United States Patent [19]

Meyer

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[54] **SPRINKLER HEAD WITH IMPROVED BRAKE AND BEARING ASSEMBLY**

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[52] **U.S. Cl.** **239/231**, 239/232, 239/233, 239/252, 188/72.1, 188/83

[51] **Int. Cl.** **B05b 3/08**

[58] **Field of Search** .....239/230-233, 252, DIG. 1; 188/83, 166, 167, 72.1

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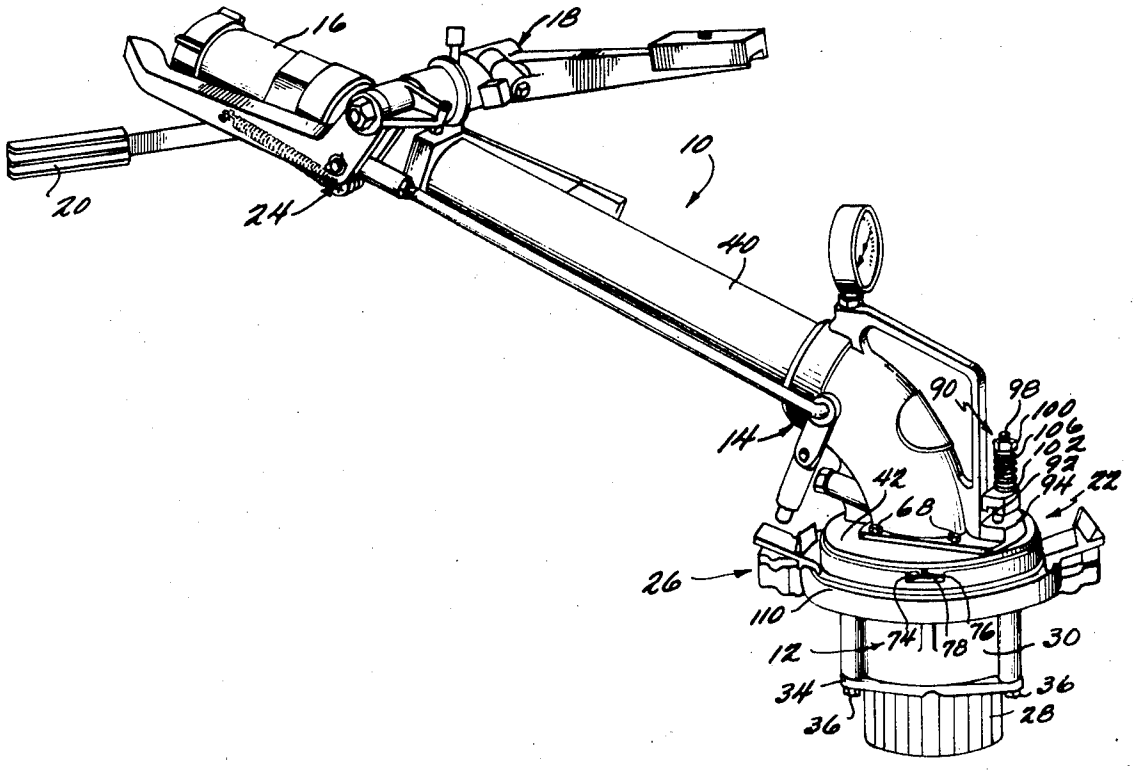
[57] **ABSTRACT**

A step-by-step rotary sprinkler head in which the brake mechanism for controlling the arcuate magnitude of the step-by-step movements is manually adjustable by turning a single threaded element to vary the pressure of frictional engagement of a pair of opposed arcuately segmental brake shoes with a ring shaped brake element.

10 Claims, 4 Drawing Figures



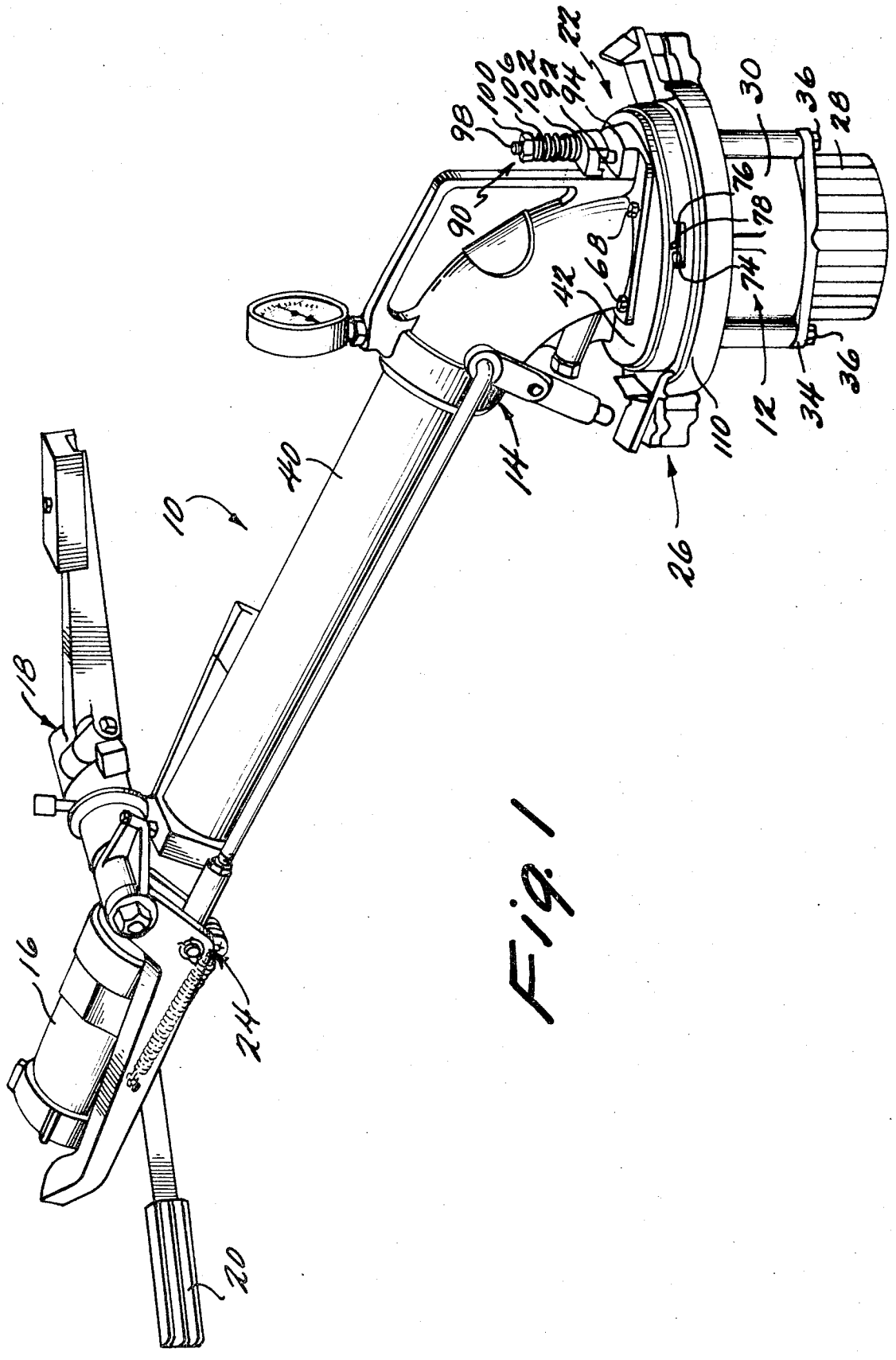

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Fig. 1

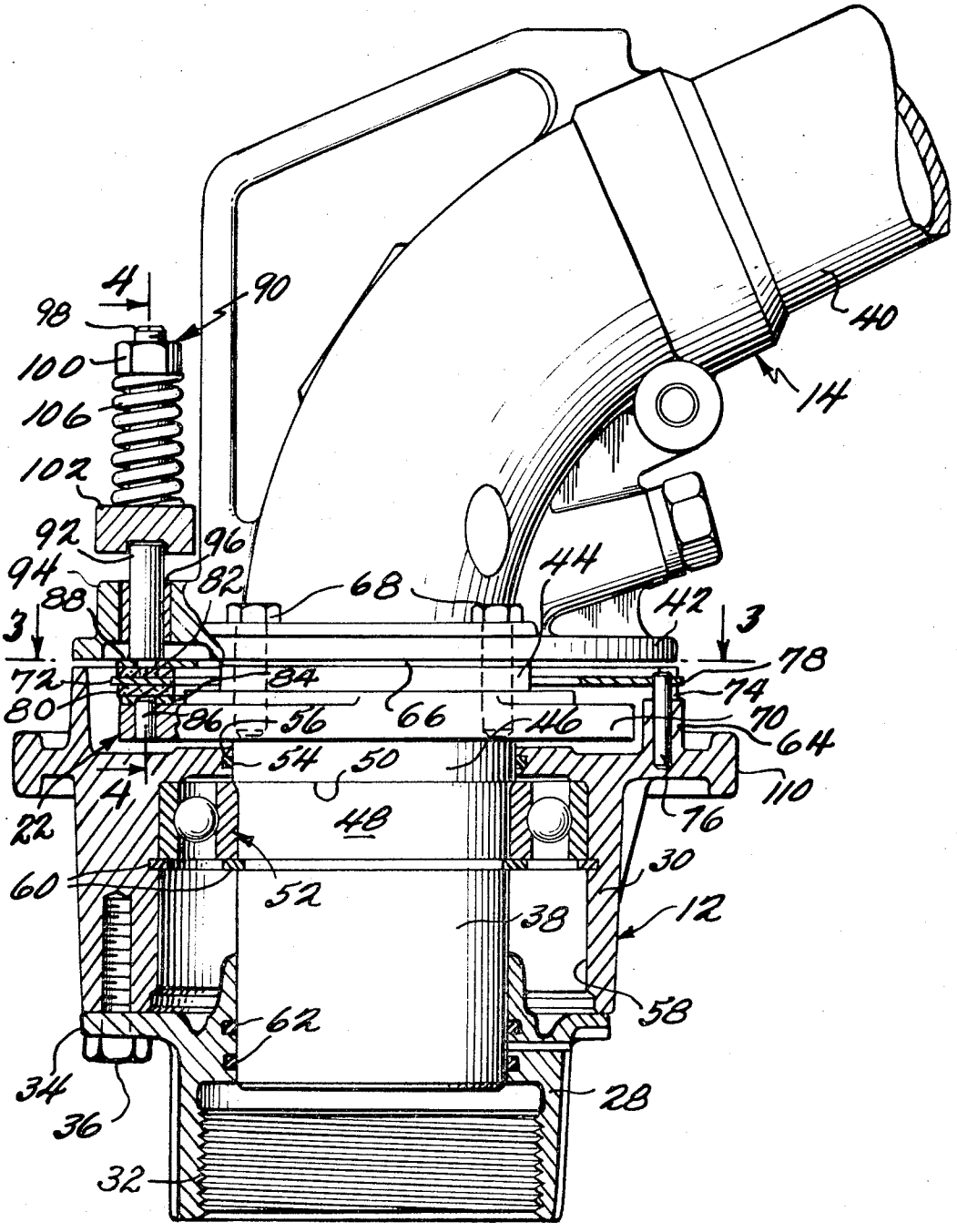
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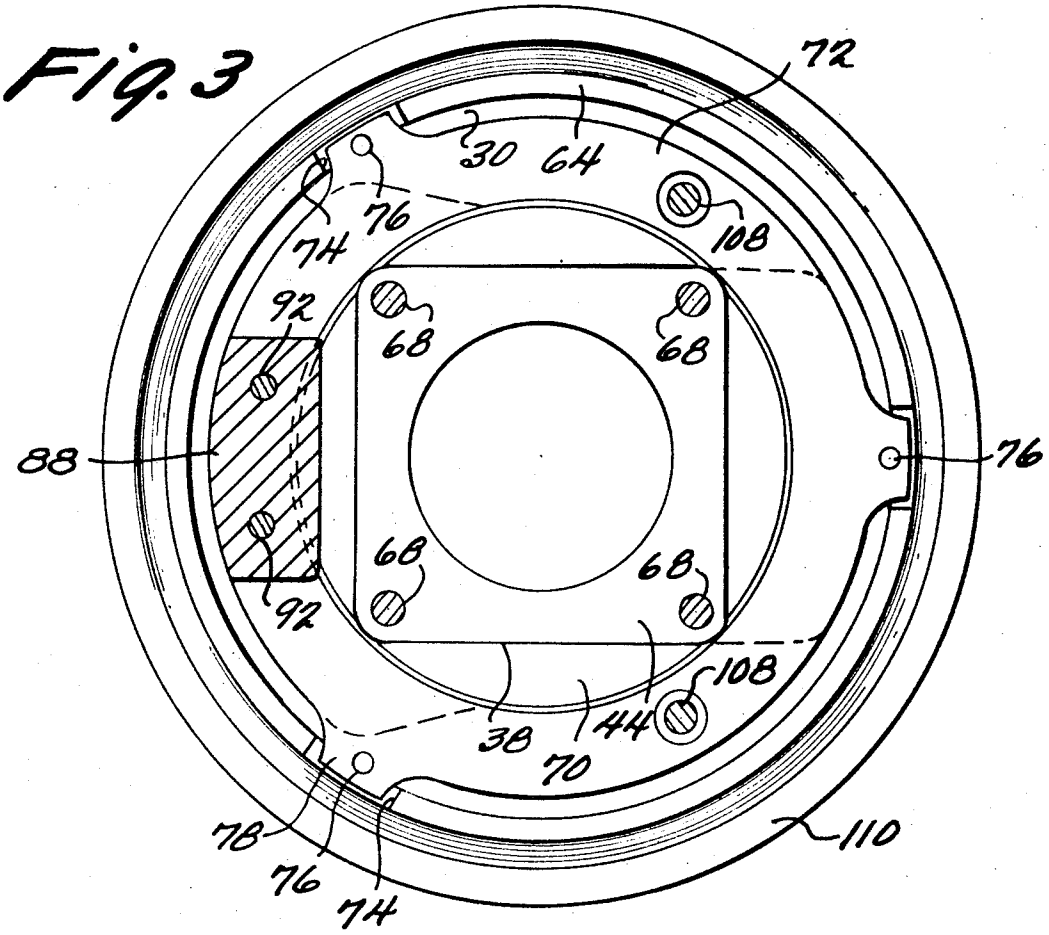
Fig. 2

Fig. 3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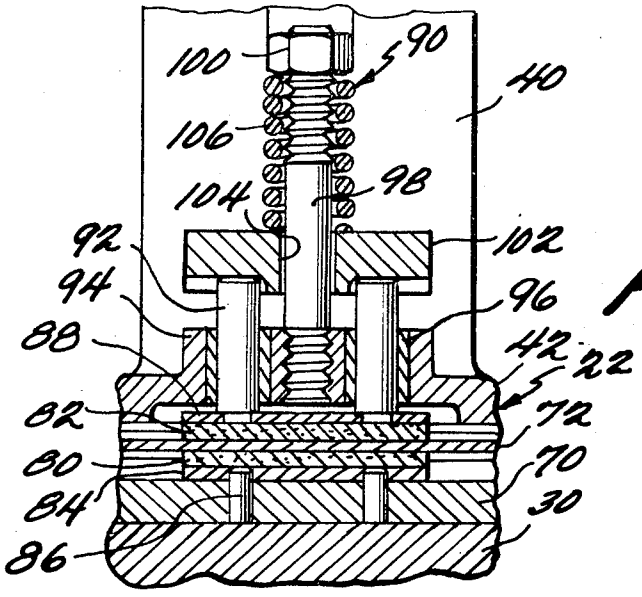
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Fig. 4

SPRINKLER HEAD WITH IMPROVED BRAKE AND BEARING ASSEMBLY

This invention relates to sprinkler heads and more particularly to improvements in step-by-step rotary sprinkler heads.

Step-by-step rotary sprinkler heads are well-known in the art. Sprinkler heads of this type are extensively used in agricultural irrigation sprinkling. All of the sprinkler heads of this type embody a pivoted impulse arm which is moved through repeated oscillatory cycles during operation. The impulse arms are moved through these repeated oscillatory cycles by the engagement of a reactant element on the impulse arm with the discharge stream of the sprinkler head during each oscillatory cycle. The step-by-step rotary sprinkler heads commonly in use in relatively low capacity installations effect the step-by-step rotary movement of the sprinkler head by an impact of the impulse arm with the rotary structure of the sprinkler head during each oscillatory cycle of movement of the impulse arm. The sprinkler head is provided with a friction brake assembly between the fixed housing structure and rotary housing structure of the sprinkler head which serves to control the amount of rotational movement imparted to the rotary sprinkler housing structure in response to the impact force applied thereto during each oscillatory cycle of movement of the impulse arm. The higher capacity sprinkler heads of the step-by-step rotary type differ from the lower capacity types in that the force applied to the rotary housing structure of the sprinkling head during each oscillatory cycle is a stream reactant force rather than an impact force. In the normal operation of these higher capacity sprinkler heads, the reactant force applied to the rotary housing structure of the sprinkler head during each oscillatory cycle of the impulse arm is relatively high, requiring the provision of a braking mechanism to control the amount of rotary movement of considerable complexity. Heretofore the braking mechanisms embodied in such high capacity sprinkler heads have embodied an annular brake element which is contacted by an annular brake shoe throughout the annular extent thereof or approximately 360°. Conventionally the braking element and brake shoe are biased into frictional engagement by a plurality of annularly spaced adjustable spring pressure units. In most instances three or more of such adjustable spring pressure units are provided. In practice, it has been found that the necessity to provide for plural adjustment of the resistance provided by the braking mechanism has caused some considerable problems. The proper operation of braking systems of this type requires that a substantially uniform spring pressure be applied by each of the adjustable spring pressure units. This requirement itself provides considerable inconvenience, so much so that it is often the case that the spring pressure units are not equally or uniformly adjusted. Where one of the spring pressure units, through carelessness, frustration or the like, remains adjusted to apply a greater frictional contact between the cooperating parts of the braking mechanism than the others, uneven wearing will occur in operation. Uneven wear can result in a rapidly altering performance, which, in turn, requires further adjustment and the introduction of possible further imbalance. The end result is not only considerable inconvenience but reduced performance and sprinkler head life.

Accordingly, it is an object of the present invention to provide a step-by-step rotary sprinkler head of the type described with an improved braking mechanism which has but a single adjusting mechanism for applying a single uniform spring pressure to the cooperating brake parts of the mechanism so as to eliminate the inconveniences and problems noted above.

Still another object of the present invention is the provision of an improved braking mechanism for a step-by-step rotary sprinkler head of the type described which embodies an improved bearing assembly.

A still further object of the present invention is the provision of a step-by-step rotary sprinkler head having an improved braking mechanism and bearing assembly which provide the sprinkler head with a highly desirable overall weight reduction.

Still another object of the present invention is the provision of an improved brake mechanism for a step-by-step rotary sprinkler head of the type described which is simple in construction, efficient in operation and economical to manufacture and maintain.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompanying drawings wherein an illustrative embodiment is shown.

In the drawings:

FIG. 1 is a perspective view of a sprinkler head embodying the principles of the present invention;

FIG. 2 is a fragmentary elevational view partly in section illustrating the improved brake mechanism of the present invention;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2; and

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 2.

Referring now more particularly to the drawings, there is shown in FIG. 1 thereof a sprinkler head, generally indicated at **10**, embodying the principles of the present invention. The sprinkler head **10** includes a fixed housing structure, generally indicated at **12**, adapted to be fixedly attached to the upper end of a riser pipe or the like (not shown) to which a source of water under pressure is communicated. Journaled in the fixed housing structure **12** for rotation about a generally vertically extending axis is a rotatable housing structure, generally indicated at **14**. The rotatably housing structure includes an inlet portion disposed within the fixed housing structure **12** and an outlet portion extending thereabove. The outlet portion includes a discharge nozzle **16** at the upper end thereof disposed to direct a discharge stream upwardly and outwardly with respect to the axis of rotation of the rotary housing structure **14**.

Pivotally mounted on the rotatable housing structure **14** is an impulse arm assembly **18** having a reactant element **20** on one end thereof adapted to engage the stream issuing from the nozzle **16**. The engagement of the stream with the reactant element **20** serves to impart successive repeated oscillatory cycles of movement to the impulse arm **18**, the reactant element **20** also serving to impart to the rotatable housing structure **14**, during each oscillatory cycle, an instantaneous force having a component tangential to the axis of rotation. The sprinkler head **10** also includes a brake mechanism, generally indicated at **22**, between the fixed

housing structure and rotary housing structure for controlling the amount of rotational movement undertaken by the rotatable housing structure in response to each instantaneous force applied thereto during each oscillatory cycle of movement of the impulse arm assembly 18.

The sprinkler head 10 shown in FIG. 1 is of the part-circle type and includes a reversing mechanism 24 and an adjustable cam assembly 26 for actuating the reversing mechanism 24. The outlet portion of the rotary housing structure 14, the discharge nozzle 16, the impulse arm assembly 18, reactant element 20, reversing mechanism 24 and cam actuating mechanism 26 are preferably constructed in accordance with teachings set forth in my earlier commonly-assigned U.S. Pat. No. 3,559,887 issued Feb. 2, 1971. It will be noted, however, that the reversing arm mechanism 24, as shown in FIG. 1, differs somewhat from that of the reversing arm mechanism disclosed in my aforesaid patent.

Specifically, the reversing arm is mounted so that the reactant element on the free end thereof is disposed below the stream when the arm is in its inoperative position and is moved upwardly into the stream rather than being moved downwardly into the stream from a position thereabove, as in the aforesaid patent. With this arrangement, the weight of the reversing arm is added to the spring to bias the reversing arm into its inoperative position. Also, due to the reverse movement of the reversing arm disclosed in FIG. 1, the connecting rod is pivoted to the actuating lever at a position above the pivotal connection of the lever with the housing, rather than at a position intermediate this pivotal connection and the cam roller as in the patented structure.

It will also be noted that since the sprinkler head shown in FIG. 1 is particularly designed to perform within a capacity range (100 – 500 GPM) less than that of the sprinkler head disclosed in the aforesaid patent, the rotatable housing has a handle integrally cast therein which facilitates manual movement of the sprinkler head from one location to another.

It will be understood that while the outlet portion of the rotatable housing structure and the impulse arm assembly 18 pivotally mounted thereon form components of an operable combination of elements to which the present invention is applicable, the details of construction of these components form no part of the present invention. For purposes of clearer understanding of the details of construction and function of these components, reference may be had to the aforesaid patent, the disclosure of which is hereby incorporated by reference into the present specification.

The present invention is more particularly concerned with improvements in the brake mechanism 22 which cooperate with the action of the impulse arm assembly to control the amount of rotational movement imparted to the rotatable housing structure 14 in response to the application of the instantaneous force by the impulse arm assembly 18 during each operative cycle thereof. The present invention is also concerned with the structural and functional interrelationship between the brake mechanism improvements and improvements in the construction and functioning of the bearing assembly between the fixed housing structure and the rotatable housing structure.

Referring now more particularly to FIG. 2, the fixed housing structure 12 is preferably formed of a pair of upper and lower housing members 28 and 30. The lower member 28 is adapted to be fixedly secured to the upper end of a riser pipe or the like and to this end is provided with internal threads 32 within the lower end portion thereof. The lower member 28 includes an annular flange 34 extending outwardly from the upper end portion thereof which is adapted to engage the lower end of the upper housing member 30. The lower member is detachably secured in engagement with the upper member by any suitable means, such as by a plurality of bolts 36 or the like.

In the preferred embodiment shown, the rotatable housing structure 14 is likewise made up of two rigidly interconnected members 38 and 40 forming the inlet and outlet portions of the housing structure respectively. As best shown in FIG. 2, the lower end of the discharge member 40 is provided with an annular flange 42 which extends radially outwardly therefrom. The lower member 38 includes an upper generally rectangularly shaped attaching flange 44 of a size less than the annular flange 42. The exterior periphery of the lower member 38 is shaped so as to provide an upper cylindrical surface 46 extending downwardly from the flange 44 and a lower cylindrical surface 48 of a slightly lesser diameter than the surface 46 so as to provide a downwardly facing shoulder 50. The shoulder 50 is adapted to engage the inner race of a ball bearing assembly 52 of conventional construction, the outer race of which is mounted within the upper member 30 of the fixed housing structure.

As shown, the upper member 30 is provided with a main bore 54 of a size to receive therein the upper cylindrical surface 46 of the member 38. Preferably, the bore 54 is grooved to receive an O-ring seal 56 which engages the periphery of the cylindrical surface 46. Formed in the lower end of the member 30 is a counterbore 58 which forms with the bore 50 a radially inwardly extending flange portion defining a downwardly extending shoulder which receives the outer race of the ball bearing assembly 52. The ball bearing assembly 52 is retained in operative position by any suitable means such as a pair of split rings 60 mounted within annular grooves formed within the counterbore 58 and cylindrical surfaces 48 respectively.

It will also be noted that the lower member 28 includes a radially inwardly extending flange portion similar to that provided by the upper member 30 which receives the lower end portion of the cylindrical surface 48. Here again, preferably the bore of the flange portion is grooved to receive a pair of O-ring seals 62 or the like. It can be seen that the portion of the exterior periphery of the member 38 and the portion of the counterbore 58 extending between the annular O-ring seals 56 and 62 defines an annular space which is preferably packed with grease so as to provide a permanently sealed lifetime lubricated bearing assembly for the sprinkler head 10.

Still referring to FIG. 2, it will be noted that the upper member 30 of the fixed housing structure 12 includes an annular wall 64 of an exterior diameter generally equal to the exterior diameter of the flange 42, which extends upwardly from the upper end portion of the member 30. The input member 38 and discharge member 40 of the rotatable housing structure are sealably interconnected by means of a gasket 66 disposed between the coextensive portions of the flanges 42 and 44. The flanges and gasket are apertured at annularly spaced locations to receive a plurality of attaching bolts

68. The attaching bolts extend through the registering apertures in the flanges 42 and 44 and gasket 66 and are threadedly engaged within an annular mounting member 70 slidably engaged over the cylindrical surface 46 and disposed in a position within the annular wall 64 when the bolts 68 are tightened. Also it will be noted that when the bolts 68 are tightened, annular flange 42 is disposed in closely spaced overlying relation with the annular wall 64.

Mounted within the annular wall 64 in surrounding relation with the flange 44 beneath the annular flange 42 is an annular brake element 72 preferably in the form of a thin centrally apertured disc. The disc brake element 72 is mounted with respect to the upper member 30 of the fixed housing structure 12 so as to be secured against relative rotational movement with respect thereto but for limited relative axial or longitudinal movement with respect thereto. While any suitable means may be provided for effecting this mounting, as best shown in FIG. 3, the annular wall 64 is formed with a plurality of annularly spaced upwardly opening recesses 74, each of the recesses having a pin 76 extending upwardly therein. The disc brake element 72 is provided with a corresponding plurality of annularly spaced ears 78 extending outwardly therefrom which are centrally apertured to receive the pins 76.

The disc brake element 72 forms one cooperating brake element of the brake mechanism 22, the other cooperating brake elements being in the form of a pair of opposed lower and upper brake shoes 80 and 82. The lower brake shoe 80, which is of arcuate segmental configuration, is bonded to a backing plate 84 having a pair of apertures formed therein to receive the upper end of a pair of pins 86 fixed to the member 70 below the disc brake element 72.

The upper brake shoe 82, which is of corresponding arcuate segmental configuration, is bonded to a backing plate 88. The backing plate 88 with brake shoe 82 bonded thereto is mounted for movement toward and away from the brake shoe 80 by a threadedly adjustable spring pressure mechanism, generally indicated at 90. While the mechanism 90 may take many forms, as shown, the brake shoe backing plate 88 has fixed thereto and extending upwardly therefrom a pair of pins 92. The pins 92 extend through an apertured boss portion 94 formed integrally above the associated portion of the annular flange 42, the apertures having bearings 96 disposed therein for slidably receiving the pins 92.

As best shown in FIG. 4, the mechanism 90 also includes a stud 98 threadedly engaged within the boss portion 94 between the bushings 96, the stud 98 extending upwardly and having its upper end threaded to receive thereon an adjusting nut 100. An equalizer bar 102 having a central opening 104 therein is engaged over the stud and positioned so as to engage the upper end of both of the pins 92. A coil spring 106 is disposed over the stud with its lower end in engagement with the the bar 102 and its upper end in engagement with adjusting nut 100.

At positions displaced 120° from the stud 98, the flange 42 is provided with a pair of apertures for receiving the shanks of a pair of buttons 108 (see FIG. 3), the heads of which are of a size to extend beneath the flange 42 just out of contact with the upper surface of the disc brake element 72, so as to limit the upward axial movement thereof.

It will also be noted that the upper member 30 of the fixed housing structure 12 is provided with a T-shaped flange 110 which extends radially outwardly thereof adjacent the lower end of the annular wall 64. This flange serves as a means on which the adjustable cam elements of the reversing mechanism are mounted as will be evident by reference to the disclosure of my aforesaid patent.

In assembling the present sprinkler head 10, the member 70 is first engaged over the lower end of the member 38 until it is disposed in engagement with the flange 44. This assembly is then fed downwardly through the bore 54 of the member 30 and the ball bearing assembly 52 is mounted in position, utilizing the split rings 60. The lower brake shoe 80 bonded to the backing plate 84 is then positioned on the pins 86, brake element 72 is then mounted in position with the apertured ears 78 receiving the pins 76. The discharge member 40 with the adjusting mechanism 90 assembled thereon and the upper brake shoe and backing plate mounted within the bearings 96 and with the buttons 108 disposed within their apertures is engaged over the lower assembly and the assembly is completed by threadedly engaging the bolts 68 through the apertures in the flanges 42 and 44 (with the gasket 66 therebetween) and threaded into the openings in the member 70.

In this way, the rotatable housing structure 14 is mounted for rotation within the fixed housing structure 12 for rotational movement about a generally vertical axis which is controlled by the frictional engagement of the brake shoes 80 and 82 with the brake element 72. To render the sprinkler head capable of being operatively connected to a riser pipe or the like, the ball bearing assembly 52 is packed with grease, the lower member 28 is disposed in engagement with the member 30, and secured in position by the bolts 36.

When the sprinkler head 10 is mounted in communicating relation with the upper end of a riser pipe and the latter is communicated with the source of water under pressure, the water under pressure from the riser pipe enters the member 38, constituting the inlet portion of the rotatable housing structure 14, and then passes through the member 40 and then upwardly and outwardly of the discharge nozzle 16. The stream flowing from the discharge nozzle 16 engages the reactant element 20 of the impulse arm assembly 18, causing the latter to undertake repeated oscillatory cycles of movement as described in detail in my aforesaid patent. During each cycle of movement, the reaction of the stream on the reactant element 20 creates an instantaneous force having a component tangential to the axis of rotation of the rotatable housing structure 14. Each of these instantaneous forces will effect a rotational movement of the rotatable housing structure 14 of an arcuate extent depending upon the setting of the adjusting mechanism 90. It will be understood that by tightening the adjusting nut 100 a greater frictional contact between the brake shoes 80 and 82 and the disc brake element 72 will be accomplished. Likewise, by loosening the adjusting nut 100 a lesser frictional contact will be accomplished. The force of the frictional contact between the brake shoes and the disc brake element determine the arcuate extent of rotary movement of the rotatable housing structure in response to each instantaneous tangential force during each operative cycle of the impulse arm assembly 18. In this way,

the arcuate extent of rotary movement of the sprinkler head can be adjusted with a simple manual turning of a single adjusting mechanism. This arrangement eliminates the need to effect adjustment of a plurality of adjusting elements and the attendant inconvenience and problems resulting from the necessity of uniformly adjusting more than one adjusting element.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing preferred specific embodiment has been shown and described for the purpose of illustrating the functional and structural principles of this invention and is subject to change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. In a sprinkler head of the type including a fixed housing structure having means thereon for fixedly securing the same to a riser pipe or the like in communicating relation with a source of water under pressure communicated with the riser pipe, a rotatable housing structure having an inlet portion journaled in said fixed housing structure for rotation about a generally vertically extending axis and an outlet portion extending above said fixed housing structure, said rotatable housing structure having interior surfaces for confining water under pressure communicating with said fixed housing structure to flow in at least one stream directed upwardly and outwardly therefrom, an impulse arm pivotally mounted on said rotatable housing structure for movement through repeated oscillatory cycles of operation, means carried by said impulse arm engageable with said stream during the operative cycle thereof for effecting repeated operative cycles of said impulse arm and for imparting to said rotatable housing structure during each operative cycle thereof an instantaneous force having a component tangential to the axis of rotation of said rotatable housing structure, and brake means acting between said housing structures for controlling the amount of rotational movement of said rotatable housing structure in response to each application of said instantaneous force the improvement which comprises said brake means including an annular brake element carried by one of said housing structures in a position with its axis concentric with the axis of rotation of said rotatable housing structure, brake shoe means carried by the other of said housing structures in a position radially outwardly of the axis of rotation of said rotatable housing structure in frictional engagement with an arcuately segmental portion only of said annular brake element, said annular brake element being free of frictional contact other than by said brake shoe means at said arcuate segmental portion, spring means operatively associated with said brake shoe means for resiliently biasing said brake shoe means into frictional engagement with said arcuately segmental portion of said annular brake element with a continuous force, and threadedly adjustable means operable by a single manual movement for varying the magnitude of the continuous force with which said spring means biases said brake shoe means into said frictional engagement with the arcuate segmental portion of said annular brake element to thereby vary the rotational movement of said rotatable housing structure in response to the application of said instantaneous forces thereto.

2. The improvement as defined in claim 1 wherein said fixed housing structure includes an annular wall formed at the upper end thereof disposed in outwardly spaced relation to the adjacent inlet portion of said rotatable housing structure, the adjacent outlet portion of said rotatable housing structure having an outwardly extending annular flange thereon closely overlying said annular wall, said annular brake element being disposed within said annular wall and below said annular flange.

3. The improvement as defined in claim 2 wherein said annular brake element comprises a thin centrally apertured disc having a plurality of annular spaced integral mounting ears extending radially outwardly from the exterior periphery thereof, said annular wall having annular spaced means therein engaging said ears so as to prevent rotational movement of said disc about its axis but permitting limited axial movement thereof with respect to said annular wall.

4. The improvement as defined in claim 3 wherein said rotatable housing structure includes a brake shoe mounting portion disposed within said annular wall in spaced relation below said disc, said brake shoe means including a lower brake shoe of friction material carried by said brake shoe mounting portion with its upper surface in frictional engagement with the lower surface of an arcuately segmental portion of said disc, and an upper brake shoe of friction material disposed in vertical alignment with said lower brake shoe with its lower surface in frictional engagement with the upper surface of said arcuately segmental portion of said disc.

5. The improvement as defined in claim 4 wherein said threadedly adjustable means comprises a stud fixed to said annular flange and extending upwardly therefrom and a nut threadedly engaged on the upper end of said stud, said spring means comprising a helical compression spring mounted over said stud with its upper end in operative engagement with said nut and spring pressure transmitting means between the lower end of said spring and said upper brake shoe.

6. The improvement as defined in claim 5 wherein said spring pressure transmitting means comprises an equalizer bar having a central opening loosely receiving said stud therethrough and operatively engaging the lower end of said spring, a horizontal plate having its lower surface bonded to the upper surface of said upper brake shoe, a pair of parallel vertically extending pins fixed at their lower ends to the upper surface of said plate and having their upper ends operatively engaged with said equalizer bar on opposite sides of said stud, said annular flange having a pair of bearings therein on opposite sides of said stud slidably receiving said pins.

7. The improvement as defined in claim 6 wherein said annular wall has a plurality of recesses formed in the upper end thereof of a size to receive said ears, said annularly spaced ear engaging means comprises a pin extending upwardly within each of said recesses, said ears having apertures formed therein receiving said pins.

8. The improvement as defined in claim 7 including a pair of buttons detachably mounted in depending relation to said annular flange at annularly spaced positions with respect to said brake shoes for limiting the upward axial movement of the adjacent portions of said disc.

9. The improvement as defined in claim 1 wherein said fixed housing structure includes a lower annular member having said riser pipe securing means on the lower portion thereof and an upper annular member detachably fixedly secured above said lower annular member, said rotatable housing structure including an interior tubular member disposed substantially completely within said upper and lower annular members, said upper and lower annular members providing interior sealing means engaging the exterior periphery of said tubular member at vertically spaced positions thereon and an annular chamber surrounding the exterior periphery of said tubular member between said positions, said annular chamber having a bearing assembly therein and being packed with grease.

10. The improvement as defined in claim 9 wherein said rotatable housing structure also includes an exterior tubular member and means for detachably fixedly securing the lower end of said exterior tubular member to the upper end of said interior tubular member.

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