SUPER-HEATED WATER MOTOR FOR RAILROAD TRACTION.

We present illustrations of a standard railroad car now undergoing trials on the New York and Putnam Railway, which is equipped with a motor that is an interesting development of the class of engines operated by super-heated water. In the earlier systems, the storage tank was charged with water at a temperature corresponding to a pressure of several hundred pounds to the square inch, the steam from this water being utilized in the cylinders of the motor in the same manner as steam from the locomotive boiler is expanded down in the locomotive cylinders. The operation of those motors was based upon the laws of temperature and pressure which govern the vaporization of liquids, and as the steam which forms at the top of the storage tank is drawn off to the cylinders, the water in the tank boils at the lower pressure, producing more steam to supply the loss. The reduction of the temperature and pressure proceeds until the pressure falls to a point at which it is not available for use in the motor, when the tank has to be blown off and recharged.

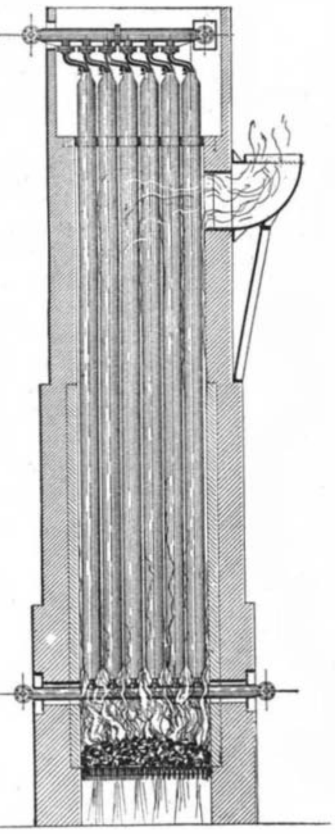
In the operation of the earlier storage motors it was found that the number of heat-units that was actually available in the cylinders was considerably smaller than had been anticipated. Indeed, it was proved that when the pressure had been run down to about half its original amount, three-quarters of the original heat-units still remained in the reservoir, and that something like nine-tenths of the water remained. It was found that only about one-ninth of the total energy contained in the heated water of the tank was available for useful work in the cylinders.

A few years ago it occurred to Mr. W. E. Prall that more economical results could be secured by withdrawing the heat from the tank, not in the form of steam, but of water, and allowing the hot water thus abstracted to give up its heat within the cylinders of the engine itself. In certain experiments carried out at Washington, D. C., in 1888, it was found that practical tests confirmed the soundness of his theories. The motors which now are being tried upon the Putnam Railway cars are the first attempt to apply these theories to the operation of a standard railroad.

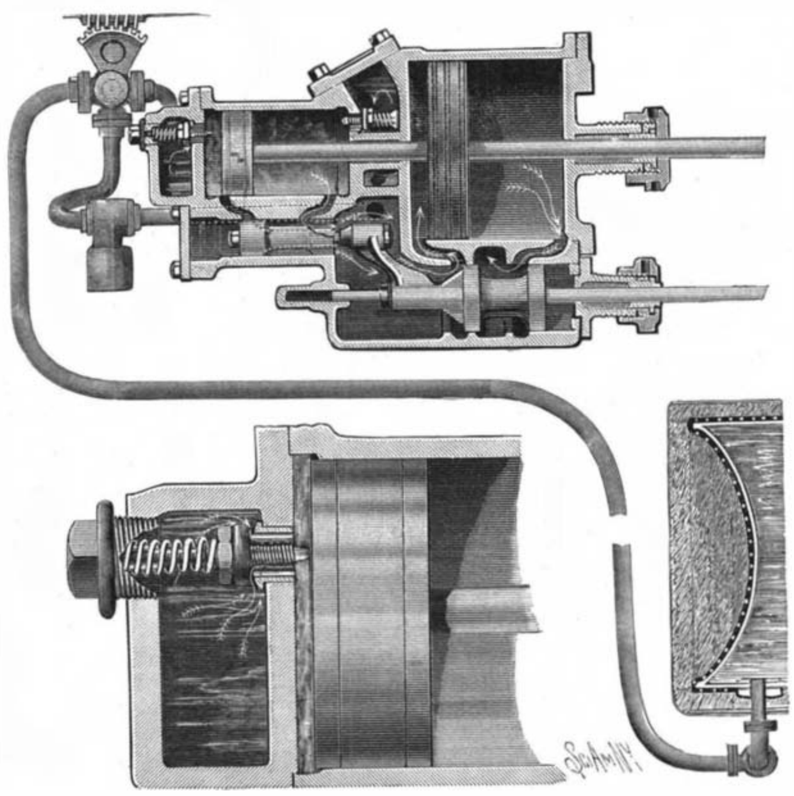
The advantages of taking water from the bottom of a storage reservoir, instead of taking steam from the top, are indicated by a comparison of the conditions which will exist in each system.

The reservoir or storage tank is in either case filled with water at a certain temperature and pressure. It is covered by non-conducting material so that there will be very little loss of heat by radiation.

Steam drawn from the top of such a reservoir must have been developed by the vaporization of a part of the stored water; and as successive volumes of steam are withdrawn there will be successive conversions of water into steam.



STEAM GENERATOR FOR SUPPLYING WATER AT 700 POUNDS PRESSURE.



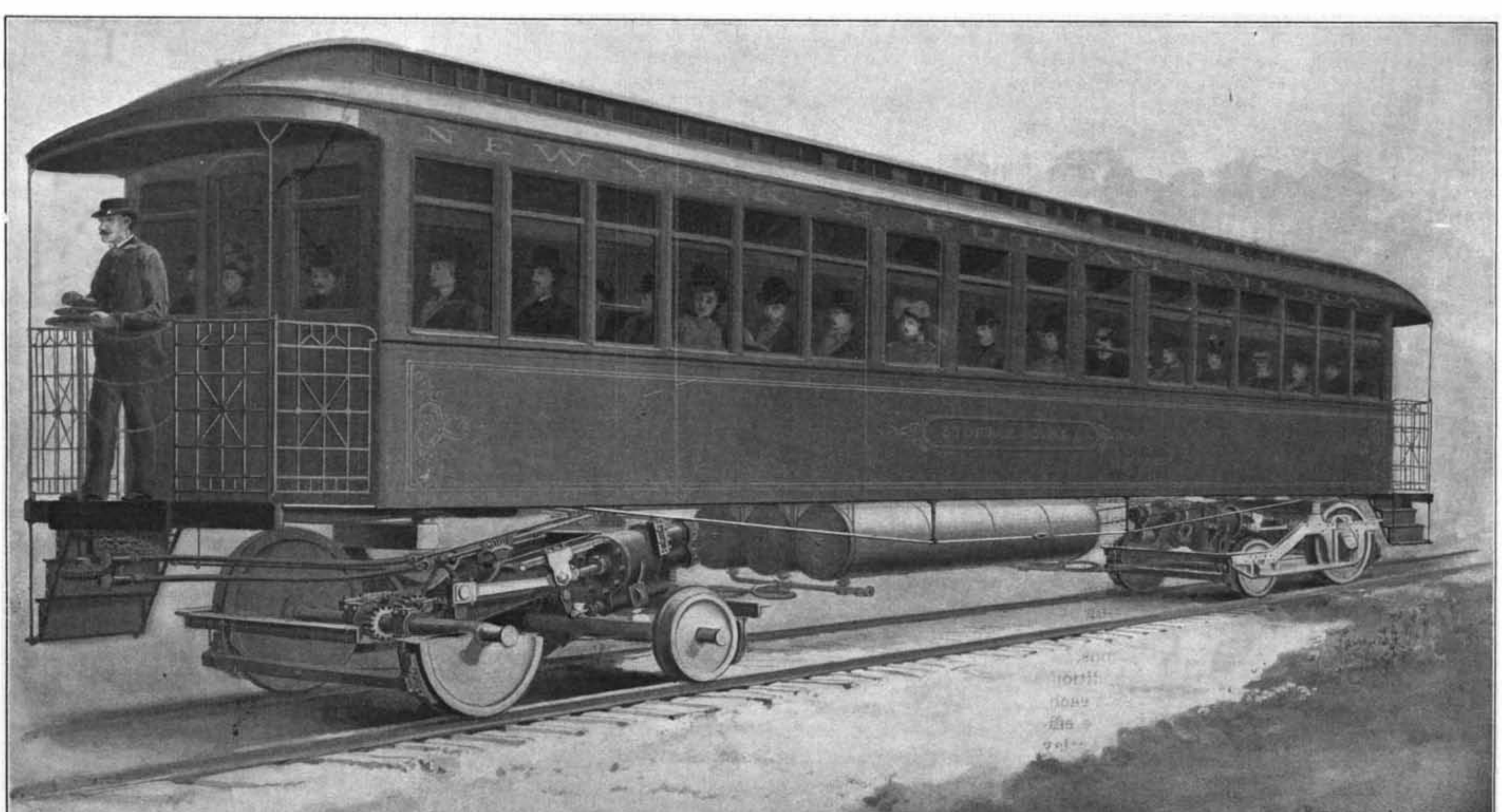
SECTIONAL VIEW OF HOT WATER TANK AND COMPOUND CYLINDER.

When a definite weight of water is converted into steam, the resulting volume of steam must hold in itself more heat than was contained in the volume of water which was actually converted into steam. In the case of a boiler with fire burning under it, this additional heat may be supplied by the fire; but when steam is drawn from the top of a reservoir of heated water with no extraneous supply of heat, this required heat for the production of steam will be abstracted from the stored water. The temperature of the stored water will be correspondingly reduced and every successive withdrawal of a volume of steam and every consequent conversion of water into steam inside the reservoir further reduces the temperature of the water still remaining. Even when beginning with high temperature and pressure, the water cools so rapidly under these conditions as to be very soon at too low a temperature to permit the development of steam. The rate of reduction from a certain pressure and temperature may be readily determined.

The processes and conditions when taking water from the bottom of a similar reservoir are quite different.

The first step is the withdrawal of a certain volume of the heated water; but none of this withdrawn water is expanded into steam inside the reservoir. The conversion occurs in the cylinder, where a portion of the water becomes steam and the other portion, cooled by the abstraction of heat as above explained, is thrown away. None of the cool water is returned to the reservoir. The volume of water taken from the reservoir at each withdrawal is small, and the only steam in the reservoir will be that which will occupy the space left vacant by the abstraction of the water. This volume is very much less than the volume of steam taken out at each withdrawal when, as in the first instance, steam and not water is abstracted. The only cooling process is, therefore, that due to the development of the very small amount of steam to fill the void—and as the temperature and pressure under these circumstances remain high, substantially all the water may be taken out of the reservoir at the bottom leaving still a residue of steam at high pressure.

The mechanical features of the system which is now undergoing test, are shown clearly in the accompanying drawings. The generator is a modification of the water-tube boiler, and is composed of a nest of tubes coupled into manifolds at the top and bottom. The present working pressure is 700 pounds to the square inch. From the generator, water is drawn off into three carefully insulated storage tanks, carried beneath the car, whose total capacity is 7,000 pounds. The water is led from the bottom of the tanks to two water chambers, which are arranged at each end of the high-pressure cylinder, as shown in the accompanying section. From these chambers it is fed into the cylinder through three Tappet valves, each of which has a screw and nut adjustment by which the amount of feed may be regulated. As the piston travels through its strokes, the water, under the decreasing pressure, continually flashes into steam. From the high-pressure cylinder the steam, and that portion of the water which has not been evaporated, pass out through large ports on the bottom of the cylinder, and the water is drained off through suitable valves which are located



SUPER-HEATED WATER MOTOR, SHOWING ARRANGEMENT OF TANKS AND COMPOUND ENGINES.

in the lower face of the valve-chest. The exhaust steam from the high-pressure cylinder is conducted in the ordinary way to the low-pressure cylinder, from which it is finally exhausted to the atmosphere.

The valves which control the admission of hot water to the motors are so constructed that water may be fed directly to both cylinders, when it is desired to exert an extra effort in starting the car, a by-pass arrangement being used which is somewhat similar to that adopted in compound locomotives of the usual type. The method of mounting the cylinders upon the trucks is clearly shown in the accompanying engravings. The Stephenson valve motion is used, and a common valve stem does duty for the piston slide valve of each cylinder.

The car may be operated from both the front and the rear platforms, the starting, stopping or reversing of the engines and putting on the brakes being performed by means of three superimposed hand-wheels, arranged just above the dashboard of the car. One of these wheels connects through a central shaft with a pair of miter wheels, one of which is keyed to the vertical shaft, and the other attached to the outer end of a length of flexible shafting. The other end of the flexible shaft is looped to a rod, on which is a worm that engages a segment of a worm wheel, which in its turn operates the reversing lever. A second hand wheel operates through a similar arrangement of miter wheels, flexible shafting, worm and worm wheel segment upon the throttle, the details of the throttle and worm wheel segment being shown in the accompanying sectional view of the cylinders. The third hand-wheel operates a brake and gear of usual pattern. Each truck is equipped with two compound engines which are coupled upon a common crankshaft, with the crank set at 90°. A pinion at the crankshaft engages a smaller pinion on the shaft of the driving wheel axle. It is estimated that with the three tanks charged with water at 700 pounds pressure, at a corresponding temperature of 500°, the car will be capable of running for forty miles at a speed of from thirty to forty miles an hour.

Telephone in Sweden.

Sweden is the country in which the use of the telephone is the most widely extended. The first long-distance line was established by the State in 1889, between Stockholm and Gothenburg, 300 miles distance. Since then the number of lines has been constantly increasing, and at the end of 1898 the longest distance covered was 2,000 miles, between Hoparando and Ystod. The progress is shown by the fact that in 1890 there were 7,680 miles of lines, 126 stations, and 4,950 instruments; in 1897 this had increased to 45,180 miles, 734 stations, and 32,890 instruments. The rapid development of the State telephone lines has not prevented the extension of the systems installed and maintained by private companies, as will be observed by the fact that in 1896 there were 25,200 miles of lines, 387 stations, and 22,500 instruments. The subscription rates asked on the State lines rarely exceed $14, but on some lines reach $25; in other cases the rates are as low as $2.80. The largest of the private companies is the General Telephone Company, of Stockholm, whose system in the city and suburbs covers a radius of 43 miles. The competition with the government lines has brought about a reduction of rates, which accounts for the extensive use of the telephone in Stockholm, and the region has no less than 30,000 telephone posts.

UNITED STATES LEGATION AT PEKING.

A New Photographic Plate.

An invention has recently been patented in England for a photographic plate or film which has the developer, or the developer and fixer on the plate, so that it is only necessary to place it in water to obtain a developed, or a developed and fixed negative. The developer is applied to the plate in dry form and is then protected by an air-tight covering, the chemical not becoming active until the plate is put into a bath of water. The combined developing and fixing methods give the best results. The ingredients are mixed with a strong solution of sugar or dextrine. The solution may be applied to the back f the plate and then protected with paper or soluble gelatine, or it may be coated upon a paper backing sheath or envelop which protects the plate. The material can also be applied to the back of the film and can be cut up with the film for development. The process of development merely consists in placing the plate in water, which softens the covering and dissolves the developer. A similar process has been applied to printing papers by the inventors.

WHARVES AT TIEN-TSIN—BASE OF SUPPLIES OF AMERICAN ARMY.

A Traveling Central Station.

According to the Technische Revue, there is in use on the French railroads a traveling central station consisting of a railway car bearing a dynamo and a petroleum motor, the latter serving for driving the former. One of the axles of the car is fitted with an electro-motor, which receives its current from the dynamo, so that the auto-car can go wherever there is work to be done. There the current generated by the dynamo is used either for running machines or for illumination. It suffices for feeding four to six arc lamps or thirty to forty incandescent lamps. This "electric power house" has been found especially valuable for working in railroad tunnels.

PROBLEMS OF THE CHINESE CAMPAIGN.

BY WALDON FAWCETT.

The military campaign in China will encounter graver engineering problems, particularly in connection with the maintenance of an adequate transport system, than have appeared in any similar operations in recent years.

In the first place, the water transportation of troops, animals, and supplies to the base of operations is a work considerably more arduous than was the corresponding task in either the Boer or the Spanish-American war. Russia, through the use of the new Trans-Siberian Railway, has perhaps the best means of access to the scene of conflict; but the United States, Great Britain, Germany, and all the other nations participating in the movement, find it necessary to transport nearly all of their troops and practically all supplies distances equal to from one-third to one-half the circumference of the earth.

In so far as this phase of the case is concerned, the experience of the quatermasters' departments of the American and British armies in the recent wars is of great value. Not only has a knowledge of the economical conduct of a transport system been acquired, but the troopships, fitted up to meet the emergencies of the past few years and remaining in service, formed the nucleus of a fleet which, under less favorable circumstances, would have required months for assemblage. It early became apparent that, owing to the length of the voyage to be made, it would be necessary to provide a good sized fle t of transports; and the various nations, therefore, lost no time in chartering practically all the vessels on the Pacific available for such purposes.

Perhaps a word should be said with reference to the transport service of the United States War Department upon the Western ocean, since it would appear to be nearly model in almost all respects. The fleet now in use for service between this country, China, and the Philippines consists of thirty-four vessels, aggregating nearly 135,000 tons burden. Of this number fourteen vessels of 60,500 aggregate tonnage are owned outright by the government and are regularly in its service, the remaining score of steamers, the tonnage of which is in excess of 75,000 tons, are chartered from private firms and individuals, and more than half of them