3 Sheets--Sheet 1.

H. B. DUNHAM.

Apparatus for Charging a Stream of Water with Carbonic-Acid Gas.

No. 161,216. Patented March 23, 1875.

Fig. 1.

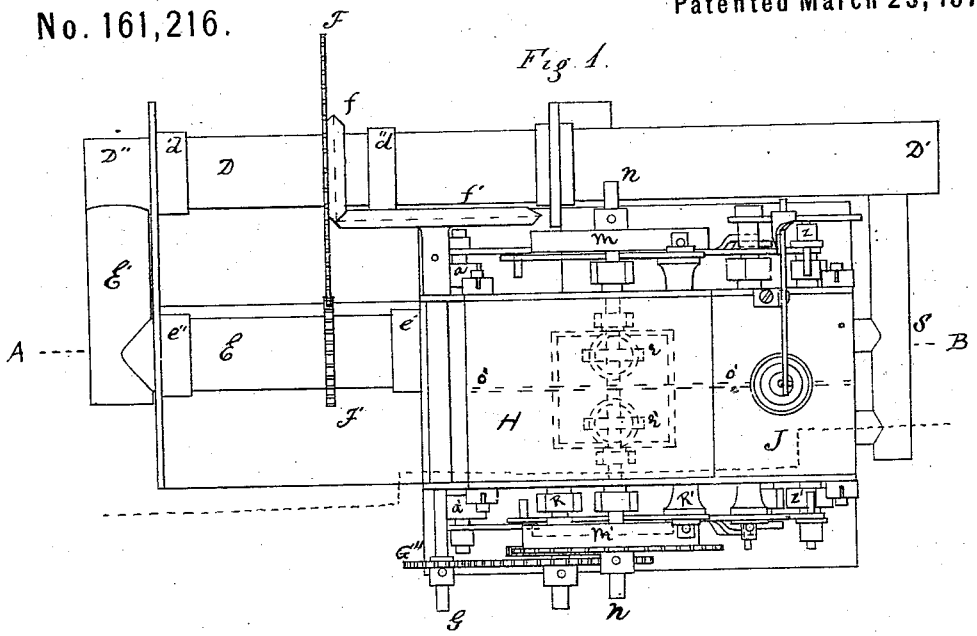

Fig. 2.

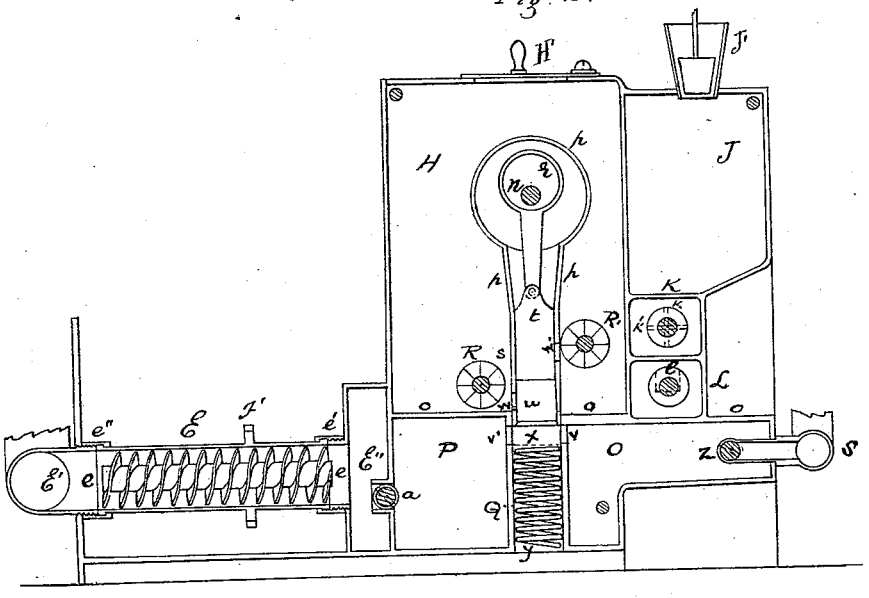

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Fig 3.

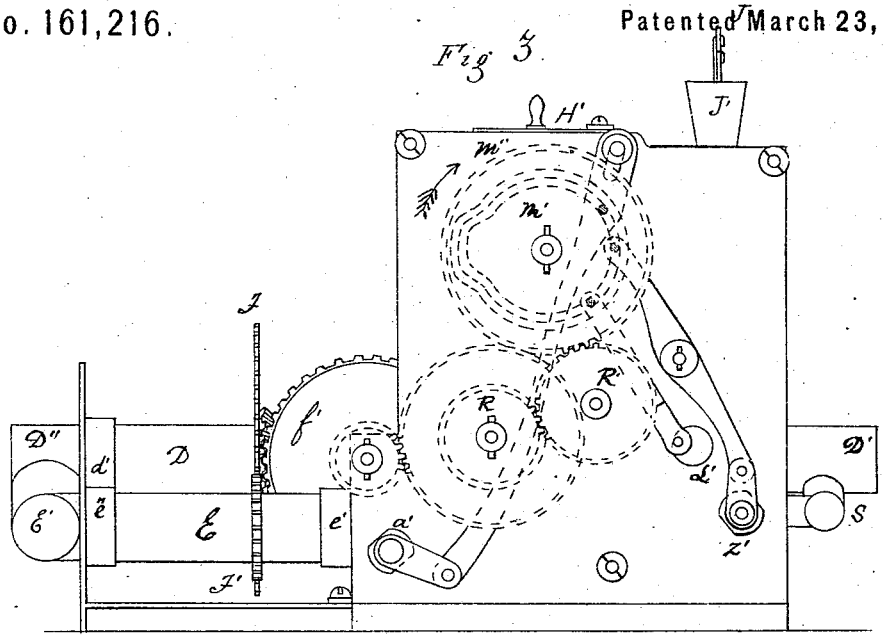

Fig. 4.

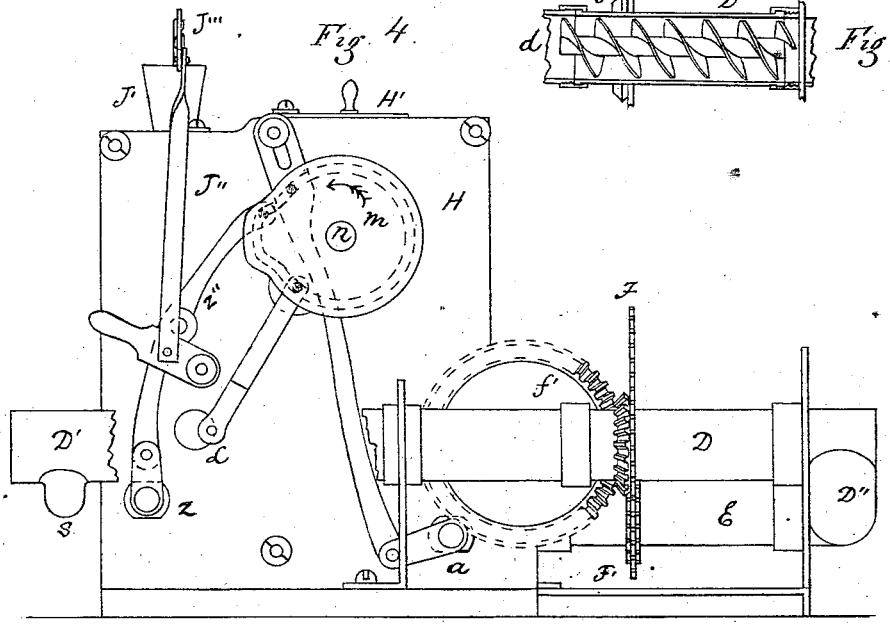

Fig. 5.

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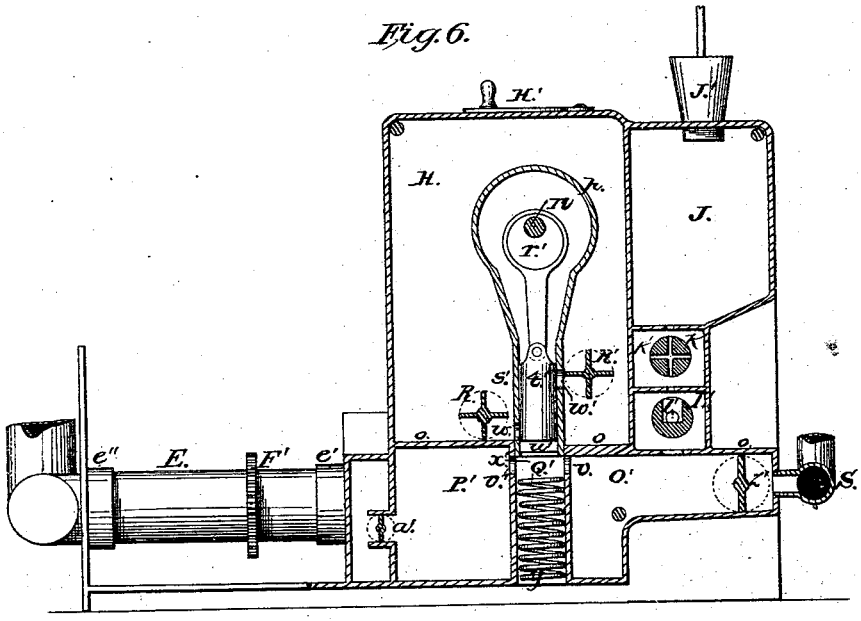
Fig. 6.



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THE GRAPHIC CO. PHOTO.-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

HUMPHREY B. DUNHAM, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN APPARATUS FOR CHARGING A STREAM OF WATER WITH CARBONIC-ACID GAS.

Specification forming part of Letters Patent No. **161,216**, dated March 23, 1875; application filed November 18, 1874.

To all whom it may concern:

Be it known that I, H. B. DUNHAM, of the city of Newark, county of Essex and State of New Jersey, have invented a new and useful Apparatus for Charging a Stream of Water with Carbonic-Acid Gas; and I do hereby declare that the following, taken in connection with the accompanying drawings, is a full, clear, and exact description and specification of the same.

My invention relates to mechanism for extinguishing fires by the use of carbonic-acid gas and a stream of water; and the object is to avoid the objections to which such apparatus is now liable, in consequence of the necessity of recharging the vessels containing the carbonic acid and water by hand, which prevents the continuous use of the apparatus to put out a fire after one charge has been exhausted.

To this end my invention consists in combining, with a stream of water, a stream of carbonic-acid gas mixed with water, after said stream of water is under motion, propelled by the force of gravity or any other mechanical force. And my invention also consists in certain combinations of mechanism to effect the mixture of the stream of water and the mixed carbonic-acid gas and water, which combinations are specifically set forth at the end of this specification.

It is now the common practice, in extinguishing fires by mixed carbonic-acid gas and water, to apply pressure to the mixture or to depend on the force of the gas alone for the discharge of the mixture upon the fire. My apparatus is to be applied to the hose or pipe through which a stream of water already under pressure is flowing, depending on a force other than the gas pressure to throw the stream.

Figure 1 of the drawing represents a top view of my apparatus. Fig. 2 represents a vertical longitudinal section on the line A B, Fig. 1. Fig. 3 is a side view of the apparatus. Fig. 4 is a side view also, showing the main supply pipe or hose D. Fig. 5 a is vertical section of the propeller in pipe D.

The pipe D is connected at the end D′ with a steam-pump or other forcing mechanism or power, and at the end D″ with an outlet-pipe or discharge-hose, provided with a suitable nozzle to deliver the mixed water and gas to the fire. At D″ the pipe E′ connects with it, conveying the gas or mixed water and gas from the chamber E″ through the pipe *e* and over the propeller *e*. In the pipe D is a propeller, *d*, attached to the pipe, and, as the pipe D, from the ring *d′* to the ring *d″*, is connected with the other parts of the pipe by packed joints, the force of the current over the propeller causes the propeller and section of the pipe D to turn around. On the outside of the pipe D is fastened a gear-wheel, F, which meshes into another and smaller gear-wheel, F′, on the pipe E, causing it to revolve faster than the pipe D and its propeller *d*. It is also connected to the rings *e′* and *e″* by means of packed joints. The pipe E and its connected propeller revolve by means of the force of the stream acting on the propeller *d* through the gears; but it also is forced to revolve partially by the force of the mixed carbonic-acid gas and water passing through it from the chamber E″ toward D″. As the propeller *e* revolves faster than *d*, it is made of less pitch. On the pipe D is attached also a bevel-gear, *f*, which meshes into the gear *f′* on the cross-shaft G, which conveys motion to all the remaining working-parts of the apparatus. H is the reservoir for holding soda or marble-dust, or other such like material, and J is a reservoir for holding sulphuric or other suitable acid.

The reservoir H is supplied with an opening, H′, at the top, for the admission of the marble-dust or soda; and reservoir J has a funnel-shaped entrance, J′, provided with a stopper. It is lined with lead or other substance not affected by acid, as are all the like parts and connections. Under the reservoir J is the faucet-valve K, provided with two passage-ways, *k* and *k′*, to supply the acid to the measuring-cups below. On the end of the faucet-shaft is a crank-pin, to which is connected a rod, J″, and lever J‴, for raising the stopper in the funnel J′ at the proper times to give vent, and to allow the reservoir J to be filled while the apparatus is in action. L is a shaft, covered with lead and turning in lead bearings, provided with a measuring-cup, *l*, placed directly under the opening in the faucet-valve K, to receive the acid as it falls from the reservoir J. L′ is another shaft, in all re-

spects like L, and placed on the same line, having also a measuring-cup, *l'*, under an opening in the faucet-valve. This shaft is operated alternately with shaft L by means of a crank attached to one end, projecting through a packing-box, actuated by a connecting-rod, which transmits motion from a cam, M', on the shaft N. This shaft N is furnished with bearings in the sides of the reservoir H, extends through it, and projects on each side through packing-boxes far enough to receive a cam, M, on one end, and a cam, M', and a gear, M'', on the other. The cam M gives motion to the shaft L through a connecting-rod and crank, operated in the same manner as is shaft L', but at intervals alternately about one hundred and eighty degrees apart. Both the shafts L and L' move or revolve a portion of a circle after the cups are filled, to empty their contents into the chambers O and O' below. There is a partition, *o*, running horizontally below the shafts L and L', extending over the whole surface of the reservoirs H and J, and a partition, *o'*, running vertically down between the cups of the shafts L and L', and dividing all the space under the partition *o* into two sets of chambers, O and O', P and P', and the cylindrical chambers Q and Q'. The shaft N is incased by a covering, *p*, which protects it from the soda or other material thrown into the reservoir H. It is furnished with two eccentrics, *r* and *r'*, set at one hundred and eighty degrees to each other over the cylinders *s* and *s'*. To these eccentrics are connected straps and rods, which are jointed to pistons *t* and *t'*. These pistons are provided with cups *u* and *u'*, which are perforated, to correspond with the openings *v* and *v'* in the top of the cylindrical chambers Q and Q when the pistons are at the lowest point of their stroke, and with the openings *w* and *w'* in the cylinders *s* and *s'* when they are at the highest point in their stroke, as shown in drawing, Fig. 2. Opposite these openings *w* and *w'* are fan-wheels, which are revolved by the gears R and R' continuously, and compel the soda or marble-dust to fill the cups in the lower portion of the pistons. They revolve in different directions, or toward each other, throwing the soda toward the openings. The cylinders *s* and *s'* are concentric, and directly over the cylindrical chambers Q and Q'; and the latter are provided with rubber stoppers *x* and *x'*, fitting the cylindrical chambers, and caused to follow and press against the bottom of the pistons *t* and *t'*, and when at the top of the chambers act as valves over the end of the cylinders *s* and *s'*, which are of less diameter than Q and Q'. They also close the openings *v* and *v'*, effectually preventing any flow of material from the chambers O and O' to the chambers P and P', except when the pistons come down and remove the rubber valves *x* and *x'*. These rubbers are kept in place by spiral springs *y* and *y'*.

In the chambers O and O' are water-valves *z* and *z'*, which connect with a pipe, S, leading from the pipe D', to supply water to the chambers O and O'. They are actuated at the proper intervals, alternately, by the cams M and M', respectively, and by similar connecting-rods and levers, as are the shafts L and L'. Between the chambers P and P and the chamber E'' are the valves *a* and *a'*, for letting out at proper intervals, alternately, the mixed gas and water from the said chambers. They are operated by the cams M and M', respectively, by means like that described before for the shafts L and and L'.

The shaft G communicates motion, through the gear G' and intermediate reducing-gears, to the gear M'' on shaft N, and also to gears of equal size and number of teeth on the ends of the shafts which drive the fan-wheels R and R'.

The operation is as follows: The reservoir H is first supplied with soda or marble-dust, or any material suitable to make carbonic-acid gas, in connection with acid. The reservoir J is supplied with acid, and the faucet-valve K turned to permit the acid to flow downward and fill the cups in the shafts L and L'. The pipe D' is now connected with the force-pump or street-main, and a pressure of water allowed to flow through the pipe D and over the screw-propeller *d*. The flow and force of the water cause the pipe D and propeller to revolve, giving motion to the gears F F' *f* and *f'*, and all the gears in connection. The fan-wheels R and R' throw the marble-dust into the cups of the pistons *t* and *t'* as they move toward their highest point. The cam M being in position, and moving in the direction of the arrows, Fig. 3 and Fig. 4, the piston *t* being near its lowest point, the valve *z* is opened by the action of the cam through the connecting-rod *z''*. At the same time the piston *t* is descending and bringing its charge of soda or marble-dust under the action of the water charged with sulphuric acid in the chamber O. The water from the pipe S rushes in through the valve *z*, and drives the contents of the chamber O through the openings *v* and *v'*, forcing the marble-dust in the cup of the piston into the chamber P, which is partly filled with water. When the piston reaches the lowest point of its stroke, having forced down the valve *x*, the valve *z* is wide open. The piston now begins to rise, and when it has moved one-sixteenth of its upward stroke, or thereabout, the valve *z* is closed, the time of remaining open being about one-eighth of the revolution of the shaft N, and as compared with the movement of the piston while the latter is making the last sixteenth of its downward stroke and the first sixteenth of its upward stroke, so that the water mixed with sulphuric acid forces out the marble-dust into chamber P through the openings *v* and *v'* while the openings in the cup of the piston are in line with them. The valve *z* is closed, the shaft L is turned, and the sulphuric acid in the cup *l* is poured into the water in the chamber O, the piston *t* having moved up and the valve *x* covering the openings *v* and *v'*. Af-

ter an interval of rest the discharge-valve *a* is opened, and the contents of the chamber P are thrown out into chamber E″ over the propeller *e*, and through the pipe E′ to the pipe D″, where the mixed gas and water unite or combine with the water flowing through pipe D, and by its force is thrown toward the nozzle and upon the fire.

As the propeller *e* revolves with the pipe E more rapidly than the propeller *d* and pipe D, any tendency for the contents of pipe D″ to flow backward into chamber E″ will be prevented, the action being somewhat similar to that of a check-valve. Precisely the same operation is gone through again, by the mechanism on the other side of the apparatus beginning as soon as the valve *l* is closed, or nearly so, two charges being delivered to the stream of water from the apparatus each revolution of the shaft N. The shaft N is connected by intermediate gearing with the shaft G, and with the gear on the pipe D, driven by the propeller inside. The rings *d′ d″* are to be filled with a suitable packing to prevent leakage, as are the rings *e′ e″*.

I do not wish to confine myself to the kind of water-wheel shown, as any wheel that will give the proper motion to the shaft G will answer the purpose; and I propose, if necessary, to turn the shaft G by other power—by a belt connection or gear. Neither do I wish to confine myself to an apparatus made in duplicate, as a single action will be entirely practicable.

The proportionate amount of carbonic-acid gas and water conveyed to the stream of pure water will, of course, depend on the size of the pipe D, and the proportionate speed between the propeller *d* and the shaft N, which may be varied at pleasure; but I do not propose to introduce into the stream of pure water large amounts of carbonic-acid gas and water at great intervals of time, but to introduce small amounts of the said gas at short intervals, producing, as nearly as possible, a continuously-flowing stream which receives its force mainly from the engine or pump to which the pipe D′ is connected, or from the gravity of the water.

All the parts of my apparatus exposed to the corrosive action of acids are to be lined or covered with lead, or other suitable material, to prevent such action.

As the sulphuric acid is discharged from the cups *l* and *l″* into the chambers filled with water O and O′, the water is warmed, and when the valve *z* is opened the upper portion is thrown toward the marble-dust, the mixing and formation of carbonic-acid gas being principally effected in the chambers P and P′.

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

1. The combination of an apparatus for charging water with carbonic-acid gas, and a pipe so arranged in connection with said apparatus that a stream of water flowing through said pipe may be mixed with water charged with carbonic-acid gas, and discharged on a fire, substantially in the manner and for the purposes set forth.

2. The combination of a water pipe or hose, provided with a water-wheel and gear, caused to revolve by the force of the water passing through a reservoir for marble-dust, or such like substance; and a reservoir for acid, provided with such mechanism, operated by said wheel, that charges of said marble-dust are mixed with sulphuric, or other suitable acid, and water, to charge the latter with carbonic-acid gas, and the mixture discharged into the said water pipe or hose, for the purposes set forth.

3. The combination of a water pipe or hose, through which water is forced by pressure, and an apparatus connected to it by a discharge-pipe, and an inlet-pipe for admitting water to said apparatus, all arranged in such manner that a stream of water may be charged with carbonic-acid gas and water by mechanism substantially as set forth.

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