March 1, 1932. J. H. KEYS 1,847,763

SLOW MOTION ROTARY SPRINKLER

Filed Oct. 13, 1930 2 Sheets-Sheet 1

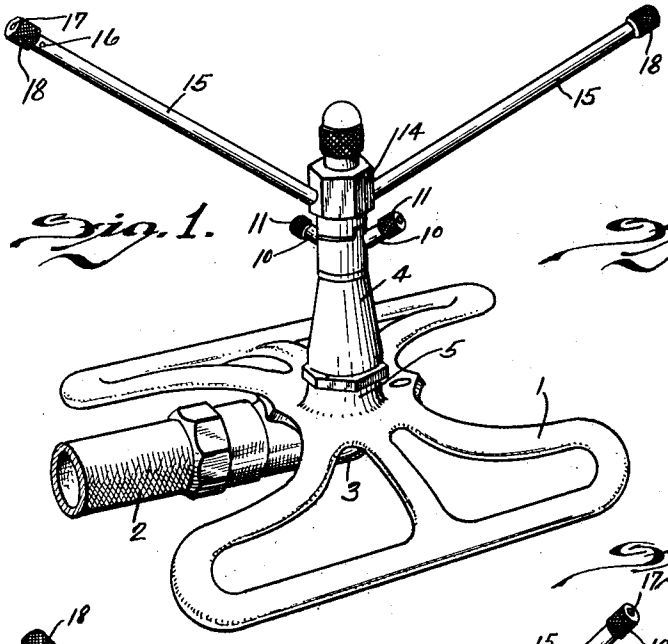


Fig. 1.

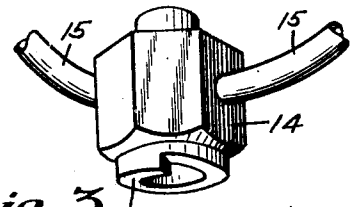


Fig. 3.

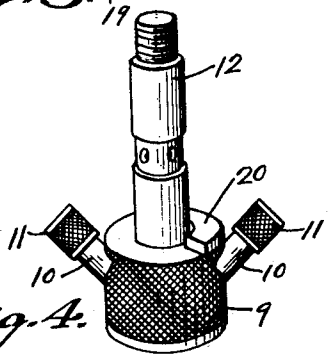


Fig. 4.

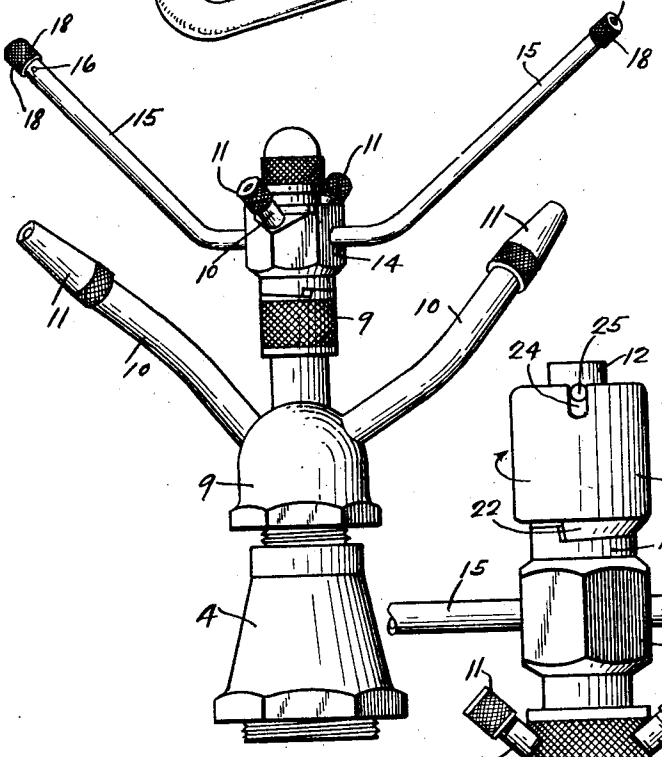


Fig. 5.

Fig. 6.

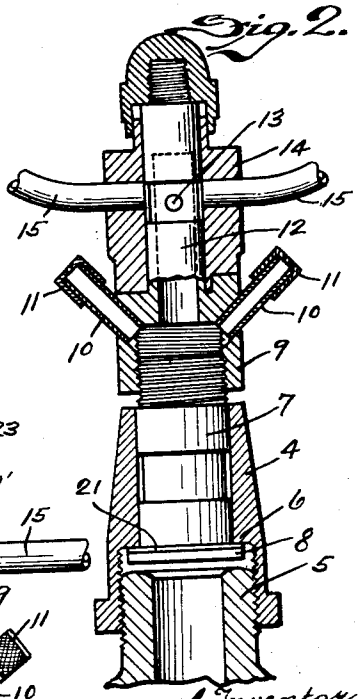


Fig. 2.

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Fig. 7.

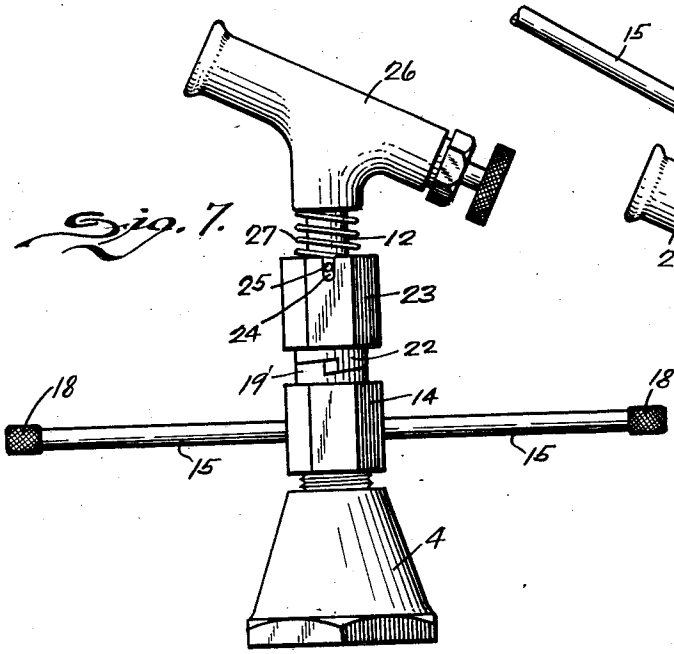


Fig. 8.

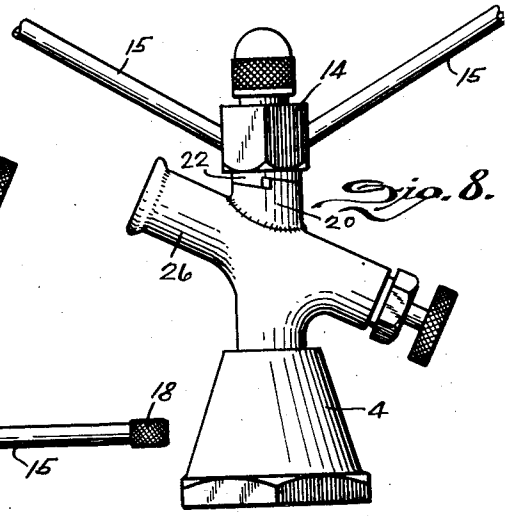


Fig. 9.

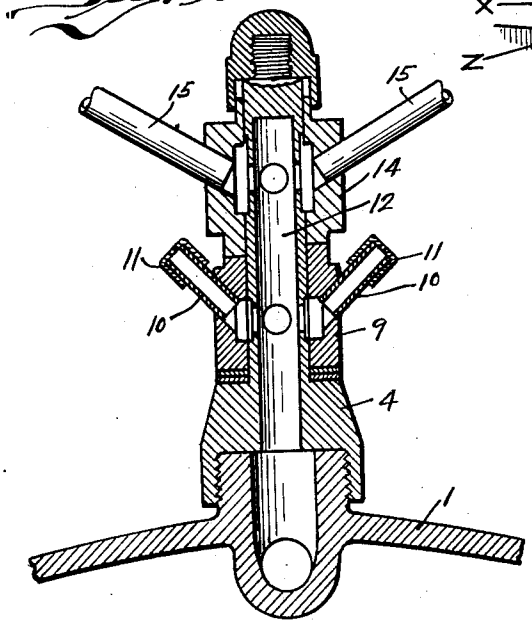
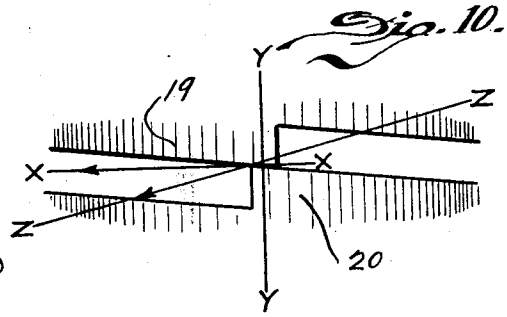


Fig. 10.



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UNITED STATES PATENT OFFICE

JOHN H. KEYS, OF DAYTON, OHIO

SLOW MOTION ROTARY SPRINKLER

Application filed October 13, 1930. Serial No. 488,400.

This invention relates to rotary sprinklers, and more particularly to a slow motion sprinkler wherein the discharge nozzle is rotated at comparatively low speed under influence of water pressure.

Slow motion sprinklers are well known in this art. Heretofore various means have been employed for transmitting rotary motion to the discharge nozzle at a low rate of speed, including sundry forms of gear drive mechanism, vibrating actuators, unbalanced rotary governors and the like. The present construction which embodies a minimum number of operating parts is designed to afford a speed reduction drive wherein a rapidly rotating impeller driven by water pressure imparts to a rotary distributor head intermittent impulses by which the distributor head is advanced step by step throughout its circle of operation. In the present device the impeller is provided with repulsion jet arms, by which it is driven at high speed, and is mounted concentrically with the rotary distributor head for both rotary and axial motion. A helical cam face upon either or both the distributor head and impeller elevates the impeller during each rotation and permits it to suddenly fall by gravity as it passes the end of the inclined cam face. The momentum of the impeller is such that it carries the impeller forwardly during its descent thereby causing it to impinge upon the distributor head in an oblique direction to the plane of rotation. The impact is sufficient to overcome the inertia of the rotary distributor head advancing it a short step in its rotation at each rotation of the impeller thereby inducing progressive advance rotation of the distributor. The construction is capable of variation as to form and instead of the impeller being axially movable it may have operative engagement with a governor weight mounted to rise and fall as the impeller rotates, which weight is operatively connected with the distributor head. The object of invention is to simplify the structure as well as the means and mode of operation of slow motion rotary sprinklers and the like, whereby they will not only be cheapened in construction but will be more efficient in use, positive in operation, uniform in action and unlikely to get out of repair.

A further object of invention is to provide a speed reduction means, or slow motion device, whereby a rapidly rotating impeller or actuator will transmit actuating impulses in rapid succession to a driven member mounted concentrically with such impeller or actuator thereby effecting unison rotation of the driven member at a materially less speed.

A further object of invention is to provide a slow motion sprinkler mechanism which will contain minimum number of operating parts, and which parts will be sturdy and strong, capable of withstanding hard usage and possessing large bearing surfaces subject to minimum wear.

A further object of invention is to provide a slow motion drive mechanism for a rotary sprinkler or other mechanism which will impart to the driven mechanism positive impulses and which will not be unduly susceptible to change of balance or change of position within a reasonable range.

With the above primary and other incidental objects in view as will more fully appear in this specification, the invention consists of the features of construction, the parts and combinations thereof, and the mode of operation or their equivalent, as hereinafter described and set forth in the claims.

Referring to the accompanying drawings where is shown the preferred but obviously, not necessarily the only forms of embodiment of invention, Fig. 1 is a perspective view of a portable type sprinkler embodying the present invention. Fig. 2 is a vertical sectional view of the operating parts. Figs. 3 and 4 are perspective views respectively, of the impeller or high speed actuator and the rotary distributor head or driven member. Fig. 5 is a side elevation of a modification of the construction adapted to a larger type sprinkler. Fig. 6 illustrates a modification wherein the impeller or high speed rotor does not possess axial movement but cooperates with an axially movable weight operatively connected with the driven member. Figs. 7, 8 and 9 illustrate further modifications or different appli-

cation of the invention. Fig. 10 is a diagrammatic view.

Like parts are indicated by similar characters of reference throughout the several views.

Referring to the accompanying drawings, 1 is a portable base or support, and 2, a supply hose communicating through an elbow conduit 3 within the base or support 1 with a vertically disposed coupling sleeve 4 screw threaded upon the boss 5 of the base. The coupling sleeve 4 is counter bored to form a shoulder or offset 6, in spaced relation with the top of the boss 5 to provide a thrust bearing for a rotary trunnion 7, extending within the coupling sleeve 4 and provided with a peripheral flange or head 8 intermediate the end of the boss 5 and the bearing shoulder 6. Screw threaded to the top of the trunnion 7 is the rotary distributor head 9 having one or more laterally directed discharge nozzles 10. These nozzles 10 may be of any suitable or desired type. For illustrative purpose they have been shown in Figs. 1, 2, 4 and 6, as short nipples screw threaded diagonally into the distributor head 9 and provided at their extremities with screw threaded perforated caps 11. This permits caps 11 having orifices of different sizes to be interchanged, thereby varying the character of the discharge stream and its range. Extending upwardly from the distributor head 9 is a hollow stem 12 which forms a continuation of the hollow trunnion 7 and supplies water under pressure through lateral discharge orifices 13 to the impeller or high speed runner 14 journalled upon the stem or extension 12. The impeller or runner 14 is provided with radially disposed jet arms 15 which are preferably though not necessarily, upwardly inclined to avoid the discharge from the nozzles 10. If desired these jet arms 15 may be extended perpendicular to the axis of rotation as indicated in Fig. 6. The jet arms 15 are provided with discharge orifices 16 adjacent to their extremities on the rear sides of such arms relative to their direction of rotation and may be further provided with discharge orifices 17 in the extremities of the arms 15 which are preferably provided with perforated caps 18 similar to the caps 11 of the nozzle 10 but having more restricted orifices. The water supplied under pressure through the hollow stem 12 and orifices 13 to the runner or impeller, is discharged through the jet arms 15 with repulsion effect thus rotating the impeller or runner 14 at a comparatively high rate of speed.

For the purpose of transmitting this rotary motion to the distributor head 9 at a lower speed of rotation, the under side of the runner or impeller 13, and the top of the distributor head 9, are formed with complementary helical cam faces 19 and 20, which ride one upon the other as the members rotate. As the impeller or runner 14 turns about the stem 12 relative to the distributor head 9, it climbs the inclined cam surface 20, thus giving to the runner or impeller an axial movement simultaneously with its rotation. As the shoulder or terminal end of the helical cam 19 of the impeller or runner 14, reaches the shoulder or terminal of the helical cam 20, the impeller or runner 14 is permitted to suddenly drop under the influence of gravity. However, the momentum of the impeller 14, is such that it continues its rotation during its descent. As a result the impeller, when released from the engaging cam face, impinges upon the rotary distributor head 9, in a direction oblique to the plane of rotation. The impact is sufficient to overcome the inertia of the rotary distributor head 9 causing it to be momentarily advanced.

The action of the impeller in transmitting successive impulses to the rotary head is diagrammatically indicated in Fig. 10, wherein the force of momentum, due to the rapid rotation of the runner, is exerted in the direction of the arrow x—x, while gravity is acting downwardly in the direction y—y. The resultant of these two forces is indicated by the arrow z—z. As indicated in the diagrammatic view, the high point or terminal of the helical cam 19 after passing beyond the corresponding terminal of the cam 20 strikes the inclined face of the cam 20 at a point some distance removed from the shoulder or terminal of the incline 20 upon the distributor head 9. The impeller or runner 14 dropping from the top to the lower portion of the inclined cam 20 of the distributor head at each rotation, transmits to the head 9 actuating impulses in rapid succession. Each impulse advances the distributor head 9 in its rotation, but a short step. The speed of the impeller 14 being rapid thus affording a continuous succession of impulses, effects what is comparatively a continuous rotation of the distributor head 9 at a relatively low rate of speed.

The water pressure upon the head 8 upon the hollow trunnion 7 forces the peripheral flange or head 8 tightly against the shoulder or seat 6 of the coupling sleeve, and while permitting relative rotary motion exerts sufficient pressure to retard the rotation of the distributor head 9, and prevent too free rotation thereof. An interposed collar or washer 21, preferably of German silver, prevents adherence of the parts and reduces wear to minimum. To further reduce wear, the contacting surfaces of the helical or inclined cams 19 and 20 are preferably chromium plated.

The nozzles 10 of the distributor head 9, are adapted to discharge streams of water to a considerable distance beyond the range of the repulsion jet arms 15 of the runner or im-

peller 14. The jet arms 15 distribute the water over a central circular area while the main discharge nozzles 10 distribute water over an annular area of greater diameter and beyond that covered by the water from the jet arms 15. The orifices 16 and 17 of the jet arms are so proportioned relative to those of the nozzles 10, that substantially uniform distribution of water is effected over the combined area.

In Fig. 5 there is shown a modification especially adapted for larger sprinklers having a range of greater radius. In this construction the distributor head 9 is provided with jet nozzles 10, which are inclined rearwardly relative to the direction of rotation. In this construction neither the impact of the impeller or runner 14, as it drops from the high to the low portion of the helical cam or incline 20, nor the repulsion influence of the jet nozzles 10′ is alone sufficient to move the head. However, the impact of the impeller added to the influence of the jet nozzles 10 is sufficient to momentarily advance the rotary head. In other words the distributor head of the construction of Fig. 5 being relatively heavy, the jet nozzles 10 tend to rotate this head but lack sufficient repulsion force to effect its movement, while the impact of the impeller 14 supplies the additional force necessary to overcome the inertia of the head.

In Fig. 6 there is shown further modification, wherein the runner or impeller 14, does not possess axial movement upon the stem 12 as before described, but rotates at all times in the same plane above the distributor head 9, the contacting faces of the impeller and the distributor head being flat. In this form of device the top of the impeller or runner 14, is provided with an inclined cam surface 19′, which has operative engagement with a similar inclined or helical cam surface 22 upon the under side of a vertically movable weight 23, keyed to the stem 12. In this construction, the impeller 14 as shown in Figs. 1 to 4 is merely inverted. The weight 23 rotates with the stem 12 which, as shown in Fig. 2, is an integral portion of the distributor head 9. The weight 23 may be keyed to the stem 12 by any suitable means which will permit axial movement thereon but compel unison rotation. In the drawings the weight 23 has been shown provided with a slot 24, within which projects a pin or stud 25 carried by the stem 12. As the impeller 14 rotates upon the stem 12 above the distributor head 9, the engagement of the cam surfaces 19′ and 22 causes the weight 23 to be elevated. As the high point or terminal shoulder of the helical cam 19′ passes beyond that of the helical cam 22 the weight suddenly drops to its lower position. The impeller 14 continuing to rotate during the descent of the weight 23, the high point of the inclined cam 19′, strikes the under side of the weight at a point somewhat removed from the shoulder or terminal end of the weight cam 22. Due to the simultaneous descent of the weight and rotation of the impeller, the impact is in a direction oblique to the plane of rotation and imparts to the weight 23 a rotary impulse which is transmitted through the stud or pin 25 to the stem 12, which in turn is connected with the distributor head 9. Thus at each rotation of the impeller 14 the distributor head 9 receives an actuating impulse.

In Fig. 7 there is shown a further modification wherein a long range adjustable nozzle 26, is fixedly secured to the upper end of the rotary stem 12, through which water under-pressure is supplied to the nozzle 26. The runner or impeller 14 rotating upon the stem 12 operatively engages the vertically movable weight 23 at each rotation to transmit an impulse to the revoluble stem 12 turning the latter intermittently within the coupling sleeve 4 and carrying with it the long range adjustable nozzle 26. Thus instead of locating a revoluble discharge head 9 below the runner or impeller 14, as shown in Fig. 6, a discharge nozzle of any suitable type may be mounted on the upper end of the revoluble stem to which motion is transmitted through the governor weight 23. While for ordinary purposes the weight 23 may be made sufficiently heavy to perform its function in effecting rotation of the supporting shaft or stem, the quick return movement of the member 23 may be effected by means of a spring 27 positioned about the shaft or stem 12 and bearing upon the axially movable control member 23 in opposition to the influence of the cam surface 19′ upon the actuator or impeller. By the use of such spring for insuring the return of the reciprocatory control element 23, the device may be operated in various inclined positions or, in fact if necessary, in a horizontal position.

The long range nozzle 26 may be located below the level of the runner as shown in Fig. 8 wherein the nozzle 26 is connected directly to the trunnion 7, and the hollow stem 12 upon which is mounted the impeller 14 is connected to the top of the nozzle 26. The nozzle is provided with a boss from which arises the stem 12, the top of the boss being formed into the cam surface 20.

By locating the nozzle 26 immediately above the bearing sleeve 6 the reaction of the discharged water does not exert such side pressure upon the bearing of the trunnion 7 as in the construction shown in Fig. 7 due to the longer leverage of the connected parts in the latter.

It is not at all essential that the trunnion or shaft shall rotate with the driven element, as heretofore described. In Fig. 9 there is shown a further modification wherein the

trunnion stem 12 is stationarily mounted and both the distributor 9 and the impeller or runner 14 are journalled about the stationary trunnion stem for independent rotation thereabout. With the single exception that the distributor head 9 is revolubly mounted upon the stationary trunnion stem instead of being formed integral with such stem, as heretofore described, the construction illustrated in Fig. 9 is identical with that shown in Figs. 1 to 4 inclusive.

While this speed reduction device has been described more particularly in adaptation for slow motion rotary sprinklers, it will be obvious that this device may be applied to other mechanisms, wherein it may be desired to transmit slow motion from a rapidly rotating prime mover to a slow motion driven element mounted concentrically for unison rotation about a common axis.

The present construction is applicable to permanently installed sprinkler systems as well as portable sprinklers, and by pivoting the jet arms 15 to the impeller as shown in my prior Patents No. 1,605,242 dated, Nov. 2, 1926, and 1,665,371 dated, April 10, 1928, the present construction may be employed in "pop-up" sprinkler systems wherein the sprinkler mechanism is automatically retracted into a receiver below the surface of the ground when not in use.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention I claim:

1. In a slow motion rotary sprinkler, a mounting, a high speed rotary runner thereon, repulsion jet arms carried thereby, and a slow speed rotary distributor mounted concentrically with the high speed runner, a discharge nozzle carried thereby, and means for effecting intermittent impact between the adjacent faces of the runner and distributor head.

2. In a slow motion rotary sprinkler, a rotary distributor head, a discharge nozzle carried thereby, means for supplying water thereto, an impeller capable of both rotary and axial motion, water pressure means for effecting rotation of the impeller, and means for effecting intermittent axial movement of the impeller, the impeller in its return axial movement impinging upon the rotary distributor head to impart thereto successive impulses in the direction of its rotation.

3. In a slow motion rotary sprinkler, a rotary distributor head, a discharge nozzle carried thereby, means for supplying water thereto, and a rotary impeller mounted concentrically with the distributor head and capable of movement toward and from said head, means for effecting a movement of the impeller away from the distributor head, the impeller being suddenly released for return axial movement simultaneously with its rotation into impinging engagement with the head and thereby imparting an advancing impulse.

4. A sprinkler including a rotary distributor head and a high speed rotary impeller mounted concentrically for independent rotation, a helical cam on the adjacent face of one of the members, engaging the other member and effecting a gradual separation of the members and a sudden return movement thereof at the end of the helical cam during each rotation of the impeller, the impact of the members when released from the cam being effected during the simultaneous axial and rotary motion in a direction inclined to the plane of rotation whereby the distributor head is momentarily advanced.

5. In a sprinkler, a rotary stem, an impeller mounted for rotation thereon, a weight keyed to said stem for sliding movement thereon into contact engagement with the impeller but held against independent rotation, means for elevating the weight at each rotation of the impeller and for releasing the weight when in elevated position, the impact of the weight upon the rotating impeller operating to momentarily advance the weight and shaft, and a distributor head carried by the revoluble stem.

6. In a device of the character described, a rotary stem, a rotary impeller mounted thereon, a driven member slidingly mounted upon the stem and axially movable into and out of contact with the impeller, means for effecting reciprocatory movement of the driven member by the rotation of the impeller, the impact of the impeller and the driven member upon return axial movement thereof serving to impart to the driven member a rotary impulse.

7. In a device of the character described two members concentrically mounted for rotation in the same direction about a common axis at different rates of speed, one of the members being axially movable in addition to its rotary motion, means for effecting axial

movement thereof, and for releasing such member for return movement into contact with the other member, the impact of the members as result of the return axial movement occurring during the rotation of the more rapidly rotating member whereby the force of the impact is exerted approximately in the direction of rotation and thereby move the other member.

8. A revoluble member having to and fro axial motion simultaneously with its rotation, and a second revoluble member upon which the axially movable member intermittently impinges at the limit of its axial movement in one direction, means for effecting rotation of one of said members at relatively high speed, the other member being actuated through a step by step motion by the intermittent axial impact engagement of the members simultaneously with the rotation of the driven member.

9. Concentrically mounted revoluble driving and driven members operating means for rotating the driving member at relatively high speed, means for transmitting to one of the members axial movement in addition to its rotary motion, the members having intermittent engagement with each other in an axial direction during their relative rotation the impact of which occurs in a direction oblique to the plane of rotation whereby the driven member is progressively advanced through its rotary motion at a lesser rate of speed.

10. Concentrically mounted revoluble driving and driven members, one of the members being capable of to and fro axial motion additional to its rotation, a helical cam on one of the members for effecting such axial motion, the axially movable member being returned at the end of the helical cam into impact engagement with the other member, said members engaging in an oblique direction to the plane of rotation due to the combined axial and rotary movements, whereby the driven member is progressively advanced through its rotary motion at a low rate of speed.

11. In a slow motion sprinkler, a revoluble discharge nozzle, a stem upon which the nozzle is carried, a repulsion operated impeller revolubly mounted upon the same stem for rotation about a common axis with the nozzle, means for supplying water under pressure to both the nozzle and the impeller, said impeller being capable of to and fro axial movement on said stem simultaneously with its rotation, means for elevating the impeller and releasing it from its elevated position, contact surfaces upon the impeller and nozzle having impact engagement upon the return of the impeller, the impact thereof being effected in an inclined direction to the plane of rotation due to the combined rotary and axial motion of the impeller whereby the rotary nozzle is progressively advanced.

12. In a slow motion sprinkler, a revoluble discharge nozzle, a stem upon which the nozzle is carried, a repulsion operated impeller revolubly mounted upon the same stem for rotation about a common axis with the nozzle, means for supplying water under pressure to both the nozzle and the impeller, a governor weight mounted upon the stem above the impeller for to and fro axial motion but keyed to the stem for unison rotation, means for elevating the governor weight and releasing it from its elevated position, contact surfaces upon the weight and impeller having impact engagement upon the descent of the weight, the impact thereof being effected in an inclined direction to the plane of rotation due to the simultaneous axial and rotary motion of the respective members whereby the weight and stem are given progressive rotary impulses the stem carrying with it the discharge nozzle.

13. In a slow motion sprinkler a water pressure actuated rotary impeller and a rotary discharge nozzle mounted for rotation at different rates of speed, one of the members being capable of axial motion additional to its rotation, into impinging contact with the other, complementary cam faces of the adjacent surfaces of the members for effecting axial motion of said member, the impact of the members upon return movement of said axially movable member coacting with the rotary motion of the impeller to exert driving influence upon the discharge nozzle.

14. In a slow motion sprinkler, a long range rotary discharge nozzle to which water is supplied under pressure, a rotary impeller mounted concentrically with the long range nozzle and capable of axial movement simultaneously with its rotary motion to which also water is supplied under pressure for rotation of the impeller at a comparatively rapid rate, and means for effecting axial reciprocatory motion of the impeller for intermittently transmitting actuating impact impulses from the rotary impeller to the nozzle whereby the nozzle is progressively advanced through its rotary movement at a lesser rate of speed.

15. Driving and driven members mounted for relative rotation about a common axis, complementary helical cams on the adjacent faces of the members normally contacting with each other, means for effecting rapid rotation of one of the members, said members being relatively adjustable from each other under the influence of the cams, having sudden movement one toward the other as the engaged cams pass their high points, the impact of reengagement of the members operating to advance the slow rotating member.

16. In a slow motion sprinkler, a rotary distributor head, and a water pressure oper-

ated vibratory impeller therefor mounted for reciprocatory motion toward and from the rotary head and having intermittent impact engagement with the rotary head in a direction oblique to its plane of rotation for transmitting thereto a succession of actuating impulses.

17. In a slow motion sprinkler, a rotary distributor head, and a water pressure operated vibratory impeller mounted concentrically with the rotary head for axial movement into and out of actuating engagement therewith, and actuating means for reciprocating the impeller axially of the rotary head into and out of impact engagement therewith to impart thereto a succession of actuating impulses.

18. In a slow motion apparatus, a rotary driven member, a vibratory impeller mounted concentrically with the rotary member for axial movement into and out of engagement therewith, and actuating means for reciprocating the impeller axially of the rotary member into and out of impact engagement therewith to impart thereto a succession of actuating impulses.

19. In a slow motion apparatus, a rotary driven member, a vibratory impeller therefor mounted for reciprocatory movement toward and from the rotary member and having impact engagement therewith in a direction inclined to its plane of rotation and transmitting thereto a succession of actuating impulses.

20. In a slow motion sprinkler, a rotary distributor head, and a water pressure operated impeller therefor mounted for movement toward and from the rotary distributor head and having intermittent impact engagement therewith in a direction angularly disposed relative to its plane of rotation, for imparting thereto a succession of actuating impulses.

21. In a slow motion apparatus, a rotary driven member, a vibratory impeller therefor mounted for movement toward and from the rotary member and having intermittent impact engagement therewith in a direction angularly disposed relative to its plane of rotation, for imparting thereto a succession of actuating impulses, and actuating means for the impeller.

In testimony whereof, I have hereunto set my hand this 11th day of October, A. D. 1930.

JOHN H. KEYS.