June 29, 1926. 1,590,893

W. B. HODGE

HUMIDIFIER

Original Filed April 25, 1923 3 Sheets-Sheet 1

Fig. 1.

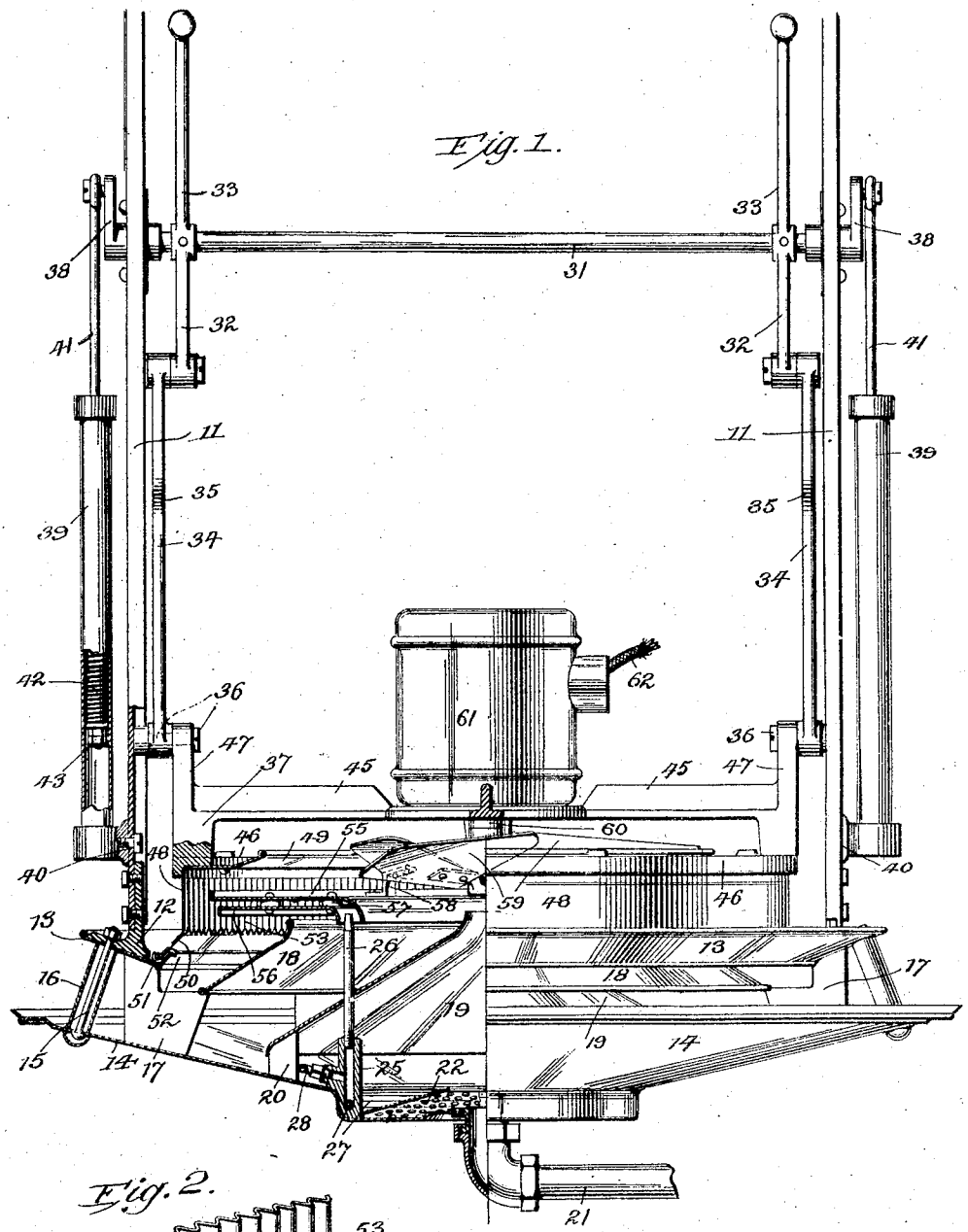
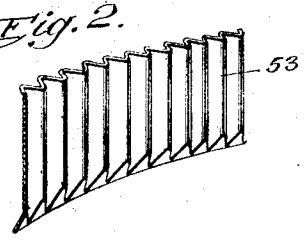


Fig. 2.



Inventor:
William B. Hodge,

Hodge and Sons,
Attorneys

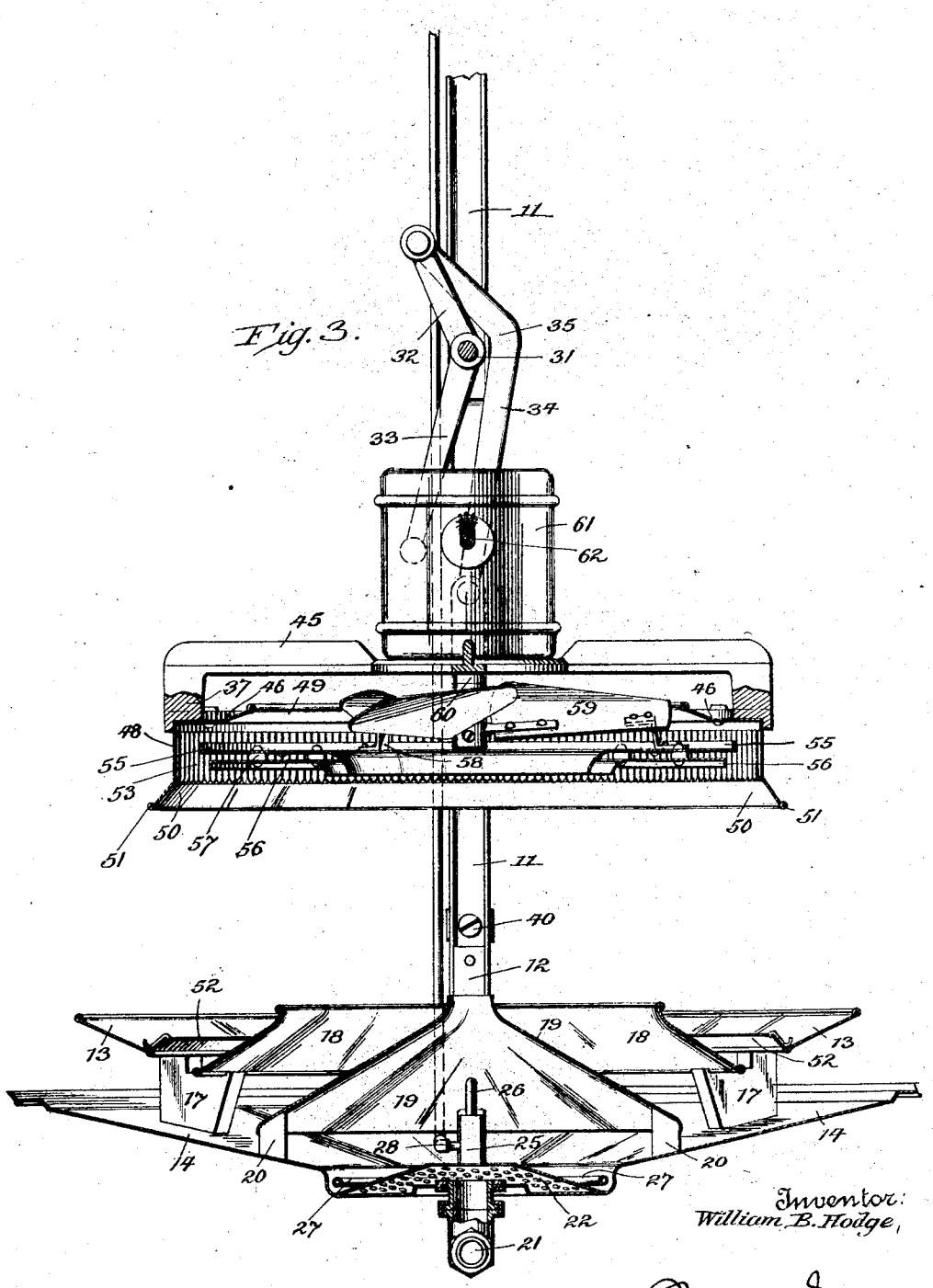
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W. B. HODGE

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Original Filed April 25, 1923 3 Sheets-Sheet 2

Fig. 3.



Inventor:
William B. Hodge,

Dodge and Dodge
Attorneys

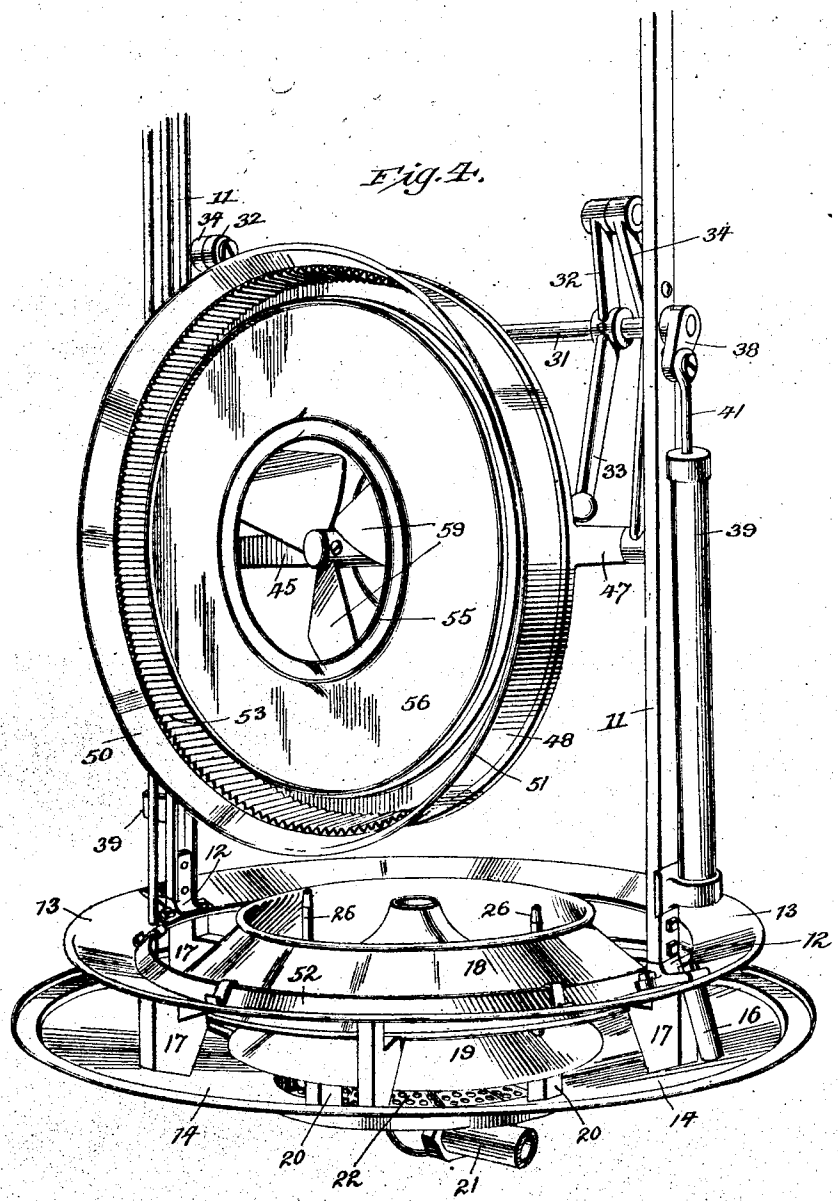
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W. B. HODGE

HUMIDIFIER

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Fig. 4.



Inventor:
William B. Hodge,

Hodge and Sons,
Attorneys

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UNITED STATES PATENT OFFICE.

WILLIAM B. HODGE, OF CHARLOTTE, NORTH CAROLINA, ASSIGNOR TO PARKS-CRAMER COMPANY, OF FITCHBURG, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

HUMIDIFIER.

Application filed April 25, 1923, Serial No. 634,640. Renewed May 13, 1926.

This invention relates to humidifiers of the centrifugal type, and resides in features of arrangement and construction which improve the general operative characteristics, and particularly the evaporative efficiency, of devices of this class.

The device belongs to that general type in which a rapidly rotating disc discharges water centrifugally in a thin film against an annular atomizing baffle.

The baffle is specially designed to effect a peculiarly fine atomization of the water, and to be capable of sustained action without loss of atomizing efficiency, by reason of the fact that it is continually scoured clean by the impinging water and hence does not accumulate a covering of dust and lint, as do the blade atomizers heretofore generally used.

A fan is used in conjunction with guide cones or air deflectors, to produce two annular air currents one of which flows at a lower velocity than the other and enters the faster moving current at a decided angle to the direction of flow of the latter. The two currents meet within the casing of the humidifier and the water is atomized in the slower moving current a short distance above the junction of the currents. This gives an opportunity for the slow moving air to take up the fine mist while the large drops, if any are present, are not taken up but are projected against the casing of the humidifier and condensed at the place where the two currents merge and the direction of the slower one changes.

In this way the slow current heavily charged with fine mist delivers this mist to the rapidly flowing air current and at the same time assures the rejection of large drops by the faster current.

This is an important feature, for an air current flowing fast at the point of atomization will pick up large drops of water and carry them out of the machine where they are precipitated and cause damage. This fact has heretofore limited the speed of air currents through devices of this general class, with resulting limitation of the volume of air handled and serious limitation of the evaporative efficiency of the machine.

My improvements not only increase the volume of air handled by a given size of machine and the evaporative efficiency of the machine, but there are certain additional advantages. The high velocity of air discharge carries the mist far into the room increasing the range of effectiveness of the device, and virtually eliminating any tendency of mist laden discharging air to return to the inlet and recirculate. This wide diffusion of the discharging air makes it possible to run the machine successfully at a very high evaporative rate, first because a large volume of air passes through the machine and second because the discharging air is immediately mixed with a very large volume of air in the room, and hence can be discharged from the machine very heavily charged with mist without danger of precipitation.

The form and arrangement of the parts, as above outlined, involved marked advantages. The effectiveness of the device may be further increased by the use of special material for the wetted surfaces particularly the centrifugal discs and the atomizing baffle. I have discovered that certain cupro-nickel alloys approximating 35% copper and 65% nickel, Monel metal being typical of the class, have the peculiar property of facilitating the flow of water over their surfaces in very thin films. This conduces to fine atomization in normal running, and is important in establishing normal operation at starting. In closely regulated rooms the humidifier is stopped and started at frequent intervals by automatic devices which either turn the water off and on or start and stop the motor. During starting particularly there is a tendency to discharge large drops of water and the use of the special alloy is peculiarly effective in reducing this tendency.

The various details above enumerated are the more important elements of the invention, but there are other features of patentable novelty which will be disclosed in connection with the preferred embodiment of the invention.

This preferred embodiment is illustrated in the accompanying drawing, in which:

Figure 1 is a view, partly in front elevation and partly in vertical axial section of the complete humidifier.

Figure 2 is a fragmentary perspective view of the atomizing deflector ring.

Figure 3 is a view, partly in side elevation, but chiefly in vertical axial section, showing the atomizer, fan and motor unit with-

drawn upward from the pan and housing unit which contains the guide plates and air deflectors.

Figure 4 is a perspective view of the whole device, showing how the atomizer, fan and motor unit may be tipped up for cleaning after being elevated as in Figure 3.

The device as ordinarily used is suspended by the two vertical supporting members 11 of channel section from the ceiling of the room whose air is to be humidified. The particular manner of supporting these uprights will depend upon the nature of the building and, being not a feature of the invention, is not illustrated. The members 11 are connected by brackets 12 to the upward and outward flaring support ring 13 (which normally supports the atomizer, fan and motor unit) and to the upward and outward flaring water-collecting pan 14. The connection between the ring 13. pan 14 and brackets 12 is made by means of bolts 15 and spacing tubes 16. The ring 13 and pan 14 are further connected and braced by a plurality of radially disposed distance pieces or spaces 17 rigidly connected to each, and these spacers 17 serve to support and position a removable flaring annular baffle or deflecting cone 18 spaced at its lower edge a considerable distance above pan 14, and smaller than and located concentrically within the supporting ring 13.

A second flaring baffle or deflecting cone 19, smaller than and positioned concentrically within the baffle 18, is removably mounted on a second set of radially disposed supports or spacers 20 rigidly connected thereto. The spacers 20 provide an interval between the lower edge of baffle 19 and pan 14 through which all excess water may flow to the center of the pan. A drain connection 21 carries such water away. The removable strainer 22 is provided to prevent clogging of the drain by lint and dirt washed from the air and carried to the center of the pan by the water.

Rigidly mounted on the pan 14, diametrically opposite each other, are two fittings 25, each of which carries an upstanding water nozzle 26. These two fittings are connected with each other by an arcuate pipe 27, and one of them is provided with a water supply connection 28. The supply of water through the connection 28 is commonly controlled by automatic means (not shown). The effect of the controlling device may be to vary the effective pressure head on the nozzles 26 or to turn the water on and off, according to the type of control adopted.

Journaled in the supports 11 is a horizontal shaft 31 which carries a pair of parallel lever arms 32 fixed thereon. The lever arms 32 are formed with opposite extensions 33 which serve as actuating handles. Pivoted to the ends of the lever arms 32 are corresponding links 34 which, as best indicated in Fig. 3, are bent or offset at 35. The lower ends of the links 34 turn on trunnions 36 fixed in a circular cast spider 37. The ends of the trunnions 36 project into the channel of the upright members 11, and are guided thereby in right line movement.

By pulling down the handles 33, the lever arms 32 will act through the links 34 to elevate the spider 37 and, when elevated, this spider may be swung on the trunnions 36 to give access to the apparatus suspended beneath the spider 37, and hereafter described. The offset in the links 34 permits the movement of the lever arms 32 past their dead center so that, at the limit of movement of the arms 32, 33, the spider is automatically retained in its upper position.

To counterbalance partly the weight of the spider 37 and the mechanism carried thereby, I make use of two balancing spring structures, each including a crank 38 fast on the shaft 31, a guide tube 39 pivoted at 40 to the corresponding upright 11, a connecting rod 41 pivoted to the crank 38, and a compression spring 42 confined between the upper end of the guide tube 39 and a pair of lock nuts 43 on the lower end of the connecting rod 41. The nuts 43 are adjusted so that the two spring devices exert the desired counterbalancing effect. Various equivalent mechanisms might be substituted, but the one illustrated is preferred because of its neatness and simplicity.

The spider 37 includes two cross-arms 45 and an annular rim member 46. The trunnions 36 are mounted in upstanding arms 47 so proportioned that the center of gravity of the spider and its connected mechanisms is below the axis of the trunnions 36. The annular rim 46 carries fixed thereto a bell-shaped member including a cylindrical depending portion 48, an inward extending flange 49 which last lies in contact with the ring 46, and an outward flaring rim or flange 50 which extends from the lower margin of the cylindrical portion 48. The rim of the flaring flange 50 is stiffened by a bead 51, and the parts are so proportioned that the beaded edge 51 rests upon the supporting ring 13 when the spider 37 is in its lowermost or normal position. In order to center the skirt 50, the ring 13 is provided at its inner margin with a narrow flange 52.

The interior surface of the cylindrical portion 48 supports a strip of corrugated sheet metal 53 whose form is clearly shown in Figure 2. This corrugated metal serves as an atomizing baffle against which the water delivered through the nozzles 26 is projected by the centrifugal discs. These discs, two in number, are illustrated at 55 and 56. They are held spaced by distance pieces 57 and are connected by rivets passing through these distance pieces.

The discs 55 and 56 are of annular form, and each is provided at its inward margin with a down-turned flange, the flanges of the two discs straddling the tips of the nozzle 26, as is clearly shown in Fig. 1, so that these nozzles deliver their water into the space between the two discs. The upper disc 55 is provided with an up-turned flange at its outer margin, and the lower disc 56 with a down-turned flange at its outer margin, these two flanges being intended merely to stiffen the discs. The flanges have no direct effect on the water flow as the water is delivered to and discharged from the space between the discs.

The two discs 55 and 56 are supported by brackets 58 on the three blades 59 of a rotary fan whose shaft is journaled in a bearing 60 at the center of the spider 37 and is driven by an electric motor 61 mounted on this spider. The conducting cable 62 serves to connect this motor to any suitable source of current. The means for controlling the operation of the motor do not form a part of the present invention, and are not illustrated, but it will be obvious to those skilled in the art that the flow of current to the motor may be controlled by an automatic mechanism, which may or may not also control the flow of water to the connection 28. The device is susceptible of automatic control by various specifically different mechanisms, and no limitation to any particular type of control is implied.

Motor 61 drives the fan blades 57 in such direction as to deliver air downward, and this air flows through the annular space between the skirt 50 and the deflecting cone 18, and also at higher velocity through the annular space between the deflecting cones 18 and 19.

Assuming that water is being delivered from the upper ends of the nozzles 26, it will flow over the opposed surfaces of the two discs 55 and 56, and will be discharged centrifugally from the periphery of these discs. The water, discharging in thin films and with high velocity, will impinge upon the corrugated ring surface 53 and will be dashed into fine spray. The downward current of air through the space between the skirt 50 and deflecting cone 18 will produce an intimate contact between the atomized water and a considerable volume of air. As the air moves downward and changes its direction to flow out beneath the ring 13, the momentum of the larger particles will cause them to strike against the pan 14 where they will condense and flow to the center of the pan. At the same time, a large volume of rapidly flowing dry air will be delivered by the fan through the space between the deflecting cones 18 and 19 and, flowing out into and mixing with the stream of mist laden air, will assist in evaporating and carrying away the finely atomized particles of water.

For this reason, the device operates to produce a very fine spray in the slow moving air current delivered by the fan, and then to mingle this portion of the air current with the remainder of the air delivered by the fan, so that, after the spray has been created and has been started in motion in the slower moving air current, it is mixed with and accelerated by the rapidly moving air current. This action is favorable to effective humidification, and is favorable to the wide dissemination of the mist laden air in the room, without danger of precipitation.

The atomizing ring 53, having no sharp edges and no deep pockets, does not tend to collect lint or dirt, but is, in fact, scoured clean and kept clean at all times by the water projected against it by the rotating discs.

The effectiveness of the device is materially increased by making the discs 55 and 56 and the atomizing ring 53 of Monel metal, because of the peculiar property of this metal of distributing the water in very thin films. While the use of this metal offers its most striking advantages in connection with the parts just enumerated, I prefer to construct all wetted parts of the humidifier of Monel metal, or of some approximately equivalent alloy, as such construction involves advantages.

Devices of this sort as customarily installed are frequently put into and out of action by an automatic control mechanism of one or another type. In closely controlled rooms, the stopping and starting will occur many times in an hour. Whenever the machine is shut down, there is a tendency for the water to collect in drops in small puddles which are blown out into the surrounding air as the machine starts up again. Water in contact with Monel metal does not tend to collect in drops or small puddles to the extent that it does when in contact with the metals heretofore used in humidifiers; for example, zinc or copper. Consequently, the use of this alloy for all parts whose surfaces are wetted during the operation of the device reduces and, in fact, almost entirely eliminates, any tendency to discharge large drops in stopping and starting.

An examination of Figs. 3 and 4 makes clear the fact that all water connections are in the fixed pan structure, and that, by means of the lever mechanism, the motor, fan and water atomizing devices may be raised clear of the pan and, when raised, may be rocked on the trunnions 36 to give easy access for cleaning and inspection.

The counterbalancing action of the springs 42, and careful attention to the location of

the trunnions 36 with reference to the center of gravity of the entire mechanisms supported thereby, permits the above operations to be carried out with the minimum physical effort.

As a result of the various features above set forth, the device has shown in actual service that it possesses a very high evaporative rate and that it is capable of maintaining this rate almost indefinitely.

What is claimed is:—

1. A humidifier of the type in which water is atomized by discharging it centrifugally from a rotary element, characterized by the use of a cupro-nickel alloy of substantially the composition of Monel metal for the wetted surface of said element.

2. A humidifier of the type in which water is atomized by discharging it centrifugally from a rotary element against an adjacent atomizing element, characterized by the use of a cupro-nickel alloy of substantially the composition of Monel metal for the wetted surfaces of said rotary and atomizing elements.

3. A humidifier of the type in which water is atomized by mechanical means, characterized by the use of a cupro-nickel alloy of substantially the composition of Monel metal for the wetted surfaces of the humidifier structure.

4. In a humidifier, the combination of a rotatable disc composed of a cupro-nickel alloy of substantially the composition of Monel metal; means for rotating said disc; means for feeding water to the surface of said disc; an annular atomizing member composed of a cupro-nickel alloy of substantially the composition of Monel metal, having corrugations extending transversely to the plane of the disc, and surrounding the disc in position to atomize water centrifugally discharged therefrom; and means for passing air through the atomized water.

5. In a humidifier, the combination of a rotatable member comprising two discs spaced apart; means for rotating said discs; means for feeding water to the space between said discs; an annular atomizing member having corrugations extending transversely to the planes of said discs, and surrounding said discs in position to atomize water centrifugally discharged therefrom; and means for passing air through the atomized water.

6. In a humidifier, the combination of an annular rotatable disc; means for rotating said disc; means for feeding water to the surface of said discs; an annular atomizing member surrounding said disc in position to atomize water centrifugally discharged therefrom; and means for passing two currents of air, one through the interval between the periphery of said disc and said atomizing member, and the other through the center of said disc and then outward and into the first current issuing from the interval aforesaid.

7. In a humidifier, the combination of an annular rotatable disc; means for rotating said disc; means for feeding water to the surface of said disc; an annular atomizing member surrounding said disc in position to atomize water centrifugally discharged therefrom; means for passing two currents of air, one through the interval between the periphery of said disc and said atomizing member, and the other through the center of said disc and then outward and into the first current issuing from the interval aforesaid; and air-deflecting and water-collecting means positioned at the junction of the two currents and serving to produce a change of direction of the first current, whereby large water drops are eliminated from the discharging air.

8. In a humidifier, the combination of a water-spraying member comprising two annular rotatable discs spaced apart; means for rotating said water-spraying member; means for feeding water to the space between the discs forming said member; an annular atomizing member surrounding said water-spraying member in position to atomize water centrifugally discharged therefrom; and means for passing two currents of air, one through the interval between the peripheries of said discs and said atomizing member, and the other through the opening at the centers of said discs and then outward and into the first current.

9. In a humidifier, the combination of a water-spraying member comprising two annular rotatable discs spaced apart; means for rotating said water-spraying member; means for feeding water to the space between the discs forming said member; an annular atomizing member having corrugations extending transversely to the planes of said discs, and surrounding said water-spraying member in position to atomize water centrifugally discharged therefrom; and means for passing two currents of air, one through the interval between the peripheries of said discs and said atomizing member, and the other through the opening at the centers of said discs and then outward and into the first current.

10. In a humidifier, the combination of a water-spraying member comprising two annular rotatable discs spaced apart; means for rotating said water-spraying member; means for feeding water to the space between the discs forming said member; an annular atomizing member having corrugations extending transversely to the planes of said discs, and surrounding said water-spraying member in position to atomize water centrifugally discharged therefrom; means for passing two currents of air, one

through the interval between the peripheries of said discs and said atomizing member, and the other through the opening at the centers of said discs and then outward and into the first current; and air-deflecting and water-collecting means positioned at the junction of the two currents and serving to produce a change of direction of the first current, whereby large water drops are eliminated from the discharging air.

11. In a humidifier, a casing unit including in a single structure means for directing the air flow through the device, means for directing water to an atomizing device and means for collecting and discharging surplus water; a water-atomizing unit including in a single structure a motor and a water atomizer and a fan both driven by said motor; and a mechanism for guiding and moving said units relatively to each other, whereby they may assume alternatively a coactive position for normal operation and a non-coactive position for inspection and cleaning.

12. In a humidifier, a fixed casing unit including a water-collecting pan provided with a drain for excess water, a series of concentric flaring baffles spaced above said pan and one or more upwardly directed nozzles; a water-atomizing unit including in a unitary structure a motor having a vertical rotary shaft, an annular water-spraying element mounted on the motor shaft, a fan mounted on the motor shaft and a fixed atomizing ring surrounding said water-spraying element; and a mechanism for guiding and moving said water-atomizing unit between an upper inoperative position and a lower operative position in which said fan serves to feed air through the center and around the periphery of said annular water-spraying element and between said concentric baffles, and in which said water-spraying element is in the discharge path from said nozzles.

13. In a humidifier, the combination of a fixed support; a casing structure including a water-collecting pan and an air baffle fixedly mounted on said support; a drain connection leading from said pan; a water-nozzle mounted in said pan and provided with a water supply connection; a frame movably mounted on said support; a motor on said frame and having a rotary shaft; a water-spraying disc mounted on said shaft, said disc being, in the normal position of said frame, in the path of discharge from said nozzle; a fan also mounted on said shaft and arranged to discharge air, in the normal position of said frame, past the periphery of said disc and through air passages defined by said baffle and pan; atomizing means serving to atomize water centrifugally discharged from said disc; and a mechanism serving to shift said frame and the parts supported thereby from their normal position to one in which they are spaced from said casing structure.

14. In a humidifier, the combination of means for producing two currents of air, one flowing faster than the other, water atomizing means arranged to deliver atomized water into the slower moving current and a guide structure serving to discharge the slower moving current into the faster moving current at an abrupt angle to the direction of flow of the latter.

15. In a humidifier, the combination of means for producing two currents of air, one flowing at a higher velocity and in larger volume than the other; means for delivering atomized water into said slower moving current and a guide structure arranged to direct said slower moving current into the faster moving current at an abrupt angle to the direction of flow of the latter.

16. In a humidifier, the combination of a fan, a guide structure constructed and arranged to divide the air discharged by said fan into a central rapidly flowing current and a surrounding annular slower moving current; water atomizing means constructed and arranged to deliver atomized water into said slower moving current; and deflecting means serving to direct the central rapidly flowing air current radially outward to mix with the water laden slower moving air current.

In testimony whereof I have signed my name to this specification.

WILLIAM B. HODGE.