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(54) **Spray nozzle assembly for piston cooling.**

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Description

BACKGROUND OF THE INVENTION

This invention relates generally to devices and systems for cooling the pistons in internal combustion engines. More particularly, this invention relates generally to crankcase oil spray nozzles employed for cooling pistons.

Internal combustion engines and in particular diesel engines employ oil and lubrication systems to cool or remove heat from the area of the piston and cylinder. In one conventional cooling system, tubular nozzles extend at the interior of the engine crankcase and are oriented to direct a spray of oil at the underside of the piston crown. The tubular nozzles communicate with the oil supply gallery. A check valve in the nozzle selectively prevents the spray of oil from the nozzle until the oil pressure exceeds a pre-established threshold. An oil spray nozzle is located in each of the engine cylinders.

In EP-A-0 100 863 there is disclosed a nozzle assembly, according to the precharacterizing portion of independent claim 1, for cooling the crown of a piston. The known assembly comprises a flange having a spray nozzle integrally formed with the flange. A separate support means consisting of a U-shaped clamp provides a seat for a check valve body and spring received in a bore of the flange.

SUMMARY OF THE INVENTION

The object of the invention is to provide a new and improved nozzle assembly of efficient and low cost construction for cooling the piston of an internal combustion engine by emitting a spray of lubricant and directing the spray at the underside crown of the piston.

In accordance with the invention, to achieve this, there is provided a nozzle assembly for cooling the crown of a piston in an internal combustion engine comprising housing means having a first nozzle end and an opposing second end, an inlet opening intermediate said nozzle end and said second end, a nozzle passageway, a restricted nozzle orifice at said nozzle end, said passageway extending from said inlet opening to said orifice, and cover plate means secured to said housing means, characterized in that said inlet opening is defined by a transversely protruding inlet well integrally formed with said housing means, that said cover plate means cooperates with said housing means to define said nozzle passageway, and that retaining flanges integrally extend from one of said housing means and said cover plate means and are bent around and against said other of said housing means and said cover plate means to secure said housing means and cover plate means in assembled relationship.

Accordingly, the oil spray nozzle has an efficient low cost sandwich-type construction which permits installation in the engine crankcase in an efficient manner. The oil spray nozzle in some embodiments incorporates an internal filter system to insure reliable operation.

In one embodiment, a check valve comprising a valve member and a spring is received in the well and captured between the housing member and the cover plate. The valve member is biased by the spring to prevent the passage of fluid through the passageway when the pressure of the fluid is below a pre-established threshold. The valve member is displaceable to permit the passage of fluid for injection through the nozzle orifice.

An intermediate plate may be disposed between the housing member and the cover plate in a sandwich-like fashion. The intermediate plate, the housing member, and the cover plate define the nozzle passageway. The spring may be employed as a filter to the passage of fluid between the inlet opening and the nozzle orifice. The housing member and the cover plate may also have an array of projections which cooperate to define an internal edge filter in the nozzle passageway.

In one embodiment, a leaf spring is anchored at one end between the housing member and the cover plate to interrupt the passage of fluid through the nozzle when the fluid pressure is below a pre-established threshold. The cover plate has an arcuate cross section and the housing member has a planar portion which cooperate to define the fluid passageway of the nozzle. The cover plate has a terminus which is rounded to define a deflector adjacent to the nozzle orifice.

In another embodiment, a tubular nozzle tip is connected to a holder member that is made entirely of sheet metal, the combination being secured together into a nozzle assembly by the bending and tightening of flanges associated with a housing or cover plate portion of the holder member. Preferably, the nozzle tip has a D shaped cross section at the end to be mounted in the holder member and the holder member includes a cover plate having a channel of similar cross section adapted to receive the nozzle tip and form a passageway for delivering oil to the nozzle tip discharge orifice.

In some spray nozzle embodiments, the nozzle body is formed from two members. One member is stamped or coined in a fine blanking or semi-shearing process to form an indentation. The indentation partially defines the walls of the passageway which extends from the nozzle inlet to the orifice. The indentation and the passageway have a rectangular section at the orifice portion for controlling the nozzle spray.

Other features and advantages will become apparent from the drawings and the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an interior fragmentary view, partly in schematic and partly in section, of an engine crankcase illustrating a cylinder and piston and an associated cooling nozzle in accordance with one embodiment of the present invention;
Figure 2 is an enlarged exploded view of the piston cooling nozzle of Figure 1 illustrated in a pre-assembled stage;
Figure 3 is an enlarged longitudinal sectional view of the piston cooling nozzle of Figure 2;
Figure 4 is a sectional view of the piston cooling nozzle taken along the line 4-4 of Figure 3;
Figure 5 is a fragmentary sectional view, partly broken away and partly in phantom, illustrating a portion of an engine and a second embodiment of an associated cooling nozzle in accordance with the present invention;
Figure 6 is a fragmentary interior underside view of the engine and nozzle of Figure 5 with the swing path of the piston connecting rod being illustrated in broken lines;
Figure 7 is a fragmentary longitudinal sectional view of a third embodiment of a piston cooling nozzle in accordance with the present invention;
Figure 8 is a longitudinal sectional view of a fourth embodiment of a piston cooling nozzle in accordance with the present invention, said nozzle being illustrated as mounted to a portion of the engine crankcase;
Figure 9 is a sectional view of the piston cooling nozzle taken along the line 9-9 of Figure 8;
Figure 10 is a sectional view of the piston cooling nozzle taken along the line 10-10 of Figure 8;
Figure 11 is an enlarged fragmentary top view of an end portion of the piston cooling nozzle of Figure 8;
Figure 12 is a fragmentary sectional view of a fifth embodiment of a piston cooling nozzle in accordance with the present invention;
Figure 13 is an enlarged fragmentary interior bottom view illustrating a filtering system employed in a piston cooling nozzle in accordance with the present invention;
Figure 14 is a fragmentary sectional view of the piston cooling nozzle taken along the line 14-14 of Figure 13;
Figure 15 is a sectional view of a sixth embodiment of a piston cooling nozzle in accordance with the present invention;
Figure 16 is a fragmentary sectional view of the piston cooling nozzle of Figure 15, said nozzle being illustrated as mounted to a portion of the engine crankcase;
Figure 17 is a perspective view of another embodiment of the invention having a tubular nozzle tip;
Figure 18 is a cross sectional view of the nozzle assembly having a tubular tip taken along the line 18 - 18 of Figure 17;
Figure 19 is a cross sectional view of the nozzle assembly of Figure 17 taken along the line 19 - 19 of Figure 18;
Figure 20 is a perspective view of another embodiment of a nozzle assembly in accordance with the present invention;
Figure 21 is a side elevational view, partly broken away and partly in phantom, of the nozzle assembly of Figure 20;
Figure 22 is a top plan view of the spray nozzle assembly of Figure 20;
Figure 23 is a bottom view, partly in phantom, of the nozzle assembly of Figure 20;
Figure 24 is a side sectional view of another embodiment of a nozzle assembly in accordance with the present invention;
Figure 25 is a top plan view of the nozzle assembly of Figure 24;
Figure 26 is a bottom view, partly in phantom, of the nozzle assembly of Figure 24; and
Figure 27 is an elevational view of the nozzle assembly of Figure 24 viewed from the left thereof.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawings wherein like numerals represent like parts throughout the several figures, an oil spray nozzle in accordance with one embodiment of the present invention is generally designated by the numeral 10 in Figure 1. Oil spray nozzle 10 is employed in an internal combustion engine 12 and oriented for spraying the underside crown of a piston 16 of a given cylinder 18. The oil spray nozzle 10 is mounted interiorly of the engine crankcase 20 and fluidly communicates with the oil supply passage or gallery 22 of the crankcase for supplying oil under pressure. When the oil pressure exceeds a pre-established threshold pressure, pressurized oil traverses through the nozzle 10 for injection or spraying at the underside crown of the piston. The nozzle thus functions to cool the piston crown during engine operation. Connecting rods and other engine components have been omitted from Figure 1 to better illustrate the invention. The location and the low-profile dimensions of the nozzle are selected to provide clearance with the operational path of the connecting rod and the counter weight. It should be appreciated that a piston cooling nozzle 10 is preferably provided for each corresponding piston of the engine.

With additional reference to Figures 2-4, the oil spray nozzle 10 in one embodiment has a sandwich-type assembled configuration formed from stamped components. The oil spray nozzle 10 comprises a three-component sandwich-type, main body structure including a housing 30, an intermediate passage

plate 40 and a cover plate 50. Each of the three components may be stamped or formed from metallic material.

The housing 30 generally defines the exterior profile of the nozzle and also functions to provide structure for securing the nozzle components in assembled relationship. The housing is initially stamped from a plate in a multi-surface shape having a nose-like end tab 32, and a pair of laterally spaced creased skirts 36 and 38 which form sidewalls and securing flanges as will be hereinafter described in detail. An integrally extending well 42 is centrally formed in the plate so as to protrude from a planar plate 31 portion of the stamped housing. The well 42 has a generally cylindrical shape with a tapered terminus which defines an inlet opening 44 for the nozzle. An aperture 46 is punched or otherwise formed in the base plate 31 equidistantly between skirts 36 and 38 and longitudinally spaced from well 44.

The base plate 31 extending between the skirts 36 and 38 essentially functions as a receiving tray for the generally planar intermediate passage plate 40. Passage plate 40 is generally planar and has a peripheral shape similar to the base plate 31 of the housing. Passage plate 40 is interiorly received by the housing and abuts against the base plate 31 in surface-to-surface relationship. The intermediate passage plate 40 has a cutout portion defining a well opening 43 and a nozzle passageway 48 leading from the opening 43 to a narrow nozzle orifice 47 formed at the forward end of the passage plate 40. The well opening 43 generally aligns with the well 42 formed in the housing. The nozzle passageway 48 extends generally from the well and obliquely angles toward the nozzle orifice 47. The passage 48 is reduced or tapered at the outlet end to form the nozzle orifice 47. The intermediate plate has a nose-like terminus which generally conforms to the shape of the nose end of the housing base plate 31. An aperture 46′ substantially similar in size and shape to aperture 46 is also stamped or formed in plate 40. The dimensions of the well opening 43, nozzle orifice 47 and passageway 48 may be precisely defined by the interior edges of the intermediate plate 40.

The cover plate 50 is generally planar and has a peripheral shape substantially similar to that of the intermediate plate 40. The cover plate 50 also has an aperture 46″ which is dimensioned to be substantially similar to that of apertures 46 and 46′ and generally alignable therewith. The cover plate 50 engages against the intermediate plate 40 which, in turn, engages against the base plate 30 in a generally tri-layered surface-to-surface relationship. The skirts 36 and 38 are bent over so as to engage against the cover plate 50 to form integral retaining flanges 37 and 39, respectively, to secure the three plates in a sandwich type-configuration. The nose end of the cover plate 50 extends beyond the corresponding nose portion of the housing. The terminus of the cover plate nose portion and a corresponding small portion of the passage plate nose is curved and/or angled so as to form a nozzle opening deflector 56 for deflecting and directing the spray toward the piston crown. The shape of the deflector 56 is selected to provide the desired spray pattern for a given crankcase/piston configuration. The cover plate, intermediate plate and housing cooperate to define an interior nozzle passage which is substantially fluid tight so that a fluid passageway extends from the inlet opening 44 through the nozzle orifice 47. The preferred application of the nozzle as a piston cooler does not require that the nozzle passageway and fluid flow path through the nozzle be hermetically sealed.

A check valve assembly comprising a ball valve 60 and a spring 62 are received in the well 42 and captured between the housing 30 and the cover plate 50. The ball valve 60 is biased to seat against an interior seat proximate to the well terminus to cover the inlet opening 44. After inserting the valve 60 and spring 62 into the well 42, the sidewalls 36 and 38 are bent around both the intermediate plate and the cover plate to enclose and retain the check valve assembly comprising the ball valve 60 and the biasing spring 62. The check valve assembly functions to close the inlet opening to the passage of pressurized oil until the oil exceeds a pre-established pressure threshold, at which time the oil communicates through the inlet 44 and the formed nozzle passage 48 for spray injection through the nozzle orifice 47. The pressure threshold is defined by the force of spring 62.

The substantially identical circular apertures 46, 46′, and 46″ which are punched or otherwise formed in the base plate, intermediate plate and cover plate align to define a fastener opening transversely extending through the flattened sandwich-type nozzle body. The nozzle 10 is thus easily mounted at the crankcase interior by means of a conventional fastener 68. The nose end portions of the intermediate passage plate and the cover plate are slightly bent to provide the correct orientation of the nozzle relative to the piston crown.

A modified embodiment of a piston cooling nozzle 11 is illustrated in Figures 5 and 6. Nozzle 11 is substantially identical in form and function to nozzle 10 except for the modifications described herein. The low profile construction allows for the outlet end of the nozzle 11 to be curved or bent away from the engine block when mounted so as to accommodate the end of the piston skirt, at the extreme piston travel position. In addition, the nozzle housing may have a pronounced bent-leg-type shape to provide sufficient clearance between the nozzle outlet and the piston connecting rod. The swing path of the piston connecting rod is denoted by numeral 24 in Figure 6.

With reference to Figure 7, the spring 62 may be configured to essentially function as an auxiliary filter.

The spring 62 is configured to permit the passage of oil from the radial exterior to the central interior, as schematically illustrated by the flow path arrows. The spacings between the coils of the spring are dimensioned to prevent the passage of particulate manner. The walls defining the intermediate plate opening 45 are bent to form an upstanding shoulder for seating the end coil of the spring 62. A passageway 48′ is defined by a contoured indented portion of the cover plate to form a fluid path from opening 45 through passageways 48′ and 48 through the nozzle orifice 47.

Another filter system for the nozzle 10 is illustrated in Figure 2 and 3. Interior opposing surfaces of the housing base plate 30 and the cover plate 50 are configured with opposing arrays of stamped dimples 39 and 59, respectively, which cooperate to form an interior edge filter of the nozzle for filtering and preventing particulate matter from being deposited or lodged in the nozzle orifice 47. If particulate matter becomes lodged in the nozzle orifice, the spray characteristics of the nozzle could be dramatically altered. In some circumstances, the nozzle orifice could be entirely closed by particular matter. The spacing between the opposing faces of dimples 39 and 59 is dimensioned to provide the restricted passageway.

Another internal edge filtering system which may be incorporated into the nozzle 10 is illustrated in Figures 13 and 14. The passageway from the inlet opening to the nozzle orifice 47 has a pair of laterally offset, longitudinally extending passage segments 72 and 74. The passage segments 72 and 74 are separated by a ridge 76. The oil flow path to the nozzle orifice (denoted generally by the arrows) essentially crosses the ridge 76 through the gap between the ridge and the housing base plate 31. The clearance between the top surface of the ridge 76 and the underside of the base plate 31 is dimensioned to prevent particulate matter having a diameter greater than the clearance from traversing across the ridge. The ridge thus functions as an edge filter. It should be appreciated that the ridge may cooperate to form a gap between either the base plate or the cover plate.

With reference to Figures 8 through 11, another embodiment of a piston cooling nozzle in accordance with the present invention is generally designated by the numeral 90. Piston cooling nozzle 90 differs from the previously described oil spray nozzle 10 principally with respect to the body construction which is essentially stamped and shaped from two plates to form a housing base 92 and a cover 94. The base 92 includes integrally extending tabs 96 and 98 which extend from laterally spaced sidewalls 100 and 102, respectively. The tabs 96 and 98 are bent over and crimped against the cover plate 94 to form the nozzle body. The cover plate 94 cooperates with the generally planar support portion of the base 92 to form a nozzle passage 104.

The housing base 92 is shaped to form a well 106 having an inlet opening 108. The well 106 receives a check valve assembly comprising a ball valve 110 and a spring 112 which biases the ball valve 110 against an interior well seat for closing the opening 108. The valve 110 and the spring 112 are captured between the cover plate 92 and the housing base 94 as best illustrated in Figure 8.

The forward nose portion of the cover plate is bent or curved to form a deflector 114. It should be appreciated that the cover plate has a concave or arc-shaped section which partially defines the nozzle passage 104. The passage 104 leads from the inlet of the well to the formed nozzle orifice 120 defined between the cover plate 94 and the base plate 92 adjacent to the deflector 114. To better control the shape of the deflector 114, the contoured-shaped portions which define the nozzle passage 104 are formed in the housing base 94 at the nozzle end portion adjacent to the deflector 114 and nozzle orifice 120. An aperture 118 formed in the nozzle is adapted to receive a fastener for mounting the nozzle to the engine block 134 as previously described relative to nozzle 10.

With reference to Figure 12, another embodiment of a piston cooling nozzle designated generally by the numeral 130 employs a leaf spring 132 in place of the previously described check valve assembly. The leaf spring 132 is positioned between opposing planar portions of the housing and the cover plate, and is secured in position by the folding over of the retaining tabs of the housing as previously described for nozzle 90. It should be appreciated that in some embodiments the retaining structures may integrally extend from the cover plate and be bent over the housing rather than the retaining structures extending from the housing sidewalls as described previously.

For some applications (not illustrated), neither a check valve assembly nor a leaf spring are required. A flow path is continuously defined between the nozzle inlet opening and the outlet orifice.

With reference to Figures 15 and 16, another embodiment of a piston cooling nozzle is designated generally by the numeral 150. Oil spray nozzle 150 is suitable for applications where there is little existing room to accommodate the nozzle. Nozzle 150 includes a sheet metal nozzle base 152, an intermediate passage plate 154, and a cover 156. The base plate is folded around the passage plate and over the cover to form a retaining flange 153 as previously described. The assembled plates are bent or rounded to form a nozzle head, terminating in a nozzle orifice 160. An aperture 158 extends through the assembled plates.

With reference to Figure 16, nozzle 150 is a highly compact nozzle for applications where there is insufficient clearance to incorporate a separately spaced check valve extension and a fastener for fastening the nozzle in position. The oil gallery 146 connects via a

bore 148 for receiving a threaded fastener 162. The fastener 162 functions to both secure the nozzle in position and to house the nozzle check valve assembly. Fastener 162 includes a longitudinal bore 164 and a diametral bore 170 which opens through bore 164 near the top head portion of the fastener. The fastener and the adjacent portions of the nozzle aperture 158 cooperate to form an annulus 172 so that a passageway may be formed communicating from the oil gallery through bore 148, bore 164, bore 170 and annulus 172 for fluid communication through the nozzle passage and out the nozzle orifice 160. A threaded surface anchors the nozzle to the engine. A spring 166 biases a ball valve 168 which is secured by a press-fit retainer ring 174. The retainer ring 174 is secured into position to retain the spring/ball valve assembly within the bore 164 by crimping material 175 from the fastener 162 over the edge of the retaining ring 174. The retainer ring also functions as the valve seat for the ball valve 168. It will be appreciated that the foregoing nozzle 150 is highly compact due to the integration of the inlet check valve assembly with the mounting fastener for the nozzle.

The oil spray nozzles 10, 90, 130, and 150 as previously described, may be formed in a relatively efficient low-cost construction and assembly process to form a sandwich-type nozzle construction which has a compact low profile while also providing a suitable nozzle spray pattern for cooling the piston crown.

The housing components for the described nozzles may be assembled by a process wherein welding, brazing or similar methods are not required. The cooperative clamping engagement of the housing components is sufficient to maintain the components in assembled relationship and to seal the nozzle passageways. In one embodiment of the oil spray nozzle 10, the assembled housing 30 has a thickness which ranges from approximately 2.8 to 3.0 mm (0.110 to 0.120 inches) and a lateral width of approximately 15 mm (0.60 inches) with a length of approximately 38 mm (1.5 inches). The diameter of the well opening 43 is approximately 7 mm (0.28 inches), and the maximum width of the nozzle passage 48 is approximately 3 mm (0.12 inches). The dimensions of opening 43 and passage 48 may be considerably different for a given engine application. In one embodiment of nozzle 90, the assembled housing has a thickness which ranges from approximately 2 to 2.7 mm (0.085 to 0.108 inches).

In some situations, nozzle clearance with the cylinder or piston is not a significant problem, so that a longer nozzle flow path away from the gallery and greater precision in orientation of discharge, can be achieved.

Figures 17 - 19 show an improvement relative to the nozzle assembly of the type shown in Figure 8, whereby a longer, more sophisticated nozzle tip formed from a tubular member, extends from a nozzle holder portion fabricated from sheet metal. The connection between the nozzle tip and the nozzle holder is by means of an interference fit and thus, the entire nozzle assembly can be easily manufactured at relatively low cost, yet provide a high degree of customization with respect to the directionality and spray pattern of the cooling discharge.

The nozzle assembly 176 includes a holder portion 178 which contains components which are the same as, or functionally similar to, many of the components shown in Figure 8. Reference thereto will be made by the same numeric identifiers as in figure 8, but followed by the suffix "a". The most significance difference between the nozzle assembly 176 of Figure 17 and that of Figure 8, is the provision of an elongated nozzle tip member 180, which is in effect, an extension of the nozzle passageway 104 and nozzle forming structure 114, 120 of Figure 8.

The nozzle tip 180 typically has a cylindrical portion 182 with a desired bend angle of, for example, 90 degrees. The mounting end 184 is adapted to fit within the nozzle passageway 104a of the holder 178, and the other end 186 has an orifice adapted to discharge cooling fluid in a predetermined spray pattern.

The nozzle holder 178 includes a housing 92a which is substantially flat at longitudinal first and second ends 200, 216 and has an intermediate protrusion 106a, defining an inlet well through which cooling oil enters the holder 178. A cover plate 94a having a first end 188 and a second end 214 substantially coextensive with the housing first and second ends 200, 216, includes a longitudinally extending, arcuate, channel portion which, in cooperation with the forward portion of the housing 92a, forms the passageway 104a.

As shown in Figure 19, the mounting end 184 of the nozzle tip 180 is preferably formed in a substantially D shape, which follows the contour of the passageway 104a defined by the cover plate 94a and the housing 92a. As with the previously described embodiments, when the integral flange portions 100a, 102a are bent over to form retaining rails 96a, 98a interacting with the lateral portions of the cover plate 94a, the nozzle holder 178 becomes self sealed and the nozzle tip 180 becomes mechanically sealed to the passageway 104a. Preferably the nozzle tip 180 is retained within the passageway 104a by means of an interference fit, such as a crimped joint 190, and locking ledge 192.

In the preferred embodiment, the features associated with Figures 7 are also incorporated into the nozzle holder 178. Thus, an intermediate plate 202 having a first end 204 and a second end 206 is sandwiched between the cover plate 94a and the housing 92a, at least at the respective second ends. Preferably, the first 204 and second 206 ends of the intermediate plate 202 are coextensive with the first 200, 188 and second 216, 214 ends of the housing and the

cover plate, such that the portion of the intermediate plate 202 that extends longitudinally between the housing inlet well and the housing first end 200, defines the flat portion of the D shaped passageway 104a. The intermediate plate 202 has an orifice 208 located intermediate the passageway 104a and the inlet well 106a, this orifice preferably being formed by an annular rim 210. The rim provides a seating surface for valve coil spring 112a which acts to keep the ball 110a in sealing engagement with the inlet opening until a threshold oil pressure is reached. The inrushing oil must pass through the small gaps between the coils 112a before entering the orifice 208, thereby being filtered of particulates. The use of an intermediate plate 202 that is substantially coextensive with the housing 92a and the cover plate 94a, prevents leakage or bypass of the fluid around the spring 112a; thus all incoming fluid must pass through the filtering action of the spring. As shown in Figure 19, in the preferred embodiment, the mounting end 184 of the nozzle tip 180 is sealed against the upper side of the first end 204 of the intermediate plate 202, rather than directly against the housing first end 200.

It should be appreciated that effective sealing between a tubular nozzle tip 180 and a holder 178 made from flat sheet metal can be accomplished by proper crimping, or tightening of the flange tabs 96a, 98a against the lateral ends of the cover plate 94a and intermediate plate 202, which are also substantially coextensive.

As with the previously described embodiments, a fastening aperture 118a can be formed in each of the housing member 92a, cover plate 94a, intermediate plate 202, and the tightening tabs 98a or flanges of the housing 92a.

As shown in Figure 17, the assembled nozzle holder 178 resembles a box-type sandwich enclosure of the housing 92a around the cover plate 94a and intermediate plate 202.

The preferred method of fabricating the nozzle assembly 176 includes forming, from sheet metal, the housing member 92a and the cover plate member 94a, with one or the other having a greater transverse dimension for eventual folding over to encapsulate the other. The cover plate member 94a is also formed with a longitudinal, raised channel portion 194 extending from a location between the ends 188, 214 of the cover plate to the first end 188 of the cover plate. The intermediate plate 202 is substantially flat, except for the rim portion 210 defining the orifice 208. These parts are assembled such that the valve components 110a, 112a are aligned in the inlet well 106a, the intermediate plate 202 is positioned on the housing 92a, and the cover plate 94a is then positioned over the intermediate plate 202 and housing 92a to form passageway 104a. With the illustrated embodiment, the transversely extending tab portions 100a, 102a can be bent at 90 degrees to retain the intermediate plate and cover plate transversely.

The nozzle tip 180 is either originally drawn with the D shape mounting end 184 or squeezed to the desired shape. The mounting end 184 is inserted into the passageway 104a and secured by an interference fit 190. Alternatively, the mounting end 184 can be slightly upset and the cover plate crimped immediately ahead of the upset. The flanges 96a, 98a are then again bent and crimped into the configuration shown in Figures 17 and 19, whereby the flow path from the inlet well 106a through the orifice 208, passageway 104a and tip mounting end 184 is sealed.

It should be appreciated that in the engine crank case, perfect sealing of the nozzle assembly 176 is not necessary. Slight leakage contributes to the lubricating function of the oil in the crank case, and is tolerable so long as the bulk of the fluid entering the inlet well 106a is discharged through the nozzle orifice 186 for cooling the piston crown.

With reference to Figures 20 through 23, a piston cooling nozzle designated generally by the numeral 250, has an efficient two piece body structure comprising a housing 252 and a cooperative plate 254. The housing 252 and plate 254 are assembled in a compact surface - to - surface, sandwich - type relationship. The housing includes an integral well 256, as previously described, and a pair of laterally spaced upstanding skirts 258 and 260. Integral extensions 259 and 261 from the skirts are bent over into engagement with the plate 254 to secure the plate to the housing. The nozzle 250 also includes an aperture 264 through the housing and plate for receiving a fastener for mounting the nozzle.

The plate 254 is formed by initially stamping a metal blank having a generally planar L-shape. An indentation 262 is coined in the blank by a fine blanking or semi-shearing process. The indentation includes a circular edge portion 266 for locating one end of the valve spring and a restricted distal portion 268 which forms the nozzle orifice 270 (in cooperation with housing 252). The indentation may be inexpensively formed by displacing selected portions of blank material by means of a conventional punch press. The punch die engages a surface of the blank which is positioned over an opening dimensioned to be complementary to the die. The coining process produces very well defined edges 272 and 274 which are essentially perpendicular to the bed 276 of the indentation. It should be appreciated that the cross section of the indentation at the distal orifice forming sections is essentially rectangular. The depth of the indentation may be uniform throughout or variably dimensioned as required. ordinarily, the indentation depth at the restricted distal portion adjacent the orifice 270 is uniform .

The coined plate 254 has a rigid structure which will allow for a significant bending without buckling or interrupting the functional and structural integrity of

the nozzle passageway. The coining or formation of the indentation may entail a corresponding material displacement which results in an indentation silhouette protrusion 280 at the opposing top surface of the plate as illustrated in Figure 22. After the housing and plate are assembled, the assembly may be bent to the final angled configuration illustrated in Figure 20. The angled nozzle configuration may be described as a compound quasi-J-shape. One of the J-shape bend is implemented in the initial stamping of the housing 252 and the plate 254, and the other J-shape bend is implemented after assembly of the housing and the plate. The shape and size of the formed passageway and, in particular, the restricted nozzle orifice 270 can be accurately dimensioned so that the spray pattern may be suitably controlled.

With reference to Figures 24 to 27, another embodiment of a spray nozzle having a two piece body construction is generally designated by the numeral 300. The housing 302 and the cooperative plate 304 have an initial offset stamping shape forming a slightly angled nozzle passageway. The plate 304 is also shaped by a fine blanking or coining process wherein a punch displaces material to form an indentation 310 having straight edges and essentially perpendicular corners at the distal orifice 306 as previously described relative to the plate 254. The plate 304 may be thus formed in a relatively inexpensive manner, but has sufficient rigidity to allow for a subsequent compound rounded bend to achieve the nozzle orifice position as illustrated in Figure 24. It will be appreciated that the (initial) planar surface portion of the housing 302 engages the plate 304 so as to form a passageway having a substantially rectangular cross section with well defined corners at the orifice defining nozzle section so that the spray pattern may be accurately controlled. Specific angular configurations and orifice positions may be implemented in accordance with the requirements of a given application.

The two component nozzle body construction of nozzles 250 and 300 provides an efficient compact nozzle structure which may be shaped and dimensioned for a wide spectrum of applications. The coining process for forming the nozzle passageway and orifice makes possible an inexpensive nozzle in which the spray pattern can be effectively controlled through precise dimensioning of the nozzle orifice.

Claims

1. Nozzle assembly for cooling the crown of a piston (16) in an internal combustion engine comprising housing means (30;92;92a;152;252;302) having a first nozzle end and an opposing second end, an inlet opening (44;108;108a) intermediate said nozzle end and said second end, a nozzle passageway (48;48′; 72,74;104;104a), a restricted nozzle orifice (47;120; 160;270;306) at said nozzle end, said passageway (48;48′;72,74;104;104a) extending from said inlet opening (44;108;108a) to said orifice (47;1.20;160; 270;306), and cover plate means (50;94;94a;156;254;304) secured to said housing means,

   characterized in that said inlet opening (44;108;108a) is defined by a transversely protruding inlet well (42;106;106a;256) integrally formed with said housing means (30;92;92a;152; 252;302), that said cover plate means (50;94; 94a;156;254;304) cooperates with said housing means to define said nozzle passageway (48; 48′;72,74,104;104a), and that retaining flanges (36,38;96,98;100,102;96a,98a,100a,102a;153 ;258,259;260; 261) integrally extend from one of said housing means and said cover plate means and are bent around and against said other of said housing means and said cover plate means to secure said housing means and cover plate means in assembled relationship.

2. Nozzle assembly according to claim 1, characterized by further comprising valve means comprising a valve member (60;110;110a;132;168) interposed between the inlet opening (44;108;108a) and said orifice (47;120;160;270;306) and captured between said housing means (30;92;92a;152;252;302) and said cover plate means (50;94;94a;156;254;304) to interrupt the passage of fluid from said inlet opening to said nozzle orifice when said fluid has a pressure below a pre-established threshold.

3. Nozzle assembly according to claim 1, characterized in that said nozzle passageway extends generally linearly in a first direction and generally linearly in a second direction, the second direction being oriented at an angle to the first direction.

4. Nozzle assembly according to claim 1, characterized in that said cover plate means (254;304) has an indentation (262;310) therein having spaced edges (272;274), said indentation (262;310) cooperating with said housing means (252;302) to define said nozzle passageway.

5. Nozzle assembly according to claim 1, characterized in that each said housing means (252;302) and said cover plate means (254;304) has at least one bend disposed between said well (256;302) and said nozzle end.

6. Nozzle assembly according to claim 4, characterized in that a check valve comprising a valve member and a spring is received in said well, said valve member being biasable by said spring to prevent the passage of fluid through said passageway when the pressure of said fluid is below a

pre-established threshold, and that said cover-plate means indentation (262;310) is dimensioned to provide a recess (266) for locating an end of said spring.

7. Nozzle assembly according to claim 4, characterized in that said edges (272,274) have substantially the same transverse dimensions throughout the restricted nozzle orifice (270).

8. Nozzle assembly according to claim 4, characterized in that said indentation (262;310) is formed by displacing material so as to form a protruding silhouette (280) of said indentation (262;310).

9. Nozzle assembly according to claim 1, characterized in that said nozzle passageway has a compound bend.

10. Nozzle assembly according to claim 1, characterized in that said nozzle passageway has a rounded bend.

11. Nozzle assembly according to claim 1, characterized in that said nozzle passageway has a compound quasi-J-shaped bend.

12. Nozzle assembly according to claim 1, characterized in that the restricted nozzle orifice (270) has a substantially rectangular cross section.

13. Nozzle assembly according to claim 1, characterized in that an intermediate plate means (40;154) is disposed between said housing means (30;152) and said cover plate means (50;156), said intermediate plate means (40;154) having a cutout portion defining said nozzle passageway (48) and said restricted nozzle orifice (47).

14. Nozzle assembly according to claim 1, characterized by comprising a tubular nozzle tip member (180) forming an extension of the nozzle passageway (104a) defined by a raised channel portion (194) of said cover plate means (94a).

15. Nozzle assembly according to claim 14, characterized in that said nozzle tip member (180) is retained in said nozzle passageway (104a) by an interference fit.

16. Nozzle assembly according to claim 1, characterized by filter means located between said inlet opening (44;108;108a) and said restricted nozzle orifice (47;120;160;270;306).

17. Nozzle assembly according to claim 16, characterized in that said filter means comprises an edge filter (39,59;76) in said nozzle passageway (72,74).

18. Nozzle assembly according to claim 6, characterized in that said spring (62;112;112a) is configured to function as a filter.

19. Nozzle assembly according to claim 17, characterized in that said edge filter (39,59) comprises an array of projections (39,59) on said housing means (30) and cover plate means (50), said projections extending into said nozzle passageway (48).

20. Nozzle assembly according to claim 1, characterized in that a leaf spring (132) is anchored at one end between the housing means and the cover plate means to interrupt fluid flow through said nozzle when the fluid pressure is below a pre-established threshold.

21. Nozzle assembly according to claim 1, 2 or 20, characterized in that the cover plate means (94;94a) has an arcuate cross-section and the housing means (92;92a) has a flat portion to define the nozzle passageway therebetween.

Patentansprüche

1. Düsenvorrichtung zum Kühlen des Bodes eines Kolbens (16) in einem Verbrennungsmotor, mit einer Gehäuseeinrichtung (30; 92; 92a; 152; 252; 302), die ein erstes Düsenende und ein entgegengesetztes zweites Ende hat, eine Einlaßöffnung (44; 108; 108a) zwischen dem Düsenende und dem zweiten Ende, einen Düsendurchlaß (48; 48′; 72, 74; 104; 104a), eine verengte Düsenaustrittsöffnung (47; 120; 160; 270; 306) an dem Düsenende, wobei sich der Durchlaß (48; 48′; 72, 74; 104; 104a) von der Einlaßöffnung (44; 108; 108a) zu der Austrittsöffnung (47; 120; 160; 270; 306) erstreckt, und mit einer Deckplatteneinrichtung (50; 94; 94a; 156; 254; 304), die an der Gehäuseeinrichtung befestigt ist, dadurch gekennzeichnet, daß die Einlaßöffnung (44; 108; 108a) durch einen quer vorstehenden Einlaßschacht (92; 106; 106a; 256) gebildet ist, der an der Gehäuseeinrichtung (30; 92; 92a; 152; 252; 302) angeformt ist, daß die Deckplatteneinrichtung (50; 94; 94a; 156; 254; 304) in Zusammenwirkung mit der Gehäuseeinrichtung den Düsendurchlaß (48; 48′; 72, 74, 104; 104a) bildet und daß Halteflansche (36, 38; 96, 98; 100, 102; 96a, 98a, 100a, 102a; 153; 258, 259; 260; 261) sich von der Gehäuseeinrichtung oder der Deckplatteneinrichtung aus integral erstrecken und um die Deckplatteneinrichtung bzw. die Gehäuseeinrichtung und gegen dieselbe gebogen sind, um die Gehäuse-

einrichtung und die Deckplatteneinrichtung in zusammengebautem Zustand festzuhalten.

2. Düsenvorrichtung nach Anspruch 1, gekennzeichnet weiter durch eine Ventileinrichtung mit einem Verschlußstück (60; 110; 110a; 132; 168), das zwischen der Einlaßöffnung (44; 108; 108a) und der Austrittsöffnung (47; 120; 160; 270; 306) angeordnet und zwischen der Gehäuseeinrichtung (30; 92; 92a; 152; 252; 302) und der Deckplatteneinrichtung (50; 94; 94a; 156; 254; 304) eingeschlossen ist, um den Durchgang von Fluid von der Einlaßöffnung zu der Düsenaustrittsöffnung zu unterbrechen, wenn das Fluid einen Druck unterhalb eines vorbestimmten Schwellenwertes hat.

3. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sich der Düsendurchlaß insgesamt linear in einer ersten Richtung und insgesamt linear in einer zweiten Richtung erstreckt, wobei die zweite Richtung unter einem Winkel gegen die erste Richtung orientiert ist.

4. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Deckplatteneinrichtung (254; 304) eine Einbuchtung (262; 310) hat, die beabstandete Ränder (272; 274) aufweist, wobei die Einbuchtung (262; 310) in Zusammenwirkung mit der Gehäuseeinrichtung (252; 302) den Düsendurchlaß bildet.

5. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Gehäuseeinrichtung (252; 302) und die Deckplatteneinrichtung (254; 304) jeweils wenigstens eine Biegung haben, die zwischen dem Schacht (256; 302) und dem Düsenende angeordnet ist.

6. Düsenvorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß ein Rückschlagventil mit einem Verschlußstück und einer Feder in dem Schacht aufgenommen ist, wobei das Verschlußstück durch die Feder vorspannbar ist, um den Durchgang von Fluid durch den Durchlaß zu verhindern, wenn der Druck des Fluids unterhalb eines vorbestimmten Schwellenwertes ist, und daß die Einbuchtung (262; 310) der Deckplatteneinrichtung so bemessen ist, daß sie eine Ausnehmung (266) zum Aufnehmen eines Endes der Feder bildet.

7. Düsenvorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Ränder (272, 274) im wesentlichen dieselben Querabmessungen im gesamten Bereich der verengten Düsenaustrittsöffnung (270) haben.

8. Düsenvorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Einbuchtung (262; 310) gebildet worden ist, indem Material so verdrängt worden ist, daß eine vorstehende Silhouette (280) der Einbuchtung (262; 310) gebildet worden ist.

9. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Düsendurchlaß eine zusammengesetzte Biegung hat.

10. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Düsendurchlaß eine abgerundete Biegung hat.

11. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Düsendurchlaß eine zusammengesetzte, quasi-J-förmige Biegung hat.

12. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die verengte Düsenaustrittsöffnung (270) einen im wesentlichen rechteckigen Querschnitt hat.

13. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß eine Zwischenplatteneinrichtung (40; 154) zwischen der Gehäuseeinrichtung (30; 152) und der Deckplatteneinrichtung (50; 156) angeordnet ist, wobei die Zwischenplatteneinrichtung (40; 154) einen ausgeschnittenen Teil hat, der den Düsendurchlaß (48) und die verengte Düsenaustrittsöffnung (47) bildet.

14. Düsenvorrichtung nach Anspruch 1, gekennzeichnet durch ein rohrförmiges Düsenspitzenteil (180), das einen Fortsatz des Düsendurchlasses (104a) bildet, welcher durch einen erhöhten Kanalteil (194) der Deckplatteneinrichtung (94a) gebildet ist.

15. Düsenvorrichtung nach Anspruch 14, dadurch gekennzeichnet, daß das Düsenspitzenteil (180) in dem Düsendurchlaß (104a) durch einen Preßsitz festgehalten ist.

16. Düsenvorrichtung nach Anspruch 1, gekennzeichnet durch eine Filtereinrichtung, die zwischen der Einlaßöffnung (44; 108; 108a) und der verengten Düsenaustrittsöffnung (47; 120; 160; 270; 306) angeordnet ist.

17. Düsenvorrichtung nach Anspruch 16, dadurch gekennzeichnet, daß die Filtereinrichtung einen Spaltfilter (39, 59; 76) in dem Düsendurchlaß (72, 74) aufweist.

18. Düsenvörrichtung nach Anspruch 6, dadurch gekennzeichnet, daß die Feder (62; 112; 112a) so

ausgebildet ist, daß sie als Filter fungiert.

19. Düsenvorrichtung nach Anspruch 17, dadurch gekennzeichnet, daß der Spaltfilter (39, 59) eine Matrix von Vorsprüngen (39, 59) an der Gehäuseeinrichtung (30) und der Deckplatteneinrichtung (50) aufweist, wobei sich die Vorsprünge in den Düsendurchlaß (48) erstrecken.

20. Düsenvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß eine Blattfeder (132) an einem Ende zwischen der Gehäuseeinrichtung und der Deckplatteneinrichtung verankert ist, um die Fluidströmung durch die Düse zu unterbrechen, wenn der Fluiddruck unterhalb eines vorbestimmten Schwellenwertes ist.

21. Düsenvorrichtung nach Anspruch 1, 2 oder 20, dadurch gekennzeichnet, daß die Deckplatteneinrichtung (94; 94a) einen gekrümmten Querschnitt hat und die Gehäuseeinrichtung (92; 92a) einen ebenen Teil hat, um dazwischen den Düsendurchlaß zu bilden.

Revendications

1. Ensemble de buse pour refroidir la couronne d'un piston (16) dans un moteur à combustion interne, comprenant un boîtier (30;92;92a;152;252;302) ayant une première extrémité de buse et une seconde extrémité opposée, un orifice d'entrée (44;108;108a) situé entre les première et seconde extrémités de la buse, un passage de buse (48;48′;72,74;104;104a), un orifice de sortie restreint (47;120;160;270;306) à l'endroit de la première extrémité de la buse, le passage (48;48′;72,74;104;104a) s'étendant à partir de l'orifice d'entrée (44;108;108a) jusqu'à l'orifice de sortie restreint (47;120;160;270;306), et une plaque formant couvercle (51;94;94a;156;254; 304) fixée au boîtier, caractérisé en ce que l'orifice d'entrée (44;108;108a) est défini par un puits d'entrée (42;106;106a;256) faisant saillie transversalement, formé intégralement avec le boîtier (30;92;92a;152;252;302), en ce que la plaque formant couvercle (50;94;94a;156;254;304) coopère avec le boîtier de manière à définir le passage (48;48′;72,74;104;104a) de la buse, et en ce que des brides de retenue (36,38;96,98;100, 102;96a,98a,100a,102a;153;258,259; 260;261) s'étendent intégralement à partir de l'un des éléments que constituent le boîtier et la plaque formant couvercle et sont recourbées autour de et contre l'autre élément parmi le boîtier et la plaque formant couvercle, afin de fixer le boîtier et la plaque formant couvercle dans une relation d'assemblage entre eux.

2. Ensemble de buse suivant la revendication 1 caractérisé en ce qu'il comprend en outre une soupape comprenant un clapet (60;110;110a; 132;168) interposé entre l'orifice d'entrée (44;108;108a) et l'orifice de sortie de la buse (47;120;160;270;306) et qui est maintenu prisonnier entre le boîtier (30; 92;92a;152;252; 302) et la plaque formant couvercle (50;94;94a; 156; 254;304), afin d'interrompre le passage du fluide à partir de l'orifice d'entrée et en direction de l'orifice de sortie de la buse, lorsque le fluide est à une pression inférieure à un seuil prédéterminé.

3. Ensemble de buse suivant la revendication 1 caractérisé en ce que le passage de la buse s'étend généralement d'une manière linéaire dans une première direction et généralement d'une manière linéaire dans une seconde direction, cette seconde direction étant orientée suivant un certain angle par rapport à la première direction.

4. Ensemble de buse suivant la revendication 1 caractérisé en ce que la plaque formant couvercle (254;304) présente, en elle, une empreinte (262;310) ayant des bords espacés (272;274), cette empreinte (262;310) coopérant avec le boîtier (252;302) pour définir le passage de la buse.

5. Ensemble de buse suivant la revendication 1 caractérisé en ce que chacun du boîtier (252;302) et de la plaque formant couvercle (254;304) présente au moins une partie courbe disposée entre le puits (256;302) et la première extrémité de la buse.

6. Ensemble de buse suivant la revendication 4 caractérisé en ce qu'une soupape de retenue, comprenant un clapet et un ressort, est logée dans le puits, cette soupape de retenue étant sollicitée par le ressort afin d'empêcher l'écoulement du fluide à travers le passage lorsque la pression de ce fluide est inférieure à un seuil prédéterminé, et en ce que l'empreinte (262;310) de la plaque formant couvercle est dimensionnée de manière à former un creux (266) pour loger une extrémité du ressort.

7. Ensemble de buse suivant la revendication 4 caractérisé en ce que les bords (272,274) ont sensiblement les mêmes dimensions transversales à travers tout l'orifice de sortie restreint de la buse (270).

8. Ensemble de buse suivant la revendication 4 caractérisé en ce que l'empreinte (262;310) est formée en déplacant de la matière de manière à créer une silhouette en saillie (280) de l'empreinte (262;310).

9. Ensemble de buse suivant la revendication 1 caractérisé en ce que le passage de la buse comprend une partie courbe composite.

10. Ensemble de buse suivant la revendication 1 caractérisé en ce que le passage de la buse comprend une partie courbe arrondie.

11. Ensemble de buse suivant la revendication 1 caractérisé en ce que le passage de la buse comprend une partie courbe composite pratiquement en forme de J.

12. Ensemble de buse suivant la revendication 1 caractérisé en ce que l'orifice restreint de sortie de la buse (270) a une section transversale sensiblement rectangulaire.

13. Ensemble de buse suivant la revendication 1 caractérisé en ce qu'une plaque intermédiaire (40;154) est disposée entre le boîtier (30;152) et la plaque formant couvercle (50;156), cette plaque intermédiaire (40;154) présentant une partie découpée définissant le passage (48) de la buse et l'orifice restreint (47) de la buse.

14. Ensemble de buse suivant la revendication 1 caractérisé en ce qu'il comprend une pointe de buse tubulaire (180) formant un prolongement du passage (104a) de la buse défini par une portion de canal surélevée (194) de la plaque formant couvercle (94a).

15. Ensemble de buse suivant la revendication 14 caractérisé en ce que la pointe (180) de la buse est retenue dans le passage (104a) de la buse par suite d'un ajustage serré.

16. Ensemble de buse suivant la revendication 1 caractérisé en ce qu'un filtre est logé entre l'orifice d'entrée (44;108;108a) et l'orifice restreint (47;120;160;270; 306) de sortie de la buse.

17. Ensemble de buse suivant la revendication 16 caractérisé en ce que le filtre est constitué par un filtre à arêtes (39,59;76) dans le passage (72,74) de la buse.

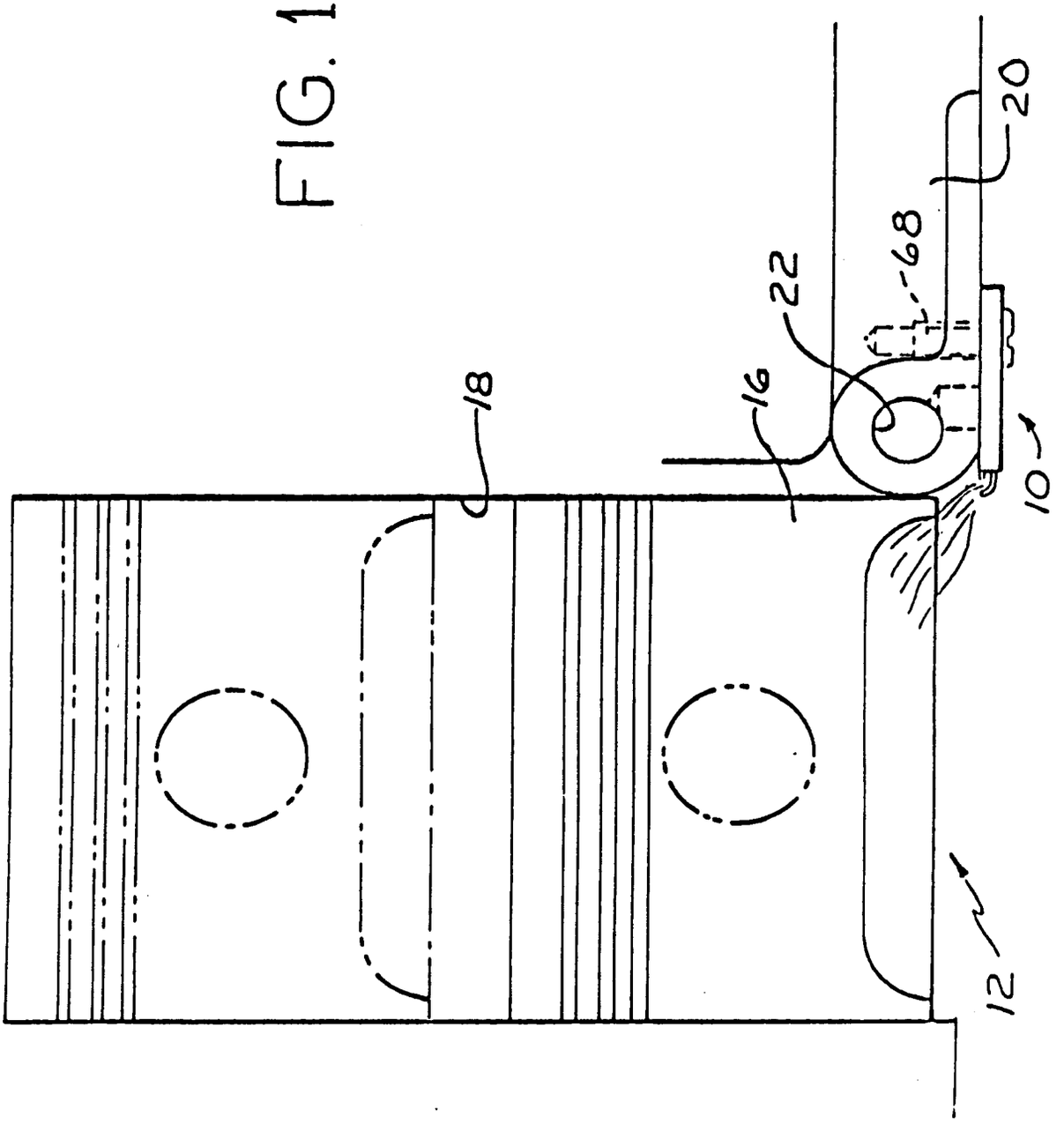
18. Ensemble de buse suivant la revendication 6 caractérisé en ce que le ressort (62;112;112a) est conformé de manière à fonctionner en tant que filtre.

19. Ensemble de buse suivant la revendication 17 caractérisé en ce que le filtre à arêtes (39,59) est constitué par un réseau de saillies (39,59) sur le boîtier (30) et sur la plaque formant couvercle (50), ces saillies s'étendant vers et dans le passage (48) de la buse.

20. Ensemble de buse suivant la revendication 1 caractérisé en ce qu'un ressort à lame (132) est ancré, à une extrémité, entre le boîtier et la plaque formant couvercle, afin d'interrompre l'écoulement du fluide à travers la buse lorsque la pression du fluide est inférieure à un seuil prédéterminé.

21. Ensemble de buse suivant la revendication 1, 2 ou 20 caractérisé en ce que la plaque formant couvercle (94;94a) a une section transversale arquée et le boîtier (92;92a) a une partie plane afin de définir entre elles le passage de la buse.

FIG. 1



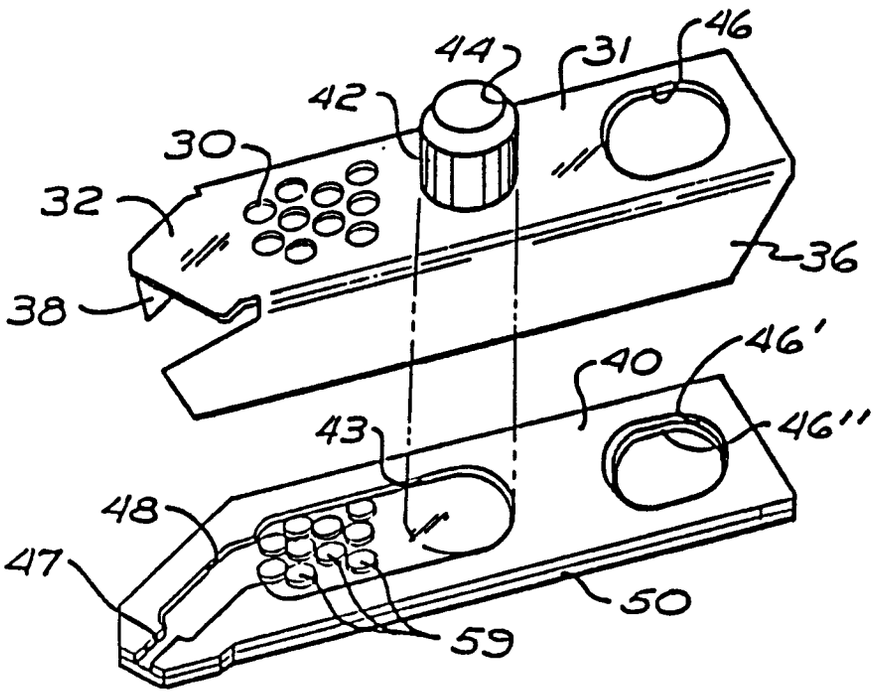


FIG. 2

FIG. 3

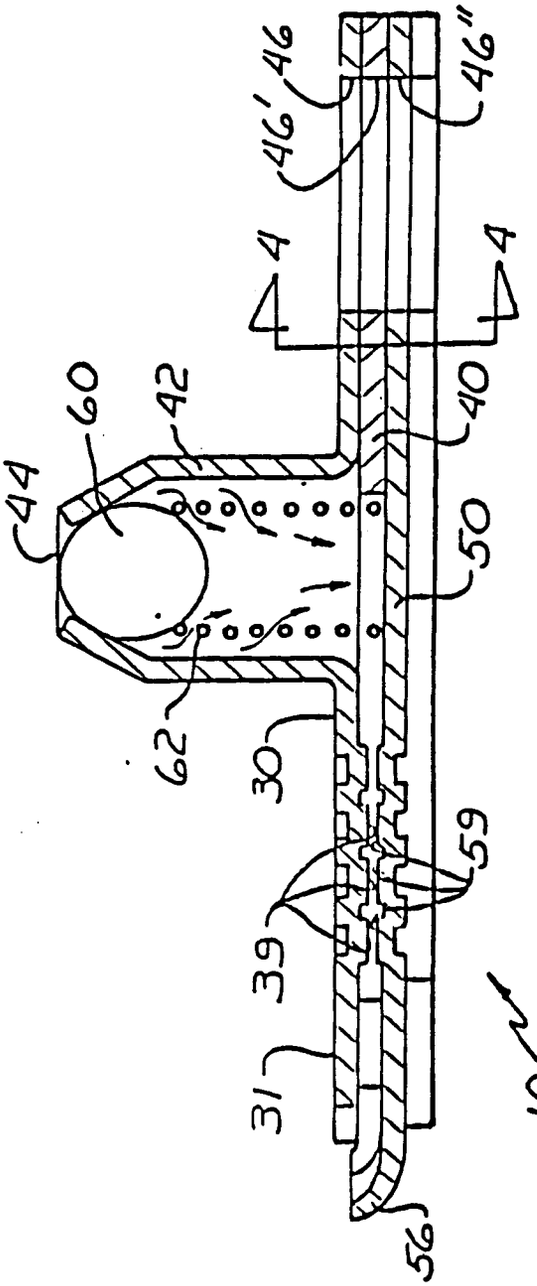
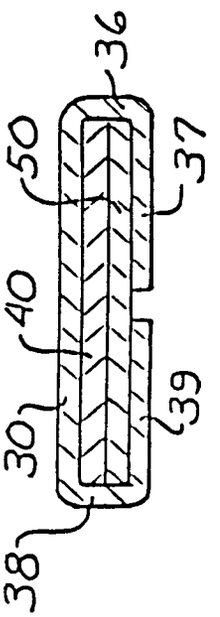


FIG. 4



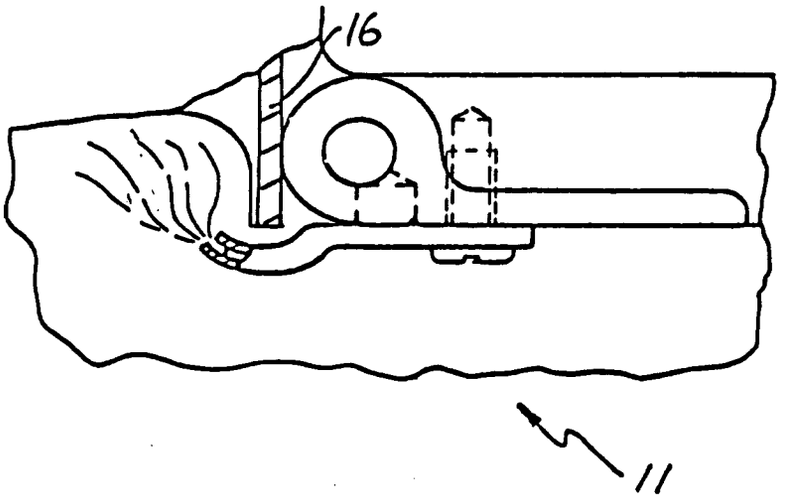


FIG. 5

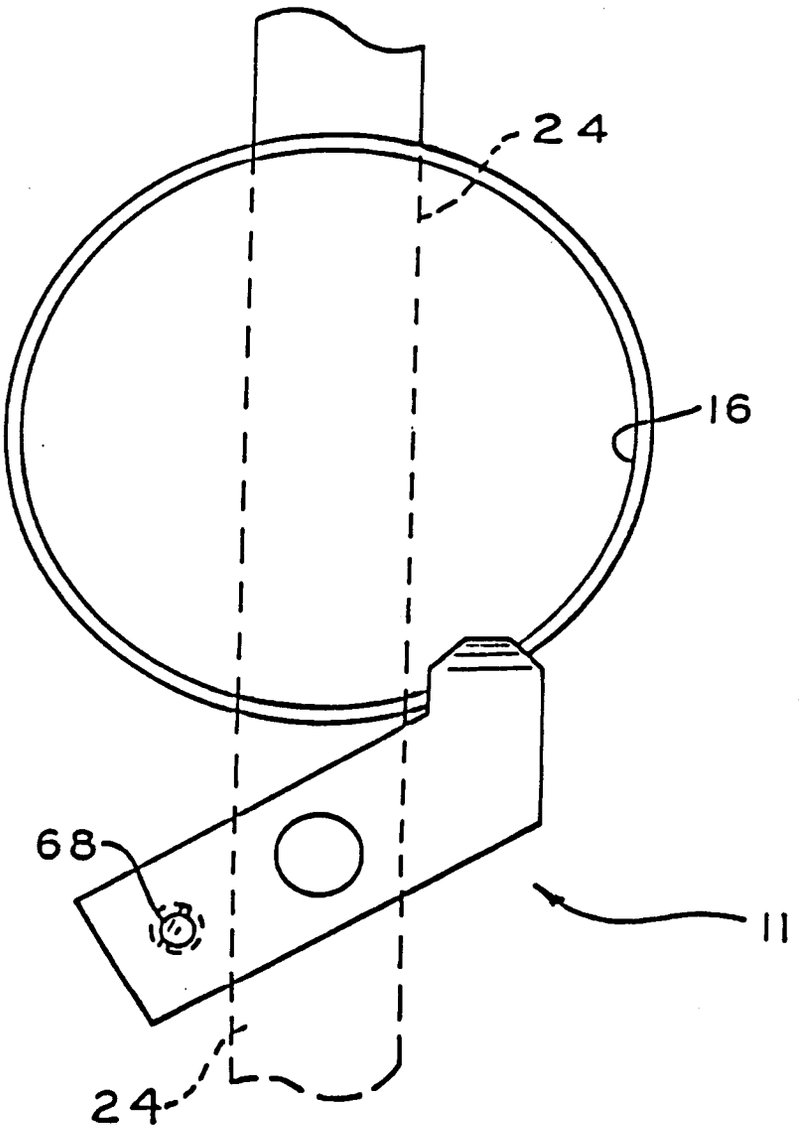
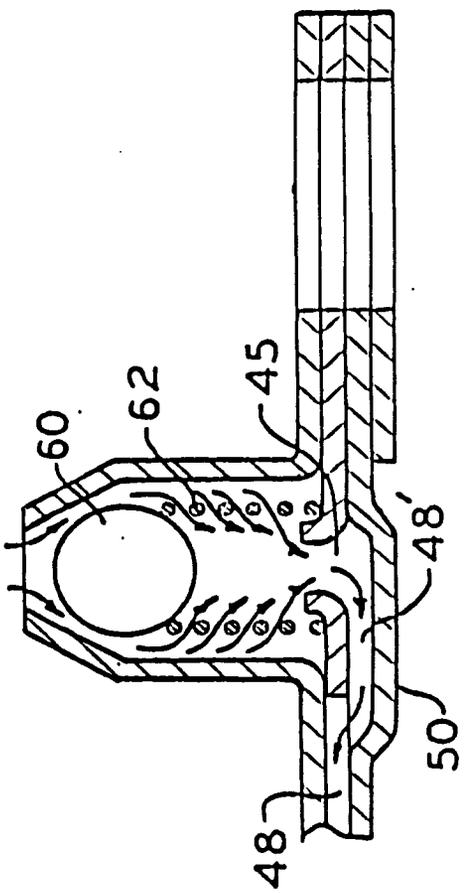


FIG. 6

FIG. 7



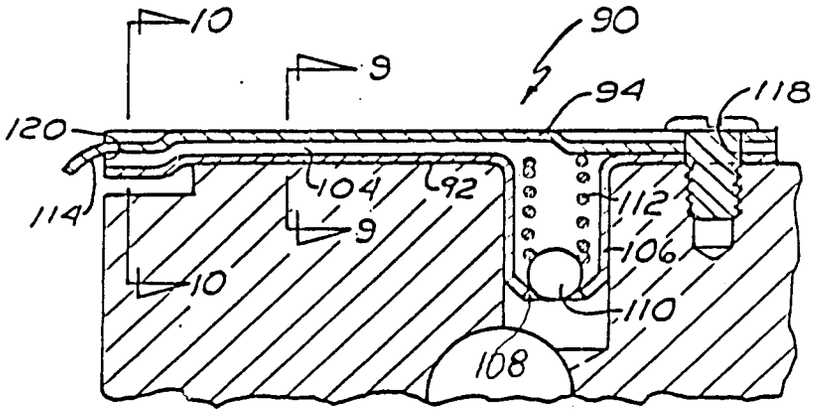


FIG. 8

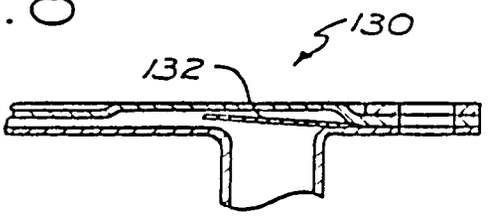


FIG. 12

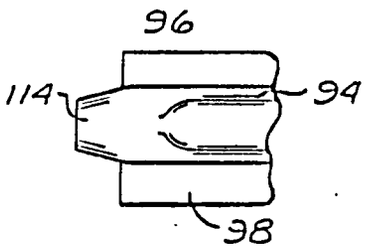


FIG. 11

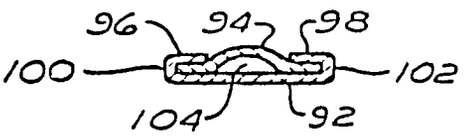


FIG. 9

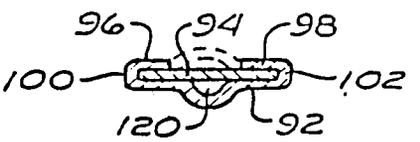


FIG. 10

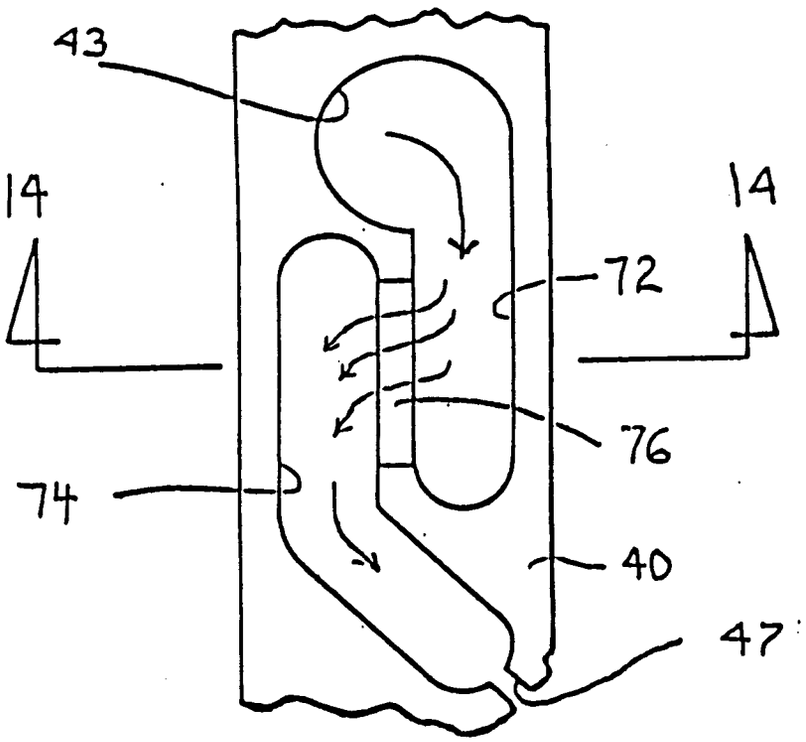


FIG. 13

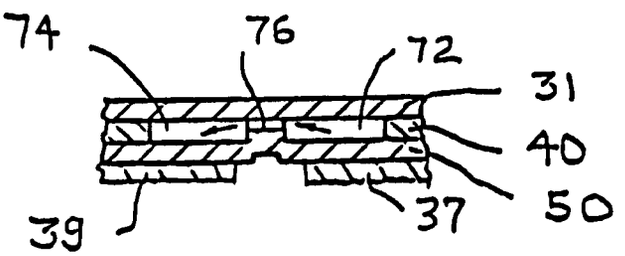


FIG. 14

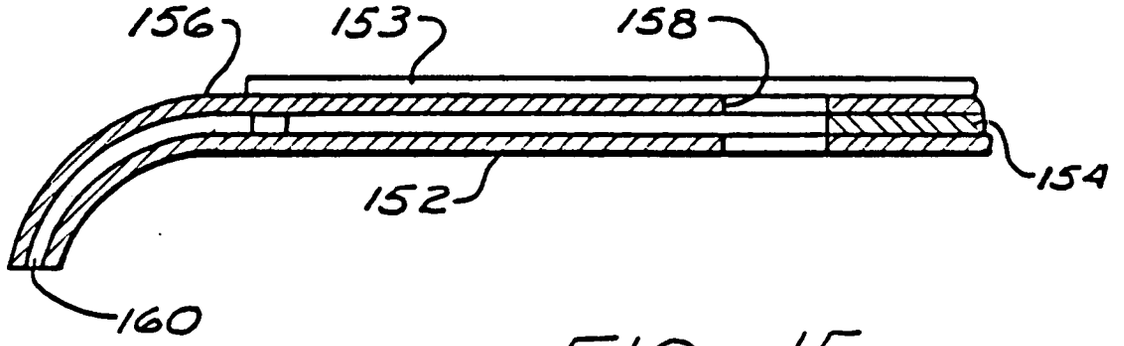

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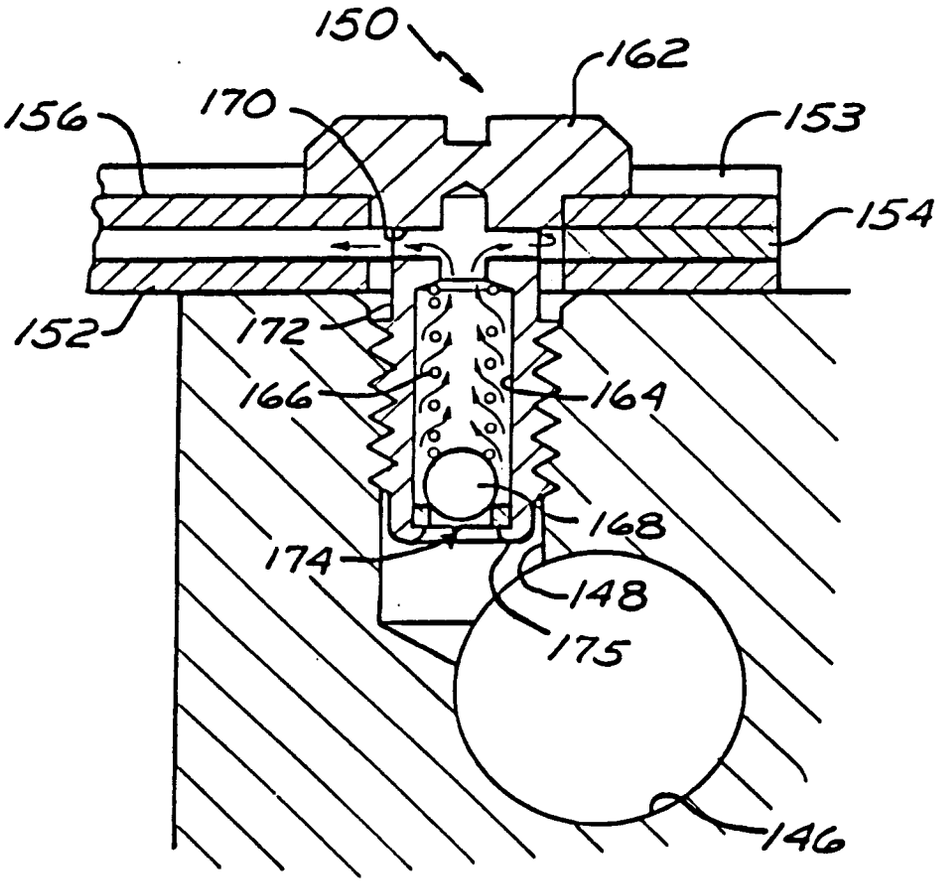
FIG. 15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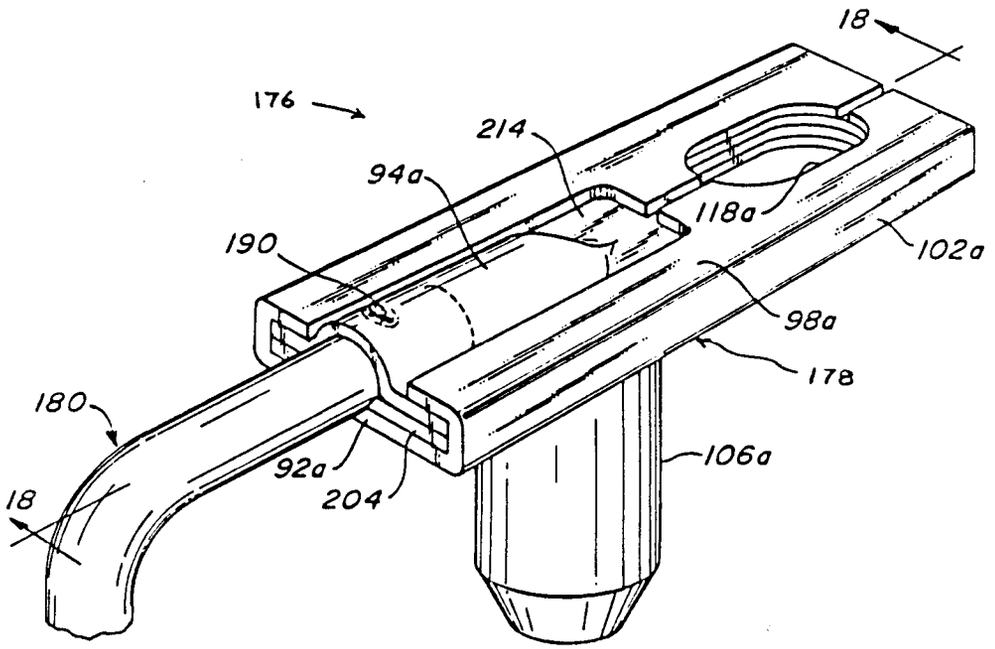
146

FIG. 16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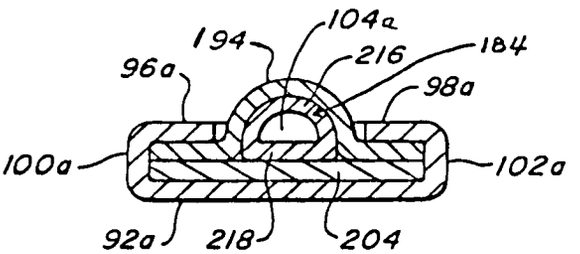
176
214
94a
118a
190
102a
98a
178
180
106a
92a
204
18

FIG. 17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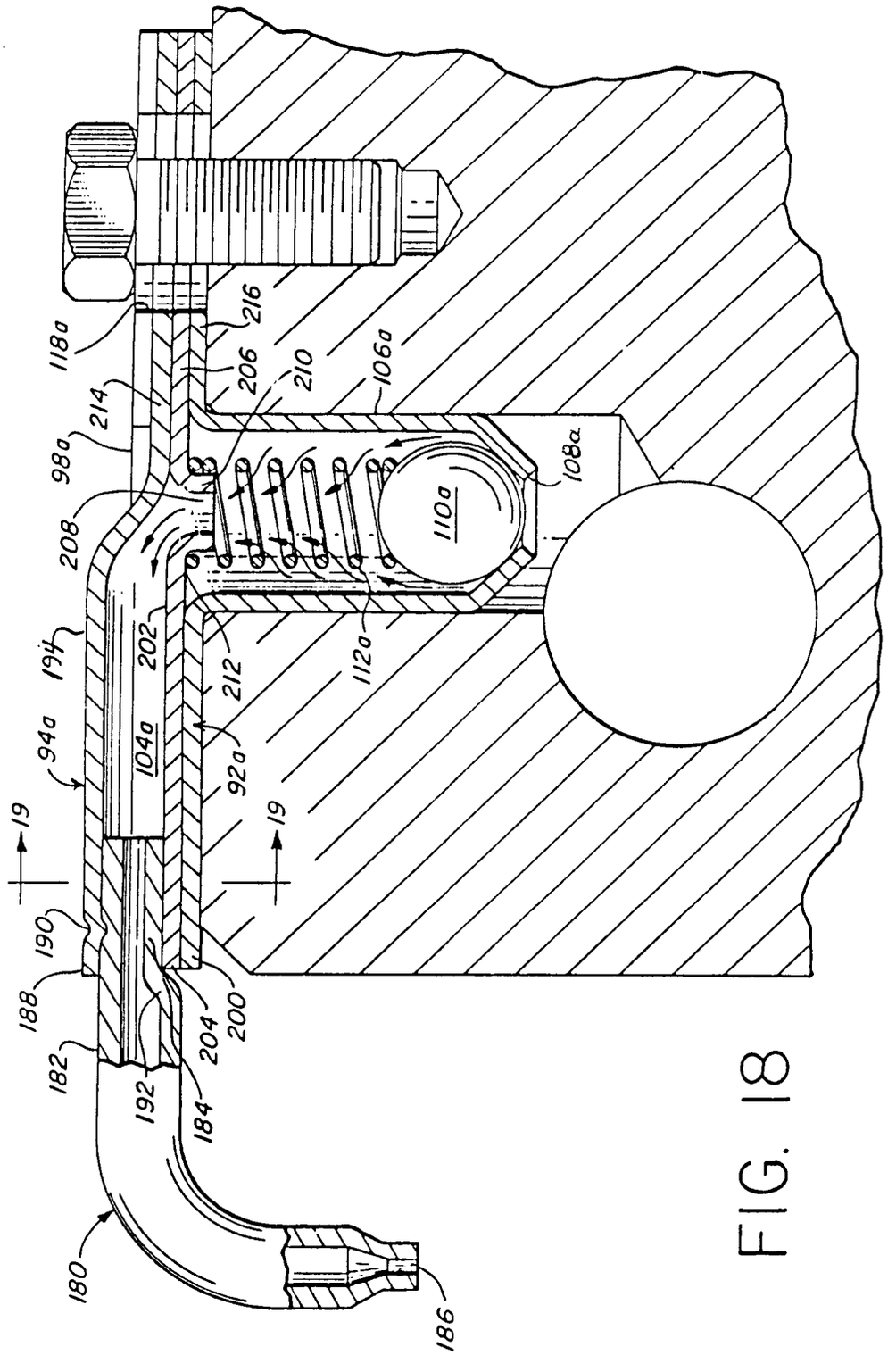
96a
98a
100a
102a
92a
218
204

FIG. 19


118a
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186

FIG. 18

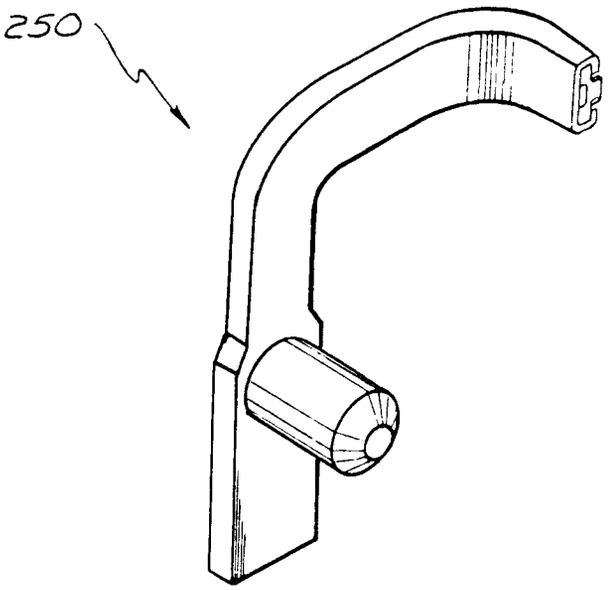


FIG. 20

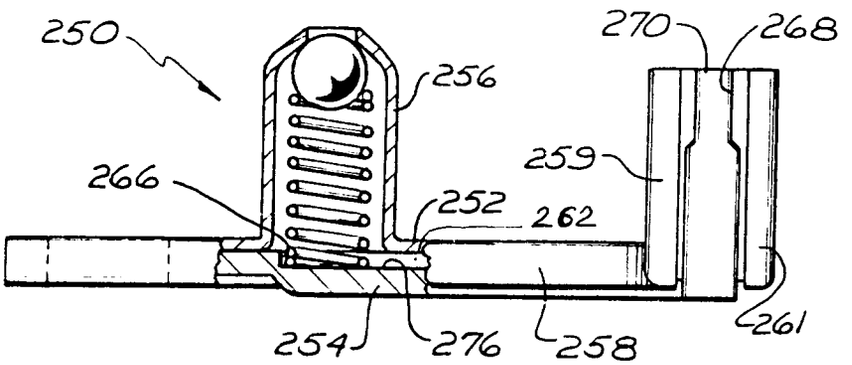
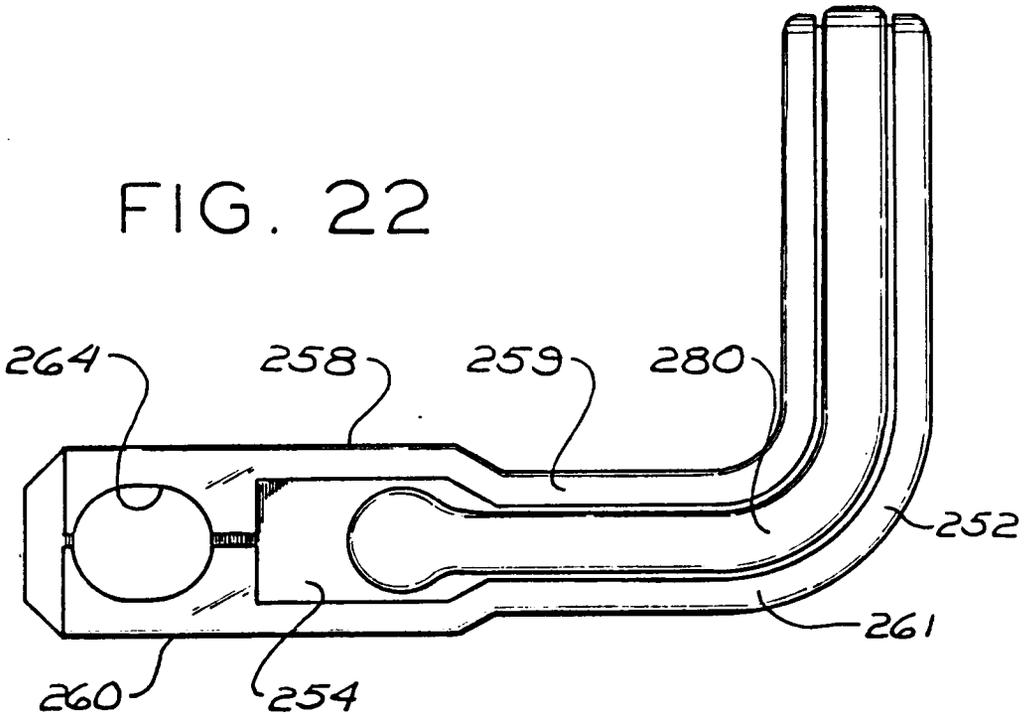


FIG. 21

FIG. 22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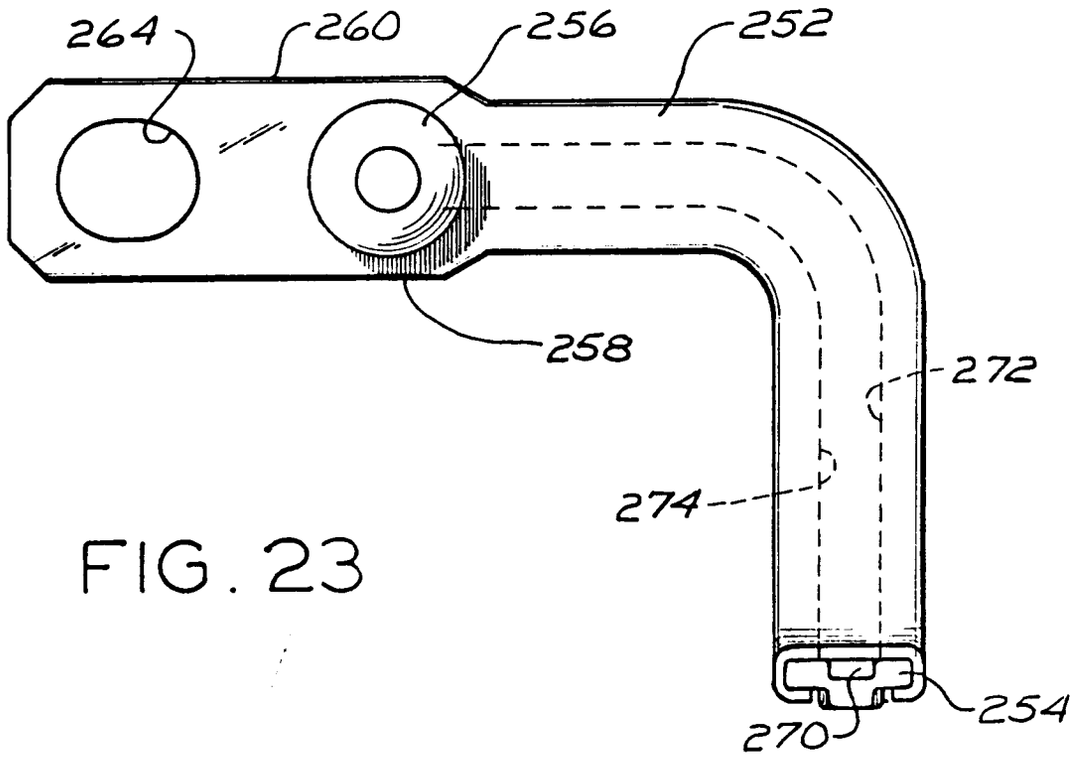
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FIG. 23

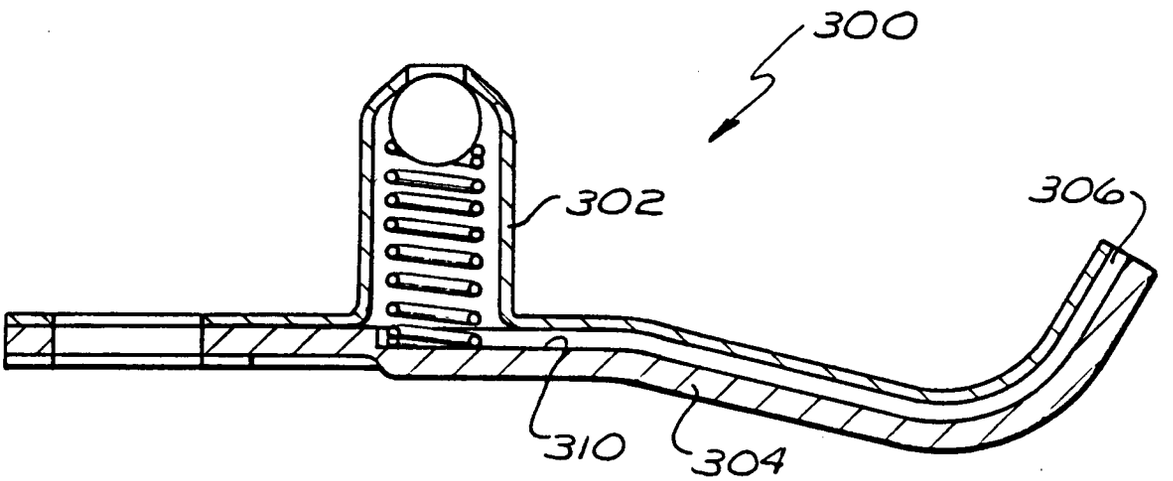

FIG. 24

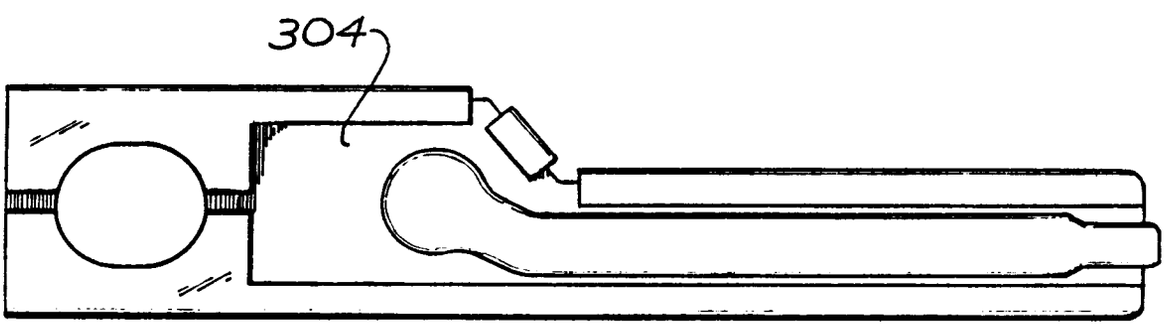

FIG. 25

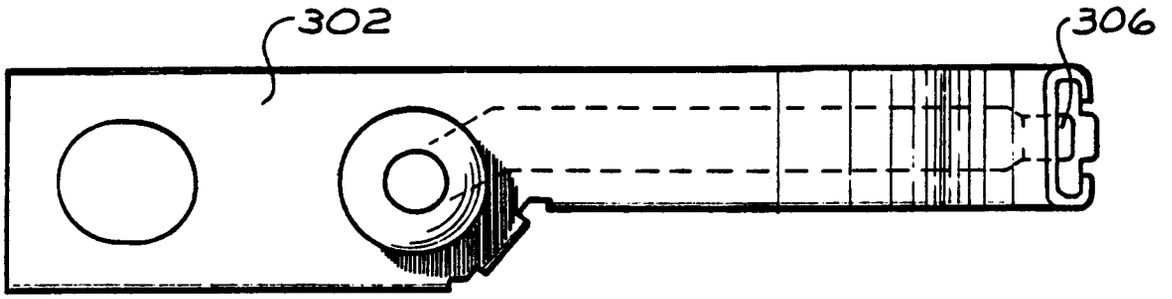

FIG. 26

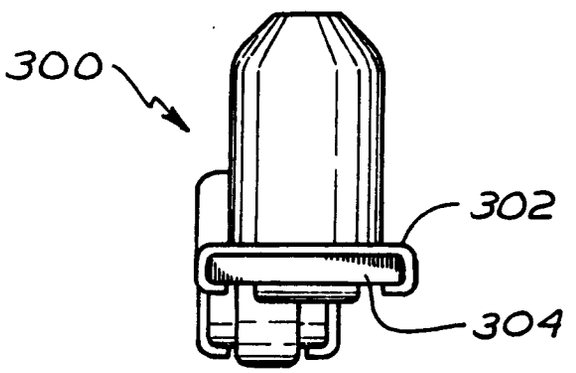

FIG. 27