(No Model.)

2 Sheets—Sheet 1.

E. C. NICHOLS.

APPARATUS FOR GENERATING COMPRESSED AIR.

No. 530,118. Patented Dec. 4, 1894.

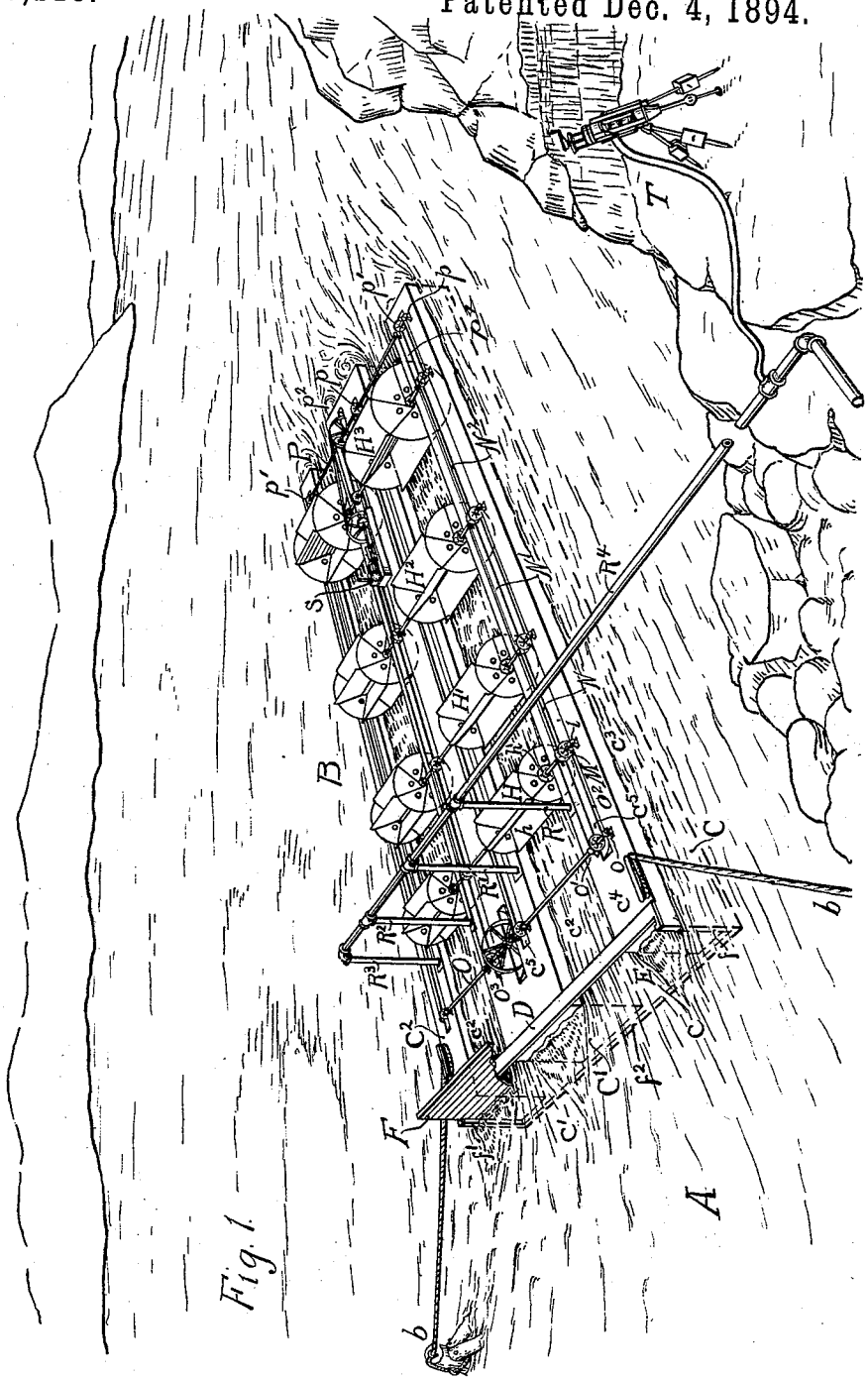

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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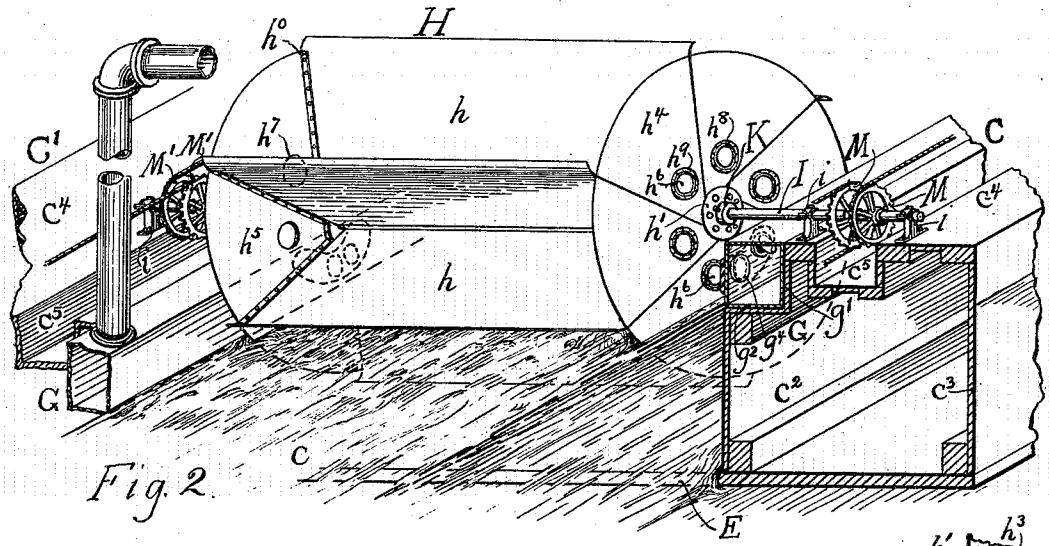

Fig. 2.

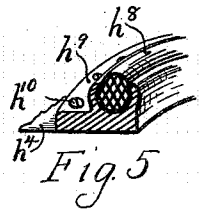

Fig. 5

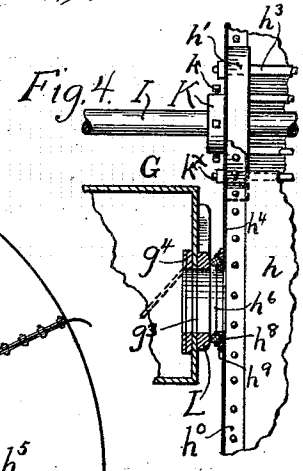

Fig. 4.

Fig. 3.

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UNITED STATES PATENT OFFICE.

EDWIN C. NICHOLS, OF KANSAS CITY, MISSOURI.

APPARATUS FOR GENERATING COMPRESSED AIR.

SPECIFICATION forming part of Letters Patent No. 530,118, dated December 4, 1894.

Application filed July 19, 1893. Serial No. 480,966. (No model.)

To all whom it may concern:

Be it known that I, EDWIN C. NICHOLS, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and Improved Apparatus for Generating Compressed Air; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others to make and use the same, reference being had to the accompanying drawings, forming a part of this specification.

The object of my invention is, first, to confine the moist air and compress the same upon the surface, and by the impulse of a stream of water; second, to transmit the compressed air to its receiver in volumes of variable energy; third, to utilize compressed air expansively.

My invention consists in the novel construction and combination of parts such as will first be fully described and specifically pointed out in the claims.

In the drawings: Figure 1, is a view in perspective of the air compressing apparatus mounted upon floats, anchored in the current of a running stream of water, and showing the air conducting pipes upon the floats connected with each longitudinal air receiver, and also with a receiver for storage of compressed air upon the land, connected with the air conducting pipes. Fig. 2, is a detail view in perspective showing one of the graded wheels and broken portion of the floats at each end of the wheel, also showing the portion of one of the buckets in a position to confine the air, the discharge openings, the receiver with the valvular openings, and the discharge pipe for the compressed air. Fig. 3, is a vertical sectional view of the bucket wheel, as seen in Fig. 2, showing the longitudinal receiver broken away at the ends, and also the side of the wheel broken showing one end of the curved extension plate on the side of the receiver, and the positions of the registering openings in the adjacent buckets and receiver, to facilitate the discharge of compressed air into the receiver. Fig. 4, is a detail broken cross section of the receiver, and of one of the buckets showing the valve on the inner side of the receiver, and the perforated extension plate, also showing a broken section of one of the buckets, and its shaft, and the elastic neck to one of the openings, in said bucket, registering with an opening in the extension plate and receiver. Fig. 5, is a broken detail view in perspective of the elastic neck showing the mode of its retention on the side of the bucket.

Similar letters of reference indicate corresponding parts in all the figures.

Referring to the drawings, A represents a stream of water in the current of which is anchored at *b. b.* a sluice carrying barge B. Said barge consists of the parallel floats C. C′ C^2 which extend in length the requisite distance to support the rotary air compressors in series. From the center float C′, the side floats C. C^2 are arranged in position, so as to form between the floats C and C′ a sluice way *c*, and between the floats C and C^2 a sluice way *c′* of the same width as the sluice *c*. Extending in a transverse direction to and connected rigidly with the forward ends of each float is a tie beam D. The barge B is constructed with a bottom E, which extends from the bottom of one float to the bottom of an adjoining float and the entire length of said floats and beneath each sluice or reservoir *c. c′*. On the forward end of the float C is a rabbeted guide strip *f*, which is arranged in a vertical position near the outer side of said float C. On the forward end of the float C^2 is a similarly arranged guide strip *f′*. Extending from one side float C to the other side float C^2, and retained at its respective ends in the guides *f. f′* is a sluice gate, F, the lower edge of which gate extends in a downward direction to and rests upon the supporting strip f^2. Said strip f^2 extends outwardly from and in line with the bottom E, and the gate is thereby enabled to close the entrance to each sluice way *c. c′*, at the proper time. Each one of the floats C. C′. C^2 consists of a longitudinal hollow water tight compartment of a sufficient buoyancy to sustain the weight of the apparatus for generating compressed air. The sides c^2, c^3 of each float are in a vertical position as respects the bottom E of the barge, and at right angles to the top c^4 of said float. Upon the side c^3 of the float C, which is toward the sluice *c*, and within and at the top portion of said float, is an air tight compartment or receiver G. The receiver G,

extends in the longitudinal direction of said float C, and as shown is made in the shape of an extended box, the top c^4 and outer side c^2 of the float constituting the top and one side of the receiver and the parts g' g^2 on the inner side of the float constituting the other side and bottom of the receiver respectively.

In the float C′ upon the side toward the float C, is a receiver G, and upon the other side of the float C′, and upon the float C^2, upon the side toward float C′, are also air receivers which are similar in construction and arranged in position in a similar manner to that of the receiver G.

The apparatus for producing the compressed air in connection with the receiver consists of a revoluble air tight compartment wheel H, which is arranged in the sluice *c*. In the top c^4 of the float C, equi-distant from the sides c^2 c^3 is a longitudinal depression c^5 which extends nearly to the forward end of the float C in one direction, and nearly to the rear end of said float in the other direction. In the floats C′. C^2 are similar depressions to depression c^5. A short distance in rear of the terminal point of the depression c^5 on the forward end of the float C, and on the top of said float on both sides of said depression are the journal boxes *i*, *i*, in which is journaled one end of a rotary shaft I, the other end of which shaft is extended in a transverse direction to the sluice *c*, and to the float C′, and journaled in the journal boxes *i*, *i*, on both sides of the depression c^5, in the top of said float. Upon the shaft I near the side of the float C is a disk h', and upon the other end of said shaft near the side c^2 of the float C, is a disk h^2. Upon the outer side of and integral with each disk is a collar K. Said collar is secured to the shaft I by means of the set screws *k*. Through disk h' a short distance from the outer circular edge is inserted one end of a rod h^3 the other end of which rod extends through the disk h^2. Both ends of the rod h^3 are screw threaded and a nut $h^\times$, fitted to each end of said rod and upon the portion extending outside of the disk. Similar rods h^3, are extended through the disks in the circular line of direction of the disks, and arranged at equal distances apart.

The air tight compartment of the wheel consists of the back portion or plate *h*, which extends from the inner side of disk h', to the inner side of the disk h^2, and also outwardly from the rods h^3, toward the radius of the wheel upon a line concentric with its axis. The portion of the plate *h*, forming one side to a compartment which is in line with one of the rods h^3, is extended in length toward and hermetically united with the lower edge of an adjacent back plate *h*, so that no air may escape. The outer side to each compartment at one end of the wheel is formed by a triangular shaped plate h^4, the edges of which extending outwardly in the line of direction of the back *h*, are bent inwardly to form the flanges h^6, h^6, which flanges are bolted to the respective backs *h*, *h*, adjacent to each other, and in a parallel position with the outer edges of said backs, and hermetically closed against the passage of air. The end of each triangular plate which is close in position to the rods h^3, is also closely united with the portion of the back *h*, which extends from one rod to an adjacent rod h^3, so as to afford an air tight end to the compartment. At the other end of the wheel the compartments are each provided with a triangular end portion h^5, which is similar to the portion h^4, and the end made air tight in a like manner. Through each triangular shaped plate h^4, a short distance from the terminal portion of said plates, with the rods h^3 h^3, and upon a circular line drawn from the shaft I is made a circular opening h^6. Through the triangular plates h^5 at the other end of the compartment is made in each plate an opening h^7, which corresponds in size and position to the openings h^6. Upon the outer side portion of the plate h^4 and adjacent to the circular edge of one of the openings h^6 is placed an elastic ring h^8, which extends a short distance outwardly from the side of said plate so as to form a neck to the opening h^6. Around the elastic ring h^8 is extended a circular metallic flange h^9, which is removably attached to the outer side of the plate h^4 by means of the screws h^{10}, the ring extending beyond the outer edge of the flange a short distance for the purpose hereinafter described. Around each opening h^6 in each plate h^4 to each compartment is a similar neck and flange as described, and also around the openings through the side of the plates h^5 at the other end of the compartment.

Through the side of the float C, and upon a circular line and registering with the openings h^6 in the wheel H, are made the openings g^3, g^3, which are arranged the proper distance apart and extend into the receiver G, and correspond in proportion to the openings h^6. Over each opening g^3 on the inner side of receiver G is placed a check valve g^4. On the outer side portion of the receiver and in contact with the elastic neck h^8 on the side of the air tight compartment of the wheel H, and extending past the openings g^3, g^3, in the receiver G is attached fixedly a curved extension plate L, which is provided with openings of the same size and registering with the openings g^3 g^3 communicating with the receiver G. The side of the plate L is made perfectly smooth so as to permit the neck h^8 on the rotation of the wheel H to pass over the plate under the requisite compression. Upon the float C′, and in the receiver G′, upon said float which is adjacent to the other end of the wheel H, having the openings h^7 are made discharge openings for the compressed air, which register with the openings h^7, in precisely the same manner as is described upon float C, and upon the receiver of said float is a perforated extension plate, and upon the triangular plates h^5 are necks

to the openings h^7, which contact with said plates in the same manner as heretofore described upon the one side of the wheel H.

To transmit the compressed air to the receiver under variable energy I mount upon the barge B, and in the sluice *c* in rear of the wheel H, a series of air tight compartment wheels H′ H². H³. The diameter of the wheel H′ is one degree in excess of the wheel H, and the wheel H² one degree in excess of the diameter of the wheel H′. The wheel H³ having the greatest diameter, or in which the sides to the air tight compartment are longer, is at the rear end of the barge. Each wheel H′. H². H³. is mounted in precisely the same manner upon the top of the barge B, as wheel H, the journal boxes *i*, *i*, being in line on both sides of the depression c^5.

On the shaft of the wheel H, and at one end of said shaft between the journal boxes *i*, *i*, and over the depression c^5 in the top of float C, are rigidly mounted the sprocket wheels M, M. On the other end of said shaft on the float C′ and over the depression on the top of said float are mounted the sprocket wheels M′. M′. On the respective shafts to each of the air compressor wheels H′, H², H³, are rigidly fixed similar sprocket wheels M, M, M′, M′. Over the sprocket wheel M on the shaft I of the wheel H, which is near the end of said shaft, is passed one end of a sprocket chain N; the other end of which chain is passed over the sprocket wheel in line with those on the shaft of the wheel H′, and the two ends of the chain fastened together in the usual manner. Over the adjacent sprocket wheel on the same shaft of wheel H′, is passed one end of a sprocket chain N′, the other end of which chain is passed over the sprocket wheel on the shaft of the compartment wheel H² and the two ends connected together in the usual manner. Upon the same shaft of the wheel H, and over the adjacent sprocket wheel is passed one end of a sprocket chain N², which is passed over the sprocket wheel on the shaft of the compartment wheel H³. Over the sprocket wheel on the other end of each of the shafts of the wheels H′, H², H³ are sprocket chains, connected and arranged in the same manner. The separate wheels are thus coupled together so as to cause the compartments of each wheel to enter the water at different intervals.

Toward the forward end of each float, and in advance of the journal boxes *i*, *i*, for shaft I of the compartment wheel H, are fixed the journal boxes *o*. *o*. One end of a line shaft O extends from the top of float C in a transverse direction to floats C′ C², and the other end is journaled in the boxes *o*. *o*. in the top of float C. On shaft O, are sprocket wheels *o*′. *o*′. which are in line with the sprocket wheels M. M′, on the shaft I, of wheel H. Over one of the sprocket wheels *o*′ on the end of shaft O on float C is passed one end of a sprocket chain o^2, the other end of which chain is extended over the inner sprocket wheel on shaft I of wheel H, and the two ends connected together in the usual manner. Similar sprocket chains are connected with the shaft O, and with the other end of the shaft I, and with the adjacent shaft, which carry the air compartment wheels in the sluice *c*′. On shaft O is a power transmitting pulley c^3. At the rear end of the barge and a short distance in rear of the compartment wheel H³ is mounted in suitable journal boxes *p*, *p*, placed in line with the boxes *i*, *i*, on float C, one end of a line shaft P, the other end of which shaft extends in a transverse direction to and over the float C′, and is mounted in similar journal boxes on the float C².

Upon shaft P, are sprocket wheels *p*′, *p*′, which are in line with the sprocket wheels M. M′, on the shaft of the wheel H³, over which are passed one end of the sprocket chains p^4, the other ends of which chains are passed over the sprocket wheels on the ends of the respective shafts I, of each wheel, so that the power transmitted to shafts O and P produces a uniform rotary movement of the shafts and wheels. On shaft P is a power transmitting pulley p^2. In the forward end of the receiver G on float C, is inserted the lower end of a vertical air conducting pipe R. With the forward ends of the receivers G′ on each of the floats C′ C² are connected the lower ends of the respective conducting pipes R′. R². R³., which extend in an upward direction, the same height as the pipe R, and are each connected at their upper ends with a horizontal conducting pipe R^4 which extends from pipe R^3 to each vertical pipe R^2 R′ R, and thence to the shore, where the air is utilized in a suitable manner.

In operation the barge B, with its series of air compressing apparatus is anchored in the stream of water and with the gate F raised to admit the currents, which pass through each sluice and carry therewith currents of air, which are dense or charged with moisture. To confine this dense air in one of the air compartments or reservoirs the current of water which is admitted within the sluice moves forcibly against one side *h* of one of the compartments, which extends into the water, and under the impulse of the current of water moves rearwardly, and the other side *h* of the compartment is forced downwardly upon the surface of the water confining the volume of air, which has passed into one of the air tight compartments of the wheels. The air thus confined is subject to the undulatory movement of the water and a certain degree of compression. In the next movement of the air compressing compartment the side *h* of the compartment is carried deeper beneath the surface of the water, and under the upward impulse of the water the air remaining in the compartment is subjected to compression in an increased degree. The neck h^3, on the side of the compartment wheel is caused to register with the opening g^4 in the receiver G at which point

the air compressed in the first described compartment of the wheel H is permitted to escape into the receiver G. In the next succeeding compartment of the wheel the opening h^6 is caused to register with the other opening g^3 placed in rear of the first described opening, and the air under compression is permitted to escape into the receiver G, the valve g^4 closing the opening after each discharge of the compressed air. The other compartments of the wheel in succession are rotated by the velocity of the water currents, and as the compartments on the separate wheels, which extend below each other receive the force of the currents of water at increased depths, the volume of compressed air is increased in energy and delivered to the receiver G, with greater intensity. The compressed air, which escapes from the series of air compartment wheels in different degrees of compression, and at alternate points, is permitted to expand within the receiver, and the energy becomes equalized, so that when the apparatus in series is generating compressed air and under various degrees of compression, the expansion of the air within the receiver enables it to be applied with uniformity in motive force. The compressed air thus generated may be conducted to the land, and utilized in running the rock drill T, or in ventilation of mines or for other purposes.

Should the currents of water from any cause remain at rest and unable to operate the air compartment wheels, I place upon the barge an engine or motor S, which may be connected by a belt with the pulley on the line shaft P, and with the series of sprocket wheels connected with the shaft each air compartment wheel is made to operate and the air compressed and transmitted in the manner as before described. The air forcing compartment wheels are used separately or in series, as the demand for the compressed air is found to exist, the separate receiver being made large or small in proportion.

Having fully described my invention, what I now claim as new, and desire to secure by Letters Patent, is—

1. An apparatus for generating compressed air, consisting of an air receiver, having an opening for the admission of the compressed air and a self closing valve and a revoluble air forcing compartment wheel having separate compartments and separate openings to each compartment registering with the opening to said receiver for the purpose described.

2. In an air compressing apparatus a receiver for the compressed air and a water sluice, a revoluble air forcing compartment wheel having an axis mounted upon the sides of and extending within said sluice and actuated by the flowing stream and having a registering valvular conductor for the compressed air from each compartment to the receiver as and for the purpose described.

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