Thus impregnated, one of the stocking's ends is sewed up with asbestos thread, a loop being left by which the stocking is manipulated in the subsequent steps of the process. The sewed stocking is ignited at its top by a flame for the purpose of consuming the thread. After this treatment, all that is left is a reticulated structure consisting almost entirely of oxide of thorium. "Shaping and hardening" are the next stages through which the mantle must pass, both being effected by the Bunsen flame. Lastly, the mantle is dipped into a coating solution in order to protect it from breakage in transportation.

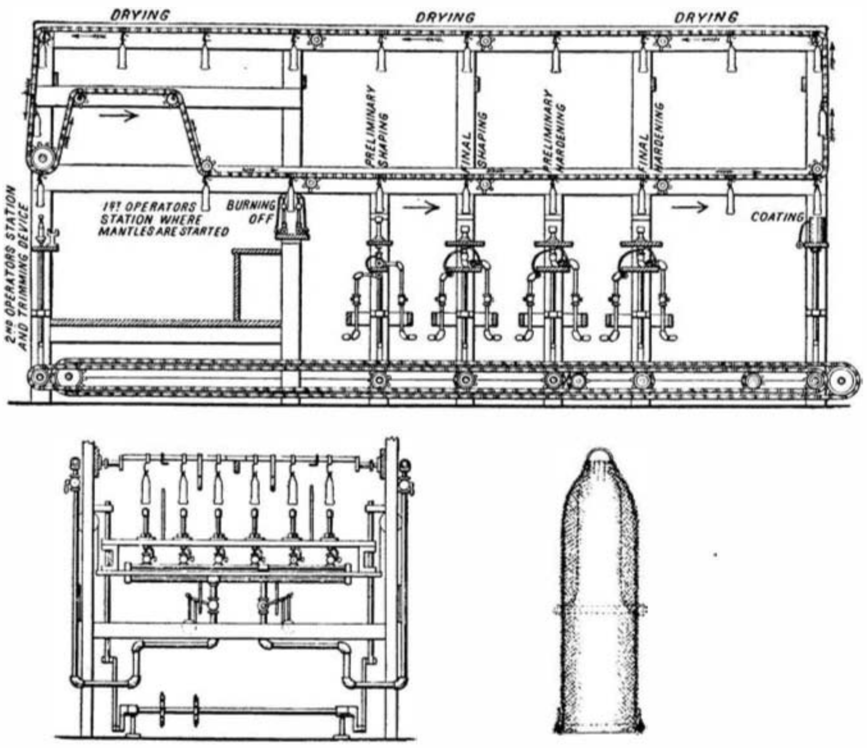
All these processes have hitherto been carried out by hand. The asbestos loop to which we have referred constitutes a means whereby a workman can pick up the mantle with a hooked rod and hold it over the Bunsen flame in shaping it. The percentage of losses incurred through imperfect shaping and breakage is high. The shaping and hardening of the mantle is accompanied by an unequal shrinkage which often renders the mantle unfit for use. Even if this did not occur, irregularities in the wall of the stocking may be formed, the result of imperfections in the thread, which cause unequal absorption of the impregnating thorium. In addition to these objections, expense naturally plays its part. The number of mantles which a single workman is able to burn off and shape in a day is necessarily limited. The number of imperfect mantles is large; consequently, the cost of the hand-made mantle is relatively high.

For the purpose of overcoming these objections, Mr. Joseph T. Robin, 258 Canal Street, New York city, has invented and patented what is probably the first machine for automatically making incandescent mantles. So successful has his apparatus been in actual operation, that it is fast taking the place of handwork in America and in Europe. A single machine is able to produce as many as four hundred and fifty perfect mantles per hour, and does the work of eight shapers, besides that of the dippers and others. Only two operators are required to serve the machine, one to place the stockings in position, the other to remove them after they are finished. An indicating device shows the exact number of mantles treated by means of the apparatus.

Naturally, the first improvement introduced by Mr. Robin in the process of making mantles was the prevention of irregularities caused by imperfections in the thread of the fabric. This difficulty Mr. Robin succeeds in overcoming by employing a metal ring, secured to the bottom of the stocking, which ring is of sufficient weight to lessen the contraction of the stocking during the operation of burning out. Furthermore, the ring prevents the formation of folds. In the accompanying diagram we illustrate a mantle, or rather an impregnated stocking, in which the full lines indicate the fabric before it is burnt off, and the dotted lines the form of the structure after the fabric has been destroyed. The ring clearly appears at the bottom of the mantle pictured in the diagram. Besides answering the purpose specified, the ring also serves to hold open the lower end of the stocking, so that the flames of the shaping and hardening burners can easily enter the interior, and to avoid the collapsing of the stocking during the dipping or coating process.

As shown in the accompanying photographic reproduction of an actual machine in operation, only two operators are needed. These operators are placed one in front and the other at one end of the machine. The operator seated within the machine has simply to hang the impregnated stockings by their asbestos loops upon the hooks of a series of carrier bars that intermittently move before her during the regular operation of the machine. Each carrier bar, by an ingenious arrangement of sprocket wheels and chains, is caused to move first over a set of burners by which the fabric of the stockings is burnt off; then to a set of burners by which the lower part of the mantle is shaped; after this, to another set of burners by which the upper portions are shaped; next, to a set of burners by which the mantles are hardened, and finally to a series of cups containing a coating solution, into which the mantles are dipped. Now practically complete, the mantles are elevated to the top of the framework of the machine, travel slowly toward the second operator, drying as they travel, and finally reach her, completely finished. Here the machine automatically removes the mantles from the hooks of the carrier-bars, each mantle falling on a trimming device. By a single movement of a lever, the operator causes a series of rotary knives to sever the bottoms of a series of mantles, thereby removing the rings (too cheap to save). Thus it will be seen that after the first operator has hung up the mantles on the carrier-bars, the machine passes them through the various processes. The gearing of the apparatus is so timed that the mantles are suspended over the burners and dipped just for the proper interval of time, the mantles traveling in an approximately oblong path from the starting point to the finishing point.

Limitations of space prevent our giving a detailed description of the machine. Broadly speaking, however, it may be said to consist of endless chains, connected with and extending between which are the carrier-bars from which the stockings are suspended. The chains are intermittently moved to bring the mantles over the various burners and the dipping cups. The accompanying diagram clearly indicates the general plan of the machine's construction and operation. Loss is entirely prevented; whatever breakage does occur is due to the carelessness of the operator. Rarely is a mantle lost. The uniform excellence of the machine-made mantles, moreover, cannot be attained even by the most skillful operator.



SIDE AND END ELEVATIONS OF THE AUTOMATIC INCANDESCENT MANTLE-MAKING MACHINE, AND A MANTLE WITH A RING, THE DOTTED LINES SHOWING THE AMOUNT OF SHRINKAGE.

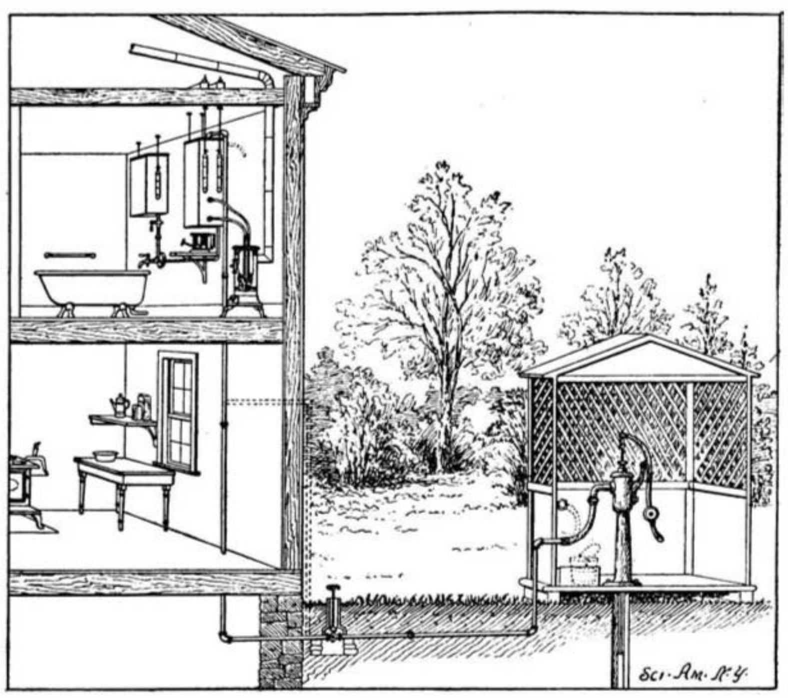
DOMESTIC BATH PLUMBING.

Throughout the country districts, one of the great needs of the residences—a convenient bath-tub—is seriously felt. The absence of this adjunct is felt in every household; for there are no water mains in the roadways, no sewers to carry away the waste, no gas to heat the water. As for heating the water by the teakettleful on the kitchen stove, and carrying it to the tub, that is too tiresome, and destroys the anticipated pleasure.

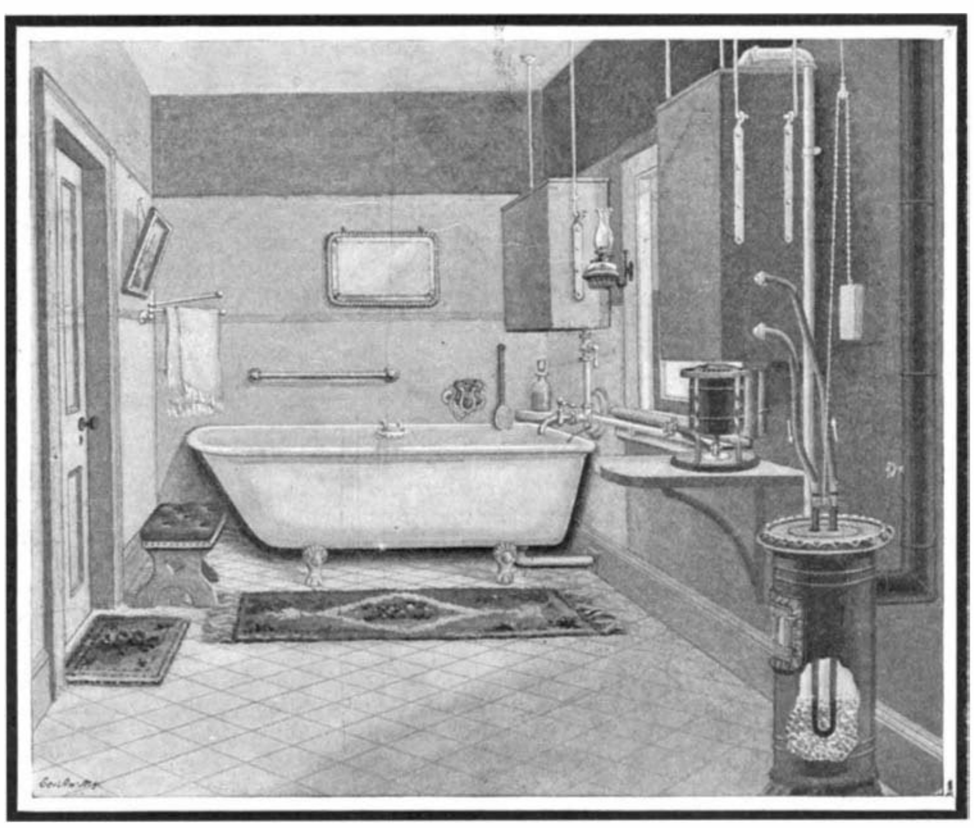
In the accompanying illustration it is shown how up-to-date facilities for a bath may be secured at a reasonable cost; given, first, a good soft water supply from well or cistern near the house, and secondly, deftness of the householder's hands to screw the pipes together, from the water supply to the tub. All of these conditions fell to the lot of the writer in his country house, within twenty miles of New York city; and the illustrations show how the idea may be realized without the aid of a plumber.

The cost (completed as shown) to the writer, was a trifle less than $75. This outlay, for a permanent luxury, seems easily within reach of many on farm or roadside.

Having decided upon the location of the tub, in the interior of the house, measure accurately the distance from the water supply, where a 1¼-inch water pipe can be laid, under the ground, through the side of the house or cellar, up to the floor on which the tub is to be located, and thence to an outlet into a suspended metal tank holding 30 gallons of water, and an additional pipe reaching from the bottom of the first tank to an auxiliary tank, as shown, having a capacity of about 20 gallons. The necessary elbows, stop cocks and waste cock for emptying the pipe of water during the winter's cold must also be allowed for. Send these measurements, with a rough diagram of the different courses and turns of the pipe, giving the lengths of each course in feet and inches, to some large plumbers' supply dealer for estimate of cost, including a porcelain-lined tub and copper-bottom, galvanized tank, the estimate to include threaded ends of pipe, threaded elbows, and cocks, all ready to screw together. The tanks for water should be for the larger 14 x 16 x 31 inches, the other 14 x 16 x 20 inches, cross-braced on the inside both ways to prevent bulging, a "tell-tale" ½-inch lead pipe soldered into a hole 1 inch from the top and long enough to pass through the side of the house, to overflow



METHOD OF OBTAINING HOT WATER IN A COUNTRY BATH-ROOM.



THE BATH-ROOM AND THE WATER HEATER.

when full, and ears on the sides, as shown, for suspension to ¼-inch hooks that pass up through ceiling and bolt through crosspieces of wood, resting on the garret joists.

The tub shown is 5 feet long, of the usual standard make. Have a piece of lead pipe 3 feet long, soldered to the bent outlet of the tub, to run the waste water out of doors; suspend the tanks as shown, with their tops on the same level, so that both tanks may fill at the same time; then close the cock in the pipe to the smaller tank, keeping the cold water in it to temper the hot water when it is run into the tub.

The connection of the iron water pipe with the pump is accomplished by the use of a piece of rubber hose, to one end of which the usual "force and lift pump" coupling is attached, the other end being wired on to the iron water pipe terminal. The hose may be loosened from the pump and held aside on a hook, to permit the usual uses of the pump.

The larger tank of water is heated by a single blue-flame, wickless kerosene heater. If there be a small stove in the room, used ordinarily for keeping the chill out of the room in the winter time, a portion of the heat of the fire may be utilized to heat the water, without using the kerosene heater. This is done by having a piece of ½-inch iron water pipe, 40 inches long, bent over like a hairpin, and having two rubber-hose connections with tank, by means of two unions, located, one near the bottom and the second a few inches above it. This insures circulation, and very hot water in the winter, when the bent pipe has been lowered into the fire, through hole or holes in the stove cover, as shown. With either of these two arrangements of water heating, both simple, and of little expense, any temperature of water desirable for bathing purposes may be had. When all is in complete working order, as pictured in our illustrations, many happy hours may be healthfully passed in its pool. It is probably unnecessary to call attention to the many accessories which add to the comfort of the bather; such as the movable soap dish, sponge holder, holding bar, towel rack, looking glass, etc.

A NOVEL RESPIRATORY APPARATUS.

BY EMILE GUARINI.

In mine explosions, in emanations of fire-damp, in catastrophes like that of the Metropolitan Railroad of Paris, and in many fires, it is not the heat of the flames, but asphyxia, that claims the greatest number of victims. In order to enter irrespirable gases, the life-saver has up to the present had no other resource than to connect himself with a tube through which air was pumped to him from the exterior, just as it is pumped to the diver. This system presents great drawbacks, and, when the distance to be traveled is considerable, the pipe becomes heavy and may become obstructed by bends, folds, etc. It is, therefore, but natural that an effort should have for a long time been made to devise an apparatus, which, by permitting a person to carry upon him a sufficient quantity of air to allow him to live for a certain length of time in any sort of atmosphere, should render him independent of the external air.

The first thing that suggested itself was the use of compressed air, and Lieutenant of Engineers Vaginot devised an apparatus that constituted a very great improvement upon all previous ones by permitting life-savers to greatly increase their sphere of action. This apparatus consisted of a reservoir of compressed air which the life-saver utilized for his respiration, and regularly expelled to the exterior the air respired. It permitted him to remain for ten or twelve minutes in any kind of irrespirable gas whatever. Physiology teaches us that in the air that we breathe (composed of 79 per cent of nitrogen and 21 of oxygen) the nitrogen plays no part in the exchange of respiratory gases. It is, therefore, useless to overload the life-saver by storing up nitrogen under pressure, for, while a tube of 35 cubic feet of compressed air weighs 30 pounds, a tube of oxygen of 7 cubic feet, which permits of living just as long, weighs but 5. On the other hand, we know that our blood absorbs only 4 per cent of the oxygen that enters our lungs, the remaining 96 per cent being expired without having been utilized.

The fact, based upon the experiments of Regnault and Reiset, and which Dr. Guglielminetti's new apparatus has clearly confirmed, is, that if the eliminated carbonic acid be absorbed by potash, and the oxygen be replaced in measure as it is consumed, a limited quantity of nitrogen may be used for respiration for an indefinite length of time.

In the Guglielminetti apparatus, the pure compressed oxygen is contained in a small receptacle provided with an expander and a meter for indicating the quantity of gas remaining in the former. The expanded oxygen is discharged at the rate of 120 cubic inches a minute, and flows automatically through a tube to the mouth of the life-saver. The escapement pressure is sufficient to allow the air expired into a respiratory bag to be drawn by the current of oxygen as by a Giffard injector, through a regenerator containing granulated caustic potash, which absorbs all the carbonic acid eliminated. The air, thus purified, having been heated in its formation, passes into a refrigerating apparatus and afterward becomes charged with oxygen by its passage in front of the aspiration device. It is thus possible for a person carrying the apparatus to remain for 25 or 30 minutes without danger in an absolutely deleterious medium; but, after the expiration of this time, since the air contained in the apparatus has become heated to 98 or 100 deg. F., the individual is less at his ease, although neither syncope nor any other accident supervenes any more than when hot air is inhaled in a Turkish bath. In practice, the apparatus is capable of operating uninterruptedly for two hours if two oxygen tubes are employed.

The important point is that all the carbonic acid expired shall be absorbed by the potash, that the oxygen shall be renewed in sufficiently large quantities, and that the person carrying the apparatus shall, without the least effort, breathe as freely as in the open air.

The accompanying figures give a diagram of the apparatus and two views of it. Fig. 2 gives a front view of the apparatus, while Fig. 3 shows an apparatus specially designed for firemen, the mouthpiece here being held between the lips, the nose being closed by pincers, and the helmet being discarded as useless.

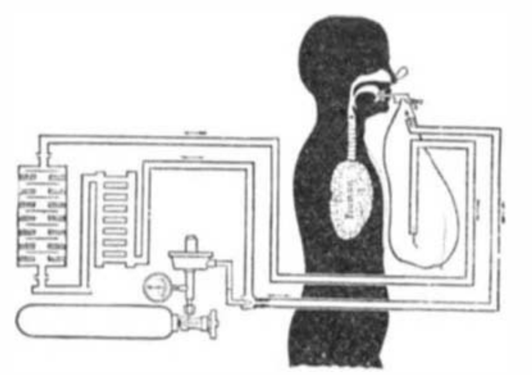


Fig. 1.—Diagram of Respiratory Apparatus.

Fig. 2. -Front View.

Fig. 3.—Apparatus for Firemen.

THE GUGLIELMINETTI-DRAEGER RESPIRATORY APPARATUS.

In conclusion, we may state that the apparatus weighs but 22 pounds, inclusive of the helmet, and that the firemen of Paris, who have placed it upon trial, have been fully satisfied with the results obtained. The inventor is at present studying the application of the apparatus to diving.

Life-Saving Bag and Box.—The object of these apparatus, both of which contain a small 4-cubic-foot tube of oxygen, is to permit of the direct respiration of oxygen from the compression tube, to which is secured an expander that accurately regulates the discharge of the gas, a pressure gage that always shows exactly the quantity that remains in the tube, and a metallic mask provided with a Cailletet valve for expiration, and that permits of fixing the mask upon the face of an asphyxiated person. It is thus possible to combine oxygen inhalation with artificial respiration and, thanks to a mask for the nose, with rhythmic tractions of the tongue. We wish to dwell particularly upon this latter arrangement, which is of great importance, since in many cases traction of the tongue in the asphyxiated brings about a beginning of respiration, which is not kept up. If, at this moment, the patient be made to absorb oxygen instead of air, we know from the experiments of Grehaut that he will have many chances for his life. As he cannot utilize the oxygen during expiration, a small bag of gold-beater's skin interposed between the tube and the mask forms a reservoir into which the oxygen flows during the expiration.

This apparatus is therefore always ready for operation, and easily carried to a place of accident, either by hand or upon a bicycle. This is a very important matter in cases of asphyxia, in which a gain of a few minutes may often save a person's life.

The 2,000,000-Mile Record Run of a Locomotive.

We have on more than one occasion drawn attention in these pages to the different practice of English and American railroads with respect to the retention of locomotives for a prolonged period of service. In this country, the general method is to run a locomotive for a limited number of years, and then to relegate it to the scrap heap in favor of a more modern type of engine. On the other side, however, the practice is to retain a locomotive in service as long as it will run, irrespective of the developments and improvements that may be incorporated in the progress of time. The result is that upon the English railroads may be seen engines still in hard use, which we should consider long past their term of service. Yet no English engine has attained the unique distinction achieved by the locomotive No. 955, "Charles Dickens," upon the London and Northwestern Railway, which has covered close upon 2,100,000 miles, in the haulage of express trains.

This engine issued from the Crewe engineering shops of the railroad on February 6, 1882, and has been engaged in the London-Manchester service regularly every day, except in those periods in which it was undergoing overhauling, ever since. This locomotive is fitted with cylinders of 17 inches diameter and having a stroke of 24 inches. The driving and trailing wheels are of 6 feet 6 inches and leading wheels 3 feet 6 inches diameter. The mean diameter of the boiler outside is 4 feet 1 inch and length of barrel 9 feet 9¾ inches, with a heating surface of 194 tubes, yielding an area of 960.2 square feet, and a firebox heating surface of 103.5 square feet. The boiler pressure is 150 pounds per square inch. The weight of the engine in working order is as follows: On leading wheels, 10 tons 12 hundredweight; on driving wheels, 12 tons 10 hundredweight; on trailing wheels, 12 tons 10 hundredweight. The tender has a water capacity of 1,800 gallons and a coal capacity of 3 tons. The total weight of the engine and tender in working order is 60 tons 12 hundredweight.

This locomotive was installed upon the express service, hauling the train leaving Manchester at 7.45 in the morning, and returning with the train out of London at 4 P. M. the same afternoon, thus covering 387 miles a day. The engine ran regularly in all weathers without the slightest mishap. On the 2,651st round trip it recorded the remarkable feat of having run 1,000,000 miles, covered in 9 years and 219 days. During this time 12,515 tons of coal were consumed, and 93,237 tons of water were evaporated. During 11 years' service but few repairs had to be effected, the most important being the supply of two new sets of "digestive organs." Even these, however, were by no means worn out when discarded, for they were immediately installed in the sister engine "Snowdon," which covered 191,236 miles with them, and then yet a third locomotive, "Balmoral," appropriated them, and ran with them for many years. The second set, after replacement, were placed in the engine "Courier," and were satisfactory for several years.

The locomotive "Charles Dickens" continued with the same express, and on the 5th of August, 1902, during the 5,312th round trip from Manchester to London, notched its 2,000,000 miles, a feat which has not been paralleled on any other railroad in any other part of the world. Notwithstanding the extensive improvements and developments that had been effected in the 20 years and 181 days that had elapsed during the covering of this enormous mileage, this engine still remained one of the fastest and most punctual upon the road.

During the latter part of this time, however, there was a great change in the character of the rolling stock. Dining and sleeping coaches were introduced, which considerably increased the weight of the train. Furthermore, the requirements of faster traveling necessitated the engine being appreciably speeded up. This was gradually done up to 50 1-3 miles per hour.

During this 2,000,000 miles, the engine consumed 27,486 tons of coal and 204,771 tons of water. The fuel consumption, including the raising of steam, has not