is advantageously made during idling and low power output operations and during acceleration after an idling period and the like instances wherein the added cetane characteristic of the fuel is required. In addition, as described previously, a partial by-pass system can be employed for any of the above conditions of operation.

Although the above description has been confined mainly to the employment of solid alkali metal dispersions, it is to be understood that other metals can be employed as, for example, the alkaline earth metals, particularly finely divided calcium.

Having thus described the apparatus of this invention, it is not intended that they be limited except as set forth in the appended claims.

I claim:

1. A fuel treating apparatus adapted for insertion in a fuel transmission line of a compression ignition engine between a fuel supply tank and the fuel discharge ports of the combustion chamber of said engine, said apparatus comprising a container provided with a fuel inlet and a fuel outlet, a basket constructed of foraminous material positioned within said container and adapted to support therein a solid dispersion of finely divided metal in contact with fuel passing through said chamber, and a foraminous member comprising a screen interposed between said basket and said fuel outlet, both said basket and said screen having openings larger than the largest particle size of said finely divided metal thereby permitting the passage therethrough of metal particles contained in the fuel.

2. A fuel treating apparatus adapted for insertion in a fuel transmission line of a compression ignition engine between a fuel supply tank and the fuel discharge ports

of the combustion chamber of said engine, said apparatus comprising a container provided with a fuel inlet and a fuel outlet, a basket constructed of foraminous material positioned within said container and adapted to support therein a solid dispersion of finely divided metal in contact with the fuel passing through said chamber, a perforated deflector positioned between said basket and said fuel inlet, and a foraminous member comprising a screen interposed between said basket and said fuel outlet, both said basket and said screen having openings larger than the largest particle size of said finely divided metal thereby permitting the passage therethrough of metal particles contained in the fuel.

3. A fuel treating apparatus adapted for insertion in a fuel transmission line of a compression ignition engine between a fuel supply tank and the fuel discharge ports of the combustion chamber of said engine, said apparatus comprising a container provided with a fuel inlet and a fuel outlet, a basket constructed of foraminous material positioned within said container, a solid dispersion of finely divided metal positioned within said basket so as to contact fuel passing through said chamber, and a foraminous member comprising a screen interposed between said basket and said fuel outlet, both said basket and said foraminous member having openings between about 3 to 20 times as large as the diameter of the largest particle of the finely divided metal of said dispersion thereby permitting the passage therethrough of metal particles contained in the fuel.

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