March 28, 1939. A. J. LOEPSINGER ET AL 2,151,982

AUTOMATIC SPRINKLER

Original Filed Feb. 11, 1933 2 Sheets-Sheet 1

Fig. 1

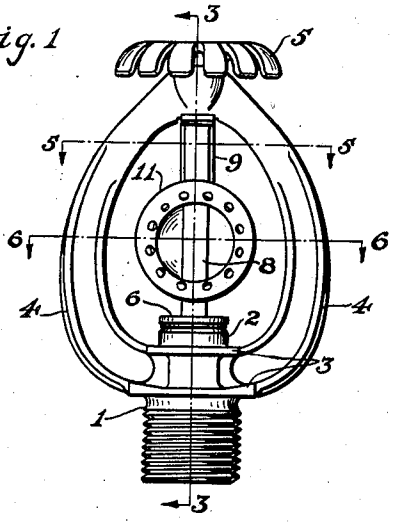


Fig. 2

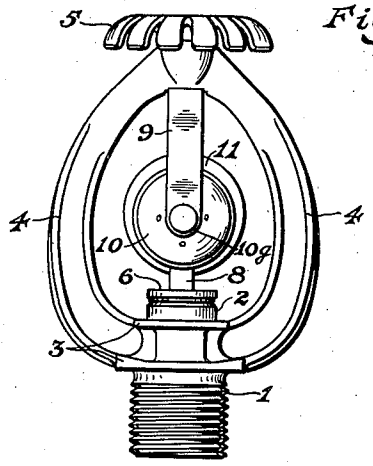


Fig. 3

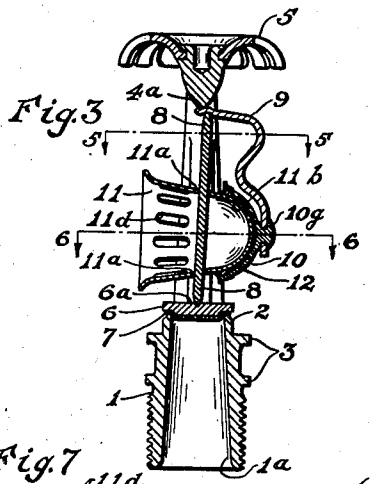


Fig 4

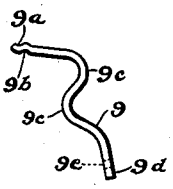


Fig. 5

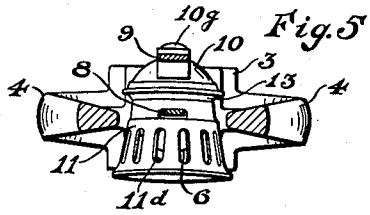


Fig. 6

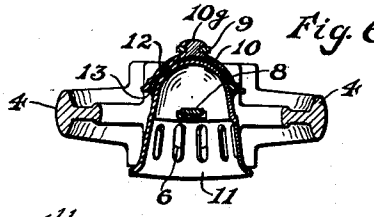


Fig. 7

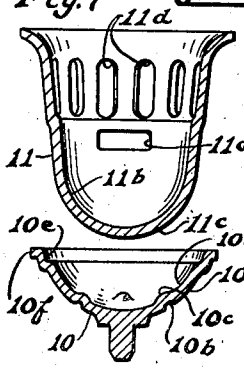


Fig. 8

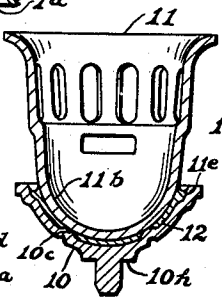
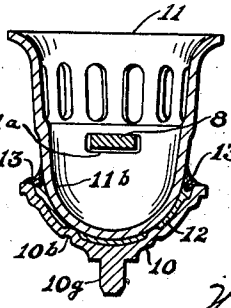


Fig. 9



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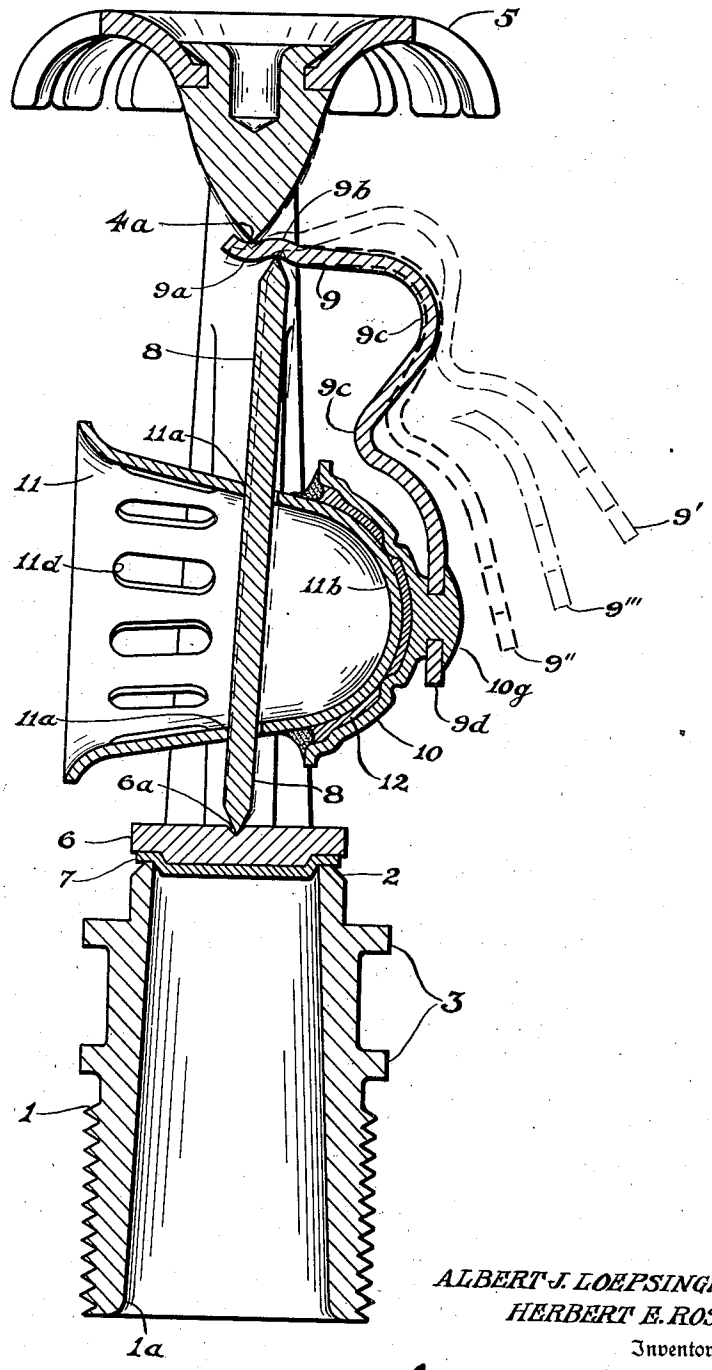
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Fig. 10



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UNITED STATES PATENT OFFICE

2,151,982

AUTOMATIC SPRINKLER

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Original application February 11, 1933, Serial No. 656,266. Divided and this application January 4, 1937, Serial No. 118,933

5 Claims. (Cl. 169—39)

This invention relates to improvements in automatic sprinklers. More especially it has to do with sprinklers which employ fusible material as the heat responsive element and is especially directed to the provision of an improved spring element between the valve and the frame.

The subject matter of this application was disclosed in our original application, Serial No. 656,266 filed on February 11th, 1933, of which this application is a division.

A sprinkler has what may be termed three distinct stages, its stage of manufacture, its stand-by stage, and its stage of action and discharge. It should be easy to make and assemble, should be reliably resistive to corrosion and abuse, should be keenly sensitive to heat, and should respond promptly and unfailingly when needed. It is among the objects of this invention to provide a sprinkler that excels in all of these requirements. It is a particular object of the invention herein claimed, to insure substantial uniformity in the desired load on the valve of the sprinkler. These objects embrace a design of parts which will be economical to produce and put together, which when assembled will have marked resistance to the dangers combated during the stand-by stage, and which when effected by heat resulting from the occurrence of fire will act promptly to open the sprinkler and bring about a most effective fire extinguishing discharge.

In the accompanying drawings a sprinkler is shown which embodies the present improvements but this is primarily illustrative and it is intended that the patent shall cover by suitable expression in the appended claims whatever features of patentable novelty exist in the invention as a whole.

In the drawings:

Figure 1 is an elevation of the sprinkler viewed from one side and Figure 2 is a similar elevation looking from the opposite side;

Figure 3 is an elevation in section as on line 3—3 of Figure 1;

Figure 4 is a view of the spring element, prior to assembly;

Figures 5 and 6 are plan views in section on line 5—5 and 6—6 respectively of Figures 1 and 3;

Figure 7 is a view in section of the heat gatherer and key prior to being soldered together;

Figure 8 is a similar view after the soldering operation;

Figure 9 is another similar view after the corroproofing material has been applied; and

Figure 10 is a greatly enlarged view of Figure 3, with possible positions of the spring element indicated.

Referring now more particularly to the drawings, the sprinkler comprises a hollow stem 1 externally threaded for engagement with a source of fire extinguishing medium, and terminating in a seat 2 upstanding from squared portions 3 adapted to receive a wrench. From the stem extend yoke arms 4 which are of channel cross section at first but whose outstanding edges merge into an ovate cross section as the arms join at the top. To the latter is secured a deflector 5.

The throat 1*a* is normally closed by a shouldered disk valve 6 (there being preferably a thin copper washer 7 between it and its seat) which has a depression 6*a* in its upper surface to receive a strut member 8. This strut extends substantially along the axis of the sprinkler from the valve to engage the end of a spring element 9. The latter is a resilient member having adjacent creases 9*a*, 9*b*, at one end to engage a blunt knife edge 4*a* on the yoke and to receive the said strut member, and having an extended portion provided with convolutions 9*c* which enhance its resiliency. The extended end 9*d* of this spring element is riveted to a formed member 10 also termed a key which is soldered to a correspondingly formed member 11, also called a heat gatherer. The latter extends from the key to beyond the strut 8, having opposed slots 11*a* through which the said strut projects and having perforations 11*d* which permit the heated air to reach more readily the inner surface and also permit a continued flow of hot air through the interior of the gatherer.

The key 10 and the end 11*b* of the heat gatherer are attached by fusible material such as a film of solder 12. When this material fuses it is intended that the key 10 will be vigorously separated from the heat gatherer 11 primarily by the resilient action of the spring element 9. Accordingly the formed surfaces to be soldered together must be so shaped and of such depth that the action of the spring element in moving from its sprung position to its natural or unsprung position will be sufficient to completely separate the formed surfaces and thus permit the upward thrust on the strut 8 to complete the dislodgment of the movable parts.

The several parts are easily manufactured and lend themselves to methods of production well adapted to insure close adherence to dimensions. Prior to final assembly the key 10 and heat gatherer 11 are soldered together and corroproofed. The outer formed surface 10*a* of the key is slightly indented during its formation (as at 10*b*) to form small protuberances 10*c* on the inner

formed surfaces 10*d*, so that when this latter surface is presented to the outer formed surface 11*c* of the heat gatherer, these protuberances will define a predetermined space between the said adjacent surfaces. This space is filled with fusible material such as solder, such slight excess as might occur being taken care of by the annular trough 10*e* formed by the outstanding flange 10*f* on the key. This trough is then filled with a non-corrosive substance 13, as for example a wax compound, known as corroproof. This is applied in a fluid state, quickly fills the trough, runs up slightly on the outer surface 11*c* of the heat-gatherer and to the edge of the key flange 10*f*, and solidifies with an exposed meniscus-shaped surface as seen clearly in Figure 9.

In the final assembly the washer 7 and the valve 6, both of which are suitably shouldered, are placed on the ring seat 2 and the previously-soldered-together key 10 and heat gatherer 11 are slipped onto the strut 8. The reversely creased end of the spring element 9 is then placed against the knife edge 4*a* on the yoke and the strut interposed between the hook and the valve. The other end 9*d* of the element is then forced toward the key, the latter being readily slidable with the heat gatherer along the strut to bring the rivet end 10*g* into alignment with a hole 9*e* in the spring element. This rivet end is slightly rounded over so as to pass easily through the hole during the arcuate movement of the element. With the latter held firmly against the raised shoulder 10*h* on the key the rivet is upset to bind the spring element and key securely together. Thus the assembling is easily and rapidly accomplished.

In all automatic sprinklers the force which holds the valve on its seat is ultimately carried by the frame. In some sprinklers there is a spring element upon which the force acts before it reaches the frame. The sprinkler illustrated in the accompanying drawings is of this type. Those sprinklers not having such a spring element usually employ an adjusting screw which threads through the top of the frame to engage the strut members, and in the process of assembly such a sprinkler the screw is turned until approximately the desired force is imposed upon the valve.

When a spring element is provided in the assembly between the valve and the frame of the sprinkler it is necessary to form the coacting parts closely to predetermined dimensions. If this is successfully accomplished, slight variations in dimensions within narrow limits may be compensated for by the capacity of the spring element to flex without imposing widely variable loads on the valve. But the accomplishment of this result has not heretofore been enjoyed to the extent desired and, as hereinbefore noted, it is a primary object of this invention to insure substantial uniformity in the loading of the valve.

As earlier described, the spring element 9 in its unflexed condition is positioned between its fulcrum 4*a* on the frame and the upper end of the strut member 8. Obviously the relative positions of the fulcrum and the strut member determine this initial position of the spring element. These relative positions are affected by even the necessary slight tolerances or variations inherent in all mechanical structures. For example, the distance betwen the knife edge 4*a* and the depression 6*a* is dependent upon the distance between this knife edge and the seat 2, the thicknesses of the washer 7 and the valve disk 6, and the extent of the depression 6*a* in this disk. Obviously the position of the upper end of the strut member 8 is effected by any variation in the length of this member.

If the distance between the depression 6*a* of the valve and the knife edge 4*a* is the permissible minimum and the length of strut member 8 is the permissible maximum, then upon the insertion of the spring element preparatory to final assembly it will assume some such position as 9′ shown in light dotted outline in Figure 10. If this element be assumed to have a high elastic limit, it follows that when it is swung to its riveted position with the key 10, (the full line position) the maximum load will be imposed on the valve. This is so because as the spring element is flexed its resilient force increases throughout the flexing. On the other hand, if the distance between the depression 6*a* and the knife edge 4*a* is the permissible maximum and the length of strut member 8 is the permissible minimum, then upon insertion of the spring hook it will assume some such position as 9″, indicated by the heavy dotted outline. Accordingly when the element is moved from this position in riveted relation with the key 10, the minimum load will be imposed on the valve.

Even when the tolerances are kept within small limits and the various parts are produced with as near duplication as possible, the variation in the loading of the valve may still be so great as to be undesirable. To overcome this and insure that regardless of variations in the parts themselves the imposed load on the valve will nevertheless be substantially uniform, is the purpose of the invention claimed herein.

To accomplish this result the spring element is so designed as to length, breadth and thickness, and as to its physical characteristics of resiliency and elastic limit, that if flexed beyond a predetermined extent it will assume a permanent deformation. To make this clear, assume the elastic limit of the element is such that when initially inserted between the knife edge 4*a* and the strut member 8 in the position 9″ indicated by the heavy dotted outline, the element can be flexed to engage the key 10 and still be within its elastic limit. This will effect, let us assume, the desired load on the valve. Should the solder thereafter fuse, the spring element will return to its initial position (the heavy dotted position) because of its resiliency.

In determining the make-up of the spring element 9 its size is, of course, commensurate with the size of the sprinkler and some suitable distance between the knife edge 4*a* and the location of the key 10 and the heat gatherer 11 on the strut 8. This need not be a critical distance because the heat gatherer 11 is positionable at any suitable location along the strut, it being desirable to have its location near the valve 6 rather than near the knife edge 4*a* to get the benefit of a greater moment arm. With the physical size of the spring thus ascertained the maximum force which the spring is to exert can be readily computed in accordance with the load chosen to be imposed on the valve 6. Knowing this maximum force, one should then assume a movement of the spring from its unflexed position to its fixed position in riveted relation to the key 10. With reasonable tolerance, the metal of the spring should then be determined so that its elastic limit will be exceeded during its complete movement from its unflexed to its fixed position. Thus in being moved during the assem-

bly of the sprinkler the spring will be flexed beyond its elastic limit and thereby permanently distorted.

Now assume that instead of initially taking the position indicated by the heavy dotted outline, the variation in the parts are such that when first inserted between the fulcrum and the end of the strut member 8 the element assumes the position 9' indicated by the light dotted outline. Upon its being moved toward the key 10 it will at first flex (just as when it moved from the heavy dotted position toward the key), but before it reaches the key, however, the element will have reached its elastic limit, say when it has reached the position 9''' indicated by the dot-and-dash outline. Movement beyond this indicated position will now cause the element to deform or assume a permanent bend. In other words, in moving from the dot-and-dash position to the full-line or riveted position, the resilient force of the element will not increase but will remain substantially unchanged and the element will bend permanently.

During this permanent bending or deformation of the spring element no material additional force is imposed on the valve and thus it is, when the element is ultimately riveted to the key, the force imposed on the valve is substantially the same as though the element had only moved from the heavy dotted position to its riveted position. This permanent bending does not unfavorably affect the spring or resilient characteristic of the element. It is permanently bent or shaped during its first formation and the further bending during its movement toward riveted position is in effect no different than if its ultimate desired shape were to be determined and the element bent accordingly before insertion in the sprinkler.

It is still desirable, of course, to keep the variations in the dimensions of the various parts within as close limits as possible, it not being intended that the improved spring element shall compensate for extreme or unreasonable conditions. But where the variations are within easily attainable limits, the element herein described and claimed will insure a very close approximation of the uniform load desired on the valve.

This limiting of the load on the valve has another advantage in that it likewise limits the load which is imposed on the soldered connection. This avoids another danger encountered by sprinklers during the stand-by period, the danger of cold-flow by which is meant the premature flow or yielding of the fusible material. This danger is not ordinarily experienced unless excessive strain is constantly being imposed upon the solder or like fusible material. No such strain is present in the improved sprinkler for several reasons. First, the total force exerted on the valve by the water or air pressure is appreciably reduced because of the taper throat. This leads to a discharge opening which is smaller than could be used if the throat were not tapered and consequently the static force imposed upon the valve is thus reduced since its area exposed to pressure is smaller than is usual in sprinklers. Secondly, this force is by virtue of the lever action of the spring hook largely imposed upon the yoke, with only a relatively small part being transmitted to the key. Thirdly, this relatively small force is not increased due to the usual variations in the dimensions of the parts but, as heretofor explained, is kept substantially uniform. And fourthly, the load on the solder is distributed throughout the entire layer of solder which, as previously pointed out, is of substantially uniform thickness and has a relatively large area of contact with the key and heat gatherer. The aforesaid construction and arrangement of parts renders all danger of cold flow entirely negligible.

As the solder fuses and loses its holding power it is important that the movable parts rapidly clear themselves from the sprinkler. This the inventiton insures by providing a vigorous and sustained follow-up which is effective to separate quickly and widely the soldered parts before water can leak past the valve and recool the solder. This follow-up action is also of advantage should the parts have become loaded with deposits of foreign material such as, for example, cement, flour, or sticky substances like sugar syrup. In the improved sprinkler the spring element 9, as its name implies, is so shaped with reversed convolutions or bends 9c as to render it highly resilient and capable of large deflection. Its open or unsprung condition is seen in Figure 4. When its creased end is interposed between the strut 8 and the yoke 4, this end becomes substantially fixed while its remote end is capable, due to the resiliency of the member, of a large arcuate movement toward the key. Thus while the solder holds, the spring element is constantly tending to return to its initial shape and as the solder melts this tendency is exerted on the key to separate it from the heat gatherer. When the holding power of the solder fails the spring element and key are vigorously and rapidly separated from the heat gatherer. Indeed this separation is complete before the spring element, with its attached key, can move far enough to afford any appreciable release to the strut member. In consequence, there is practically no leaking past the valve until after the soldered parts have been widely separated. The follow up of the spring element not only draws the key away from the heat gatherer but as the hook continues to swing upward it influences the deflection of the strut member, thus aiding in the complete dislodgement of the moving parts from the sprinkler. Accordingly the improved sprinkler is not only keenly sensitive, being quickly responsive to the heat changes caused by a fire, but it has a vigorous and rapid opening action consequent upon its response.

We claim:

1. An automatic sprinkler having movable means for holding the sprinkler closed comprising a valve and a spring element imposing a load on said valve; said element having a predetermined elastic limit below which the element in moving increases the load on said valve and beyond which the element distorts in moving without substantial increase of said load, and being moved during the assembly of the sprinkler beyond its said elastic limit and thereby permanently distorted.

2. An automatic sprinkler having movable means for holding the sprinkler closed comprising a valve and a spring element imposing a load on said valve; said element having a predetermined elastic limit which determines the extent to which the element may be resiliently flexed and beyond which the element is permanently distorted without substantially changing its resilient characteristic, and being flexed during the assembly of the sprinkler beyond its elastic limit and thereby permanently distorted.

3. An automatic sprinkler having a frame, a valve for holding the sprinkler closed, and means interposed between said frame and valve imposing a load on the latter; said means comprising a movable spring element capable of being re-

siliently flexed a predetermined amount to thereby establish a desired load on said valve and thereafter to be further flexed without materially changing said load, and being flexed during the assembly of the sprinkler beyond said predetermined amount and permanently distorted.

4. An automatic sprinkler having a stem with passage therethrough; a frame extending from said stem; a valve closing said passage; a strut member engaged at one end with said valve; a spring element engaged at one end with the other end of said strut member; and means fusibly connecting the other end of the spring element to the strut member intermediate the ends of the latter; the said spring element during the assembly of the sprinkler having been moved a predetermined distance toward its fusibly connected position to increase its resilient force and having been additionally moved in said direction in excess of said predetermined distance and thereby permanently distorted.

5. An automatic sprinkler having movable means for holding the sprinkler closed comprising a valve and a spring element imposing a load on the valve to hold said valve in closed position; the said element in its assembled position being flexed beyond its elastic limit and thereby permanently distorted.

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