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.

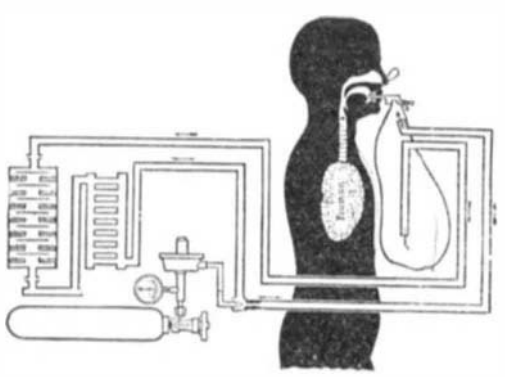

Fig. 1.—Diagram of Respiratory Apparatus.

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

once exceeded 32 pounds per mile, while the cost of maintaining the engine in working efficiency has averaged 3.56 cents per mile run. Owing to the system of standardization which is a feature of the Crewe Works, the enforced idleness of the engine consequent upon renewals and repairs has only averaged 12 per cent of working time. This huge mileage has been covered without the slightest mishap of any kind. Although the speed of many trains upon this system has been considerably augmented during the past few years, yet this express hauled by "Charles Dickens" still remains one of the fastest upon the system, and owing to the present excellent condition and running of the locomotive, it will probably still be retained upon the 387-mile daily run for some time to come.

LAUNCHING OF THE "CONNECTICUT" AND "MILWAUKEE."

On September 29, eighteen months after the laying of her keel, the United States battleship "Connecticut," which shares with the British battleships of the "King Edward" class the distinction of being the largest yet constructed, was launched at the New York navy yard, Brooklyn. The event was marked by the customary ceremonies, and it was witnessed by a great crowd of visitors, who had been admitted to the grand stand and inclosures of the navy yard by tickets of invitation. It is an historical fact, deserving of mention in this connection, that the "Connecticut" was launched from the very spot at which the old prison ship "Jersey" was beached, after she had performed her notorious duties during the Revolutionary war; and when the piling was being driven for the building ways, no little difficulty was experienced in getting it down through the remains of the sunken vessel.

The "Connecticut," and the sister ship "Louisiana," which was launched a month ago at the Newport News yard, were authorized by act of Congress on July 1, 1902, and under the terms of the act the contract for one of these vessels was to be let to a private firm, and the other ship was to be built in a government yard. The determination of Congress to renew the practice of building warships at the navy yards was brought about by the urgent representation of the Navy Department, which claimed that with its present plant and fine organization, such a yard as that at New York was thoroughly equipped for the speedy and economical construction of warships. Consequently, the construction of the "Connecticut," being undertaken at the same time as that of the "Louisiana," has been watched with the keenest interest; and it is extremely gratifying to the government that she should have been completed in practically the same space of time as the contract-built vessel.

The "Connecticut" is 450 feet in length on the waterline, 76 feet 10 inches in beam; and when the ship is fully equipped ready for sea, with all stores on board and a normal supply of coal in the bunkers, she displaces 16,000 tons on a draft of 24 feet 6 inches. Her full load displacement with her bunkers filled and stores aboard for an extended cruise is 17,666 tons. She is propelled by twin-screw, vertical, triple-expansion engines, of 16,500 indicated horse-power, which are designed to drive her at a speed of 18 knots an hour. The normal coal supply is 900 tons, but her bunker capacity is 2,200 tons. When the ship is fully loaded, her maximum draft aft is 26 feet 9¼ inches. Her boilers are of the Babcock & Wilcox type, and she carries enough coal to enable her to steam at a speed of 10 knots an hour continuously for a distance of 5,275 miles.

Officially, the "Connecticut" is known as a sea-going battleship with two 12-inch and four 8-inch barbette turrets. She is remarkable for her great offensive and defensive powers, in both of which she is unexcelled by any foreign ship. All of her armor is of the best Krupp face-hardened type. The protection consists of a waterline belt, which extends from stem to stern. For one-third of her length amidships, the belt is 11 inches thick at the top and 9 inches thick at the bottom, and from these dimensions it tapers fore and aft to an even thickness of 4 inches at the bow and stern. Above the main belt, and for the distance between the main barbettes, there is a continuous wall of side armor 7 inches in thickness reaching from the main belt to the main deck. At the ends of this armor, bulkheads of 7-inch armor extend athwartship to a connection with the main barbettes. There is a continuous protective deck, which is 1 inch thick on the flat and 2½ inches thick forward and aft, the thickness of the side slopes being 3 inches. The main barbettes are protected by 10 inches of armor, and the main turrets by 12 inches. The four turrets of the 8-inch guns are protected by 8 inches of armor, while the barbettes below carry 6 inches.

The unusually powerful battery is composed of four 12-inch 40-caliber guns in two turrets fore and aft, eight 8-inch 45-caliber guns in four turrets, two on each broadside, the two forward turrets having an arc of fire from dead ahead to a point well aft of the beam, and the after pair of turrets is similarly able to fire from forward of abeam to dead astern. On the gun deck, and firing through casemates in the 7-inch side armor, is a powerful battery of twelve 7-inch, 50-caliber guns. The 7-inch gun is a new piece of high velocity and great penetration, that in these vessels takes the place of the usual 6-inch guns. This piece has a velocity of 2,900 feet a second and a muzzle energy of 9,646 foot-tons. It fires a projectile of 165 pounds with sufficient energy to penetrate 28.7 inches of iron at the muzzle. This is a great advance over the 6-inch guns which will be mounted on the "Georgia" class, the smaller weapon having the same velocity and firing a 100-pound projectile with a muzzle energy of 5,840 foot-tons and a penetration of iron at the muzzle of 24.2 inches. The armament also includes twelve 3-inch 14-pounder rapid-fire guns, six of them mounted on the gun deck, two in the bow and four at the stern, and firing through casemates protected by 2 inches of armor, the other six being mounted on the main deck in broadside between the 8-inch gun turrets, with 2 inches of protection on the casemates. There are also twelve 3-pounders and fourteen machine guns distributed on the roof of the turrets, the superstructure, the bridges, and in the fighting tops. The forward conning tower, which incloses the base of the military mast, is protected with 9 inches of Krupp steel, and the after conning tower, sometimes known as the signal tower, which is located beneath the after bridge, has 5 inches of protection. As originally designed, the "Connecticut" does not carry any submerged torpedoes, but in consequence of agitation of the subject it was subsequently decided to provide her with four such tubes, two located in a compartment forward and two in a compartment aft, in a position slightly forward and aft, respectively, of the 12-inch turrets.

Although she is not such an important vessel as the "Connecticut," the "Milwaukee," of 9,700 tons displacement, which was launched on the tenth of the same month at the yards of the Union Iron Works, San Francisco, is a vessel which a few years ago would have excited widespread attention.

She is a twin-screw protected cruiser, and a sister ship to the "St. Louis" and the (new) "Charleston," now building at the yards of Neafie & Levy and the Newport News Shipbuilding and Dry Dock Company. The dimensions of the "Milwaukee" are: Length on normal load waterline, 424 feet; breadth, extreme, 66 feet; mean draft, 22 feet 6 inches; displacement, about 9,700 tons; speed, 22 knots; bunker capacity, 1,500 tons.

The "Milwaukee" will have a protective deck of nickel-steel the entire length of the ship, 1½ inches thick on flat and 2½ inches on slopes. The nickel-steel plates are laid on ½-inch steel plating, giving the deck a total thickness of 2 and 3 inches. The main side armor belt is 7 feet 6 inches wide and 4 inches thick, and is placed abreast of boilers and engines for a distance of about 196 feet. Above the main belt is the lower casemate, with a uniform thickness of 4 inches, protecting the central portion of the hull for a distance of about 196 feet, and extending up to the gun deck. Above the lower casemate is the upper casemate, with a uniform thickness of 4 inches, protecting the central portion of the hull for a distance of about 136 feet, and extending up to the main deck. At each end on the berth and gun decks, and worked in to meet the ends of the side armor, is athwartship armor 3 inches in thickness. There will be worked in from the protective deck to above the waterline the usual cellulose cofferdam.

The main battery consists of fourteen 6-inch breech-loading rapid-fire rifles of 50 calibers in length. Of these, six are mounted on the main deck, and eight are mounted on the gun deck. The secondary battery consists of eighteen 3-inch breech-loading rapid-fire rifles, of 50 calibers in length; twelve 3-pounder semi-automatic guns; four 1-pounder automatic guns; and eight 1-pounder rapid-fire guns; there are also two 3-inch field guns, two machine guns 0.30 caliber, and eight automatic guns 0.30 caliber.

The "Milwaukee" will have twin engines of the vertical, inverted-cylinder, direct-acting, triple-expansion type, each with a high-pressure cylinder 36 inches, an intermediate-pressure cylinder 59 inches, and two low-pressure cylinders 69 inches in diameter; the stroke of all pistons being 45 inches. The order of the cylinders, beginning forward, is: Forward low-pressure, high-pressure, intermediate-pressure, and after low-pressure. The framing of the engines consists of forged-steel columns trussed by forged-steel stays; the bedplates are of cast steel. The indicated horse-power of both engines will be 21,000 when making about 133 revolutions per minute and with steam pressure of 250 pounds at the throttle. The designed speed on trial is 22 knots.

There will be sixteen boilers of the water-tube type, placed in four water-tight compartments forward of the engine rooms; the forced draft system will consist of blowers discharging into closed ashpits, there being one blower for each boiler. There will be a complete electric plant on board, consisting of two 150-kilowatt and three 50-kilowatt generators, direct-connected to compound engines, using steam at 150 pounds. Over 78 electric motors will be installed, of from one to thirty horse-power; they will be used to operate boat cranes, deck winches, blowers for ventilation, ammunition hoists, etc.

The "Milwaukee" will have a complement of 645 officers and men.

A few years ago the "Milwaukee" would have ranked as an armored cruiser; but to-day, because of the unprotected ends at the waterline, and the weakness of the side armor (only 4 inches in thickness), she is classed in the navy list only as a protected cruiser.

Automobile Notes.

The crowning racing event of the year in this country will take place on Long Island, October 8. The race is known as the Vanderbilt Cup race, and it is an international race for a trophy presented by Mr. William K. Vanderbilt, Jr. It will be run on a 30.24-mile course, which will be traversed ten times by the competing cars. Some of the best European cars are found among the eighteen entries, while but few leading American makes are represented. Among the latter are two 60-horse-power Pope-Toledo racers, the Packard 30-horse-power "Gray Wolf," a 30-horse-power Royal Tourist, and a 75-horse-power Simplex. The French team consists of three 90-horse-power Panhards and one Renault of the same power, besides a De Dietrich and a Clement-Bayard 80-horse-power car. Five 60-horse-power Mercedes cars will represent Germany, and two 90-horse-power Fiat machines Italy. In order to entirely do away with dust, the course will be thoroughly sprinkled with oil throughout the entire distance, and it is estimated that 100,000 gallons of crude petroleum will be needed for this purpose. The course has a number of very sharp turns, which it will require skillful driving to round without mishap.

A 614-mile reliability test of light cars has just been held in England. The test consisted of a 50-mile run out from Hereford and back again, or 100 miles in all per day, besides hill-climbing, stopping, and starting on grades as high as 15 per cent. Twenty minutes was allowed each morning for adjusting the cars. Out of thirty-eight cars that started, twenty-six finished successfully, while but four managed to make absolute non-stop runs throughout. Of these, two were 6-horse-power Wolseley and Siddely cars, which sell for about $875 each; and the remaining two were a 6-horse-power De Dion and an 8 to 10-horse-power Croxted, valued at $1,000 each. Nearly all of the cars were of the light, two-passenger type. Besides the four cars mentioned, four others—a 6½-horse-power Wolseley, two 7½-horse-power Humbers, and another 6-horse-power De Dion—made eleven out of a possible twelve non-stop runs. The two Wolseleys and the two De Dions were run as teams, and it speaks very well for the former that but 10 minutes time was lost between them during this long road test, while the only troubles with the De Dion cars happened to the second one, driven by Miss Dorothy Levitt, which was detained an hour and a quarter during the last 50-mile run by the needle-valve sticking in the carbureter. The trials have shown very well the possibilities of the runabout automobile for touring purposes, and have again demonstrated the reliability and lack of tire trouble which are the features of this type of car.

The Current Supplement.

The current SUPPLEMENT, No. 1500, is opened with an excellently illustrated article by our St. Louis correspondent entitled "The United States Commission of Fish and Fisheries Building." Of technological importance are an instructive contribution on the practical production of bronze leather, a *résumé* of the action of explosives, and a very exhaustive paper on artificial stone. Mr. Harold Busbridge writes on the shrinkage and warping of timber, illustrating his opinions with many striking illustrations. "Art and Engineering" is the title of a discourse upon a subject of considerable importance, in so far as it affects American municipalities. Prof. Robert MacDougall outlines in an interesting way the evolution of the human hand. The Porta Volta electric supply station of Milan is noteworthy, in so far as it embodies a 5,000-horse-power three-phase turbo-alternator of new design. A fully illustrated article on the plant is published in the SUPPLEMENT. The Prime Minister of England, Mr. Henry A. Balfour, delivered a splendid address before the British Association for the Advancement of Science, a discourse in which he outlines the development of modern anthropology. One of those practical articles in which the construction of experimental apparatus is described, and for which the SUPPLEMENT is noted, is also published. It bears the title, "The Construction of an Indicating or Recording Tin Plate Aneroid Barometer." It is written by Dr. N. Monroe Hopkins.