No. 802,575. PATENTED OCT. 24, 1905.

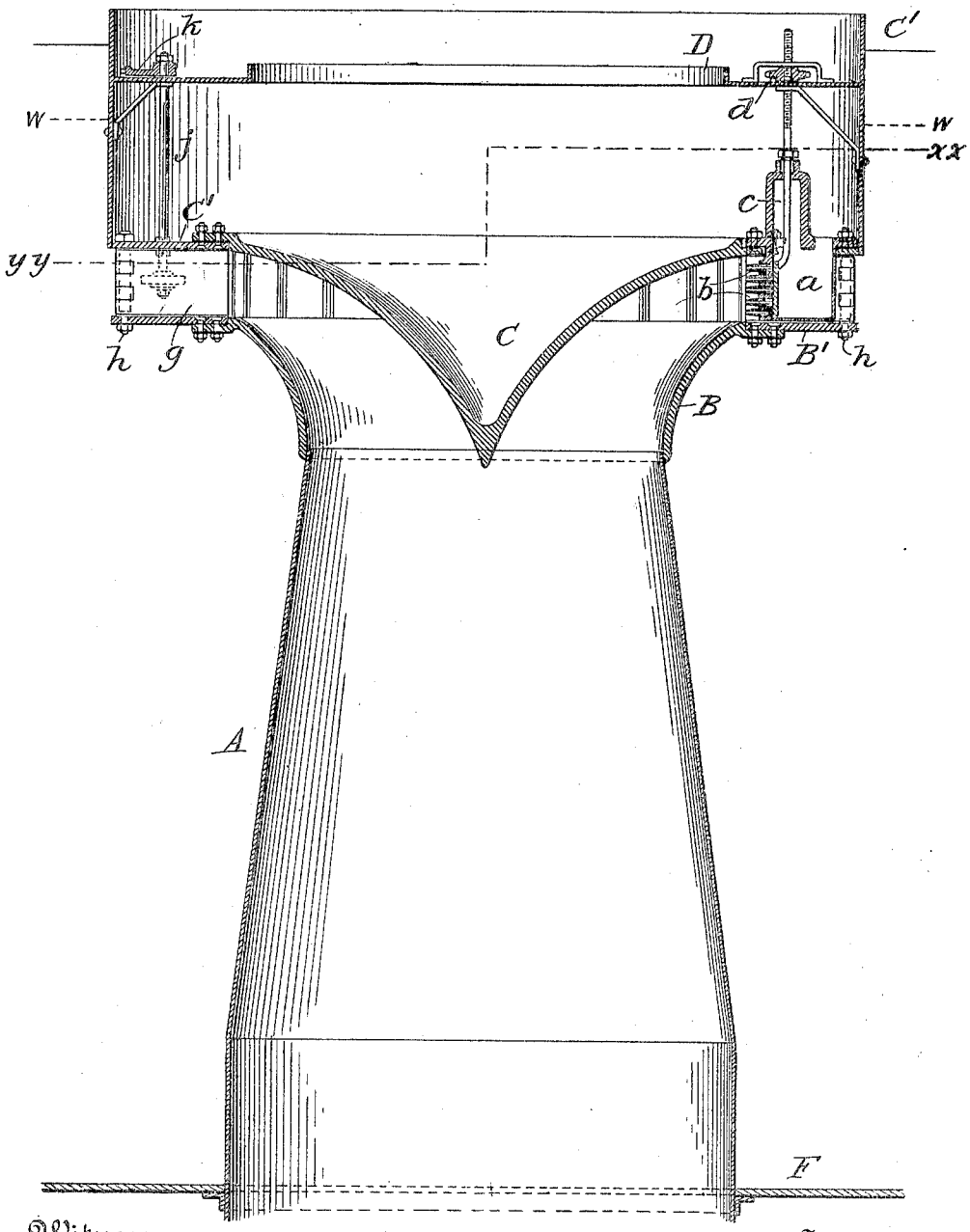
W. J. LINTON.

HYDRAULIC AIR COMPRESSOR.

APPLICATION FILED JUNE 4, 1903.

3 SHEETS—SHEET 1.

Fig. 1.



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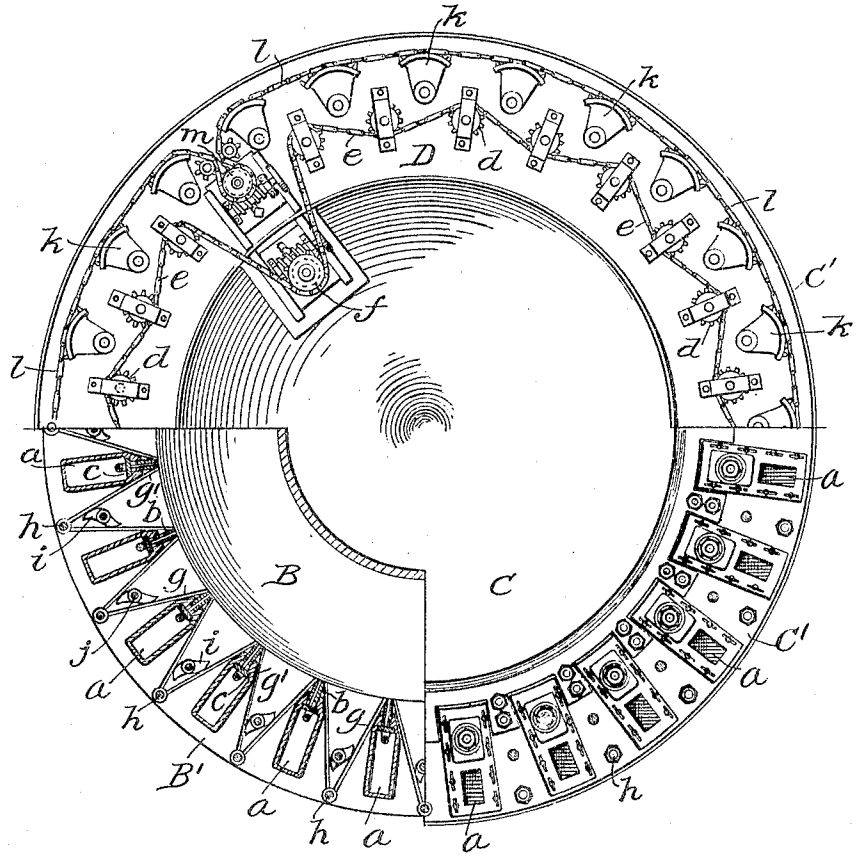
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

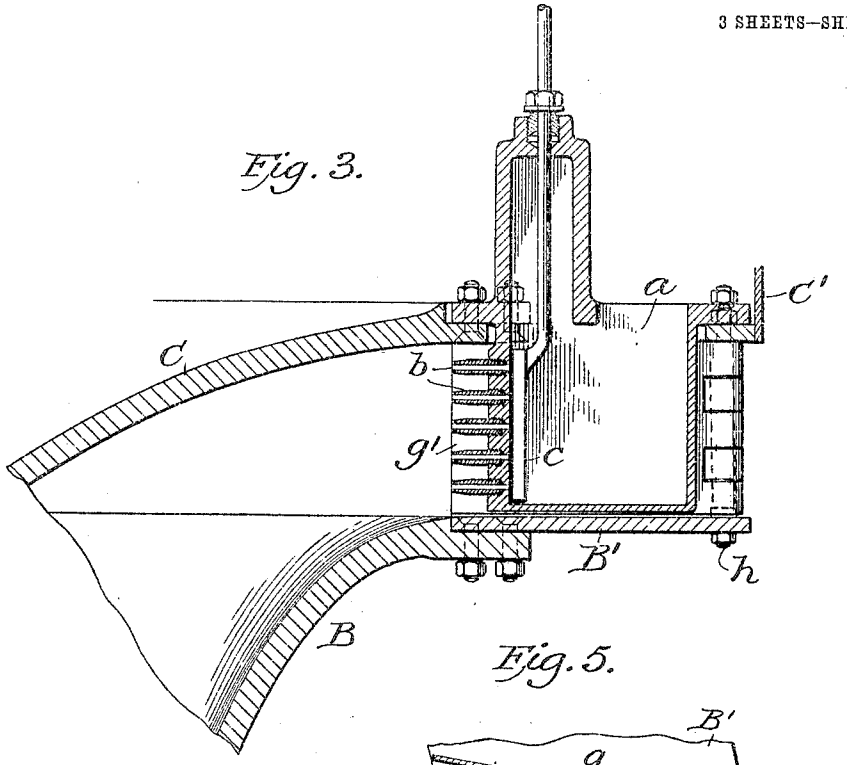

Fig. 5.

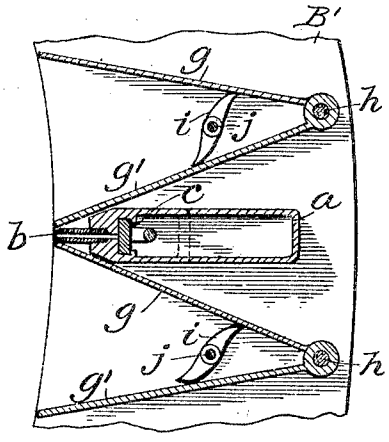

Fig. 4.

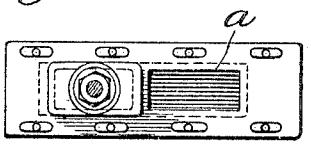

Fig. 6.

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UNITED STATES PATENT OFFICE.

WILLIAM J. LINTON, OF WOODSTOCK, CANADA.

HYDRAULIC AIR-COMPRESSOR.

No. 802,575. Specification of Letters Patent. Patented Oct. 24, 1905.

Application filed June 4, 1903. Serial No. 160,002.

To all whom it may concern:

Be it known that I, WILLIAM J. LINTON, a subject of the King of Great Britain, residing at Woodstock, county of Oxford, Province of Ontario, in the Dominion of Canada, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification.

My invention relates particularly to that well-known type of air-compressing apparatus in which a body of water flowing first downwardly and then upwardly in a well is used as the compressing agent, air being entrained in the water at the head and separated therefrom at the foot of the descending column and compressed by the weight of the ascending column. In apparatus of this character the degree to which the air is compressed depends upon the depth to which the downflow or stand pipe is carried below the outlet from the well or outflow-pipe, and in a given plant the amount of air compressed depends upon the quantity or proportion of air that can be entrained in the water and carried down thereby to the separation-chamber at the lower end of the stand-pipe and there separated out. A certain head of water, dependent principally upon the length and shape of the pipes, would of course be required to overcome the friction and cause water alone to flow through the apparatus; but when air is entrained therein the mixture known as the "airy column" is so much lighter than a column of water that it will "balance up" much higher in the stand-pipe, its level depending both upon the proportion of air to water therein and upon the depth of the separation-chamber. Consequently in the operation of the apparatus there is required to form the airy column and maintain it in motion a head of water sufficient to overcome not only friction, but also the levity of the air—in other words, to carry the water down through the stand-pipe with a rapidity great enough to enable it to draw in air at the head-piece of the apparatus and carry it down with it into the separation-chamber. It therefore becomes apparent that in order to secure its greatest efficiency the head-piece of the apparatus should be provided with means for carefully regulating the quantity of water and air supplied thereto and the proportion of each to the other, so that the airy column may be made to balance up to the highest level permitted by the varying working conditions; but in the head-pieces heretofore constructed such means have been wanting or have been inadequate for the purpose, and a further loss in efficiency or working head has resulted from the fact that it was impossible, as found in practice, to entrain the air and start the downward movement of the mixture through the stand-pipe with continuous flow and without interruption and loss of a portion of the air. A part of the air drawn into the water would not be thoroughly sealed therein and would immediately separate, collect in the upper part of the head-piece, and thence force a way out through the water above and escape, the result being that the airy column would not balance up as it otherwise should, thus leaving a space between its top and the point at which the entrainment of the air is effected through which the mixture of water and air falls in a more or less broken and intermittent way, causing the separation out and loss of still more of the air.

The object of my invention, therefore, is to provide a head-piece for an hydraulic air-compressor of the type described which shall have both means for regulating the supply of water and air and of each independently of the other and for adjusting the points at which the air is introduced into the water and which shall be so constructed as to prevent so far as possible the separation from the water of the air once it is entrained therein, and thereby reduce to a minimum the loss in the effective working head which is measured by the space between the level where the air is entrained in the water and the top of the balanced-up column, and this object I accomplish by the construction and combination of parts hereinafter described, and illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of the head-piece of the apparatus; Fig. 2, a composite figure, the upper half being a plan of half of the head-piece, the lower right-hand portion a section on line $x\,x$, and the lower left-hand portion a section on line $y\,y$ of Fig. 1; Fig. 3, an enlarged detail of the air-inlet chamber shown in Fig. 1; Fig. 4, a plan of an air-inlet chamber from above; Fig. 5, an enlarged detail of the air-inlet chambers and water-gates shown in the lower left-hand portion of Fig. 2, and Fig. 6 a detail showing a water-gate opened to its fullest extent.

Similar letters refer to similar parts throughout the several figures.

My improved head-piece comprises the upper end of a stand-pipe A, a bell mouthpiece

B, and a top or cover C of inverted cone shape. The stand-pipe, which extends upward through the floor F of the water-supply tank, is tapered inwardly and upwardly at its upper end at an angle of, say, from five to eight degrees, the tapered portion extending upward from a point somewhat below the level to which the mixture of air and water balances up therein in the operation of the apparatus. The bell mouthpiece is mounted on the tapered upper end of the stand-pipe and is extended outwardly, preferably, for convenience in manufacture by a separate plate B′, attached thereto. The cover is extended outwardly to correspond and then upwardly to a height above the level of the water (line W W) in the supply-tank, preferably also by a separate plate C′, and is secured in place over the mouthpiece by means of shouldered bolts *h h* or in any suitable manner. The parts form an annular mouth for the apparatus with a contracted throat, which gradually expands downwardly to the full size of the main portion of the stand-pipe.

Air is supplied to the apparatus through a series of air-inlet chambers *a a*, which are regularly distributed around the mouth. They are suspended from the cover through openings therein and are longitudinally adjustable, the openings in the cover being made somewhat longer than the bodies of the air-chambers and the bolt-holes slotted for this purpose. Each air-inlet chamber is open at the top to the air within the upwardly-extended sides of the cover and communicates with the water as it runs through the mouth of the apparatus through a series of small openings, preferably extended by tubes *b b* in its vertical inner wall, and the area of contact between the air within and the water without through these openings is regulated by a gate *c*, which is arranged to slide up and down in the inner end of the chamber to close any desired number of the air-outlets. The air-gates may be operated by any suitable means, but preferably so that they may be raised or lowered simultaneously in all of the inlet-chambers, as by sprocket-wheels *d d*, which are mounted on the plate D and act upon the screw-threaded upward extensions of the gates and which are turned by an endless chain *e*, worked by a worm and gear *f*, also mounted on the plate D.

Alternating with the air-inlet chambers around the mouth of the apparatus and located one in each of the water-passages formed between two adjoining inlet-chambers is a series of water-gates, each of which consists of two wings *g g′*, hinged at their outer ends on the bolt *h* and swinging laterally thereon to divide and close or partially close the passage. The wings of the gates may be spread apart and held in any desired position by means, as shown, of double cams *i*, mounted on the lower ends of shafts *j*, which are provided at their upper ends with toothed segmental arms *k* and all turned simultaneously by an endless chain *l*, worked by a worm and gear *m*, or by any other suitable means. The force of the water will swing back the wings of the gates and open the passages as soon as the cams are turned so as to allow such movement; but, if desired, springs can be used to assist the movement.

With a head-piece constructed as described it will be seen that the supplies of water and air are not only easily and completely controlled, but the proportion of air to water may be changed whenever and as found desirable, since the quantity of each is regulated independently of the other, and it will also be observed that both are regulated at the points where the air comes in contact with and is entrained by the water, the latter being divided up into thin columns and directed past and through channels which are narrowest, and the speed of its flow consequently greatest, at the ends of the air-outlets, conditions which insure the entrainment of the air in the most efficient manner. The air-inlet chambers are adjustable, so that the air may be introduced into the water through their outlet-tubes at the exact points required to secure the best results, and the contracted throat formed by the taper given to the upper end of the stand-pipe acts both as a draft-tube to draw the mixture of water and air down into the stand-pipe and by reason of its smaller area to raise the level of the balanced-up column, thus bringing that level up closer to the level where the air is entrained (or permitting the latter to be correspondingly lowered, and thereby increasing the effective working head) and at the same time carrying the water and entrained air down through the space between the two levels and starting it on its downward movement in more unbroken column and with the loss of a minimum amount of air.

While I have shown and described only an annular form of construction, it is obvious that a curvilinear or angular form could be used as well; nor do I wish to limit myself to the details of construction of the air-inlet chambers as shown or to the specified means for operating either the air-gates or the water-gates, as various modifications may be made in all these respects without departing from the spirit of my invention. For example, the air-gates may be provided with a vertical series of holes which register with the openings in the walls of the air-inlet chambers, so that all of these openings can be partially or wholly closed by a slight movement of the gates either up or down, or instead of a series of disconnected openings a single narrow opening may extend from top to bottom of the inner wall of the air-inlet chamber.

Other modifications will readily occur to any one who is familiar with the construction

of this class of apparatus and need not be mentioned.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus and a series of air-inlet chambers arranged within said mouth and dividing it into separate water-passages each of which chambers is connected with the air outside and is open to the water at its inner end, and means for regulating the size of said water-passages.

2. In an hydraulic air-compressor, a head-piece having a horizontally-opening mouth through which water is admitted to the apparatus and a series of air-inlet chambers arranged within said mouth and adjustable outwardly and inwardly with respect thereto, each of which air-inlet chambers is connected with the outside air and is open to the water along its vertical inner end.

3. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus and a series of air-inlet chambers arranged around said mouth, each of which chambers is connected with the air outside and is open to the water at its inner end and provided with means for regulating the area of the opening between the air within and the water without independently of any regulation of the water-supply.

4. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of air-inlet chambers arranged around said mouth each of which is connected with the air outside and is open to the water at its inner end and provided with a vertically-sliding gate whereby the area of contact between the air within and the water without may be regulated, and means for raising or lowering said gates in all of the air-inlet chambers simultaneously.

5. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of air-inlet chambers arranged around said mouth and dividing it up into separate water-passages each of which air-inlet chambers is both connected with the air outside and with the water passing into the apparatus and is provided with means for regulating the area of contact between the air within and the water without, and independent means for regulating the area of said water-passages.

6. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of air-inlet chambers arranged around said mouth and dividing it up into separate water-passages each of which air-inlet chambers is connected with the air outside and with the water passing into the apparatus, means for regulating the area of said water-passages and directing the water passing therethrough to either side past and in close proximity to the air-outlets from the adjoining air-inlet chambers, and means for regulating the area of contact between the air within and the water without said air-inlet chambers.

7. In an hydraulic air-compressor, a head-piece, forming the mouth through which water is admitted to the apparatus, a series of gates arranged around said mouth and dividing it up into separate passages for the water each of which gates consists of two vertically-disposed wings hinged at their outer ends and is provided with means for spreading the movable inner ends of its said wings, and means for admitting air to the water passing into the apparatus through said water-passages.

8. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of gates arranged around said mouth and dividing it up into separate passages for the water, each of which gates consists of two vertically-disposed wings hinged at their outer ends, means for simultaneously spreading the inner ends of each pair of wings, and means for admitting air to the water passing into the apparatus through said water-passages.

9. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of gates arranged around said mouth and dividing it up into separate passages for the water each of said gates consisting of two vertically-disposed wings hinged at their outer ends and provided with means for spreading their inner ends, and means for admitting air to the water passing into the apparatus through said water-passages and for regulating the area of contact between the air and water.

10. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of gates arranged around said mouth and dividing it up into separate passages for the water each of said gates consisting of two vertically-disposed wings hinged at their outer ends and provided with means for spreading their inner ends, and means for admitting air to the water as it passes through the narrowest part of said water-passages and for regulating the area of contact between the air and water.

11. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of alternating air-inlet chambers and gates arranged around said mouth, and dividing it up into separate passages for the water, said gates being adjustable to regulate the area of said water-passages and said air-inlet chambers being connected with the air outside and having adjustable openings for the passage of air from within to the water without.

12. In an hydraulic air-compressor, a head-piece forming the mouth through which water is admitted to the apparatus, a series of alter-

nating air-inlet chambers and gates arranged around said mouth, each of said air-inlet chambers being connected with the air outside and having an adjustable opening through which the air within is brought into contact with the water without and each of said gates dividing a passage formed between two adjoining air-inlet chambers and directing the water flowing on each side through said passage in adjustable quantities past, and through channels which are narrowest at or opposite, the openings through which the air within the air-inlet chambers is brought into contact with the flowing water without.

13. In an hydraulic air-compressor, a standpipe which is tapered inwardly and upwardly at its upper end, a bell mouthpiece mounted thereon, and a cover above said mouthpiece, the said parts forming an annular mouth and a contracted throat through which water and air are admitted to the apparatus, and a series of alternating air-inlet chambers and water-gates arranged around said annular mouth, substantially as described.

14. In an hydraulic air-compressor, a standpipe which is tapered upwardly and inwardly at its upper end, a bell mouthpiece mounted thereon, and a cover above said mouthpiece, the said parts forming an annular mouth and a contracted throat through which water and air are admitted to the apparatus, a series of alternating air-inlet chambers and water-gates arranged around said annular mouth, said water-gates being adjustable to regulate the area of the water-passages formed between the air-inlet chambers and said air-inlet chambers being provided with means for regulating the area of contact between the air within and the water without, substantially as described.

In testimony whereof I have hereunto affixed my signature in presence of two witnesses.

W. J. LINTON.

Witnesses:
FRANK H. BROWN,
DOROTHY S. DEEDMEYER.