equal parts) and over this the concrete. The walls and piers are made by ramming the concrete into wooden forms, due allowance being made for contraction and expansion, while the concrete forming the roof is also put on over wooden forms in such a way that each pier is actually, and the whole chamber practically, a monolith, or single stone, the leakage through which, either in or out, may be disregarded. On the floors of the bed, in parallel lines between every two rows of piers, are laid perforated terra-cotta pipes 8 inches in diameter. These pipes, running to the center of the floor of the bed, meet there a pipe running at right angles to them, and this pipe conducts the filtered water out of the chamber.

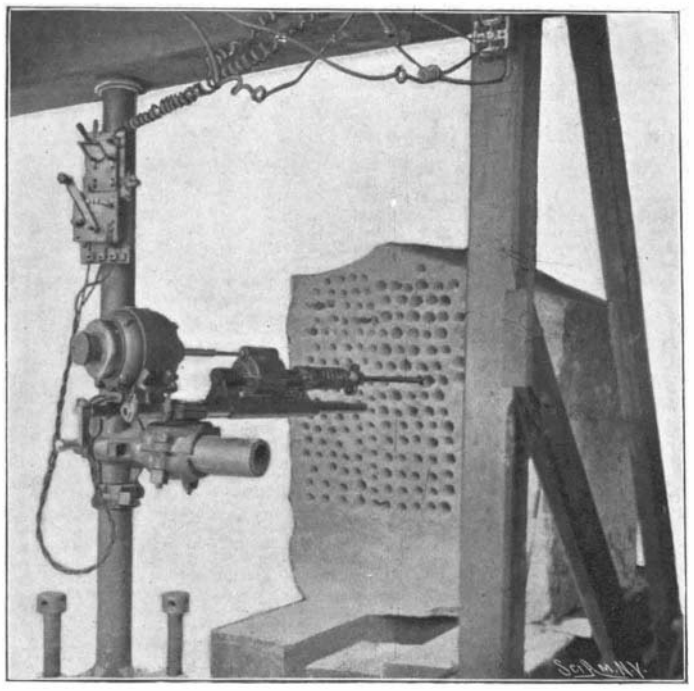
Over the perforated pipe is put broken stone or coarse gravel, the first layer being of stones the size of a walnut, to a depth of a foot. Over this is put from three to three feet and a half of sand. It is this sand which does the work of filtering. Over the roof is about two feet of earth, and such surface water as may fall on this and find its way to the concrete roof is taken up by a two-inch drain pipe.

The water to be filtered is let into the bed directly from the river through a twenty-four inch pipe; there is only one outlet for each bed. The water filters through the sand and into the perforated pipe, and thence into the pipe, which carries it out of the bed. Just outside of the bed it goes to the regulating chamber, whereby the flow of water, and consequently the rate at which it is filtered, is automatically controlled. The filtered water flowing into this chamber fills it to a point where it may flow out by passing over and into the upper end or mouth of a pipe which stands vertically in the chamber, and which is so supported on a float that its mouth is always at a given distance below the surface of the water. If the mouth is raised above the surface, as it can be of course, no water flows out; the lower it is sunk below the surface the faster the water will flow. From the regulating chamber the water flows by gravity into pipes which run along the alleys—or courts as they are called—between the batteries or sets of filter beds, and thence it finds its way to the conduit running along the west side of the plant. This conduit is practically one solid stone pipe made out of concrete, beginning with a diameter of 7½ feet and increasing to 10. It empties into the filtered water basin, which covers an area of 10½ acres and has a capacity of 50,000,000 gallons. The basin is made entirely of concrete. Its inside height in the clear is 18 feet, and its roof is supported by piers similar to those in the filter beds. The roof is covered with earth, as are those of the beds, but since the water is now filtered, no surface water is allowed to get into it, but is carried away by drainage pipes.

From the filtered water basin another solid concrete conduit 10 feet in diameter runs for a distance of 900 feet, carrying the water to a shaft that connects with a tunnel that runs to what is called Lardner's Point, three and a half miles away.

The water supplied to the filters is pumped to the preliminary filters, through which it will pass and flow by gravity to the plain sand filters. The preliminary filters contain a bed of granulated material, which may be broken trap rock or slag, varying in size from ⅜ to 3-16 of an inch and in depth about 30 inches, above which is placed a mattress of compressible material, through which the raw water flows from the bottom to the top.

In cleaning the beds it is necessary to take great care not to disturb the layers of sand. Filtered water is at first put in very gently from the under side, taking just the reverse course it has when being filtered. Once the surface of the sand is sufficiently covered with water, the rest may be again put in through the regular supply pipe. These "refill pipes" are as numerous and complete in their system as the supply pipes. They are each 16 inches in diameter. Each bed has a sand incline, by which the sand is taken out or new sand put in. This sand incline is built upon iron channel beams, which are set into the two middle rows of piers. At the apex of every other one of the arches of which the roof is formed is a manhole, which serves for light and ventilation while the bed is being cleaned. Each filter bed has to be cleaned once a month, which requires a day's work on the part of thirteen or fourteen men. For the entire system there will be needed about 400 permanent employes working as filter-bed cleaners. It is expected that the work will be finished this fall.



THE LOCKE ELECTRIC PERCUSSION ROCK DRILL.

THE LOCKE ELECTRIC ROCK DRILL.

This drill is one of the percussion type, the drilling tool having a combined reciprocating and rotary motion. In this it resembles the usual form of air drills, but being driven by electricity it has, instead of the somewhat unmanageable air tubes, simply flexible wire connections. It is essentially a ball bearing machine, is made dust and water proof, and only requires a few drops of oil at intervals of an hour or more to keep it in perfect working order. Any overheating can be readily felt, and at once reduced with a little oil. The shank or base of the drill (see figure) is made to fit the clamp or saddle generally used upon the ordinary 4½-inch column or 4½-inch arm.

The motor, which is inclosed in a spheroidal shell (at the left of figure) is directly connected by means of a hollow extension shaft, thus doing away with the usual flexible shaft of other drills. It is readily detached, and as it only weighs 95 pounds one man can carry it about, or two men can handle the whole drill without disconnecting it. The motor is a shunt wound ¾ horse power making 2,500 revolutions per minute and using 220 volts of direct current. The drill strikes the rock 300 to 350 blows per minute, and the spring which gives the forward motion of the piston has a final compression at the end of the back stroke of 720 pounds, thus giving a very high forward velocity to the piston. The drill will rarely if ever stick in the rock when crossing seams or soft spots, as the mechanism is so constructed as to have much greater power to pull the drill back than the spring has to drive it forward.

The Locke Drill Company makes specially favorable arrangements to supply duplicate parts. A number of extra parts are supplied with each drill.

The weights of the different parts of the drill are as follows: Motor, 95 pounds; drill bore, side bar, and feed screw, 53 pounds; front and back cylinders and interior mechanism, 91 pounds; total weight, 239 pounds.

Among the advantages of this drill may be mentioned that the insulated wire connections of the drill are much more easily handled and much cheaper than the air pipes of pneumatic drills. Many mining districts are now well supplied with electric power, and it is only necessary to put in rotary transformers where the current is alternating or the voltage unsuitable. Many mines however have their own electric light plant, usually furnishing direct current, and a few drills using less than one horse power each would not overload the dynamo.

THE GORTER WATER TOWER.

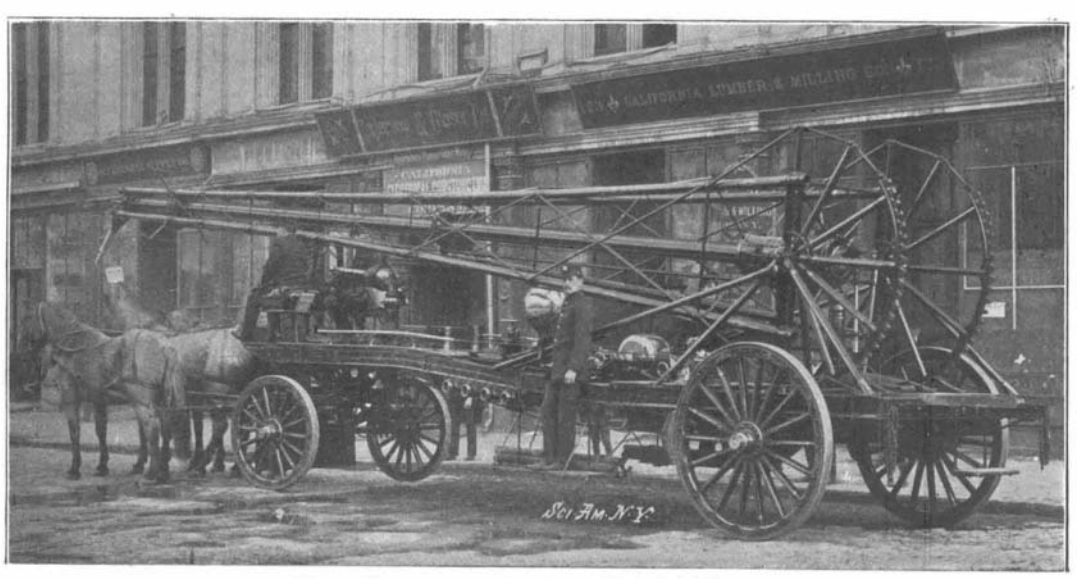
BY H. J. BENNET.

San Francisco has in service among its fire apparatus a "water tower" embodying in its design and construction some very novel features and radical departures from any other tower heretofore constructed.

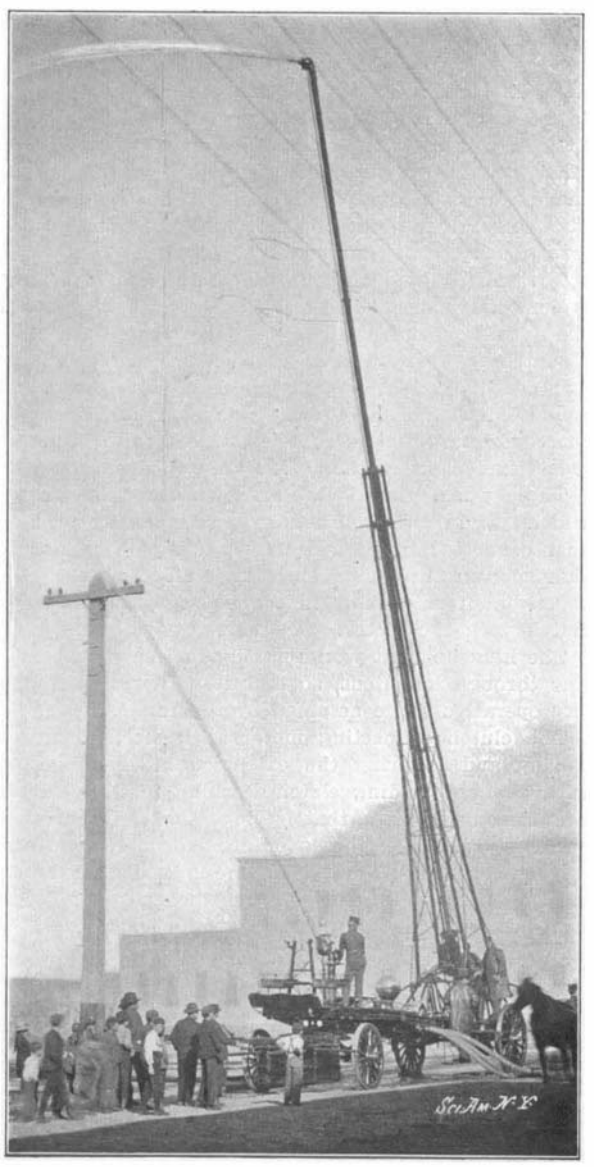
It was invented and designed by Henry H. Gorter, a mechanical engineer in the fire department of that city. This tower has fully demonstrated its superior efficiency, during its few months of service under rigid tests and at large fires, in a manner such as to attract wide attention from fire officials of various cities throughout the United States and Europe. Its construction and general features are as follows: The body frame or truck proper is of 5-inch channel steel, built on the truss principle, the rigidity being obtained by various hog braces and truss rods. The main mast is 3-inch light steel tubing, properly braced and reinforced, forming a very rigid, yet light pyramidal frame so arranged as to swing on trunnions at its lower end; said trunnions being carried on two tripod frames resting on truck proper.

The extension of mast which slides up and down through center of mast proper is of 5-inch light steel boiler tubing, reinforced by two feathers on the outside, to take up excess of spring under back pressure strain from nozzle.

The full extension of this tower is 76 feet to center of nozzle ball joint, the nozzle itself reaching 2½ feet beyond that, making this, by far, the highest water tower in service, in either the United States or the world. This tower is metallic telescopic, no hose at



THE TOWER SWUNG DOWN ON THE TRUCK.



THE TOWER IN ACTION.

all being employed. Inside the extension of mast and fastened to the base of main frame, a light four and one-half (4½ inch) inch brass tube is connected, forming a water conduit, carrying at its upper end a hydraulic packing joint, working inside mast extension and which tightens up under pressure.

This arrangement entirely obviates the accumulation of dead water in extension of mast, which in winter time might freeze and incapacitate the machine from service.

The manipulation of the tower is accomplished by a Pelton water wheel, placed on the body of the truck. This wheel is reversible, working both ways, two jets being used moving in opposite directions and controlled by a three-way valve. A lever in the hands of the fireman in charge enables him to shut off entirely, or open either jet.

The tower proper is raised by means of right and left-handed worms working segmental worm gears fastened to base of mast proper. By this means the tower is locked in all positions the moment the motor stops.

An unusually strong feature of the tower is, that it will operate at an angle of 35 degrees either way of the perpendicular and can be swung backward or forward through said angles while delivering its stream and at all pressures. To render this innovation possible, the water conduit connection between base of mast and main supply is made on the ball and socket joint principle, said joint being axially in line with the center line through trunnions of mast. When the tower is raised to an approximate vertical position, the fireman detailed for this purpose simply locks the segmental threaded connection between the main supply, previously mentioned, and ball joint of mast, by one-third of a turn. The advantage of the swinging mast is that an entire front of a building can thereby be covered, as the mast, when swinging through its entire arc oscillation of 70 degrees, will cover a frontage of no less than 90 feet.

The nozzle is at all times in a position to throw a stream clear through a building to the rear, a feat impossible when merely rotating the nozzle as in other towers. However, the nozzle on the Gorter tower also possesses a rotary movement to its vertical axis.

The second main feature is that the extension of the mast is both raised and lowered by the water motor, and can at all times be raised and lowered while the tower is in action, by which means the stream can be instantly changed from the eighth to the third story, and *vice versa*.

No tower heretofore built has or does embody this feature. Of course by raising or lowering the nozzle, the stream from this tower can be deflected up or down, but the same objection holds good in this case as that which exists when rotating a nozzle horizontally; namely, that a stream thus deflected fails to reach the rear of a building and consequently loses much of its usefulness.

The raising and lowering of extension of the mast is done by means of two test chains running over two chain pulleys, fastened to two worm-geared wheels mounted in base of mast proper. These test chains run over idlers fastened to upper head of mast and connected with base of mast extension at both ends, thereby forming endless chains, which raise or lower "mast extension" as the chains are pulled up or down.

These worm-geared wheels are operated by worms which are in turn worked by an internally meshed gear connected by intermediate gearing on a vertical shaft driven through a knuckle joint. And the continuation of said shaft is connected by means of a clutch with the motor.

The knuckle joint works axially in line with center line through trunnions, so that it will work through any operative angle assumed by the tower.

The clutch connecting motor with mechanism for raising and lowering the extension is so connected with a corresponding clutch working mechanism for operating main mast, that by engaging one, the other becomes disengaged, thus avoiding danger of accidents.

Another strong point is, that the up and down movement of the nozzle at the top of the extension is effected through a ball and socket joint and operated from below by means of a hollow shaft, and an octagonal extension in same, to which is connected a worm working a segmental gear fastened to the nozzle proper. This feature entirely eliminates the danger of mishaps caused from bursting hose. The nozzle being mechanically connected, can at all times be maintained in any desired position, as it is not dependent on the pressure to raise same as when hose is used. In latter case, when hose is used as in other towers then the elevating of the nozzle depends on the tendency which hose has to straighten out under pressure. The Gorter tower is not thus handicapped.

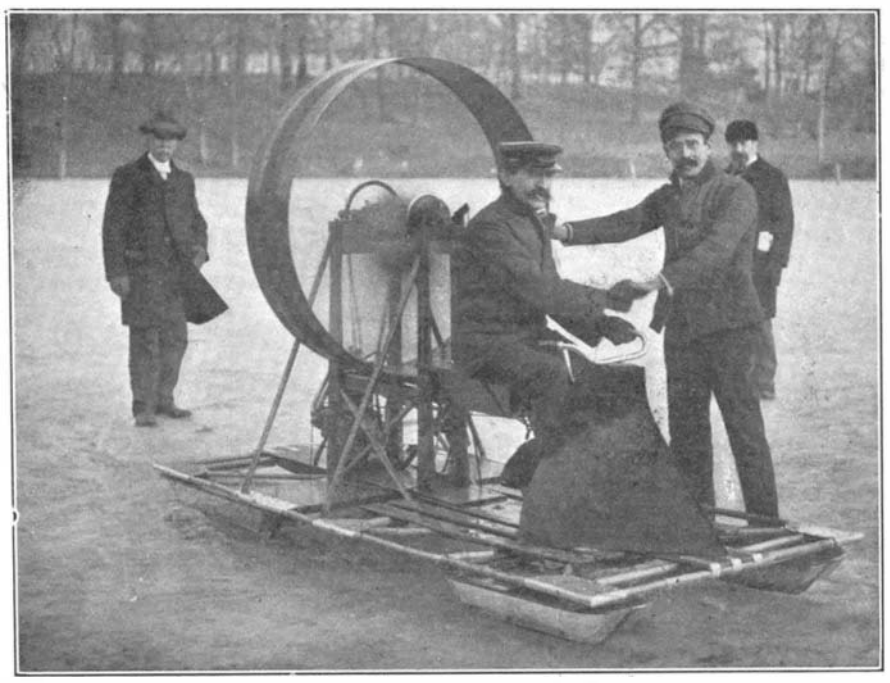
The truck of the tower proper carries a receiver having eight 3-inch inlets and surmounted by an air chamber, the latter being necessary to minimize excessive pumping vibration. In addition there is carried on forward part of truck a Gorter Monitor battery, also telescopic and attaining a height of ten feet from ground when fully extended, and being employed to throw a stream from a third story to basement. Diameter of battery nozzle is 3 inches, with different reducing tips when smaller jet is desired.

When working to its utmost capacity the tower will receive the water from four first-class fire engines and deliver about 4,500 gallons per minute, weighing about 37,500 pounds.

The nozzle of tower proper is 2¼ inches in diameter, and it will be understood that a nozzle of this size working on a lever 76 feet long exerts an enormous power tending to capsize the tower.

To prevent same, there is attached to top of tripod frames a swinging strut carrying at its outer end a pair of compass legs, which, in opening out form an "A" frame. Two chains fastened to truck an equal distance apart from center of tripod frame hook in two eyes movably mounted on outer end of said strut. These eyes connect with a screw, and by merely turning a small handle on outer end of strut described, can be moved in or out.

To operate this strut it is simply necessary to swing out same at right angles to truck, hook in the chains in eyes, open out compass legs, permitting them to rest on the ground, then by merely turning the handle, chains will pull out, force down strut on "A" frame, pressing same in ground, thus forming a rigid self-supporting brace. This construction avoids difficulty found in other struts or braces made to engage with the ground by means of sharp points, which, on cement or stone sidewalks and hard-paved streets, often slip.



A SLED DRIVEN BY AN AIR-PROPELLER.

The tower is ready to throw a stream within 90 seconds from the time of connecting up the engines, and its weight complete is about five and one-half tons, or a load easily pulled by three horses to any part of the city.

Altogether the Gorter tower has won distinction as a fire fighter unequaled as a water tower, and in it San Francisco claims a perfect machine for its splendid fire department.

Wireless Telegraphy Between Guadeloupe and Martinique.

Regular daily communication has been established between Guadeloupe and Martinique by a system of wireless telegraphy. The station in Guadeloupe is situated near Gosier lighthouse, and that in Martinique somewhere on the peninsula of La Caravelle on the east side of that island. These stations have been installed by a detachment of army engineers. Thus far only official messages between the governments of the two colonies have been exchanged. The system in use is not that of Marconi, but one devised by the French engineer corps.

In a recent number of Petermann's Mitteilungen, Dr. G. Schott gives a summary of recent observations in respect to the distribution of the surface salinity of the oceans. It appears that in the Atlantic there are two large areas, north and south of the equator, with a very high percentage of salinity, but in the Pacific there is one comparatively small area with a like percentage, south of the equator. W. Stavenhagen sketches the history and present condition of cartography in Russia, and the editor, Dr. Supan, sums up the scientific results of the German and English antarctic expeditions so far as they have been received.

A MOTOR-DRIVEN ICE-BOAT.

An interesting experiment touching the problem of transportation on ice, is the air-sled or ice-boat driven by an air propeller, which is illustrated herewith.

The craft has a platform 12 feet in length by 4 in width, made of stout wooden slats, mounted on four big wooden skates fitted with steel blades, the front ones being so made as to respond to the steering gear, and turn, similarly to the front wheels of an automobile.

The steersman sits astride a narrow plank seat, which runs from the motor and propeller to the front end. His legs are protected behind a wind shield shaped like a plow. He guides his craft by means of an ordinary pair of bicycle handle bars, while the levers for controlling the spark, the mixture, and the clutch are within his reach. The propeller, which is 4 feet in diameter, is mounted on a frame above the motor, which is a 2¾ h. p. de Dion, connected with it by sprocket and chain. Its four blades are inclosed at the periphery by a flat band of their own width, riveted to them. This outer rim and the shape of the blades or pitch of the screw, are the vital features of the construction, and hold the secret of the successful operation of the machine. The inventor says that this mode of construction prevents the waste of any particle of air, all of it which comes in contact with the propeller being used for propulsion.

When the motor is started at slow speed and the clutch is thrown in, the propeller begins to revolve slowly, and gradually gains headway. As soon as it has attained a certain velocity of revolution, the sled starts slowly and gains speed, along with the propeller, until the maximum velocity of revolution is reached. This is about five hundred revolutions per minute.

There is no jerking motion, either when starting or stopping, a brake being provided that enables the operator to bring the sled to a stop in a very short distance.

Only one model has been made, but this was successfully tested, a few weeks ago, on the ice of a lake at Ridgewood, Long Island, when it carried three full-grown persons at a rate of fifteen miles an hour. The inventor believes twenty miles per hour can be attained by it, and a machine with twin propellers, operated by two 10 horse power motors, would easily make two miles a minute. At this trial of the model the weight of even six passengers did not affect its speed. It seems to run just about as fast across or into the wind, as against it; but when it goes into the wind, the number of revolutions increases and the motor runs faster.

The sled is the invention of Mr. J. Bruce Macduff, a native of Scotland, now residing in Brooklyn, N. Y.

Mechanical Brick-making.

A brickyard with an exceedingly up-to-date equipment is in operation at Dover, N. H., which is said to be the first radical departure from the time-honored methods of the ancients. By this means the item of labor, which has been one of the greatest considerations of brick yard operation, is now one of the least. Hand labor has been almost abolished, and its place has been taken by mechanical means. Thus, one man is said to take the place of fifteen or twenty.

The time required to put the bricks through all the various stages, and the great number of pieces to be handled, makes the conveyor system as now in general use unavailable for this purpose, but an adaptation of it was devised by which the material is handled in units of fifteen hundred. These are known as "stacks." The bricks are piled in these stacks after being shaped, and remain in the frames until they have passed through all the various operations. The "green" bricks are placed in these, just as they are piled in the stacks in kilns under ordinary circumstances. In this manner they are conveyed to the kilns, where they are baked. Here, by an ingenious arrangement, the bricks just entering are placed at a part of the kiln where the air striking them has been tempered by passing over the drier bricks, which have been there longer and consequently are nearer finished. This has the advantage of making a better brick, for the reason that the moist pieces are not twisted or warped out of shape by an intensely hot blast. It also represents economy of fuel. This plant has been in operation long enough to demonstrate its economies beyond all question of doubt, and it is exceedingly likely that the idea will be adopted in other parts of the country.