ment painful places were felt in this region, and a peculiar purplish rash appeared. Forty-eight hours after the test this rash was still discernible. The opinion of the investigators on this point is that the rash was attributable to small bubbles embolizing the vessels of the subcutaneous fat, while in the case of Mr. Greenwood the pain experienced was probably caused by small bubbles in the nerve sheaths in the first case, and in the knee joint in the second instance. The imperative necessity of active movement during decompression is thus shown, and caisson workers should be instructed to freely exercise and massage every part of the body while undergoing decompression in the air lock.

THE INDUSTRIAL USES AND VALUE OF ALCOHOL.

BY HENRY HALE.

The decision of the government to permit the manufacture and sale of ethyl alcohol free of any tax where it is denaturized, or rendered unfit for use as a beverage by treating it with some suitable denaturant, is of the highest importance to this country, owing to the effect it will have on so many different industries. While the number of plants for the manufacture of alcohol will undoubtedly be greatly increased, its benefit in other forms of industry is of far more moment.

It is needless to more than refer to the raw material from which alcohol can be produced at such a small expense that it can be utilized in place of refined petroleum and other liquids to a greater advantage. As corn is one of the principal materials, a brief reference to the quantity of spirits which can be secured from this grain may be given. Tests which have been made at distilling plants in Illinois show that from one bushel of corn no less than five gallons of proof alcohol can be distilled. This means a liquid which is from 90 to 95 per cent pure and from 185 to 190 degrees proof—a standard which allows it to be utilized in nearly every product in which it is required as an ingredient, and which shows it to be superior to gasoline and kerosene as a fuel and as an illuminant. Estimating the cost of a bushel of corn at 42 cents, the entire expense of a gallon of this alcohol is but 10.78 cents, for with the modern equipment of a distilling plant the cost of mechanical treatment is actually less than two cents per gallon. According to recent statistics compiled by the government, crude wood alcohol costs no less than 40 cents per gallon to manufacture. As low-grade molasses from sugar cane is another base for the spirit, reliable data have been obtained as to the percentage which a given quantity of it will yield. The Cuban distilleries extract a gallon of alcohol (which is 90 per cent absolute) from two gallons of the molasses—molasses of a quality which is brought to this country and sold at three cents a gallon. The average expense of manufacture, based on this price for the raw material, is less than 10 cents. The difference between the molasses and corn spirit is that the former has an odor which is somewhat disagreeable, but it can be utilized as effectively as the other for all purposes except in preparation of liquors and medicines. The low cost of the molasses alcohol is of much significance, as this base is similar to the waste product obtained in the manufacture of sugar from beets. Consequently, it should be an additional incentive in the expansion of the beet-sugar industry, while an opportunity is offered to manufacture alcohol especially in Louisiana and Hawaii.

As is well known, potatoes and fruit are two other inexhaustible sources of supply in this country. The importance of the potato as an alcohol producer can be appreciated when it is known that 20 per cent of its substance represents alcohol, and that an acre of potatoes yielding 300 bushels will supply over 250 gallons. At present the aggregate American potato harvest exceeds 200,000,000 bushels, grown practically in every part of the United States. Overripe fruit, which is now largely a waste product in the various orchard districts, can be utilized in the same manner.

As ethyl alcohol can be employed to greater advantage than the methyl spirit in nearly every branch of manufacture in which alcohol is an essential, some of the products in which it will be utilized extensively may be mentioned. They are as follows:

Aniline colors and dyes; hats (stiff, silk, and straw); electrical apparatus; transparent soap; furniture; picture moldings; burial caskets; cabinet work; passenger cars; pianos; organs; whips; toys; rattan goods; lead pencils; brushes; wagons; boots and shoes; smokeless powder; fulminate of mercury; brass beds; gas and electric-light fixtures; various kinds of metal hardware; incandescent mantles; photographic materials; celluloid and other like compounds; sulphuric ether and organic chemicals.

Nearly every one of these represents material extensively used in this country as well as in Europe. The manufacture of aniline dyes, however, has been greatly handicapped for the reason that Germany, permitting the use of tax-free alcohol, has become the great center of the industry, as the spirit is one of the main essentials. At present only 200 barrels of grain alcohol are used yearly for this purpose in the United States. In the making of hats about one-half gallon of ethyl or methyl spirit is needed to every half dozen, which will give an idea of the extent it is used in this industry. Its value in finishing woodwork, such as furniture and pianos, lies in the fact that it is the best solvent for shellac, and is indispensable as an ingredient in the preparation of fine varnishes and polishes. It is an interesting fact that solutions of shellac and alcohol enter largely into the manufacture of hats, and are used also as a lacquer for the coating of polished metalwork. In modern explosives alcohol is required in such quantities in the preparation of fulminates and smokeless powders, that here again some of the European nations have had the advantage of us, since they have been enabled to secure supplies of ammunition at a much smaller cost. Tax-free alcohol is therefore of vital importance to the country from a military point of view. Most of our fulminates, for example, are made in Canada from American alcohol and returned to the United States to be sold.

The popularity of illumination by means of the incandescent mantle has caused this device to be made literally by the millions. From one plant alone in Camden, N. J., come 15,000,000 mantles a year. The spirit required by this company is about 50,000 gallons. In the past it has largely consisted of wood alcohol mixed with cotton especially treated to form a coating which protects the mantle while being handled. It is this coating which is "burned off" when the mantle is placed upon the fixture for service. In chemical solutions for photographic work, and for the artificial drying of negatives and prints, grain alcohol may be considered invaluable. Substitutes have been employed for it to a large extent in America, but the price of such articles in Europe averages considerably lower than in this country, owing to the higher grade of spirit which can be employed tax-free. As an indication of the enormous quantity of inferior substitutes utilized in place of ethyl alcohol at present, the report of the Commissioner of Internal Revenue shows that during 1905 less than 175,000 gallons of ethyl spirits were used by American manufacturers of aniline dyes, soap, woodwork, photographic material, celluloid, and electrical apparatus. Prior to 1862, when the internal revenue law, which has been abolished, went into effect, the annual production of this grade of alcohol was 90,000,000 gallons, of which a large percentage was consumed in industries exclusive of the preparation of beverages.

Thus far reference has been made only to some of the minor ways in which grain alcohol will take the place of other fluids when the tax upon it is removed. Unquestionably, its importance as a factor in producing light, heat, and power is of the greatest magnitude. Indeed, it promises to become one of the main elements for illumination in the United States, not excluding petroleum, gas, and the electric lamp, for the light produced by it is of a very high quality. We have been chiefly familiar with the small taper used in the sick chamber, where the expense of buying alcohol at 40 and 50 cents a pint for this purpose could be met. With a flame of intense whitness, almost free from odor, the spirit lamp has recommended itself to physicians and nurses. To illustrate its advantage over kerosene and other forms of illuminating oils, a French inventor has perfected a lamp which burns alcohol in connection with a Welsbach mantle. The alcohol is drawn by means of a wick into the burner, as in the example furnished by the ordinary kerosene lamp, by means of capillary attraction. In thirty seconds after being lighted the light is at its maximum brilliancy, unless it is turned down purposely. Tests which have been made with this type of lamp resulted in producing illumination equal to 25 candle-power for a period of 59 hours with a consumption of one gallon of alcohol. This quantity therefore sufficed for 1,475 candle-power hours. With the same quantity of kerosene and employing the same lamp, the illumination was equal to only 783 candle-power hours, the average candle-power of the oil light being but nine. Consequently, the total illumination furnished by the alcohol was nearly double that of the oil. The tests referred to were conducted by experts at the Electrical Testing Laboratories in New York. They agree with the statements of Prof. Rousseau, of the University of Belgium, that alcohol at 31 cents per gallon is more economical as an illuminant than kerosene at 15 cents per gallon, owing to its superior light-producing properties. Prof. Rousseau bases his argument on a series of photometric tests conducted at Brussels, when it was found that denaturized alcohol 90 per cent absolute would give this result. It has been shown in laboratory investigations that high-grade kerosene contains but 8,000 heat units per pound, while ethyl alcohol contains 12,000, thus being 50 per cent more productive of heat. As already stated, alcohol has been made from both corn and molasses, at a total cost not exceeding 12 cents a gallon. According to Prof. Rousseau's conclusions, a given quantity for lighting and heating purposes is equal to at least twice the quantity of highly-refined petroleum in the form of kerosene. As recent market quotations for the latter fluid at retail are from 15 to 20 cents per gallon, the fact seems to be verified beyond question that the spirit is preferable to the oil from the standpoint of economy, aside from the fact that it is without offensive odor, is less liable to ignition in handling, and gives a far better light or fuel where it is designed for cooking and other domestic purposes.

(*To be continued.*)

AUTOMOBILE NOTES.

The Automobile Club of America is planning to conduct an alcohol fuel consumption test next fall.

Simultaneously with the news that Percy Pierce finished the 1,000-mile Herkomer Trophy test with a perfect score for his Pierce "Arrow," word has been received that the 3,000-mile European circuit endurance test in which he is entered has been indefinitely postponed. Mr. Pierce will doubtless return at once to America in order to compete for the Glidden Trophy, which he was so successful in winning last year.

In order to test the energy consumption of electric carriages under unfavorable conditions, a 100 kilometer (62 mile) test run was recently organized in Paris over dirty and slippery roads, fog prevailing at the time. A number of carriages carrying four passengers, and weighing complete over 2 tons, covered the entire distance at an average speed of nearly 15 miles an hour, and consumed less than 160 watt-hours per ton mile. The first prize was gained by a carriage entered by M. Védrine, which required 155 watt-hours per ton-mile. According to L'Industrie Electrique, the energy consumption of this vehicle under ordinary conditions is from 110 to 120 watt-hours per ton-mile.

The leading automobile event of the season is to be the Grand Prix, organized by the Automobile Club of France, which will be run on the 26th and 27th of June upon a circular route known as the circuit of the Sarthe, not far from the town of Le Mans. The foreign automobile constructors have been making great efforts to surpass the cars which ran in last year's Gordon Bennett Cup race. As the list of entries has now been completed, we are able to give a list of the new cars which are to enter the race, and also some points about their construction. In the order of starting, we find the following makes: De Dietrich, Fiat, Renault, Darracq, Richard-Brasier, Mercedes, Gobron-Brillié, Itala, Gregoire, Panhard & Levassor, Vulpes, Hotchkiss, and Bayard-Clement. Three cars of each of these makes have been entered (excepting three) making 36 in all. The first series of 13 cars will be started, then the second and third, beginning at 6 o'clock A. M. We expect to illustrate some of the leading types at an early date. As to the main points of this year's cars, we find that chain and jointed rod driving are used in about an equal proportion, and none of the makers have changed their system. The gasoline tanks contain in general about 50 gallons, and the cars will all take on gasoline *en route*. About 15 or 20 gallons per 100 miles is expected for the consumption, this differing according to the power of the motors, the carbureters, the speed, etc. Special precautions are taken to re-fill the tanks as quickly as possible. Owing to the hard wear of the tires, the makers have been looking specially to this matter, and are to employ a rather light form, but very solid and having a great number of cloth layers. They are lessening the thickness, seeing that it is not the absolute wear, but the separation of the cloth that is to be feared in the circuit race. This year many of the new spring damping devices are used to deaden the shocks and jumping of the cars. The Truffault suspension is used on some of them, and also the new Eds spring damper. On the Panhard cars we find the progressive damper of Capt. Krebs, while the Renault cars have a liquid damper. This year the Mercedes cars use the Truffault suspension, and also a Jenatzy damper, which consists of a strong rubber band used to check the rebound. As to the carbureters, each maker uses his standard type, but some improvements have been made this year. In general, the wheels are larger than in last year's cars. This tends to diminish the wear of the tires, seeing that the latter will now have a lower speed. Most of the cars will have three gear speeds, but four will also be used on some of them. As to weight, the lightest cars are the Darracq and Gregoire, which weigh 1,900 and 1,980 pounds respectively. Most of the others are very near the limit of 2,240 pounds. The motor power is quite variable, and while the Richard-Brasier, Renault, and Gregoire motors have from 100 to 110 horse-power, the Itala, for instance, has 140 horse-power. With one exception, the chassis are built of pressed steel. One of the Gobron cars uses a steel chassis. All of this year's motors have four upright cylinders, and most of them are cast in pairs. Only the Bayard-Clement and the Panhard are using copper water jackets. The Gobron-Brillié motor continues to use a double piston in each cylinder. Italy, Germany, and France only are represented in the race. The Fiat and the new Itala cars will represent Italy and the Mercedes Germany.

ARTIFICIAL REGULATION OF ATMOSPHERIC HUMIDITY AND TEMPERATURE.

It is surprising that in an age which is remarkable for the rapid advance which has been made in sanitation and in all matters affecting the comfort of the individual in his daily life, so comparatively little should have been done to control the atmospheric conditions encountered in the various buildings—dwelling rooms, offices, factories, and places of amusement—in which the greater part of our time is spent. As a matter of fact, the only serious attempt at such control occurs during the winter months, when we raise, or endeavor to raise, the interior temperature to the 68 or 70 deg. Fah. which has been found to be the most agreeable to the average person. When we have raised the temperature to the desired degree, we are content to let the equally important question of humidity take care of itself. Consequently, in steam-heated rooms, and particularly in the apartments and flats in which the majority of city dwellers now live, the atmosphere is dried out to an extent which is answerable for an untold amount of discomfort and even disease. Unfortunately, the average individual, if he be warm in winter, is perfectly satisfied; and no doubt it is largely the lack of a demand for means to control the humidity, or ignorance of the necessity for such control, that has prevented the more extended use of the devices which have been provided for this very purpose.

As for the modifying of temperature and humidity in the summer time, the conditions are even worse; and it is really remarkable how little serious attempt there has been to develop suitable systems for the cooling and reduction of the humidity of the interior of buildings during the hot summer weather. This is said with full appreciation of what the inventor and manufacturer have already done in this direction; but attention is drawn to the fact that, in view of the enormous amount of discomfort and distress endured during the hot and humid waves which are continually sweeping over the country, it is surprising that there should not be a more widely-extended effort to bring the heat and humidity in the interior of buildings down to a point at which life would be made comfortable.

Furthermore, the artificial regulation of atmospheric humidity and temperature is a matter of vital concern to certain manufacturing interests, and particularly to the textile industries. In order to secure the best results in spinning mills, it is necessary that both the temperature and humidity be held at a certain relative proportion, and each at a certain degree. Thus, in what is known as the "Bradford spinning," to secure the best results, there should be a low temperature and a low humidity, a fair average for the former being 68 deg. Fah., and for the latter a percentage of 58 to 60. The "French spinning," on the other hand, needs a high temperature of 85 deg. Fah. and a high relative humidity of 85 per cent. Moreover, there are many other lines of business whose success is largely dependent upon the regulation of temperature and humidity, particularly those which deal in confectionery, meat, and provisions, where, if the conditions be not just right, the goods will melt, lose their crispness and freshness, and generally deteriorate in quality.

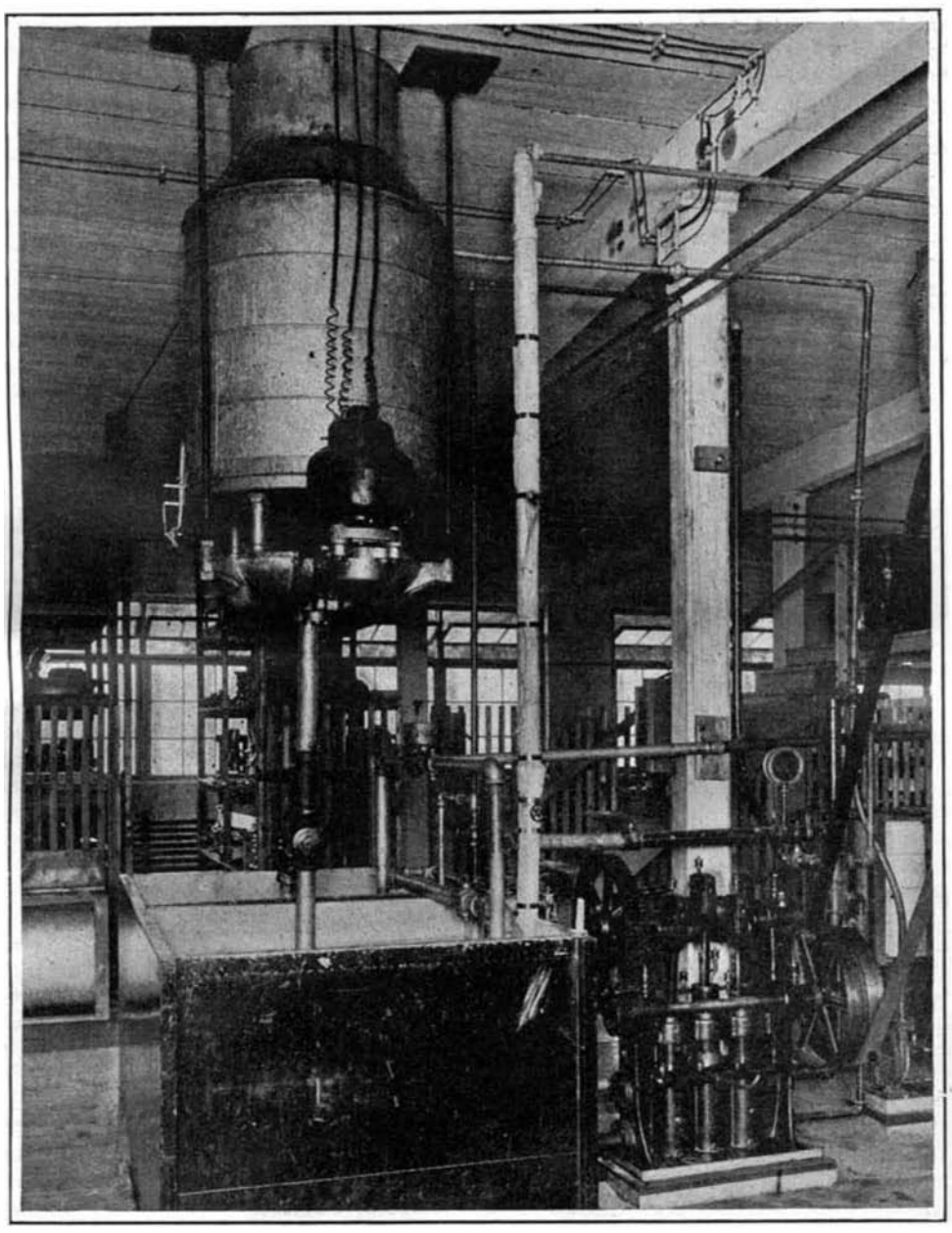
Comfortable weather is that in which there is a desirable relation of humidity to temperature. High temperature alone is not necessarily uncomfortable, nor high humidity alone. There may be days in the fall of the year when, although the relative humidity may be 100 per cent, no discomfort is experienced, for the reason that the temperature is low. On the contrary, in the dry air of the deserts one can endure a temperature of well over 100 deg. without experiencing distressing symptoms. The comfortable weather is that in which the humidity relative to the temperature is in a certain fixed ratio.

The machine which is herewith illustrated has been designed to regulate artificially the ratio between the temperature and the humidity by passing water over a large cooling surface over which, at the same time, large volumes of air are being drawn. By this simple expedient it secures the double effect of cooling the air and imparting to it the moisture of the evaporated water. The "Regenerator," as this machine is called, is made by the Regenerated Cold Air Company, of 88 Broad Street, Boston, Mass. The accompanying illustrations show two sizes of machines. The sectional view is taken through an 18-inch unit, which is capable of handling 1,250 cubic feet of air per minute. The other illustration is of a 24-inch machine, with a capacity of 5,000 cubic feet per minute.

The 18-inch machine consists of an outer casing or covering more or less ornamental in design, which incloses inner cylinders arranged concentrically within it, within which is carried the cooling and humidifying apparatus proper, the whole being mounted upon a hollow base or collecting basin, *M*, which may be carried either upon a pillar set upon the floor, or may be suspended by rods from the ceiling of the room in which the apparatus is used. Mounted centrally is a shaft, *D*, carrying at its upper end an 8-inch impulse wheel, *A*, which is driven by a ¼-inch jet supplied through a pipe, *B*, at a pressure of 85 pounds to the square inch. Immediately below the impulse wheel is another wheel, *C*, which is carried upon a hollow shaft arranged to turn concentrically about the shaft, *D*, moving in the same direction. This movement is effected by the water, which, reacting from the buckets of the impulse wheel, strikes the blades of the lower wheel, causing it to rotate, as described. At the lower end of the hollow shaft on which the wheel, *C*, is mounted, is carried a four-armed distributor, *E*, and the water falling from the wheel, *C*, and flowing down the interior of the casing which incloses the mechanism above described, collects in the hollow hub of the distributor, and is carried thence by centrifugal force out into the four arms, *F*. These are formed with a number of side outlets, which enlarge in cross-sectional area from the center to the circumference, the openings being so adjusted that there shall be an even distribution of the water as it flows out of the arms.

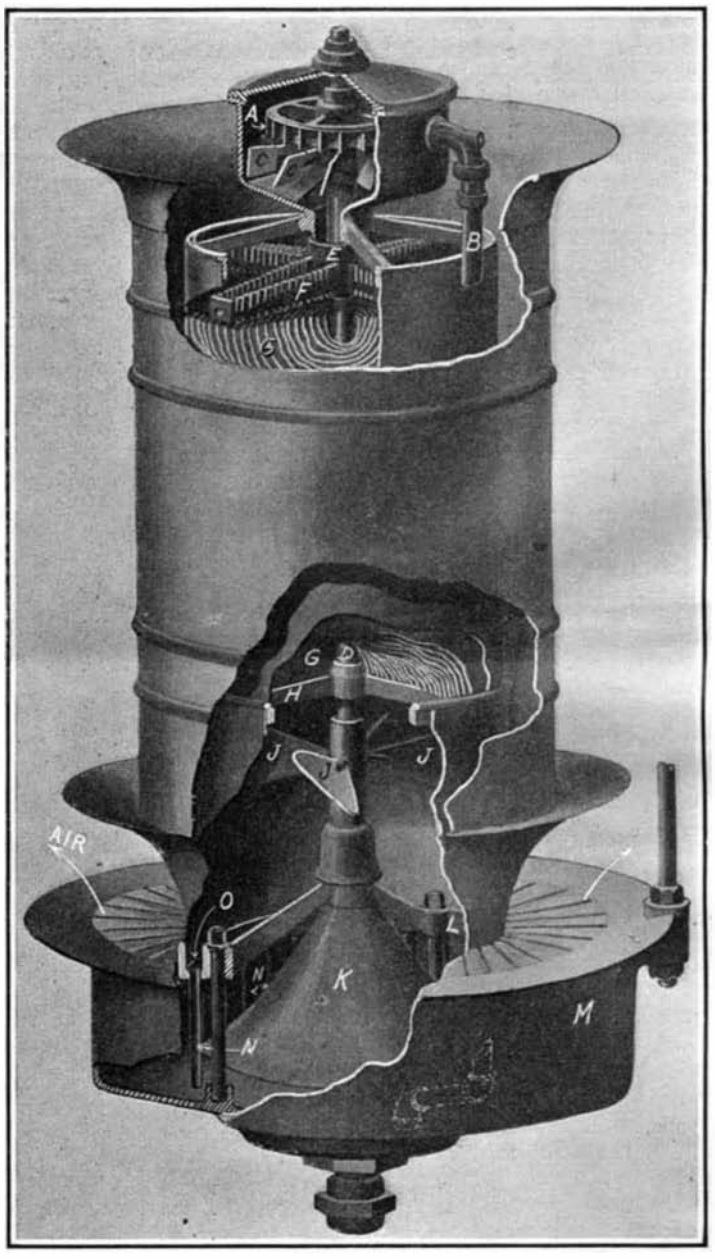
Immediately below the distributor is arranged a set of twenty-four galvanized sheet-iron cylinders, which are placed concentrically, one within the other. The outermost cylinder is 24 inches in diameter, and the whole series is supported upon the four-armed spider, *H*. The water flows down over both sides of each cylinder, the total amount of wetted surface thus afforded being 250 square feet. Immediately below this nest of evaporating cylinders, and mounted at the base of the shaft, *D*, which is driven by the impulse wheel at a speed of 900 revolutions per minute, is a fan, *J*, which serves to create a powerful down draft through the evaporating cylinders.

As the water drains from the base of the cylinders, part of it falls past the fan directly onto a hollow cone, *K*, over which it flows, and finally is caught in the collecting basin, *M*. The water which is caught upon the blades of the fan, representing about 50 per cent of the whole, is thrown against the walls of the incasing cylinder and drains down into an annular trough, *O*, formed in the periphery of a three-armed casting, *L*, which serves to support the bottom bear-



This View Shows the Regenerator, Hung from the Ceiling; the Motor for Driving the Fan; the Feed and Return Tanks; the Pump and Connections.

A 24-INCH AIR REGENERATOR; CAPACITY, 5,000 CUBIC FEET PER MINUTE.



This Machine Has a Capacity of 1,250 Cubic Feet Per Minute.

SECTIONAL VIEW THROUGH AN 18-INCH AIR REGENERATOR.