No. 697,296. Patented Apr. 8, 1902.

# G. R. TYLER.

## COMPRESSED AIR WATER ELEVATOR.

(Application filed Nov. 25, 1901.)

(No Model.)

Fig. 1.

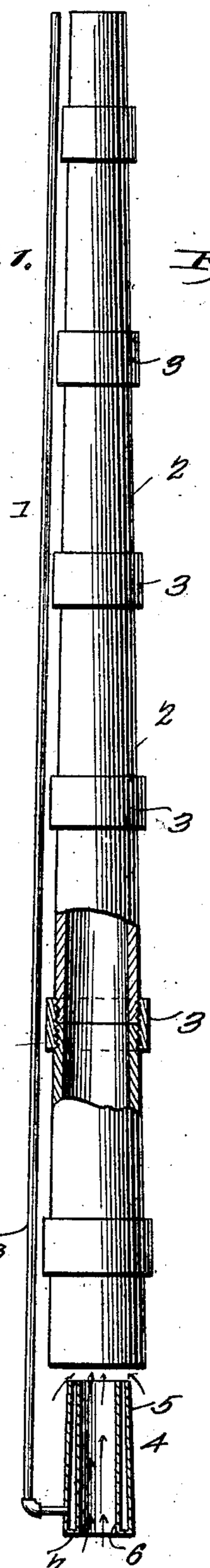



Fig. 2.

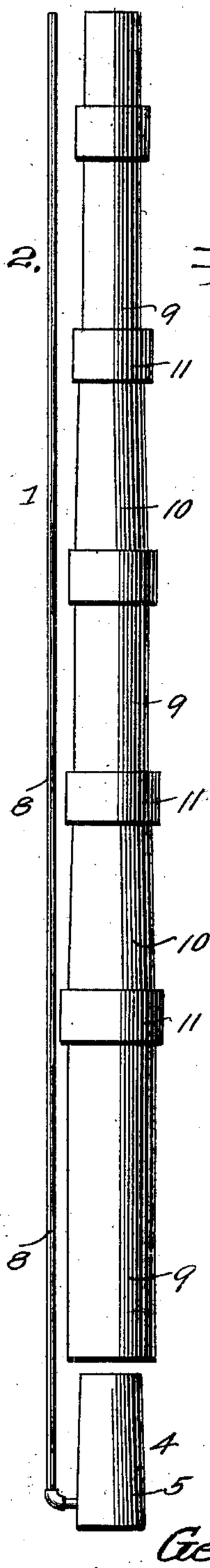
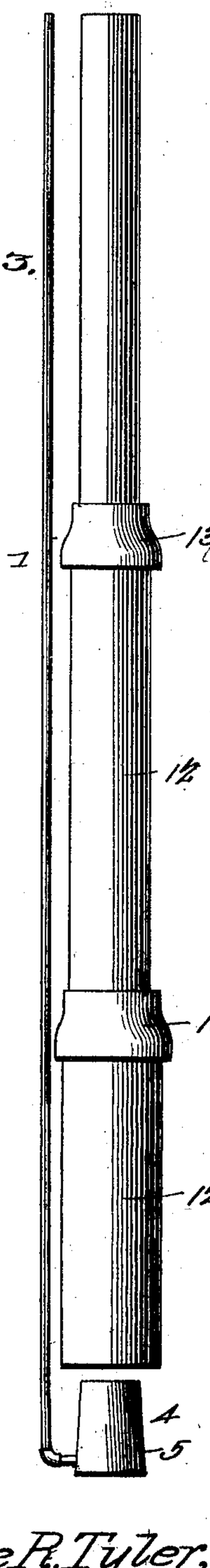



Fig. 3.

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# UNITED STATES PATENT OFFICE.

GEORGE R. TYLER, OF POMONA, CALIFORNIA.

## COMPRESSED-AIR WATER-ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 697,296, dated April 8, 1902.

Application filed November 25, 1901. Serial No. 83,614. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE R. TYLER, a citizen of the United States, residing at Pomona, in the county of Los Angeles and State of California, have invented a new and useful Compressed-Air Water-Elevator, of which the following is a specification.

This invention relates to compressed-air water-elevators.

The object of the invention is to increase the lifting capacity of the elevator without excessive air-pressure and to obviate slippage and cutting of the slugs of water by the air-current.

With these and other objects in view, as will appear as the nature of the invention is better understood, the same consists in the novel construction and combination of parts of a compressed-air water-elevator, as will be hereinafter fully described and claimed.

In the accompanying drawings, forming a part of this specification and in which like numerals of reference indicate corresponding parts, there is illustrated three forms of embodiment of the invention, each capable of carrying the same into practical operation, it being understood that the elements therein exhibited may be varied or changed as to shape, proportion, and exact manner of assemblage without departing from the scope of the invention, and in these drawings—

Figure 1 is a view in elevation, partly in section, of a form of elevator wherein the eduction-pipe is a true taper from end to end. Fig. 2 is a similar view exhibiting an eduction-pipe in which the taper or reduction in the diameter thereof is produced by alternate straight and tapered sections of pipe. Fig. 3 is a similar view exhibiting an eduction-pipe in which the taper or reduction in diameter is produced by successive sections of pipe, each decreasing in diameter from the lowest section thereof to the top of the pipe.

The water-elevator of this invention belongs to that class wherein an eduction-pipe is employed the lower end of which is submerged in the liquid to be raised, combined with a nozzle for directing a current of compressed air into the pipe in successive impulses, operating thereby to draw into the pipe slugs of water held separated by cylinders or cushions of air. The eduction-pipes heretofore employed in devices of this character have generally been of uniform diameter from end to end, and the air-blast has generally been discharged centrally of such pipes from a nozzle projected some distance within the same. An inherent disadvantage of this arrangement is that when the bore of the pipe is of the same diameter throughout as the successive slugs of water enter the pipe the downward pressure at the bottom thereof increases in proportion to the weight of the successive slugs, so that the cylinder or cushion of air at the bottom of the pipe cannot present sufficient resistance to prevent slippage or passage thereby of a portion of the slug of water above it, and so on throughout the limit of the tube, the slippage of course gradually increasing toward the discharge end of the pipe. Furthermore, where the jet of air strikes the center of a slug of water a portion of the air will cut therethrough, the pressure of the cylinder of air being thus reduced both as to lifting force and to resistance to slippage, the latter then taking place.

A further disadvantage in the constructions above noted in connection with the disposition of the nozzle within the eduction-pipe is that the air as it leaves the nozzle expands laterally, and thus presents an obstruction to the water from beneath, so that while theoretically the efficiency of an elevator so constructed is high, in reality the output for the energy expended is low. It may be stated, as a general proposition, that where the diameter of the eduction-pipe is the same throughout its length, and the air-nozzle discharges centrally thereof and projects within the same, that the lifting capacity of the elevator diminishes in a fixed ratio proportioned to the length of the pipe and the combined weight of the slugs of water.

By the device of the present invention the objections above noted are obviated in a practical, feasible, and inexpensive manner and are effected by the employment of an eduction-pipe the diameter of which gradually decreases from its intake to its discharge end, preferably in proportion of about one-half—that is to say, if the intake end of the pipe be ten inches the discharge end will be five inches in diameter. It is to be understood, however, that the above-stated proportions

existing between the terminals of the pipe are those that have been found highly effective in use; but in practice these may be varied if found necessary or desirable. By tapering the eduction-pipe, as described, the terminal areas of the successive slugs of water under the operation of the device are gradually decreased as they approach the discharge end of the pipe, and thus present added resistance to any cutting tendency on the part of the cylinders of air, while the latter being compressed in a ratio corresponding to the areal reduction of the said plugs operate to present an effectual bar to slippage. The feature of interference between the entering volume of air and the incoming flow of water at the intake end of the pipe is eliminated by disposing the discharge end of the nozzle below the said end of the eduction-pipe and discharging the air in a tubular column concentric with the pipe, the water and air entering the pipe at the same time and the air by expansion laterally in both directions—that is to say, toward the center and the circumference of the pipe—presenting a thoroughly effective cushion, which bears with equal pressure upon the entire exposed terminal area of the slug of water above it, whereby any cutting, and thus escape of air upward through the slug, with attendant loss of energy and permission of slippage, is positively prevented. It may be stated, therefore, as a general proposition in connection with an elevator constructed in accordance with the present invention—that is to say, where the diameter of the eduction-pipe gradually decreases from its intake to its discharge end and where the air-discharge nozzle discharges the air below the end of the pipe and in a tubular column concentric therewith—that the area of the slug of water is reduced and the pressure of the cushion of air is increased in direct proportion to the taper of the pipe and the distance the water is to be lifted.

Referring now to the drawings and to Fig. 1 thereof, 1 designates the eduction-pipe, the same being constructed of a plurality of tapered sections 2, held assembled by collars 3. Disposed below the lower end of the eduction-pipe is the air-discharge nozzle 4, consisting of an outer tapered shell 5 and a concentrically-arranged inner straight cylindrical shell 6, the two shells being held assembled by an annulus 7, which may be either integral with the shells or secured thereto. It will be seen by reference to Fig. 1 that where the air-supply pipe 8 enters the nozzle, being at or near the bottom thereof, that the annular space between the two shells is comparatively wide, while at the upper or discharge end of the nozzle the space is constricted. The object of this arrangement is to permit the air within the nozzle to encircle the inner shell thereof and to be discharged in an even tubular column without exterior lateral expansion into the eduction-pipe, thereby to effect positive upward projection of a slug of water therein. The means for supplying compressed air to the pipe 8 is not herein shown, as any suitable source of power may be employed therefor. The upper or discharge end of the nozzle is of less diameter than that of the pipe and terminates some distance below the same, thereby leaving ample space for the water to enter the pipe around the entire outer diameter of the nozzle and also upward through the inner shell 6, as indicated by arrows in Fig. 1. The space between the opposed terminals of the pipe and of the nozzle is to be sufficient to permit uninterrupted entrance of water to the pipe, so that at each impulse of compressed air a clearly-defined slug of water and cushion of air will enter the pipe, and by reason of the fact that the air will be evenly distributed over the entire exposed terminal area of the slug slippage will be positively prevented. As each successive impulse of air and slug of water enters the eduction-pipe the composite column of water and air within the pipe will be gradually lifted toward the discharge end thereof, and as its upward movement is effected in a step-by-step manner there is a progressive decrease in the terminal areas of the slugs of water and a progressive compression of the cylinders of air, which operates with the water to render it more difficult of permeation by the air and with the air to render it more dense, and thus more effective in supporting the superposed slug of water. It will be apparent that each successive cylinder of air from the top of the pipe downward will be subjected to added compression in a ratio proportionate to the added weights of the successive slugs of water, so that the film or skim of water that is always flowing down the sides of the inner surface of the pipe will meet with progressive resistance to escape from the top to the bottom thereof, whereby, in effect, owing to the above-described progressive compression of the cylinders of air, there will be practically no escape of water at the bottom of the pipe, thereby effecting with a given output of energy the lifting and discharge of a maximum bulk of water.

In the form of elevator shown in Fig. 2 the nozzle is arranged in the same manner as that shown in Fig. 1 and operates precisely the same, the only difference between the two structures being in the construction of the eduction-pipe to cause it to present a gradually-reduced structure. Instead of having the succeeding sections of pipe true tapers the lowest section 9 in this instance will be a true hollow cylinder, the next section 10 a tapered cylinder, and so on throughout the entire length of the pipe, the sections being connected by threaded collars 11. Of course it is to be understood that, if preferred, the lowest section 9 may be a tapered, the next a straight cylinder, and so on.

In the form of elevator shown in Fig. 3 the

taper or reduction of the eduction-pipe is accomplished by the employment of successive sections 12 of straight pipe, each of smaller diameter than its successor, the sections being connected by reducing-couplings 13. The form of discharge-nozzle is the same as that shown in the other figures and operates in like manner.

By reason of the fact that the air from the discharge-nozzle enters the eduction-pipe in a tubular column concentric therewith and that a column of water enters the nozzle also concentrically thereof it will be apparent that, if preferred, the nozzle may project within the lower end of the eduction-pipe without offering any resistance to or obstructive interference with the free entry of water into the same, and as this will be perfectly obvious detailed illustration thereof is deemed unnecessary.

It will be seen from the foregoing description that by a very slight change in the structural arrangement of the eduction-pipe and by the novel construction of the air-discharge nozzles, that obstacles that have been heretofore insurmountable in water-elevators of this character are easily and in a thoroughly practical manner overcome, and, further, that by obviating slippage of the slugs of water within the pipe and the cutting thereof by the cylinders of air, that practically all of the energy employed is utilized for doing effective work.

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

1. In a compressed-air water-elevator, an eduction-pipe having its bore diminished in diameter from its intake to its discharge end, and means disposed below and spaced from the lower end of the pipe for discharging a current of air concentrically of the pipe.

2. In a compressed-air water-elevator, an eduction-pipe having its bore diminished in diameter, in a predetermined ratio, from its intake to its discharge end, and means disposed below and spaced from the lower end of the pipe for discharging a current of air concentrically of the pipe.

3. In a compressed-air water-elevator, an eduction-pipe tapered from its intake to its discharge end, and means disposed below and spaced from the lower end of the pipe for discharging a current of air into and concentrically of the pipe.

4. In a compressed-air water-elevator, the combination with an eduction-pipe having its bore diminished in diameter from its intake to its discharge end, of a nozzle adapted to discharge a tubular column of air into and concentrically of the pipe.

5. In a compressed-air water-elevator, the combination with an eduction-pipe having a tapered bore, of a nozzle having its discharge end disposed below the lower end of the pipe and constructed to project a tubular column of air into and concentrically of the pipe.

6. In a compressed-air water-elevator, the combination with an eduction-pipe having a tapered bore, of a nozzle having an annular air-discharge mouth and a centrally-disposed water passage-way.

7. In a compressed-air water-elevator, the combination with an eduction-pipe having a tapered bore, of a nozzle disposed below and spaced from the lower end of the pipe and comprising an outer tapered shell, an inner straight cylindrical shell, and an annulus connecting the lower edges of the two shells.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

GEO. R. TYLER.

Witnesses:
ARZA CRABB,
G. L. FRISBEE.