No. 616,646. Patented Dec. 27, 1898.

P. K. WOOD.

ROTARY PUMP.

(Application filed Aug. 31, 1897.)

(No Model.)

Fig. 1.

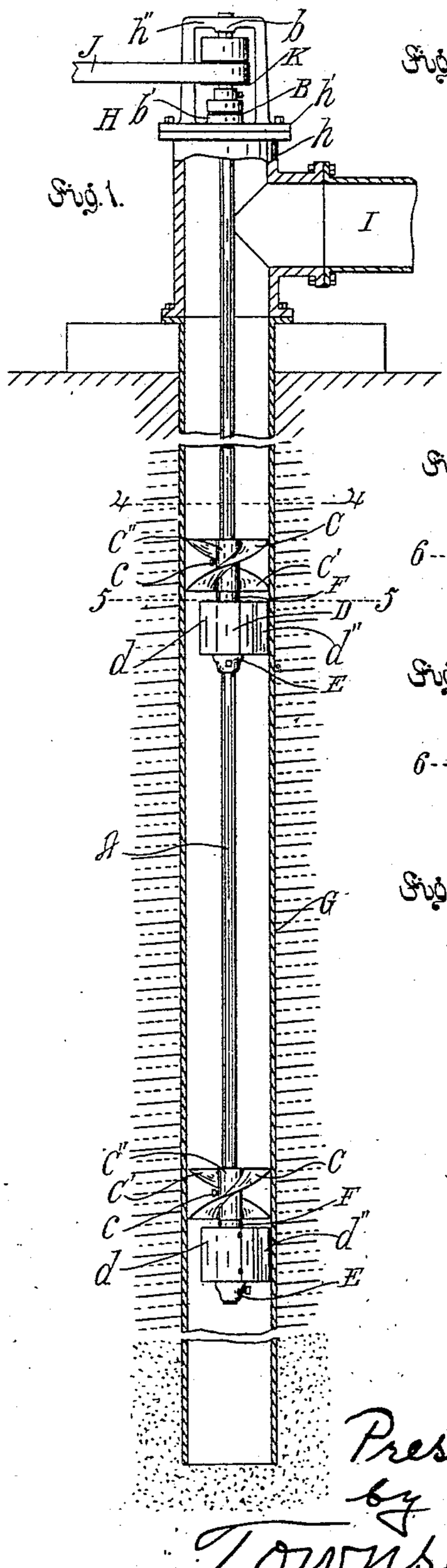


Fig. 2.

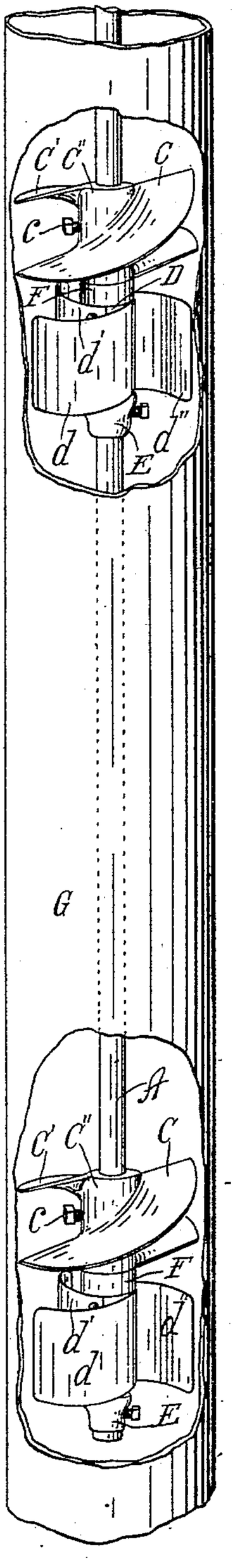


Fig. 3.

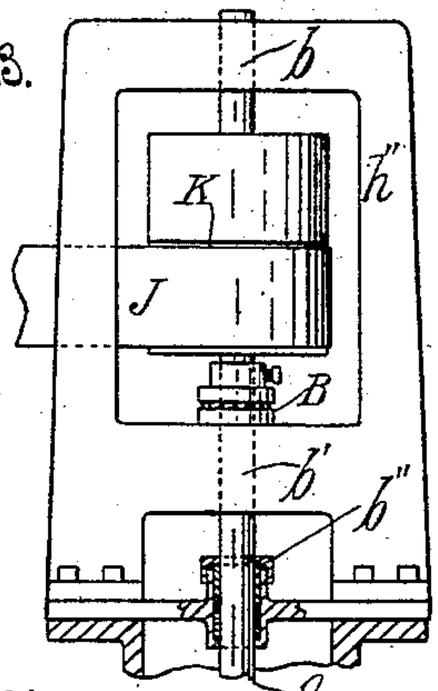


Fig. 4.

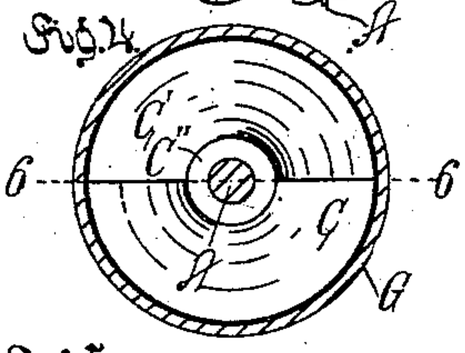


Fig. 5.

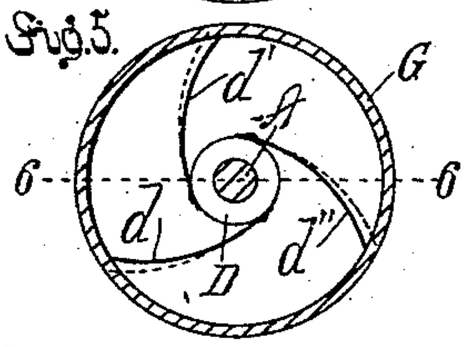
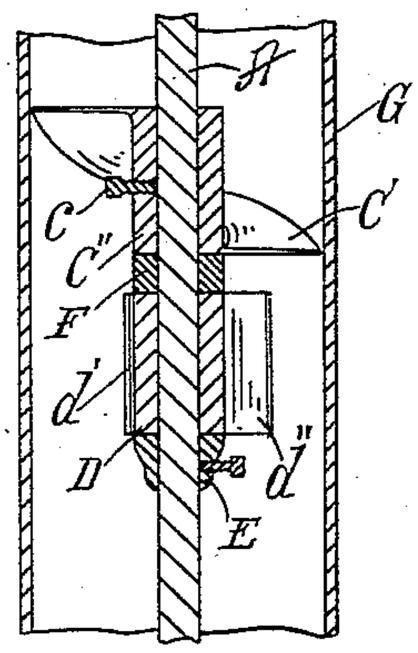


Fig. 6.



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UNITED STATES PATENT OFFICE.

PRESTON K. WOOD, OF LOS ANGELES, CALIFORNIA.

ROTARY PUMP.

SPECIFICATION forming part of Letters Patent No. 616,646, dated December 27, 1898.

Application filed August 31, 1897. Serial No. 650,195. (No model.)

To all whom it may concern:

Be it known that I, PRESTON K. WOOD, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Improvement in Rotary Pumps, of which the following is a specification.

One object of my invention is to provide a rotary pump of superior cheapness, simplicity, and power; also, to provide a pump of this character which is adapted to be readily applied inside the casing of bored or driven wells and to use the casing of such wells as the pump-casing. By my invention I provide such a well with my pump by simply running down into the well a shaft with blades and guides mounted thereon, the top of the shaft being supported by a suitable head having antifriction ball-bearings.

A further object is to increase the output from such wells.

It is an object of this invention to provide means whereby the water may be lifted from the bottom of deep bored or driven wells and carried up the same and discharged at the top in great volume with comparatively little expenditure of power.

This invention is applicable for use in any situation where water is to be raised and comprises, essentially, the combination, with the pipe, tube, stock, or casing for conducting the water, of a shaft with two or more sets of rotary spiral blades in the casing, and guides in the casing between any two sets of blades and close below the bottom of the upper one of such sets to utilize the rotary motion of the liquid produced by the lower set of rotary blades, and being arranged to receive the rotating liquid thrown from the lower of said sets of blades and deflect said liquid and throw the liquid onto the upper set of rotary blades in a direction opposite that in which the blades are turning, thus to take advantage of the momentum of the water which is thrown upward spirally by the blades, and thus to increase the lifting capacity of the pump without a proportionate increase of the power consumed. These guides are preferably thin sheets of metal which extend lengthwise the casing for a sufficient distance to catch the water and reflect it, and thereby set it to whirling around within the casing in the direction opposite to that in which the blades rotate. These guides in their preferred form are resilient and are fixed upon a boxing in which the rotary shaft turns, and they are arranged extending to the casing from the boxing tangential to the boxing and extending from the boxing in the direction the blades rotate, so that the water passes freely out to the casing. In practical operation they give to the moving water a direction opposite to that imparted to it by the rotating blades, and this greatly increases the capacity of the pump, because the momentum of the water forces the water up the blades and counteracts the tendency of the liquid to whirl around in the same direction with the blades until the liquid has been caught and thrown upward by the blades. The blades give the liquid a spiral motion, and I prefer to arrange them in pairs at intervals along the rotary shaft and to place a set of stationary guides close below each pair of blades, and I prefer to use in each set three guides mounted on a box in which the shaft rotates, each of the guides being preferably curved in the direction in which the blades rotate. I prefer to so arrange the curved guides that they inscribe a circle somewhat larger than the inside of the casing or pipe, into which they are to fit, so that they must be sprung inward to be inserted into the casing, and the friction of the blades against the casing will prevent the blades (and boxing to which they are attached) from turning. The guides form a support which centers the boxing and the rotary shaft in the casing. I prefer to leave a sufficient clearance between the top of the guides and the bottom of the blades to avoid undue friction of the water between the guides and the blades and also to allow any obstruction—such as gravel, &c.—to pass between the guides and the rotating blades.

The accompanying drawings illustrate my invention.

Figure 1 is an elevation with casing in vertical mid-section showing my newly-invented pump ready for operation. Fig. 2 is an enlarged fragmental perspective view showing a portion of a well-casing and two sets of guides and runners on a rotary shaft for lifting the water. Fig. 3 is a fragmental vertical mid-section showing a modification of the

head which supports the shaft and column of water. This form is designed for pumps which discharge through a pipe having an outlet above the head. Fig. 4 is a cross-sectional plan on line 4 4, Fig. 1. Fig. 5 is a cross-sectional plan on line 5 5, Fig. 1. Fig. 6 is a vertical mid-section on line 6 6, Figs. 4 and 5.

A indicates a rotary shaft carried by ball-bearings B or any other suitable support to allow the shaft to rotate.

C C′ indicate a pair of spiral blades fixed to the rotary shaft A to rotate therewith.

D indicates a boxing around the rotary shaft and provided with guides *d d′ d″*. The guides below the lower set of blades are designed to prevent the water from whirling around in the casing at the place where the guides are arranged. The guides are stationary and the shaft rotates in the boxing. The action of these guides is such that when the rising liquid whirling in one direction encounters the guides the liquid is not only interrupted from whirling in the direction of the rotary blades, but issues above the top of the guides in a direction opposite to that in which it was whirling before it encountered the guides, so that the liquid is thrown upon the rotary blades immediately above them in a direction opposite to that in which the blades rotate, and its momentum tends to carry it up along the blades toward the top thereof at the same time that the blades are rotating and tending to force themselves underneath the liquid. By this means the momentum of the whirling liquid is caused to materially assist in raising the water.

E indicates a collar fixed to the rotary shaft A below the guides *d d′ d″*. Each set of guides rests upon such a collar.

F indicates a loose collar or washer around the shaft between the top of the guides and the bottom of the rotary blades to hold them apart.

G indicates the casing.

H indicates the pump-head, composed of a T *h*, and a cap *h′*, bolted on the top of one arm of the T and provided with a yoke *h″*, with bearings *b b′*, in which the rotary shaft A is journaled.

When it is desired to lift the water after it has been ejected from the pump—that is to say, when the discharge-pipe I is led to an elevation above the place where the power is applied to the pump—below the lower bearing *b* will be provided a stuffing-box *b″*. See Fig. 3.

I term each set of blades C C′ and their hub C″ upon which they are mounted a "runner."

c indicates a set-screw screwed through the hub C″ and against the shaft, A to fix the hub firmly on the shaft, so that it will not slide on the shaft, but will rotate with the shaft to lift the water.

It is only necessary for starting the pump that the lower runner shall be immersed in the water; but the capacity of the pump is so great that the lower runner should be immersed to a considerable depth, so as to get the advantage of the water-pressure for supplying water to the lower runner. It is to be understood, however, that where the supply of water is inexhaustible for all practical purposes the lower runner need only be immersed sufficiently to allow sufficient water-pressure above it to keep the runner always supplied with water. It is preferable, however, to immerse two or three runners spaced on the shaft about four feet apart, more or less.

In practical operation the shaft is rotated by any suitable means, such as the belt J over pulley K, and when the blades C C′ have reached a speed sufficient to throw the water thereon upward the pressure of the liquid below will supply the vacuum thus formed and the liquid passing upward between the guides is prevented by the guides from being whirled around to any very great extent by the friction of the water below the blades. The blades pick up the ascending water and discharge it at the top and force it up along within the casing. The liquid is given a whirling motion by the blades, and as it ascends whirls around in the same direction in which the blades rotate until the liquid reaches the set of guides just below the next runner, and these guides deflect the water, which is thereby turned in its course and started to whirling in the opposite direction, so that when it strikes the blades above this guide it will be whirling in the direction opposite to that of the second runner, and the momentum of the liquid will tend to force the liquid up along the blades at the same time the blades are whirling to lift the liquid. The liquid when it issues from this second set of blades will be whirling in the same direction with the blades.

It is to be understood that any number of runners and guides may be provided and that the operation with each set of guides and runners will be substantially that which I have just described.

It is always desirable to have a number of runners and guides, so as to take advantage of the momentum of the whirling water driven by the runners and also to prevent the water from slipping back past the runners. The larger the number of runners the less liability of slipping back.

The runners should be speeded up to a considerable speed, depending upon the size and pitch of the runner and the amount of water required. The higher the speed the greater amount of water discharged. For a runner seven inches in diameter a speed of from one to two thousand revolutions per minute gives satisfactory results.

In practice to apply the pump to a bored well the runners will have about one-eighth of an inch clearance in the casing and the rotary shaft with runners and guides will be lowered into the casing to any suitable depth and will be supported by the ball-bearings B,

and power will be applied to turn the rotary shaft. The water will be thrown up by the runners which are covered by water, and the water from the well below the lower runner and from the earth surrounding the well will rush in to supply the vacuum thus induced, and it is to be noted that there is no possibility of air finding its way down inside the well-casing to supply any vacuum formed, because the column of liquid thrown up by the runners fills the well-casing. For this reason this pump will increase the output of wells over that produced when pumped by ordinary pumps which allow the air-pressure to get down inside the casing of the well.

My invention includes the use of one set of guides in combination with the two sets of runners when said guides are arranged just below the upper set of runners to turn the whirling water and direct it onto the upper runners in a reverse direction, and said guides may be of various forms and arrangements, and such forms and the various ways in which they can be arranged will suggest themselves to mechanics; but I have shown the form and the arrangement which I deem preferable, the guides being resilient and curved in the same direction in which the blades rotate. By reason of this arrangement the whirling water which strikes upon the blades is directed outward toward the casing and is caused to whirl in the opposite direction.

The purpose of curving the guides and also making them resilient is to allow them to be easily inserted into the casing and at the same time give the pressure and the friction which will hold the boxing and the shaft steady within the casing. The curvature of the guides also causes them to more readily throw the liquid outward toward the casing and to direct the liquid onto the blades in the direction opposite to that in which the blades rotate.

It is very important that there be no obstruction between any set of runners and the guides which are just below the set of runners next above, so as not to interrupt the whirling motion of the water until just before the water comes to the upper set of runners. The superior capacity of this pump depends upon having the guides so arranged as to allow the water to ascend spirally from one set of runners until just before it reaches the next set above and then to set the water to whirling in the other direction. The space between the runner-blades and the guides next above is sufficient to allow the inertia of the water and the friction of the casing to diminish the violence of the rotation of the water before the water strikes the guides, so that the water will be reflected and directed onto the blades in a direction opposite that in which they rotate without the waste of force which would occur if the rotation were stopped immediately above instead of immediately below the blades. Practical tests which I have made show that any obstruction to the course of the water is a detriment when placed close above any set of runners, for the reason that it prevents the ready discharge of the liquid upward from such set of runners.

The blades will vary in pitch for various pumps, according to the height of lift, the amount of water to be thrown, and the amount of power available for operating the pump. Where there is plenty of power and a large supply of water to be lifted, the pitch can probably be as high as thirty-five degrees or forty degrees, and with less available power and a greater height of lift the pitch will be correspondingly less. I prefer to employ a low pitch. The less the pitch the less power required to drive the blades at an effective speed; but the quantity of water lifted at each rotation of the shaft will be less. In practical operation the water is thrown upward in a constant stream, so that the inertia of the liquid at rest needs to be overcome but once.

Each runner is provided with two blades arranged symmetrically on opposite sides of the hub which carries them, so that when in operation the two blades will take up an equal amount of water on opposite sides of the shaft, so that the pump is perfectly balanced in its operation and the weight of the water throughout the pump is evenly balanced on the shaft. The lower edges of the blades are in the same plane, and this is also true of the upper edges.

Now, having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A pump comprising two or more sets of rotary inclined blades mounted on a shaft in a casing; and guides on said shaft, a set of guides being provided for and arranged close to and just below each set of superposed blades and arranged at a considerable distance above the set of blades next below so as to allow the liquid thrown by the lower blades to ascend in a spiral path from said lower blades to the guides, and whereby said guides are caused to reflect the whirling liquid thrown by the blades of the lower set and to direct the liquid onto the upper set in a direction opposite to that in which the blades rotate.

2. The combination of a casing; a shaft to rotate in the casing and provided with two or more sets of rotary blades and resilient guides with boxing for the shaft and curved in the direction in which the blades rotate, and when free, inscribing a circle somewhat larger than the inside of the casing or pipe into which they are to fit so that they must be sprung inward to be inserted into the casing and the friction of the blades against the casing will prevent the blades and their boxing from turning.

3. The combination of the casing; the rotary shaft therein; a boxing on the shaft with curved resilient liquid-guiding blades extending therefrom and engaging the inside of the casing to form supports for the boxing and

to form guides for the liquid in the casing; and inclined rotary blades carried by the rotary shaft.

4. The combination of the casing; the rotary shaft therein; two or more sets of rotary blades within the casing and carried by the shaft; and guide-blades mounted on a box which journals the shaft and arranged stationary just below the blades of the upper set of runners and extending from said boxing tangentially from said box to the casing to direct the whirling water outward to the casing and to deflect it onto said blades in a direction opposite to that in which the blades rotate.

5. The combination of a casing; a shaft to rotate in the casing and provided with two or more sets of rotary blades; and resilient water-guides with boxing for the shaft attached thereto, said guides extending along the casing and from the boxing outward toward the casing, and when free, inscribing a circle somewhat larger than the inside of the casing or pipe in which they are to fit so that they must be sprung inward to be inserted into the casing and the friction of the blades against the casing will prevent the blades and their boxing from turning.

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