United States Patent [19]

Hunter

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[54] **SPRINKLER SYSTEMS**

[75] Inventor: **Edwin J. Hunter**, Rancho Santa Fe, Calif.

[73] Assignee: **The Toro Company**, Minneapolis, Minn.

[21] Appl. No.: **800,794**

[22] Filed: **Nov. 22, 1985**

Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **3,854,664**
Issued: **Dec. 17, 1974**
Appl. No.: **405,690**
Filed: **Oct. 11, 1973**

U.S. Applications:

[63] Continuation of Ser. No. 346,445, Mar. 30, 1973, abandoned.

[51] **Int. Cl.**[4] **B05B 3/16**
[52] **U.S. Cl.** **239/206**; 239/240
[58] **Field of Search** ..... 239/201, 203, 204, 206, 239/240, 241, DIG. 1

[56] **References Cited**

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Primary Examiner—Andres Kashnikow
Attorney, Agent, or Firm—Robert V. Jambor

[57] **ABSTRACT**

Improvements in sprinkler systems having fluid under pressure flowing therethrough and a sprinkler head with a pop-up nozzle actuated by fluid pressure. An impeller is actuated by the fluid flow to rotate the nozzle and thus rotate the spray of fluid therefrom. A transmission is disposed between the impeller and the nozzle for transmitting rotation of the impeller to the nozzle. The transmission is sealed off from the fluid passing through the system by a resilient expandable diaphragm at one end. A fluid pressure responsive seal is provided in the system in sealing engagement with the nozzle. The sealed-off portion of the transmission is completely filled with a lubricating medium which is free to selectively contract or expand against the diaphragm in response to varying ambient conditions encountered by the sprinkler head. The nozzle may also include means for varying the pattern of the sprayed fluid and may be comprised of molded plastic components which may be assembled together.

32 Claims, 13 Drawing Figures

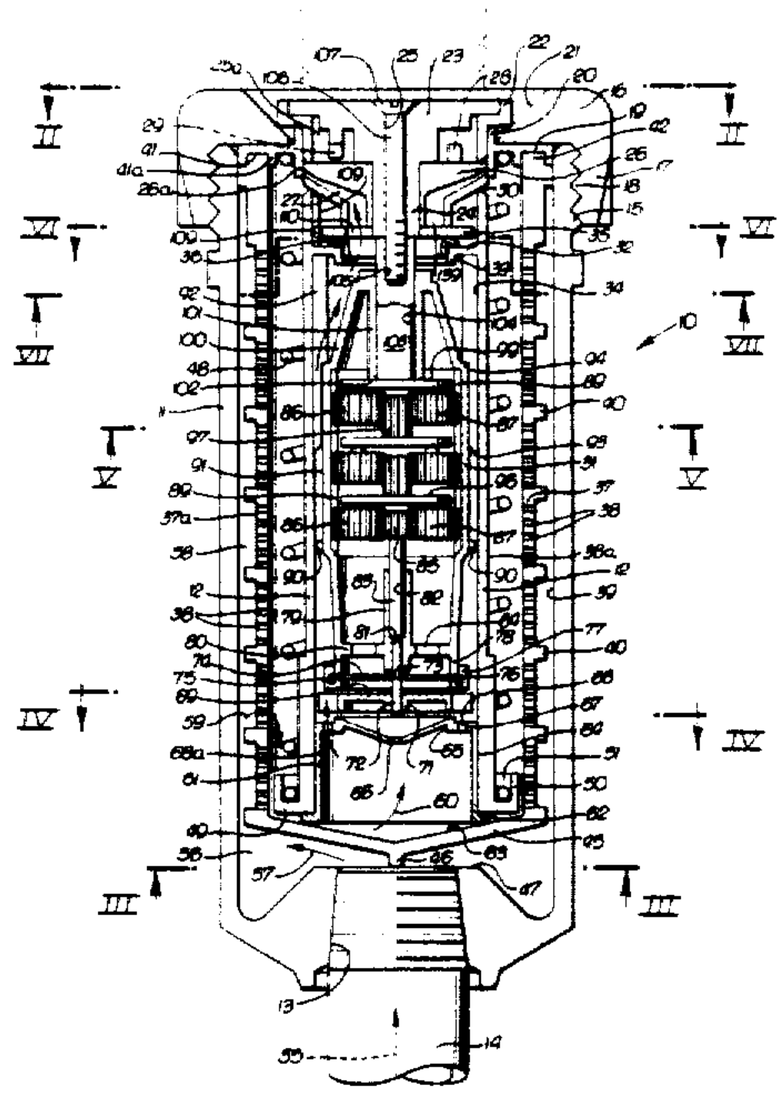

FIG. 1.

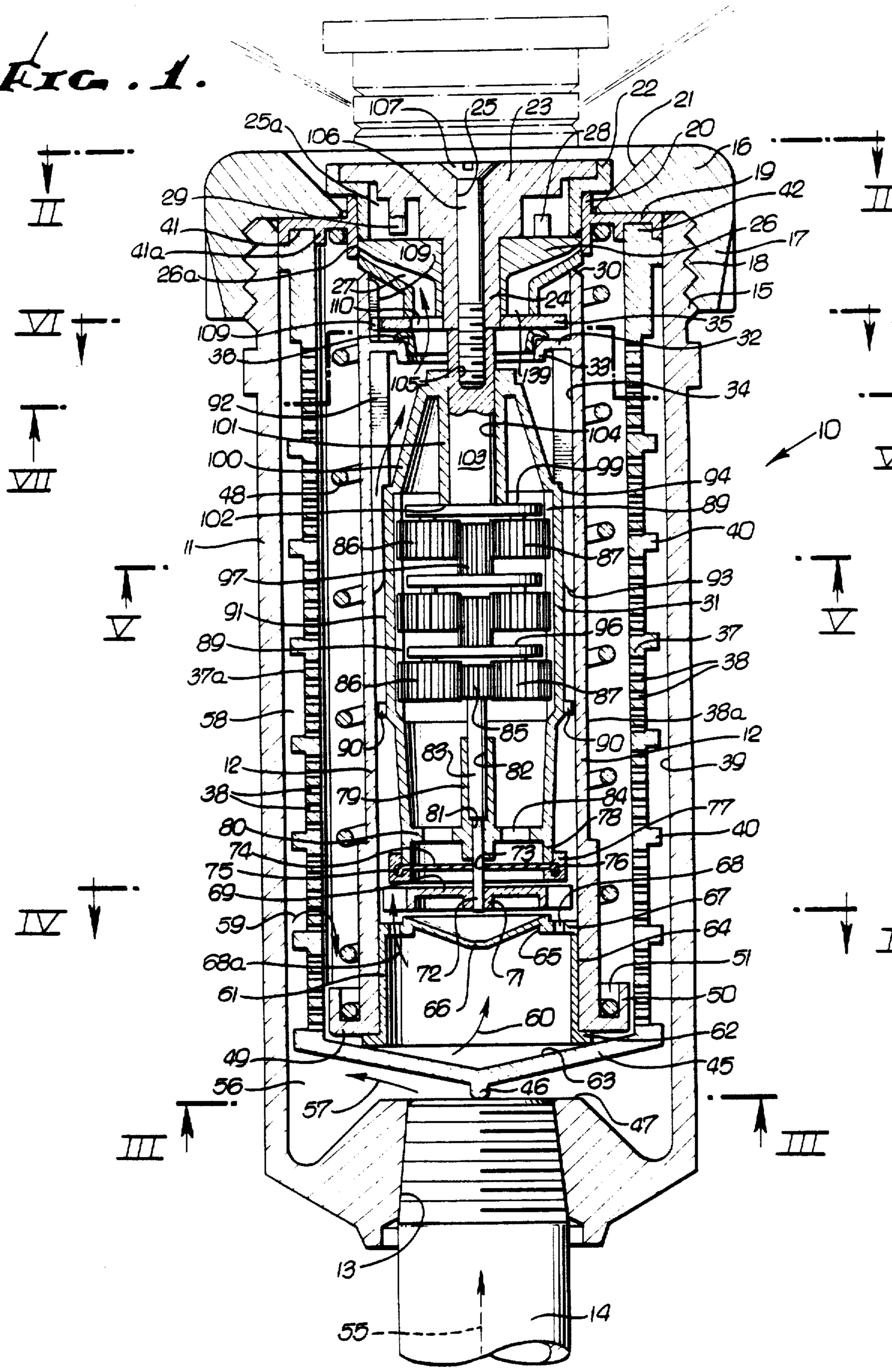
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FIG. 2.

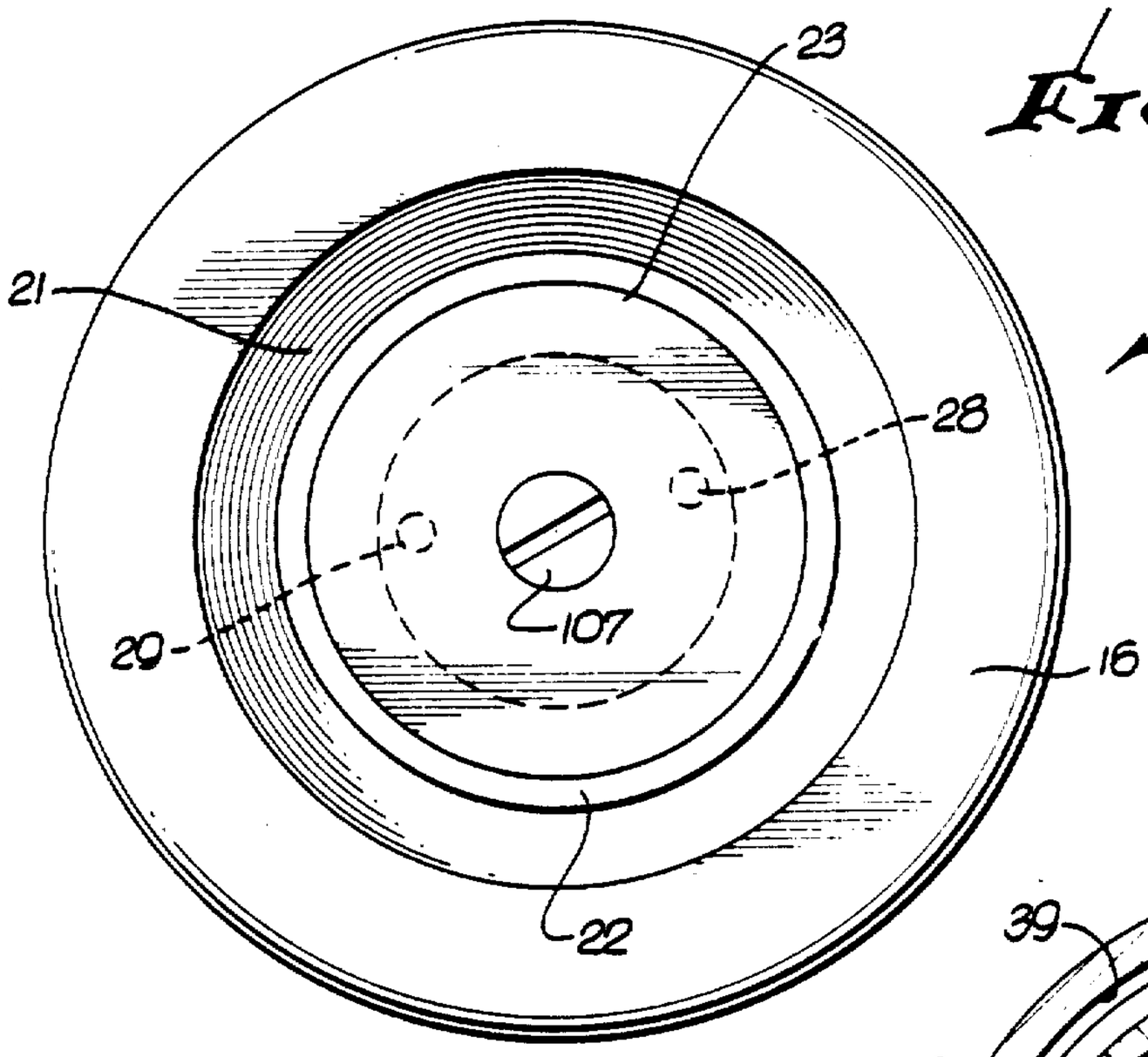


FIG. 4.

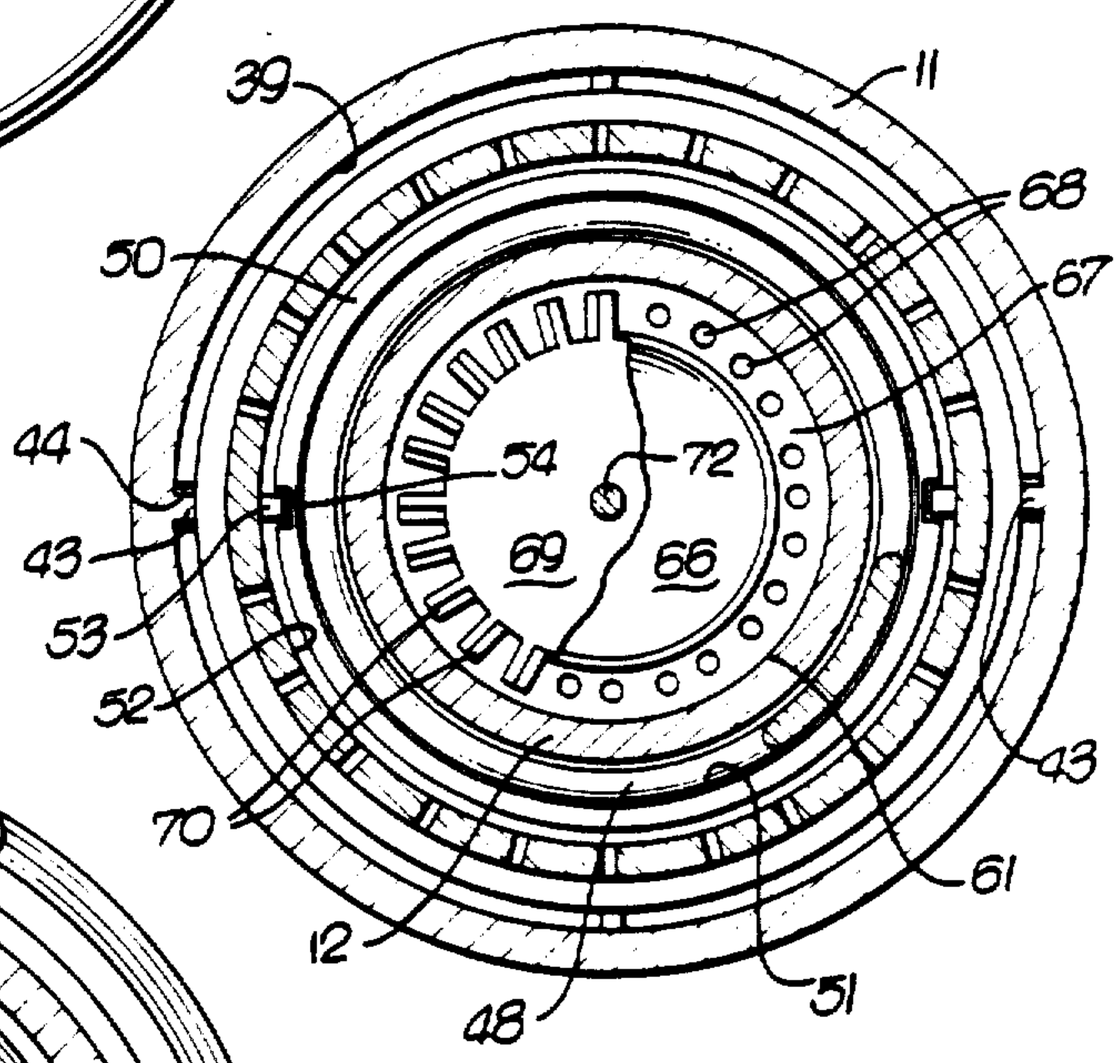


FIG. 3.

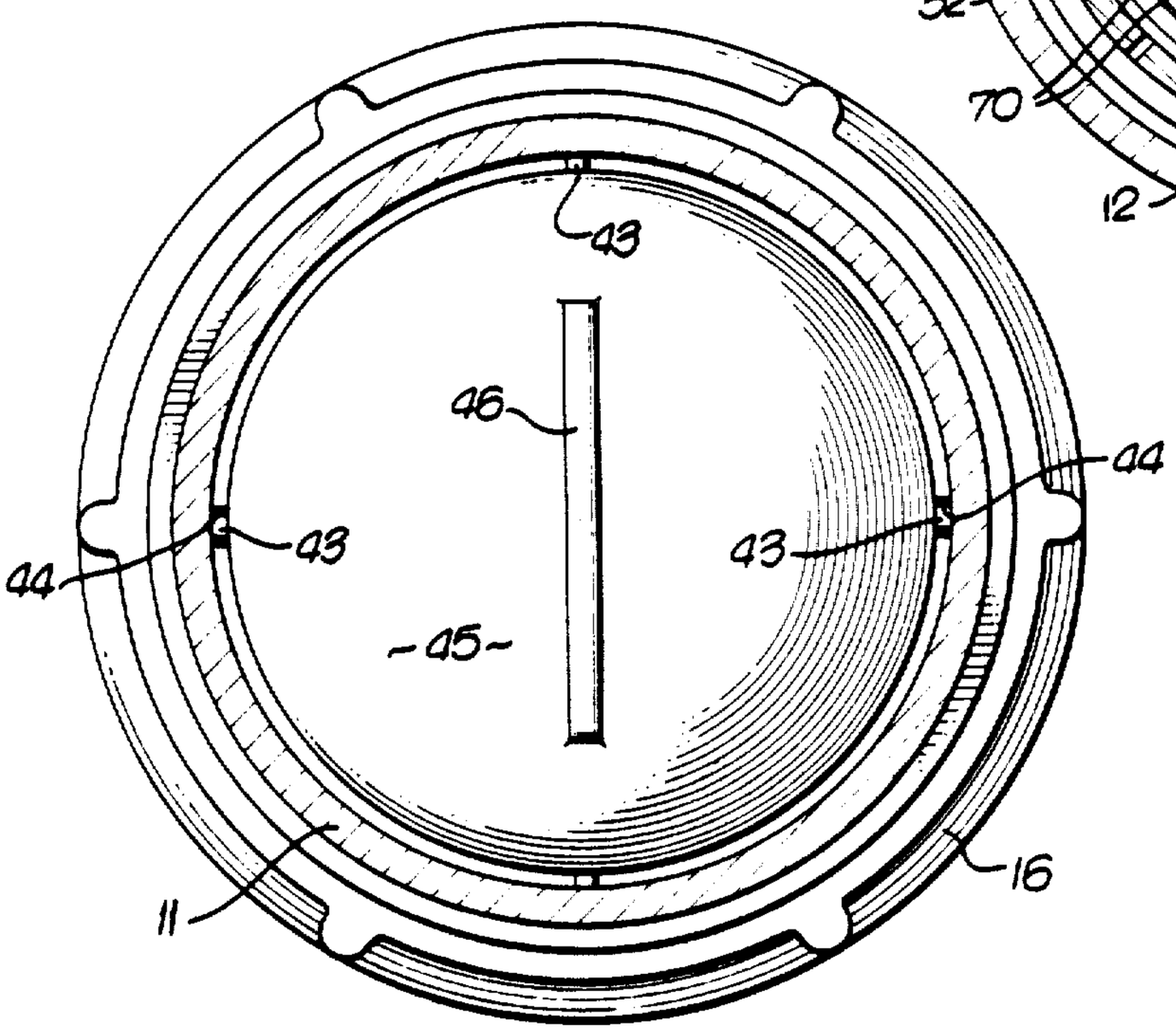


FIG. 5.

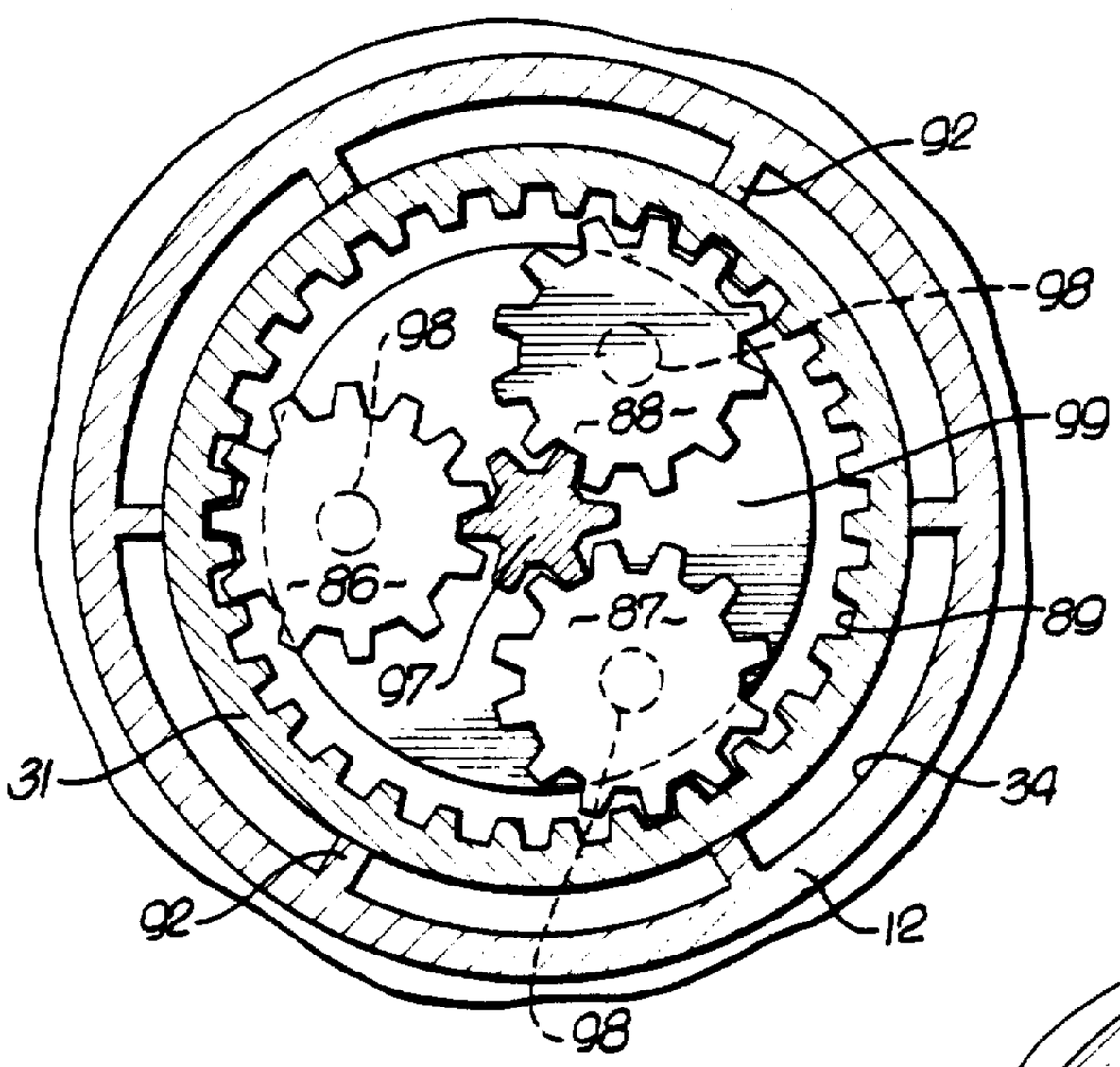


FIG. 8.

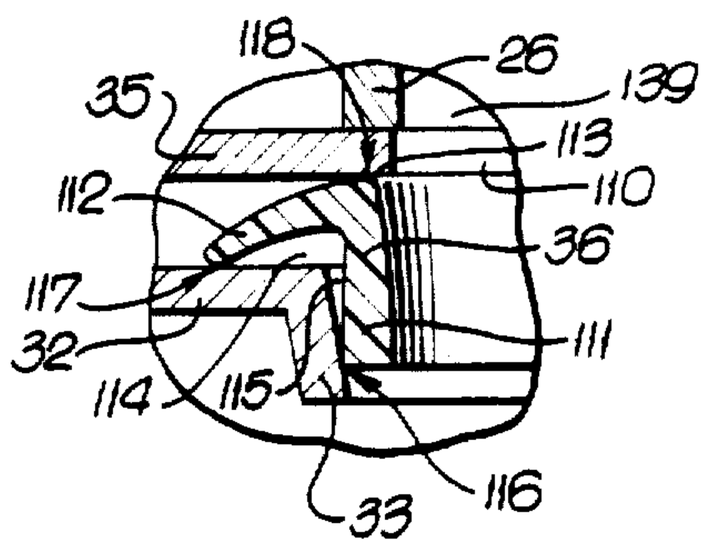


FIG. 6.

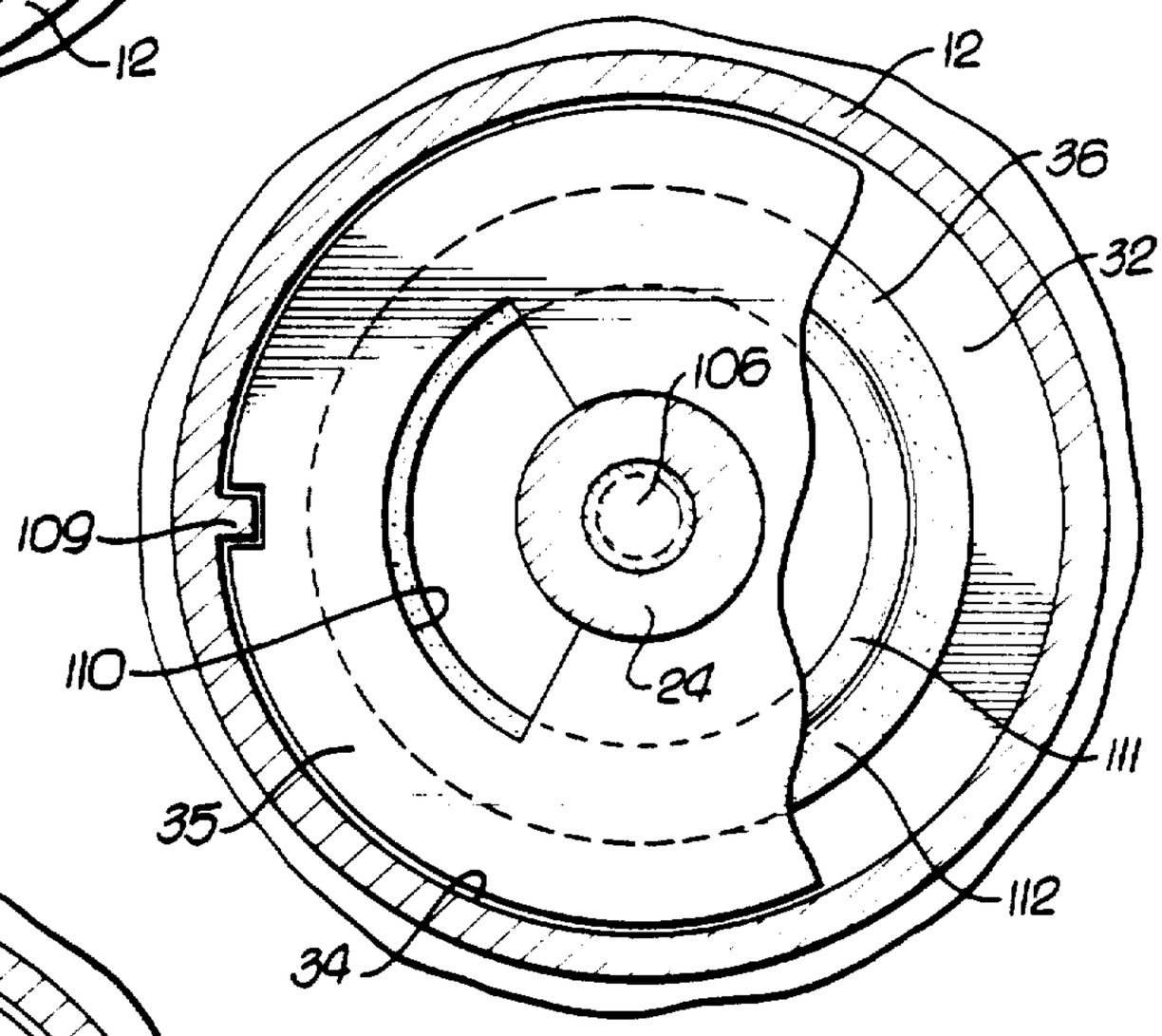


FIG. 7.

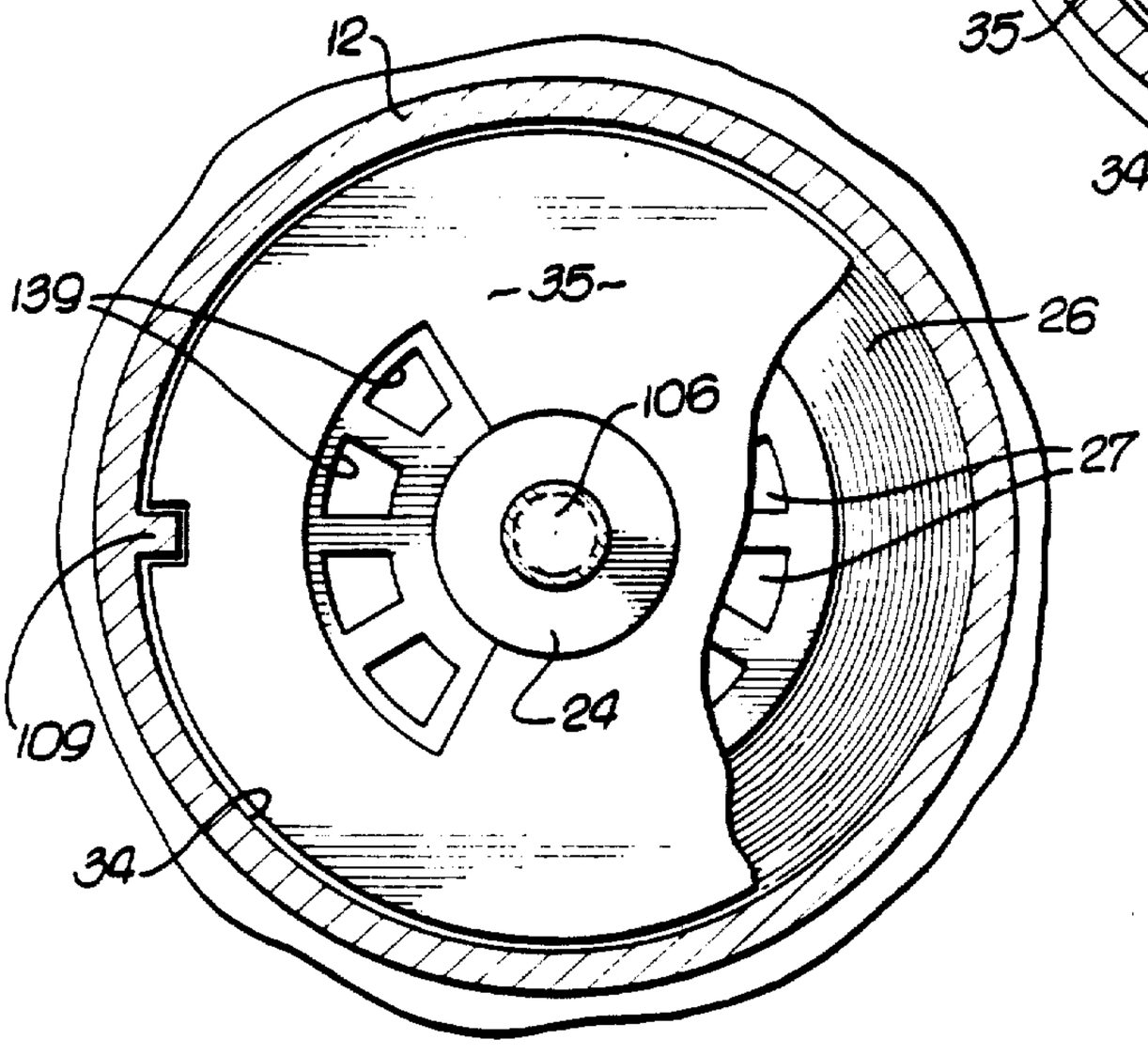


FIG. 10.

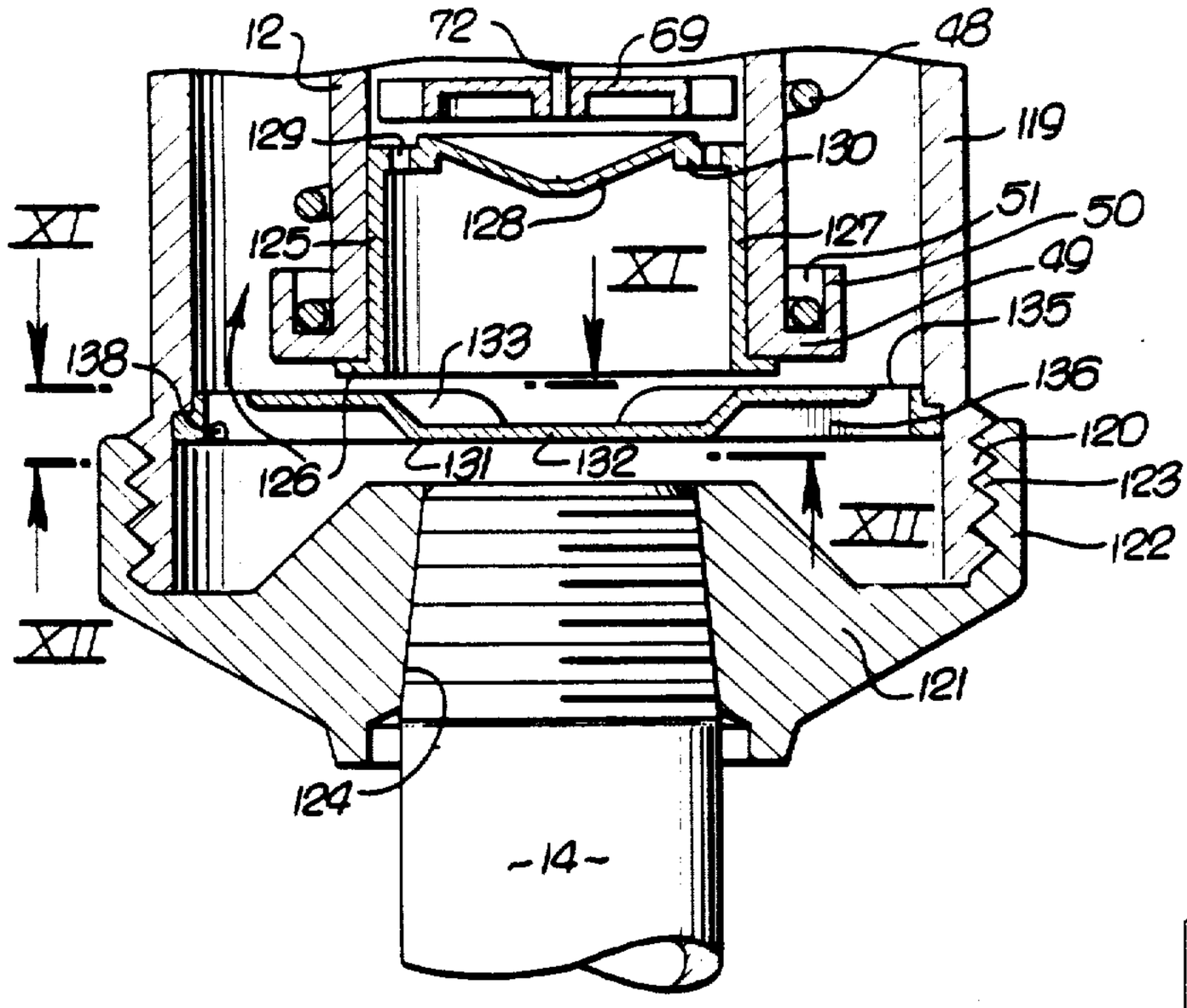


FIG. 9.

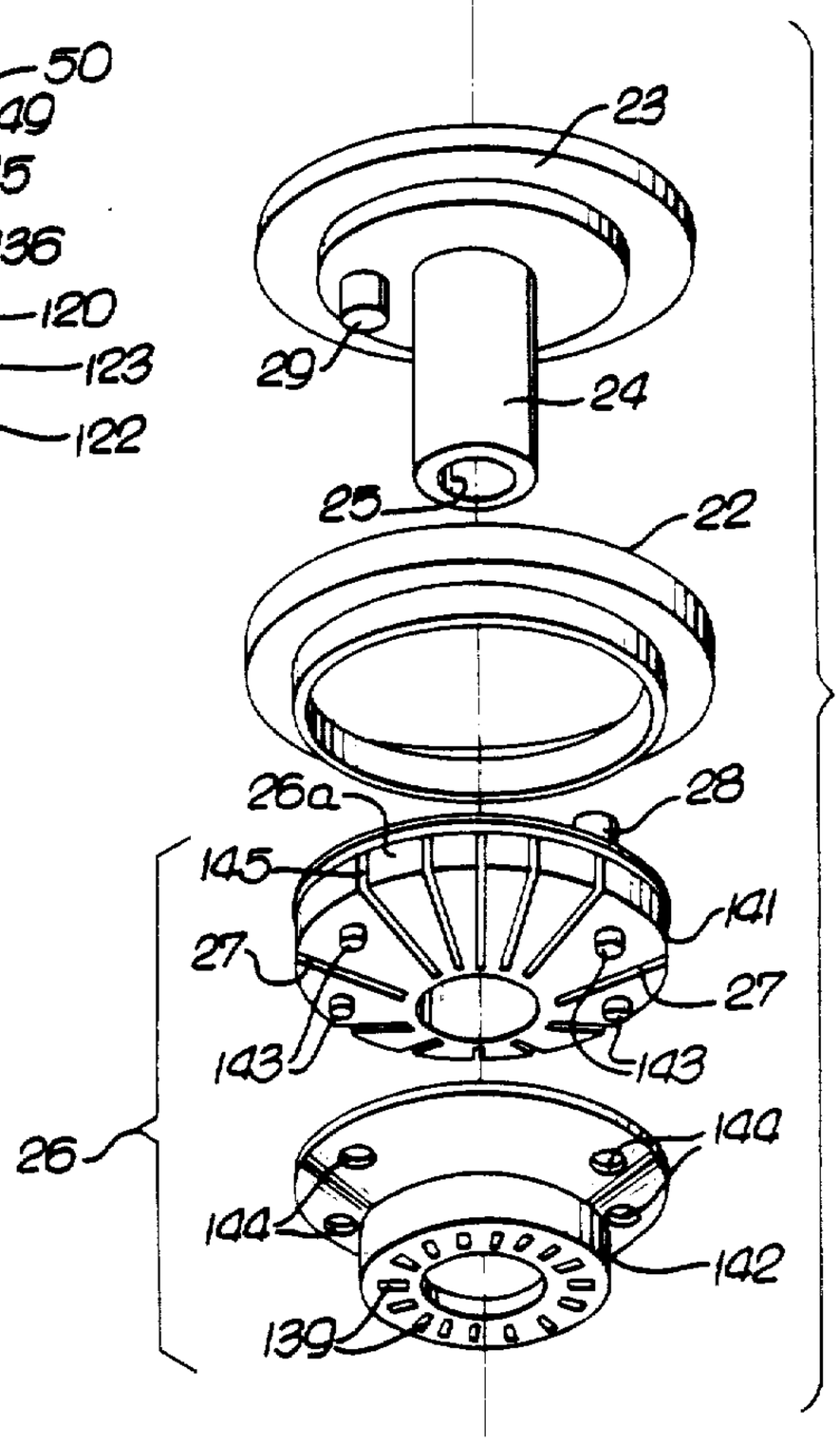


FIG. 11.

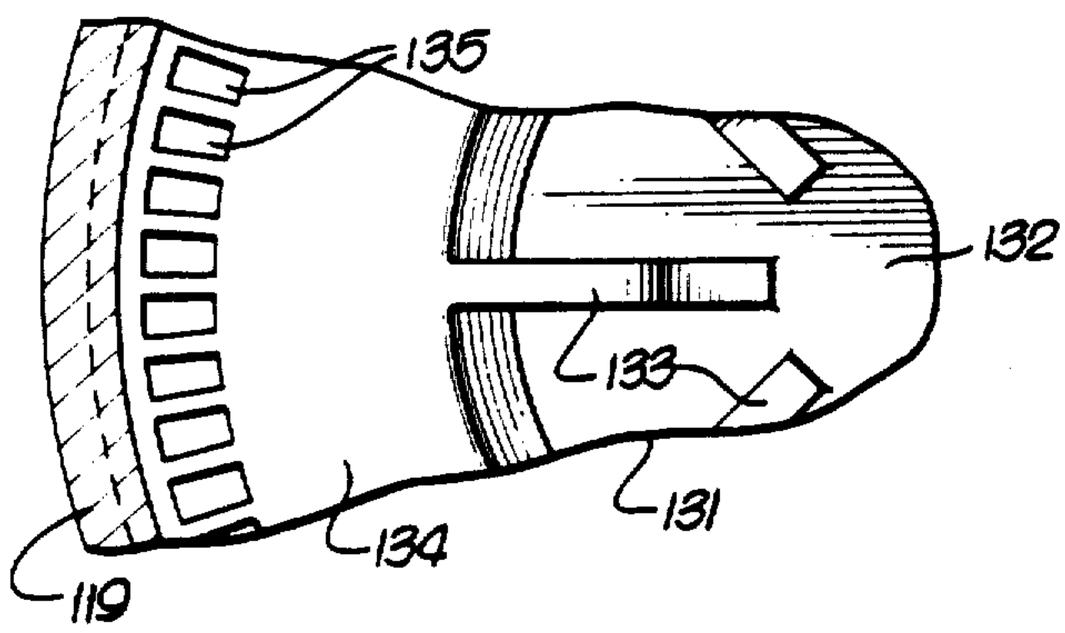


FIG. 12.

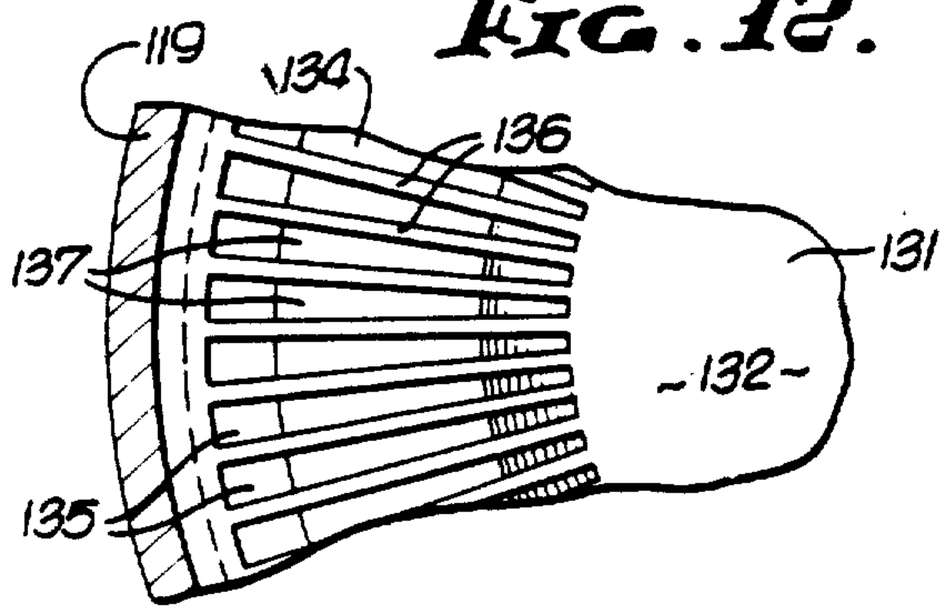
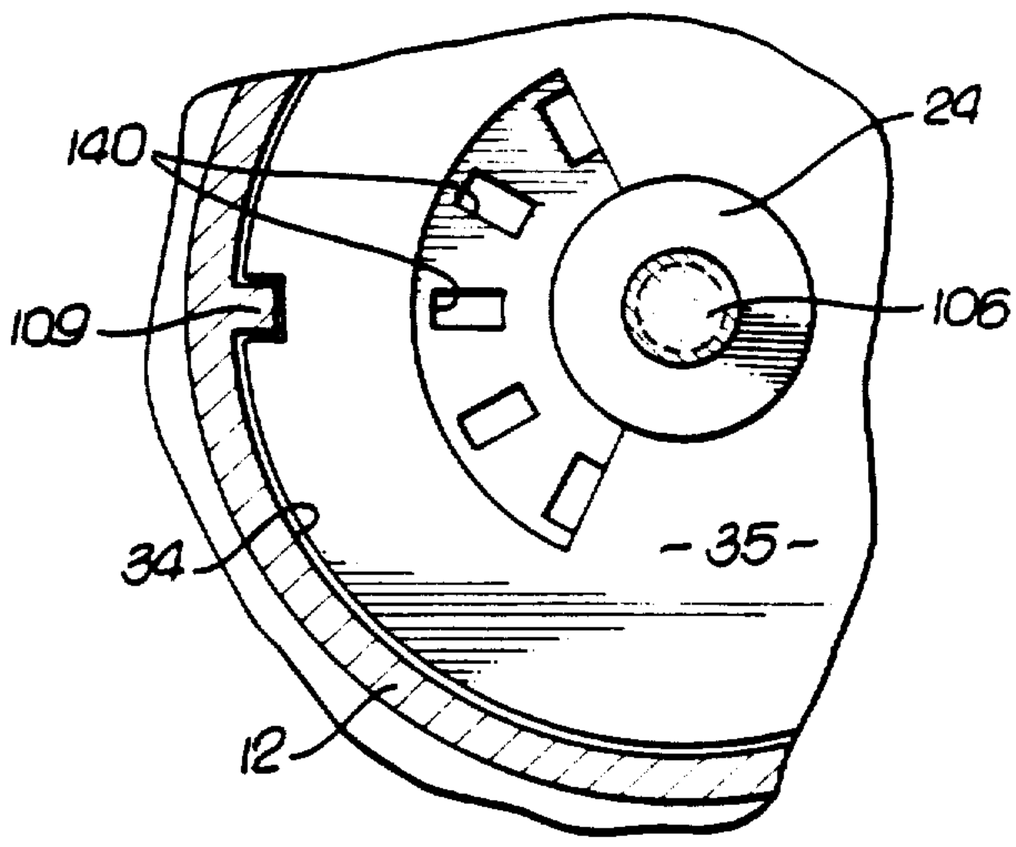


FIG. 13.



SPRINKLER SYSTEMS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is a continuation, of application Ser. No. 346,445, filed Mar. 30, 1973.

Original U.S. Pat. No. 3,854,664 was subject to two reexamination proceedings: Reexamination Proceeding Control No. 90/000,089, filed October 11, 1973, reexamination vacated Feb. 12, 1982; and, Reexamination Control No. 90/000,542, resulting in Reexamination Certificate B1 3,854,664, issued Jan. 21, 1986.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The invention relates to sprinkler systems; and, more particularly, to improvements in sprinklers used in such systems wherein water under pressure causes the sprinkler head and nozzle thereof to pop-up to disperse water therefrom.

2. Description of the Prior Art

In both commercial and residential water sprinkling systems, it has been conventional in the past to employ means for selectively opening and closing remotely located automatically operated water line valves to selectively operate sprinklers in various areas of such systems.

In my U.S. Pat. No. 2,909,325, I disclosed a sprinkler system wherein sprinkler heads of the pop-up type are utilized. In this system, a small water turbine wheel rotating at relatively high speed effects slow rotation of the sprinkler nozzle means. The instant application is an improvement over the sprinkler head of the aforementioned patent and discloses improved means for dispersing the water therefrom, for transmitting rotating from the turbine wheel to the sprinkler nozzle means, and discloses generally improved sealing means so that leakage or the like is prevented therefrom and dirt cannot enter such sprinkler heads in a manner rendering them inoperative. Further, a unique method of lubricating the internal parts is also disclosed.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved means for dispersing fluid under pressure from the sprinkler head of a sprinkler system.

It is a further object of this invention to provide improved means for converting fast rotation of an impeller actuated by fluid under pressure in such sprinkler heads to slow rotation of the nozzle thereof.

It is an even further object of this invention to provide a system which allows for changes in ambient conditions encountered by such sprinkler heads which changes may interfere with the operating parts thereof.

It is still another object of this invention to provide an improved sprinkler head which admits water under pressure and sprays the water therefrom, yet seals out dirt or the like which could interfere with the operation thereof.

It is even another object of this invention to provide an improved sprinkler head, the components of which can be easily and economically manufactured, then preassembled into subassemblies which can be quickly and easily connected together.

These and other objects are preferably accomplished by providing a sprinkler head having a pop-up nozzle actuated by fluid pressure. An impeller is actuated by the fluid flow to rotate the nozzle and thus vary the spray pattern therefrom. A transmission is disposed between the impeller and the nozzle for transmitting rotation of the impeller to the nozzle. The transmission is sealed-off from the fluid passing through the system by a resilient expandable diaphragm at one end a fluid pressure responsive seal is provided in the system in sealing engagement with the nozzle. The sealed-off portion of the transmission is completely filled with a lubricating medium which is free to selectively contract or expand against the diaphragm in response to varying ambient conditions encountered by the sprinkler head. The nozzle may also include means for varying the pattern of the sprayed fluid and may be comprised of molded plastic components which may be assembled together to form the nozzle passages. In addition, varying types of screening means may be provided for screening fluid entering the sprinkler head.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational view, partly in section, of a water valve apparatus in accordance with my invention;

FIG. **2** is a horizontal view of the apparatus of FIG. **1** taken therein along the plane II—II;

FIG. **3** is a horizontal view, partly in section, of the apparatus of FIG. **1** taken therein along the plane III—III;

FIG. **4** is a horizontal view, partly in section, of the apparatus of FIG. **1** taken therein along the plane IV—IV;

FIG. **5** is a horizontal view, partly in section, of the apparatus of FIG. **1** taken therein along the plane V—V;

FIG. **6** is a horizontal view, partly in section, of the apparatus of FIG. **1** taken therein along the plane VI—VI;

FIG. **7** is a horizontal view, partly in section, of the apparatus of FIG. **1** taken therein along the plane VII—VII;

FIG. **8** is a detailed sectional view of a portion of the sealing means of the apparatus of FIG. **1**;

FIG. **9** is an exploded view, in perspective, of the subassembly of a portion of the apparatus of FIG. **1**;

FIG. **10** is a partial sectional elevational view of a modification of a portion of the apparatus of FIG. **1**;

FIG. **11** is a partial horizontal view, partly in section, of the apparatus of FIG. **10** taken therein along the plane XI—XI;

FIG. **12** is a partial horizontal view, partly in section, of the apparatus of FIG. **10** taken therein along the plane XII—XII; and

FIG. **13** is a partial horizontal view, partly in section, of a modification of the portion of the apparatus of FIG. **7**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1** of the drawing, a sprinkler head **10** is shown having an outer generally cylindrical housing **11** and a coaxially mounted generally cylindrical inner housing **12**. Housing **11** is reduced at its lower end and internally screw-threaded to form a water inlet **13**. A water supply line **14** is screw-threaded therein as shown. The upper end of housing **11** is open and in-

cludes screw-threads **15** on the upper outer periphery thereof. A cap **16**, having a downwardly extending marginal flange **17** with threads **18** on the inner periphery thereof, is screw-threaded onto threads **15** as shown.

The inner housing **12** is a riser slidably mounted within outer housing **11** and is arranged to protrude from cap **16** as shown in the dotted lines. A channelled ring member **19** is disposed below cap **16** and includes a generally vertical cylindrical wall **20** with housing **12** slidable therealong. As can be seen in FIG. **1**, the upper surface of cap **16** is bevelled as at **21** to form a cavity or the like for seating a nozzle cap ring **22** (See also FIG. **9**). A nozzle cap **23** seats on ring **22** and includes a downwardly extending tubular portion **24** having an axial passageway **25** extending therethrough.

As can be seen in FIG. **1**, the underside of cap **23** is configured so that it makes a tight seal with ring **22** but leaves a space **25a** between ring **22**, cap **23** and the top of nozzle **26**. As will be discussed further hereinbelow, nozzle **26** includes a plurality of spaced passageways **27** (See also FIG. **9**) communicating at the bottom with the interior of housing **12** and at the top with the outer periphery **26a** of nozzle **26** (See also FIG. **9**).

A dimple **28** is formed on the upper surface of nozzle **26** extending a short distance into space **25**. A downwardly extending dimple **29** is also provided on the underside of cap **23**. This dimple **29** is also spaced from the upper surface of nozzle **26** so that no interference therebetween is present. As cap **23** is rotated, as will be explained further hereinbelow, dimple **29** engages dimple **28** to transmit rotation to nozzle **26**. It can be seen in FIG. **9** that elements **22**, **23** and **26** may be quickly and easily snap-fit together to form a nozzle subassembly of the head of FIG. **1**.

The underside of nozzle **26** abuts against the top **30** of inner housing **12**. In this manner, the downward extent of nozzle **26** is prevented by engagement with top **30**.

Transmission means for imparting rotation to cap **23** is disposed within sprinkler head **10** and includes a transmission housing **31** mounted generally coaxially within inner housing **12**.

A peripheral flange **32**, having a downwardly extending lip portion **33**, is integral with the inner wall **34** of inner housing **12**. As can be seen in FIG. **1**, an apertured disc **35** (See also FIG. **6**) is disposed between the bottom of nozzle **26** and the top of flange **32**. Means for sealing these members in the form of a resilient sealing ring member **36**, the exact structure of which will be described further hereinbelow with respect to FIG. **8**, is disposed between the underside of disc **35** and the top of flange **32** (and also the outer surface of lip portion **33** as shown).

Screening means in the form of a generally cylindrical screen member **37**, having a plurality of openings **38** therein, is mounted in sprinkler head **10** between the outer wall **38a** of inner housing **12** and the inner wall **39** of outer housing **11**. Screen member **37** may include a plurality of horizontally and peripherally extending ribs **40** as shown and ring member **19** may include a peripheral channel **41** or the like separated by a divider wall **41a**, for receiving in one side thereof the upper end **42** of screen member **37** in close-fitting relationship. Ring member **41** is preferably of a yieldable material, such as plastic or the like, so that when the inner housing **12** is retracted into sprinkler head **10**, the ring member **41** acts as a seal between cap **16** and cap ring **22**. Thus, when head **10** is inactive, low pressure water is prevented from seeping out of the head **10** and dirt is excluded from entering. Ring member **41** also wipes clean the outer wall **38a** of inner housing **12** when it is retracted back into head **10**.

As shown in FIG. **4**, the inner wall **39** of outer housing **11** may include longitudinally extending spaced splines **43** of the like for receiving notches **44** or the like on the upper end **42** of screen member **37** so that rotation is prevented between screen member **37** and housing **11** and the screen member **37** is properly aligned therein.

The lower end **45** of screen member **37** is generally conically shaped as shown terminating in a rib **46**. Rib **46**, as shown in FIG. **3**, extends transverse of the interior of housing **11** and abuts against the upper end **47** of inlet **13**. Finally, a return spring **48** is interposed between the other side of channel **41** of bearing member **19** and a peripheral lip portion **49**, having an upstanding portion **60** forming a channel **51** or the like, integral with the bottom of inner housing **12**. Spring **48** thus urges inner housing **12** from its retracted position in FIG. **1** to its extended position (indicated by the dotted lines at the top of sprinkler head **10** in FIG. **1**).

As shown in FIg. **4**, the inner wall **52** of screen member **37** may also have one or more longitudinally extending splines **53** for engaging notches **54** formed on the outer periphery of the upstanding portion **50** of inner housing **12** for keying the inner housing **12** to its proper non-rotating position within screen member **37**.

A more complete description of the operation of sprinkler head **10** will be given further hereinbelow. However, for convenience of illustration, fluid, such as water, enters inlet **13**, as indicated by arrow **55**, passes into the space **56** formed between the bottom of the lower end **45** of screen member **37** as indicated by arrow **57**, then enters the space **58** formed between the outer wall **38** of screen member **37** and the inner wall **39** of housing **11**.

As indicated by arrow **59**, the fluid then enters openings **38** in screen member **37** and enters, as indicated by arrows **60**, upwardly into the interior of inner housing **12**.

The means for impelling fluids entering inner housing **12** as indicated by arrow **60** and out of the top thereof will now be described. Such means may include an inverted apertured cup member **61** having a bottom peripheral lip portion **62** adapted to abut the top surface **63** of the lower end **45** of screen member **37**. Cup member **61** includes a generally cylindrical wall **64** press-fitting into the bottom of inner housing **12**. The aperture **65** at the top of cup member **61** is closed off by a dish-shaped member **66** integral therewith. The peripheral wall **67** forming aperture **65** includes a plurality of spaced openings **68**, which may be either circular in cross-section, as shown in FIG. **4**, or square, or any other suitable configuration through which fluid exits as indicated by arrow **68a**. Transmission housing **31** is mounted within inner housing **12** as previously described and carries a rotor **69** having a plurality of impeller blades **70** spaced thereabout (See FIG. **4**) at its lower end. The plane of these blades **70** may be angled from the vertical (i.e., inclined) to assit in the impelling of fluids striking such blades **70**. Rotor **69** includes a generally centrally located apertured boss **71** or the like for receiving a pin **72** in tight press-fitting relationship.

As particularly contemplated within the present invention, the transmission housing **31** is provided with expandable diaphragm means. In the exemplery em-

bodiment, such diaphragm means comprises a pin 72 which passes through a suitable aperture 73 generally centrally located in an expandable diaphragm 74, which may be of rubber or the like. Diaphragm 74 includes a peripheral downwardly extending lip portion 75 snap-fitting into a groove 76 of a ring member 77. Groove 76 may be bevelled on its inner surface.

The transmission housing 12, which may be made up of one or more parts snap-fitting or otherwise secured together, has its lower end 78 press-fitting or the like into ring member 77. Thus, diaphragm 74 is retained therein by ring member 77 and the lower end 78 of housing 12.

The lower end 78 of housing 12 includes an upstanding boss 79 centrally mounted on a divider wall 80. Boss 79 has an aperture 81 at its lower end communicating with a passageway 82 at its upper end. Pin 72 is press-fit at its upper end into apereture 81 and into a first shaft 83 press-fit or the like in passageway 82 as indicated by the dotted lines. Divider wall 80 includes a plurality of spaced openings 84 therein surrounding boss 79.

The reduction gearing means of the transmission means will now be described. Such means may include a small center gear 85 which is either press-fit onto shaft 83 or otherwise rotatable therewith. This gear 85 is in meshing engagement with a first set of a plurality of larger diameter planetary gears 86 through 88 (See FIG. 5), three such gears being shown, which are in meshing engagement with the splined inner surface 89 of transmission housing 31.

As can be seen in FIG. 1, a plurality of spaced protruberances 90 extend about the outer periphery 91 of transmission housing 31 for properly aligning the transmission housing 31 within inner housing 12. A plurality of spaced longitudinally extending ribs 92 are disposed about the inner wall 34 of inner housing 12 below flange 32. These ribs 92 include a first tapered portion 93 for guiding transmission housing 31 into the upper portion of inner housing 12, then an abutment portion 94 for stopping the upward movement of transmission housing 31. In this manner, transmission housing 31 may be quickly and easily properly aligned within and spaced from the inner wall 31 of inner housing 12 (See also FIG. 5).

The planetary gears 86 through 88 are rotatably carried on pins 95 integral with and depending downwardly from a generally circular plate 96. Any suitable means may be provided for rotatably mounting such gears on pins 95 while retaining gears 86 through 88 in their proper location within transmission housing 31.

A small center gear 97 is carried by the top of plate 96 and rotatable therewith. Gear 97 is in meshing engagement with a second set of planetary gears 86 through 88 also in meshing engagement with splined surface 89. A second plate 96 with pins 98 thereon carries the second set of gears 86 through 88 as described hereinabove. A second gear 97 is disposed at the top of plate 96 and in meshing engagement with a third set of planetary gears 86 through 88 also in meshing engagement with splined surface 89. These latter gears are also rotatably mounted on pins 98 depending downwardly from top plate 99. Plate 99 thus differs from plate 96 previously described in that no center gear is carried at the top thereof.

The upper end of transmission housing 31 terminates in a generally frusto-conically shaped portion 100 having a generally axially and downwardly extending apertures boss 101 therein. The bottom 102 or lowermost portion of boss 101 abuts against the upper surface of plate 99.

A sleeve member 103 is press-fit or the like in a fluid-tight manner into aperture 104 of boss 101. Sleeve member 103 includes an axially extending threaded aperture 105 communicating with passageway 25 in nozzle cap 23. Finally, a threaded bolt 106 extends through passageway 25 and is threaded into aperture 105 for fixedly connecting the cap 23 to sleeve member 103 and thus to the transmission housing 31. The slotted head 107 of bolt 106 may be selectively loosened or tightened, as by means of a screwdriver or the like.

It can be seen from the foregoing that the various elements carried by the transmission housing 31, i.e., including rotor 69, diaphragm 74 and the various gears and means for connection thereof can also be quickly and easily snap-fit together to form a transmission subassembly for the sprinkler head 10. In addition, the transmission subassembly is completely sealed off from fluids entering head 10 through water inlet 14. Further, the previously described nozzle subassembly (See FIG. 9) can be quickly and easily coupled to the transmission subassembly via bolt 106.

The assembly of the various components to make up the completed sprinkler head 10 will not be described. First, spring 48 is mounted on the outer wall 38a of inner housing 12 and retained at its lower end in channel 51. Ring member 19 is now placed on housing 12 above the upper end of spring 48. The spring 48 is retained within channel 41. Cap 16 is now placed over ring member 19. The disc 35 and ring member 36 are assembled in inner housing 12 as shown in FIG. 1. Elements 22, 23 and 26 are then pre-assembled as described hereinabove with respect to FIG. 9 to make up the nozzle subassembly and placed onto the open upper end of housing 12. The transmission subassembly is also pre-assembled as previously described. These assemblies may now be connected together within housing 12 via bolt 106 with disc 35 and ring member 36 disposed between the subassemblies. The transmission housing 31 is keyed within inner housing 12 as previously described. Cup member 61 may now be press-fit into the open bottom of housing 12 below rotor 69.

Screen member 37 may now be mounted within outer housing 11 and keyed therein as previously described. The previously completed nozzle-transmission-cap subassembly may now be inserted into the screen member-outer housing aub-assembly and keyed therein as previously described to form the final assembled sprinkler head 10 when cap 16 is threaded onto the top of outer housing 11.

The operation of the assembled sprinkler head 10 will now be described with respect to FIG. 1. The fluid, such as water, under pressure enters the bottom of head 10 through inlet 13 as previously described. The fluid is jetted through openings 68 and against the inclined blades 70 of rotor 69. The blades 70 are rotated while the fluid is thrown centrifugally outwardly so that it rushes up the space formed between the outer wall 91 of the transmission housing 31 and the inner wall 34 of inner housing 12. This force acting on housing 12 overcomes the force of spring 48, causing inner housing 12 to extend to the dotted line position in FIG. 1 (i.e., the nozzle assembly carried by housing 12 pops-up to the FIG. 1-dotted line position) with the fluid sprayed out of passageways 27 as indicated by arrow and the dotted lines. The resilient ring member 19 prevents dirt or the like from entering into housing 11. The compression of

spring **48** and the portion **50** of inner housing **12** controls the upward extent of the nozzle assembly **22**, **23** and **26**.

As soon as nozzle assembly **22**, **23** and **26** is clear of cap **16**, water flowing against the inclined blades **70** of rotor **69** rotates first center gear **85** via connecting pin **81**, which in turn actuate the first set of planetary gears **86** through **88**. These gears **86** through **88** in turn rotate the various plates **99** and the transmission housing **31** and the remaining gears in the gear reduction system all as previously described. Due to this reduction gear system, the nozzle assembly **22**,**23**,**26**, coupled to trasmission housing **31** via bolt **106**, revolves at a reduced rate. In this manner, the rate of revolution of the nozzle assembly **22**,**23**,**26** and thus the amount of spraying of water from passageways **17** may be controlled. Of course, the total number, size and location of the gears may be varied accordingly. For example, although three sets of center gear and planetary gears have been described, the total number of sets of gears may vary. Also, the reduction at each stage may be varied. For example, an 8:1 reduction may exist at each stage. Thus, the relatively fast rotation of rotor **69** is converted into slow rotation of nozzle **26** via cap **23**.

It is to be understood that, aside from pin **81** and diaphragm **74**, all of the components making up the transmission subassembly may be made of a suitable plastic material or the like. Such material permits the snap-fitting of parts as previously described and results in a relatively inexpensive and durable subassembly. However, it is desirable to lubricate the inner working parts (i.e., the various gears) of the transmission subassembly. Thus, the entire interior of the transmission subassembly may be filled with a suitable lubricant having a different coefficient of expansion than the plastic used in manufacturing the transmission subassembly. That is, the transmission subassembly is vacuum-sealed with a suitable lubricant. This difference in coeffients is important because temperature differences between the fluid entering the head **10** and the ground or the like in which it is mounted are generally different. Such differences may result in an expansion of the lubricant with resulting damage to the transmission subassembly unless a lubricant of a differing coefficient than the coefficient of the materials of the transmission subassembly is used.

It can be seen in FIG. **1** that the lip portion **75** of diaphragm **74** forms a bead about its outer edge which fits snugly into the groove **76** of ring member **77**. Thus, diaphragm **74**, which is resilient and expandable, may expand with its lip portion **75** retained against the bevelled lip of groove **76** trapping diaphragm **74** between ring member **77** and the bottom of transmission housing **31**. The diaphragm **74** can thus expand as the lubricant changes its volume.

The disc **35** which is situated below nozzle **26** may be keyed to a spline **109** on the inner wall **34** of inner housing **12** above flange **32** as shown in FIG. **1**. As also shown in FIG. **1**, disc **35** may have an opening **110** therein so configured as to close off one side of the passageways **27** while opening the other side. Since disc **35** is keyed to inner housing **12** and thus remains stationary while nozzle **26** rotates, the pattern of spray may be varied. That is, as the passageways **27** are rotated over the stationary guide disc **35**, the water enters differing passageways **27** in nozzle **26**. Of course, discs similar to disc **35** with various types of openings therein may be substituted for disc **35** to obtain any desired spray pattern.

As particularly contemplated within the present invention, sealing means are provided for sealing the interior of inner housing **12** so that fluids cannot bypass housing **12** when entering nozzle **26**. In the exemplary embodiment, such sealing means comprises, as shown in FIG. **8**, a ring member **36**. Ring member **36** is comprised of a resilient material and includes a first generally vertically extending ring portion **111** and an integral generally horizontal flange portion **112**. The intersection of these portions **111** and **112** forms a lip **113** which abuts against the underside of disc **35** as shown in FIG. **8**. However, flange portion **112** extends from lip **113** generally outwardly and downwardly as shown to thus form a space **114** when it is seated on top of flange **32**. It can also be seen that the lip portion **33** of the flange **32** of inner housing **12** is inclined from the vertical, that is, extends generally downwardly and outwardly as shown, to form a second space **115** between lip portion **33** and ring portion **111** when ring member **36** is seated as shown.

The foregoing is the normal position of ring member **36** when in its operative position within inner housing **12**. The lip **113** is thus squeezed under disc **35** and a water-tight seal is created at the point of contacts **116**, **117** and **118**. Water pressure on ring member **36** at point of contact **116** causes the ring member **36** to seat; however, the resiliency of ring member **36**, at lip **113** and point of contact **118**, permits a slight amount of up and down travel. That is, since disc **35** is of metal or the like and nozzle **26** is of plastic or the like, a problem is encountered in maintaining a seal between such dissimilar materials. However, ring member **36** acts as a spring holding disc **35** firmly up against the bottom of nozzle **26**. Even if nozzle **26** wears during use, the ring member **36** bears against the underside of disc **35** to maintain disc **35** in sealing engagement with the bottom of nozzle **26**. In fact, such seal may even be improved during wear. The resiliency of ring member **26** and the aforementioned configuration thereof, together with the configuration of flange **32** and the spaces formed therebetween, assist in carrying this out.

Referring now to FIG. **10** wherein like numerals refer to like parts of the sprinkler head **10** of FIG. **1**, outer housing **12** of FIG. **1** may be modified by providing an outer housing **119** having screw-threads **120** on its outer peripheral bottom thereof. A separate outer housing bottom portion **121** having an upwardly extending generally circular portion **122** which screw-threads **123** on the inner periphery thereof may be screw-threaded onto screw-threads **120**. Water inlet **124** having internal threads therein is carried by bottom portion **121** for connection to water supply line **14**.

In this embodiment, the cup member **61** of FIG. **1** may also be modified and, as shown in FIG. **10**, is of a unitary construction. That is, cup member **125** has a lip portion **126** similar to lip portion **62** and a cylindrical wall **127** similar to wall **64**. However, disc-shaped portion **128** is integral with cylindrical wall **127**. Openings **129** are thus part of portion **128** and formed in the top generally horizontally extending peripheral wall **130** as shown.

Further, screen member **37** may be eliminated and replaced by a disc-shaped screen filter **131** (See also FIGS. **11** and **12**). As shown in FIG. **11**, filter **131** includes a depressed central portion **132** having a plurality of spaced radially extending ribs **133** on its upper surface (See also FIG. **10**). Filter **131** also includes an outer portion **134** having a plurality of spaced openings

135. These openings 135 are generally rectangular, as shown, at the upper surface of filter 131. However, as shown in FIG. 12, the underside of outer portion 134 includes a plurality of radially outwardly and downwardly extending elongated members 136 forming a web. These members 136 may be generally triangular in cross-section and may also form generally triangular spaces 137 between adjacent members 136 as clearly shown in FIG. 12. That is, the web tapers from the point of engagement with central portion 132 to the openings 135 so that, as can be seen in FIG. 10, if a piece of dirt 138 or the like enters the web, it is pushed to the outside and water can bypass the dirt 138 to enter the interior of housing 11 via openings 135 as indicated by arrow 141.

As discussed hereinabove, with respect to FIGS. 1 and 9, as nozzle cap 23 is rotated, dimple 29 engages dimple 28 on nozzle 26 to also rotate the same. This engagement directs the spray through passageways 27 in a more thorough pattern. The openings 139 at the bottom of nozzle 26 leading into passageways 27 have been illustrated in FIG. 7 as being generally trapezoidal in cross-section; however, as shown in FIG. 13, these openings 140 may be generally rectangular in cross-section, if desired. The variation in configuration of such openings 139, and 140 enables one to obtain better control over the disposition of water. The two configurations described hereinabove are given by way of example only; obviously, openings 139 and 140 may be triangular, square, or any other suitable configuration. Further, nozzle 26 has been described as of unitary construction; however, nozzle 26 may be comprised of two or more parts secured together in any suitable manner. In the latter case, various components which include the openings 139 and 140 leading into passageways 27 may be substituted as desired.

Thus, referring once again to FIG. 9, nozzle 26 may be comprised of an upper housing portion 141 and a lower housing portion 142. Upper housing portion 141 may have a plurality of spaced depending dimples 143 which fit into a plurality of like spaced apertures 144 on lower housing 142. Passageways 27 have three sides thereof on upper housing portion 141 which are closed off on their fourth sides by the inter-engagement of portions 141, 142. The orifices 145 on the outer periphery 26 of upper housing portion 141 are closed off by engagement with the margin 146 of lower housing portion 142. These two portions may be welded together, as by solvent or sonic means, to obtain the integral nozzle 26 of FIG. 1.

Other than the materials specifically referred to hereinabove, any suitable materials, such as plastic or the like, may be used throughout the sprinkler head 10. It can be seen from the foregoing that I have described an improved sprinkler head having a pop-up nozzle which head screens out dirt or the like while rotating the nozzle thereof under reduced speed. The means for rotating the nozzle is well lubricated and sealed off from the water flowing through the sprinkler head.

I claim:

1. In a sprinkler system having fluid under pressure flowing therethrough, and a sprinkler head operatively connected to said system having a nozzle for dispersing said fluid therefrom, the improvement which comprises:

impeller means associated with said head operatively engaging said nozzle for rotating said nozzle in response to said fluid passing through said system, said impeller means including transmission means for transmitting movement of said impeller to said nozzle, said transmission means being sealed off from engagement by said fluid at one end by an expandable diaphragm separating said transmission means from said fluid and closed-off in a fluid-tight manner at the other end and a lubricating medium completely filling the sealed-off portion of said transmission means, said lubricating medium being free to selectively contact or expand thereby displacing said diaphragm in response to varying ambient conditions encountered by said sprinkler head.

2. In the sprinkler system of claim 1 wherein the lubricating medium is of a differing coefficient of expansion than the materials comprising said transmission means.

3. In the sprinkler system of claim 1 wherein said transmission means includes reduction gearing means disposed in said sealed-off portion and in operative engagement with said impeller means for transmitting rapid rotation of said impeller means to slow rotation of said nozzle.

4. In the sprinkler system of claim 1 wherein screening means is disposed in said sprinkler head adapted to screen fluid entering said system before said fluid contacts said impeller means.

5. In the sprinkler system of claim 4 wherein said screening means includes a screen member encircling said impeller means, said screen member having a plurality of openings therein for screening fluids passing therethrough.

6. In the sprinkler system of claim 4 wherein said screening means includes a screening member disposed within said sprinkler head in contact with said fluid entering therein, said screening member having a main central imperforate body portion and a plurality of radially outwardly extending upstanding ribs, said ribs forming generally triangular openings between adjacent ribs, said triangular openings tapering from said central body portion outwardly to the periphery of said screening member forming a plurality of peripheral spaced openings disposed about the periphery of said screening member and in fluid communication with the spaces between adjacent ribs, the portion of said screening member between said peripheral openings and said central body portion also being imperforate.

7. In the sprinkler system of claim 1 wherein said nozzle includes a first nozzle cap portion operatively connected to said impeller means and rotatable thereby, and a main nozzle body having a plurality of passageways extending therethrough, said passageways having openings leading into said passageways for receiving fluid from said impeller means and orifices leading from said passageways, for spraying fluid therefrom, and means associated with both said nozzle cap portion and said main nozzle body for transmitting rotation of said nozzle cap portion by said impeller means to said main nozzle body.

8. In the sprinkler system of claim 1 wherein said main nozzle body includes an upper nozzle body portion and a lower nozzle body portion, three sides of said passageways extending through said upper nozzle body portion and leading into said orifices with said orifices open on one side thereof and the fourth side of said passageways and the closing-off of said orifices being formed by the interengagement of said upper and lower nozzle body portions, guide means associated with both of said nozzle body portions for guiding said nozzle

body portions into interengagement in a manner whereby said fourth sides closes off said passageways and said orifices in said upper nozzle body portion in a fluid-tight manner, and said openings being disposed on said lower nozzle body portion.

9. In the sprinkler system of claim 8 wherein said upper and lower nozzle body portions are welded together.

10. In the sprinkler system of claim 7 wherein said openings are generally trapezoidal in cross-section.

11. In the sprinkler system of claim 7 wherein said openings are generally rectangular in cross-section.

[12. In a sprinker system having fluid under pressure flowing therethrough, and a sprinkler head operatively connected to said system having a nozzle for dispersing said fluid therefrom, said nozzle having a plurality of passageways extending completely therethrough, the improvement which comprises:

impeller means associated with said head operatively engaging said nozzle for rotating said nozzle in response to said fluid passing through said system, said impeller means enclosed by a housing havir ; an upper portion and an open lower end for receiving said fluid therein, and sealing means disposed between the upper portion of said housing and said nozzle for preventing fluid entering said housing from passing between the upper portion of said housing and said nozzle while permitting said fluid to flow out of the passageways in said nozzle, said sealing means being adapted upon application of fluid under pressure to increase the pressure between it and said nozzle and the upper portion of said housing.]

13. [In the sprinkler system of claim 12] *In a sprinkler system having fluid under pressure flowing therethrough and a sprinkler head operatively connected to said system having a nozzle for dispersing said fluid therefrom, said nozzle having a plurality of passageways extending completely therethrough, the improvement which comprises:*

impeller means associated with said head operatively engaging said nozzle for rotating said nozzle in response to said fluid passing through said system; said impeller means enclosed by a housing having an upper portion and an open lower end for receiving said fluid therein, and sealing means disposed between the upper portion of said housing and said nozzle for preventing fluid entering said housing from passing between the upper portion of said housing and said nozzle while permitting said fluid to flow out of the passageways in said nozzle, said sealing means being adapted upon application of fluid under pressure to increase the pressure between it and said nozzle and the upper portion of said housing; and wherein said impeller means includes transmission means therein for transmitting movement of said impeller means to said nozzle, said transmission means being enclosed by a second housing and an expandable diaphragm seal disposed within said second housing between said impeller means and said transmission means.

[14. In the sprinkler system of claim 12 further including template means associated with said sprinkler head disposed between said nozzle and said sealing means adapted to set a predetermined pattern of spray of fluid under pressure from said nozzle.]

[15. In the sprinkler system of claim 14 wherein said template means is a metallic disc having aperture means therein shaped for providing said predetermined pattern of spray in a fluid communication with the fluid entering said sprinkler head and in selective fluid communication with the passageways of said nozzle.]

16. [In the sprinkler system of claim 15] *In a sprinkler system having fluid under pressure flowing therethrough, and a sprinkler head operatively connected to said system having a nozzle for dispersing said fluid therefrom, said nozzle having a plurality of passageways extending completely therethrough, the improvement which comprises:*

impeller means associated with said head operatively engaging said nozzle for rotating said nozzle in response to said fluid passing through said system, said impeller means enclosed by a housing having an upper portion and an open lower end for receiving said fluid therein, and sealing means disposed between the upper portion of said housing and said nozzle for preventing fluid entering said housing from passing between the upper portion of said housing and said nozzle while permitting said fluid to flow out of the passageways in said nozzle, said sealing means being adapted upon application of fluid under pressure to increase the pressure between it and said nozzle and the upper portion of said housing; and

further including template means associated with said sprinkler head disposed between said nozzle and said sealing means adapted to set a predetermined pattern of spray of fluid under pressure from said nozzle; wherein

said template means is a metallic disc having aperture means therein shaped for providing said predetermined pattern of spray in a fluid communication with fluid entering said sprinkler head and in selective fluid communication with the passageways of said nozzle and;

wherein the upper portion of said housing includes an inwardly extending flange having a downwardly extending lip thereon, and said sealing means includes a resilient ring member having a first generally upright portion and an integral generally horizontally extending flange portion, the intersection of both of said portions forming a lip bearing against the underside of said disc with a first space formed between the lip of said housing and the upright portion of said ring member and a second space formed between said flange portion and the flange of the upper portion of said housing.

17. A sprinkler head comprising:

an outer housing;

an inner housing coaxially mounted therein and moveable from a first position within said outer housing to a second position extended from said outer housing;

a nozzle rotatably mounted at the upper end of said inner housing having a plurality of radiating fluid discharge passageways opening beyond said outer housing when said inner housing is extended out of said outer housing, said passageways being in fluid communication with the interior of said inner housing;

biasing means operatively engaging said inner housing for biasing said inner housing to its first position; and

impeller means associated with said inner housing in operative engagement with said nozzle for transmitting rotation of said impeller means to said nozzle, said impeller means including transmission means disposed within said inner housing, said

transmission means being adapted to convert rapid rotation of said impellar means to slower rotation of said nozzle, said transmission means having a portion sealed-off from the atmosphere with an expandable diaphragm disposed between said sealed-off portion and said impeller means, and a lubricating medium completely filling said sealed-off portion, said lubricting medium being free to selectively contract or expand thereby displacing said diaphragm in response to varying ambient conditions.

18. The sprinkler head of claim **17** wherein said lubricating medium has a differing coefficient of expansion than the coefficient of expansion of the internal portions of said sealed-off portion.

19. In a sprinkler having a head mounting a nozzle for dispersing fluid through said head and out of said nozzle and impeller means associated with said head operatively engaging said nozzle for rotating said nozzle in response to said fluid passing through said head, said impeller means including transmission means for transmitting movement of said impeller means to said nozzl_, the improvement comprising:

sealing means for sealing off at least a portion of said transmission means from engagement by said fluid including a displaceable member separating said transmission means sealed-off portion from said fluid; and

a lubricating medium completely filling the sealedoff portion of said transmission means, said lubricating medium being free to selectively contract or expand and thereby displace said member in response to varying ambient conditions encountered by said sprinkler.

20. In the sprinkler of claim **19**, wherein said displaceable member is an expandable diaphragm.

21. In a sprinkler system having fluid under pressure flowing therethrough, and a sprinkler head operatively connected to said system having a nozzle for dispersing said fluid therefrom, said nozzle having a plurality of passageways with bottom and top ends and extending completely therethrough, the improvement which comprises:

impeller means associated with said head operatively engaging said nozzle for rotating said nozzle in response to said fluid passing through said system, said impeller means enclosed by a housing having an upper portion and an open lower end for receiving said fluid therein, and sealing means disposed between the upper portion of said housing and said nozzle for preventing fluid entering said housing from passing between the upper portion of said housing and said nozzle while permitting said fluid to flow out of the passageways in said nozzle, said sealing means being adapted upon application of fluid under pressure to increase the pressure between it and said nozzle and the upper portion of said housing;

said upper portion of said housing defining an outlet from said housing, said nozzle having a bottom through which the bottom ends of said nozzle passageways extend in overlying relation to said outlet defined by said upper portion of said housing to communicate with the interior of said housing therethrough, and wherein, said sealing means is disposed between said upper portion of said housing defining said outlet and said bottom of said nozzle.

22. In the sprinkler system of claim 21 further including template means associated with said sprinkler head disposed between said bottom of said nozzle and said sealing means adapted to set a predetermined pattern of spray of fluid under pressure from said nozzle.

23. In the sprinkler system of claim 22 wherein said template means is a metallic disc having aperture means therein shaped for providing said predetermined pattern of spray in a fluid communication with the fluid entering said sprinkler head and in selective fluid communication with the passageways of said nozzle.

24. In the sprinkler system of claim 21 wherein an apertured disc is disposed between said upper portion of said housing defining said outlet and said bottom of said nozzle, said aperture in said disc providing fluid communication between said outlet from said housing and the bottom ends of said nozzle passageways, and said seal means is disposed between said upper portion of said housing and said apertured disc.

25. In the sprinkler system of claim 24 wherein said upper portion of said housing includes a peripheral flange defining said outlet, and said sealing means is in the form of a resilient sealing ring disposed between the top of said peripheral flange and the underside of said apertured disc.

26. In the sprinkler system of claim 25 wherein said peripheral flange defining the outlet from said housing further defines a downwardly extending lip portion and said resilient sealing ring is further disposed between the underside of said apertured disc and the outer surface of said lip portion.

27. In the sprinkler system of claim 26 wherein said sealing ring includes a first generally vertically extending ring portion and an integrally formed generally horizontal flange portion with the intersection of said portions forming a lip abutting the underside of said apertured disc, said flange portion extending from said lip and being seated on the upper surface of said peripheral flange of said upper portion of said housing and said vertically extending ring portion extending from said lip of said resilient sealing ring into contact with said downwardly extending lip portion of said peripheral flange.

28. In the sprinkler system of claim 24 wherein said apertured disc is stationary relative to said housing and closes off a portion of the bottom ends of said passageways in said nozzle and defines a fluid communication path from the outlet defined by said upper portion of said housing and the remainder of the bottom ends of said passageways in said nozzle.

29. In the sprinkler system of claim 25 wherein said apertured disc is stationary relative to said housing and closes off a portion of the bottom ends of said passageways in said nozzle and defines a fluid communication path from the outlet defined by said upper portion of said housing and the remainder of the bottom ends of said passageways in said nozzle.

30. In the sprinkler system of claim 28 wherein said sealing means acts as a spring and urges said apertured disc into contact with the bottom of said nozzle.

31. In the sprinkler system of claim 29 wherein said resilient sealing ring acts as a spring and urges said apertured disc into contact with the bottom of said nozzle.

32. In the sprinkler system of claim 21 wherein said sprinkler head includes an outer stationary housing defining a water inlet connected to said system and said housing enclosing said impeller means is an inner housing slidably mounted within said outer housing and moveable between a first position in which said inner housing is retracted within said outer housing and a second position in which said inner housing protrudes from said outer housing exposing said nozzle therefrom, said inner housing being

moveable between said first and second positions by fluid under pressure in said system.

33. In the sprinkler system of claim 32 wherein a generally cylindrical screen member is disposed between said outer housing and said inner housing such that water entering said water inlet passes through said screen before entering said open lower end of said inner housing.

34. In the sprinkler system of claim 24 wherein said sprinkler head includes an outer stationary housing defining a water inlet connected to said system and said housing enclosing said impeller means is an inner housing slidably mounted within said outer housing and moveable between a first position in which said inner housing is retracted within said outer housing and a second position in which said inner housing protrudes from said outer housing exposing said nozzle therefrom, said inner housing being moveable between said first and second positions by fluid under pressure in said system.

35. In the sprinkler system of claim 34 wherein a generally cylindrical screen member is disposed between said outer housing and said inner housing such that water entering said water inlet passes through said screen before entering said open lower end of said inner housing.

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