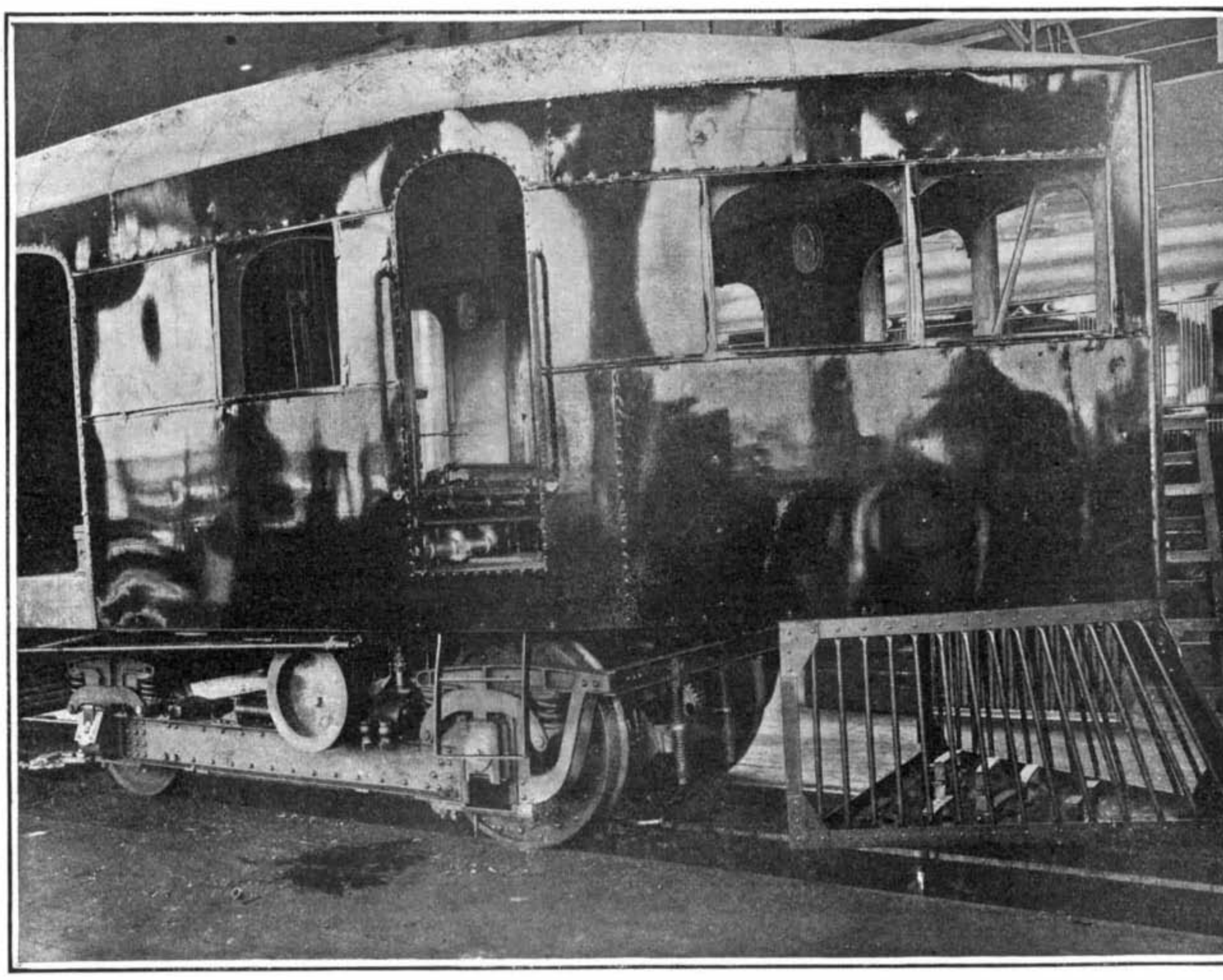
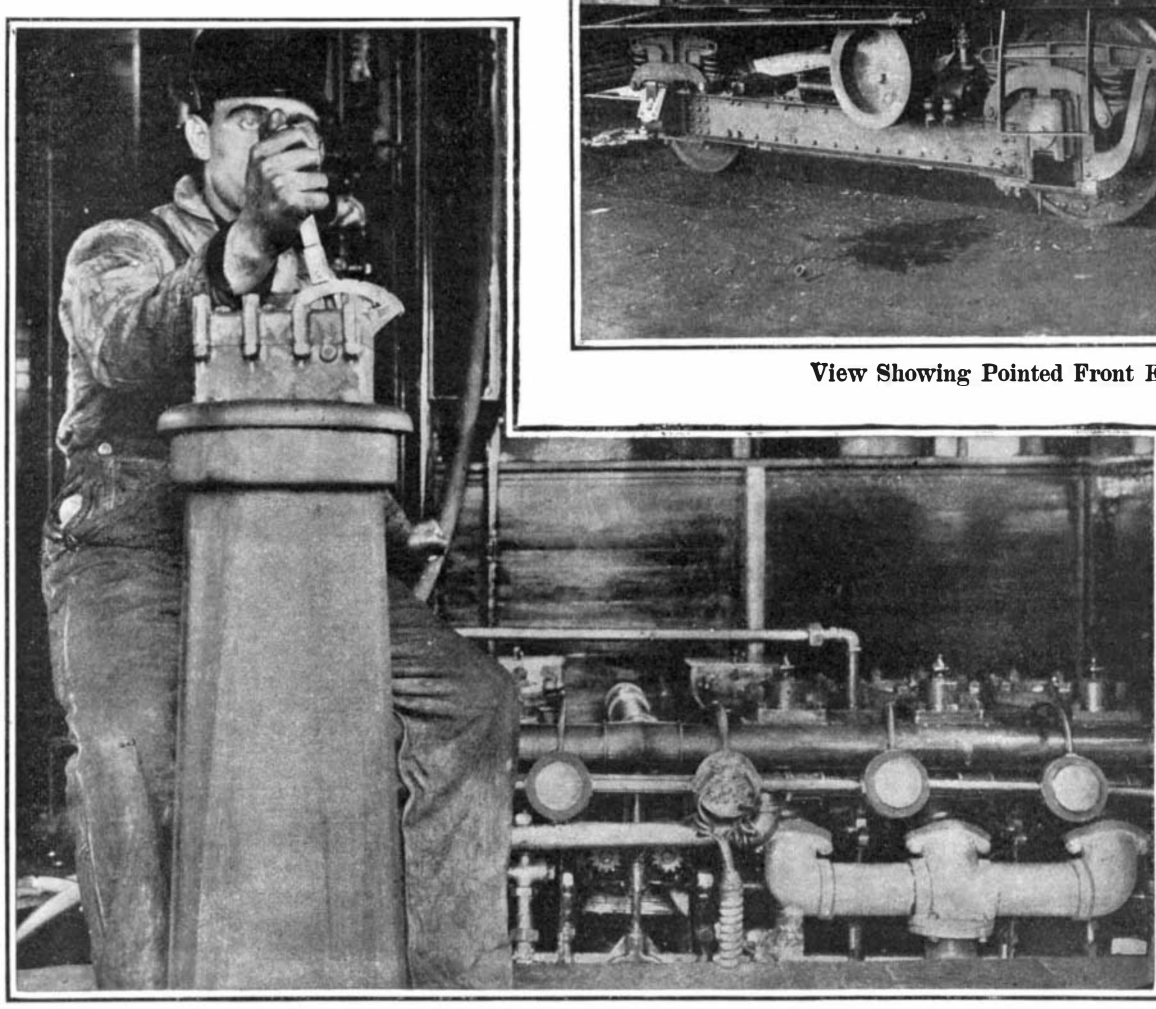
THE NEW GASOLINE MOTOR CAR.

In our issue of August 26 of the present year, we gave an illustrated description of the trial gasoline railroad car constructed by the Union Pacific Railroad Company. This car has proved such an unqualified success that the company has constructed a second and much larger car of the same general type, and by the courtesy of the superintendent of motive power, Mr. W. R. McKeen, Jr., we are enabled to present illustrations showing its leading characteristics. As compared with motor car No. 1, the dimensions have been increased as follows: The seating capacity has been raised from twenty-five persons to fifty-seven, the length from 31 feet to 55 feet, and while the weight of the first car was a trifle over 20 tons, the car herewith illustrated weighs 28 tons. The great reduction in weight per passenger carried is highly creditable, and it is to be attributed to the fact that the car is built entirely of steel, and that great attention has been paid to the question of strength, the material being so judiciously disposed that, although the weight is so low, there has been no sacrifice of essential stiffness and strength. In case of collision the car should afford great protection to its occupants, and render them secure against the fatal effects of telescoping. The general features of motor car No. 1 were so satisfactory that they have been embodied in the new car, particularly as regards ventilation, sanitation, heating, and lighting. The roof is domed and provided with a type of ventilators which experience has proved to be capable of thoroughly and continually renewing the air inside the car. The car is heated by means of the hot-water circulation coils, which in this case serve the double purpose of cooling the engine and heating the interior of the car. It is lighted by acetylene gas, twenty-five opalescent panel lights being provided for this purpose. The inside finish of the car is antique mahogany and the seats are finished in leather. A feature that is greatly appreciated is the provision of a semi-circular rear end, around which runs a tufted seat. As the rear is abundantly lighted by large single-glass windows, an excellent point for observation is thus afforded.

The car is driven by a 100-horse-power, six-cylinder gasoline engine, built after special railroad patterns, and designed to meet regular railroad car service requirements. It has a "make-and-break" spark ignition, with a primary battery to start on, and a magneto for regular running service. The driving wheels are 42 inches in diameter, and the other wheels of the car are 34 inches in diameter. The metal clutch operated

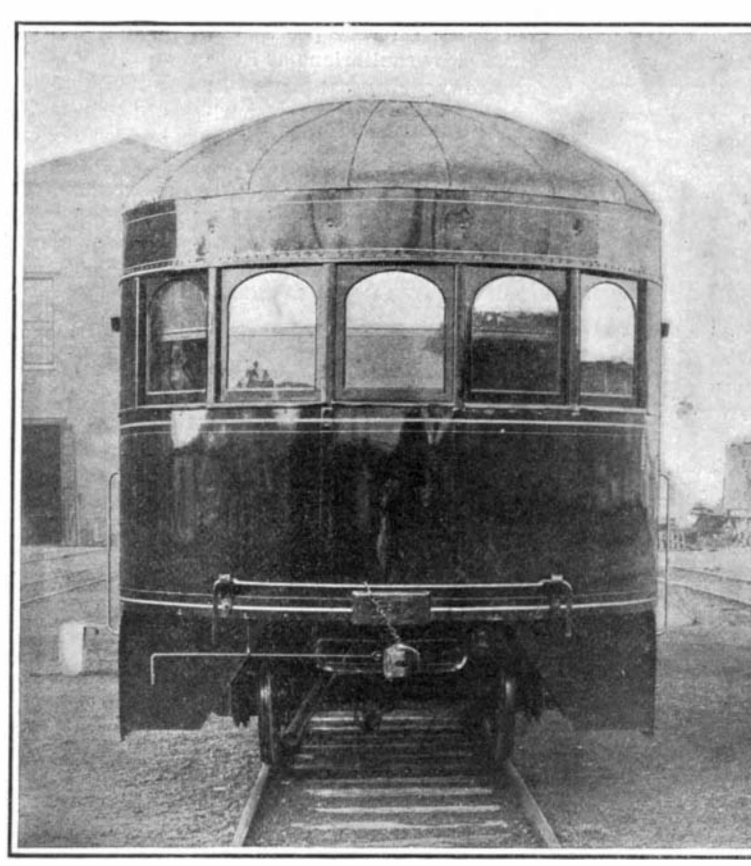


View Showing Pointed Front End, Which Forms the Engineer's Cab.



Cab and Engineer of a Railroad Gasoline Motor Car.

Interior View of Car.



Rear View, Showing the Rounded End and Observation Windows.

THE NEW STANDARD SIZE GASOLINE MOTOR CAR FOR THE UNION PACIFIC RAILROAD.

by hand levers which proved so successful on motor car No. 1 has been applied to car No. 2; but it is operated by air pressure controlled by a specially designed operating valve. The car is started at low speed and the engine disconnected or thrown into high speed, at will, simply by means of the operating valves.

The initial trip of this car was made on September 14, when a run took place from Omaha to Valley, Neb., on the main line of the Union Pacific, a distance of 34.8 miles. On the west-bound trip no effort was made for a fast run, but special mention should be made of the performance of the car in ascending Elkhorn Hill, where the grade is 42 feet per mile. This hill was climbed at the rate of 32½ miles per hour. The return trip was made at an average speed of 37 miles per hour, with a maximum speed during the run of 52 miles per hour.

On September 22 the car made a second trial run to Valley and return, and on the west-bound trip an average speed of 39.4 miles per hour was maintained. On the east-bound trip the car made 25 miles from Valley to Gilmore in thirty minutes, or at an average speed of 50 miles per hour. Several miles were covered in 57 seconds—a rate of 63.2 miles per hour—and mile after mile was run at a speed of over a mile a minute.

THE BACTERIAL PURIFICATION OF SEWAGE.

(*Continued from page 456.*)

out-of-date method except, perhaps, for finally disposing of sewage works effluents, or in isolated cases where topographical and other conditions are specially favorable to its adoption. Land treatment is used successfully at Berlin, Germany, on a tract of land of over 19,000 acres—larger than the city itself. It is kept in condition by convict labor. In one instance, a year of exceptional drought, the crops from these farms realized receipts which more than defrayed all cost of administration and maintenance. Land treatment on the whole, however, is haphazard, uncertain, and expensive.

In 1895 Donald Cameron, of Exeter, England, brought the septic tank into prominence. This consists of a large tank, in which sewage is allowed to remain, where it is acted upon by anaerobic bacteria—micro-organisms that live without the presence of air. Sewage contains a considerable portion of solid matter in suspension. By means of anaerobic action part of it becomes liquefied and goes into solution, part rises to the top as scum, while part descends to the bottom as sludge. The inlet and outlet of the tank are placed below the surface, so that the sewage may pass quietly through with as little commotion as possible. The scum which rises to the top becomes oxidized after a time, and passes off into the air as harmless gas. A certain amount of decomposition takes place in the sludge at the bottom. When the tanks are large, sludge accumulates very slowly at the bottom. At a septic tank at Mansfield, Ohio, only a few inches of deposit were drawn off after it had been in use for a year and a half.

The septic tank has proved a most useful factor in sewage purification. It is used extensively as preliminary treatment for contact beds and percolating filters. It cannot, however, be considered by itself as a system of purification; it can be used successfully only as part of one.

There are some small towns in this country, however, where septic tanks alone have been used. The results in these places have invariably been very poor. The septic tank by itself is regarded by sanitarians as little better than an apology for a sewage disposal plant. In some cases, however, when only a low degree of purification is needed, such as when sewage is put into the ocean, septic tanks have proved useful.

Perhaps the most practical method of sewage disposal is the combination of the septic tank and the contact bed. The contact bed system was devised by W. J. Dibdin, who installed the famous bed at the town of Sutton, England. In this system sewage is first passed through a screen, to prevent the floating particles from blocking the interstices of the bed. It is then passed over a coarse-grained bacteria bed. This consists of a tank three feet deep filled with broken stone, coke, burnt ballast, or other suitable material not more than three inches in diameter. It is supplied with underdrains, so that it can be easily emptied. The sewage is allowed to enter the bed until the level of the filtering material is reached. The inlet is then closed, and the sewage is allowed to remain standing "in contact" for a certain length of time. During this period the aerobic bacteria do their work. They oxidize the organic matter in solution, and in their search for food they decompose a considerable portion of the impurities. Furthermore, certain ferments knowns as enzymes aid in the work of decomposition, while the solid particles adhere to the filtering material. The sewage is then allowed to flow slowly out of the bed, leaving many impurities upon the filter material. It flows into another similar bed, where further similar action takes place. Now that the bed is empty, aerobic action goes on among the particles of sewage left in the interstices of the material. Before the next flush comes, most of the spongy matter in the bed has been converted into gases. When the bed fills again, the gas is driven out of the bed into the air above.

Such is the method in use at Sutton. It is simple and effective, and has been widely used in systems laid out more recently. After the sewage has been treated in a septic tank, it generally need only be treated in one contact bed to secure the necessary purification.

Most septic tank-contact bed systems contain several bacteria beds, so that while one bed is filling, another may be in contact, another emptying, and another resting empty. Four is a favorite number of beds for a small town plant, while six are often used.

The contact bed system involves only a small fall, so that it can be applied to almost any district. It has been in successful operation in many towns both in this country and in England. The secret of its success is the regularity of the time of contact and aeration. Experience has shown that unless such regularity is maintained the bacteria will not remain in healthy condition.

At Manchester, England, is the largest septic tank-contact bed system in the world. The beds are opened and closed at regular intervals by hand. In the more recent contact bed systems installed in this country, the invention of automatic airlock apparatus has made it possible to have the beds fill and empty at regular intervals automatically.

A more recently devised system of filtration, and one that is gaining favor in England, is known as intermittent downward filtration, percolating, or trickling filters. These filters are many feet in depth. The sewage is distributed in intermittent doses—often by means of a large revolving sprinkler. They are filled with material similar to that used in contact beds. At the bottom there is an open space for the circulation of air.

In order that percolating filters work successfully, great care must be taken in their construction. It is essential that air should always be present in all parts of the filter, scum must not be allowed to accumulate; there must be a thorough draining at the base, so that the filtrate may come from the filter easily and force air to come in by induction. During the fall of the sewage through the bed, the aerobic bacteria get a splendid opportunity to oxidize organic matter, provided they have a sufficient supply of air. The effectiveness of a percolating filter increases with its depth, so that the filters are made as deep as possible. They are generally used with septic tanks. This system is in use at Birmingham and Hanley, England, but it has practically never been applied in this country. The objections to its use are first the great fall required, and secondly the danger of stoppage through frost unless artificial heat is used. At an experimental plant at Leeds a purification of over 80 per cent was secured in three minutes by this method.

The method of intermittent downward filtration is largely used in New England. It is, however, merely an adaptation of the old system of land treatment. It consists of passing sewage over soil intermittently, so that the land after receiving one charge of sewage is allowed to rest for a certain space of time before receiving the next. Underneath are generally placed underdrains so that the effluent can easily escape. Although areas averaging as much as from ten to twenty acres per million gallons are necessary for these beds, the results obtained have been satisfactory. It is frequently necessary to pump the sewage to the filters. The best-known examples of intermittent downward filtration through sand are those at Brockton and Framingham, Mass. In both cases pumping stations are required. This system has one or two drawbacks besides its expense. Unless great care is taken, the sewage goes through the filters in channels instead of percolating through the material, while the beds frequently freeze and become useless in winter.

There is no doubt that the bacterial process of sewage treatment has come to stay. The question raised is no longer shall the bacterial system be used, but which kind of bacterial system best complies with the given conditions. All the methods I have described work successfully under the proper conditions, but the contact bed system has proved the most generally applicable because of the small fall required and its ability to operate in all weather.

THE FLAX INDUSTRY OF TO-DAY.

Of all the plants cultivated for fiber, flax, *Linum usitatissimum*, is doubtless one of the earliest, and we know of its existence from the times of the first authentic records. Even cotton, which was mentioned in the writings of Herodotus in 445 B. C., must take its place as a comparatively modern product with reference to its forerunner—linen. Because of this very antiquity, the origin of the flax plant is rather uncertain; but it is believed that it arose in the region between the Caspian Sea and the Persian Gulf. That it was cultivated and manufactured by the Swiss lake dwellers in the Stone Age in Europe is proved by the well-preserved specimens of straw, fiber, yarn, and cloth to be found in the museums. This ancient flax was, however, from another species, *Linum angustifolium*. The Egyptians produced and used flax thousands of years ago, and the Chaldæans and Babylonians carried its use to the highest state of development, employing it particularly in tapestry work. Three thousand years ago the Phœnicians extended the culture, the Greeks and Romans made it a household industry, and it subsequently became the aristocratic fiber. It is claimed that the ancient Mexicans were acquainted with both flax and hemp, and their culture in that country goes back far beyond the earliest date of our civilization. It was introduced in this country in Massachusetts as early as 1630.

While the plant can be grown in nearly every portion of the temperate world, flax is cultivated, primarily, for the production of fiber in central and northern Russia, in Holland, Belgium, Ireland, and northern Italy. In southern Russia, British India, Argentina, and the United States it is grown almost exclusively for seed production; in these regions the straw is used for fuel, stable bedding, and sometimes for forage. In a few localities in this country the straw is used for paper stock, or is made into upholstering tow. While the cultivation of flax for seed, and the manufacture of this into oil and oil-cake, have grown into industries of enormous proportions in the United States, only in a few vicinities is the plant grown for the production of spinning fiber. At Yale in Eastern Michigan, at Northfield and Heron Lake, Minn., and at Salem and Scio, Ore., the flax is cultivated for its fiber.

While flax was extensively grown and its fiber spun and woven during colonial times, it was used almost entirely as a home product for consumption in the families of the weavers, and it is probable that very little linen was manufactured for purposes other than this. While it is possible that after the successful termination of the Revolutionary war the industry would have grown to considerable importance in the hands of the American people, with the abolition of England's repressive colonial policy in regard to manufactures, the invention of the cotton gin by Eli Whitney checked its future development at once. This invention placed within reach of the manufacturer a fiber that was cheaper than flax, that required less care in preparation, more easily worked, superior for many purposes, and decidedly inferior for very few, and in consequence the manufacture of linen was practically abandoned. Until within comparatively recent times the attempts to reintroduce it have been few and far between and generally unsuccessful. Additional reasons for this are found in the expenditure of time and labor entailed by the retting process, in the difficulty in spinning and weaving a fiber with as little elasticity as this, in the consequent precariousness of the margin of profit, and finally, in the fact that the demand for the finished product is not nearly as broad or general as is that for other textiles. Nevertheless, while the linen industry in the United States is not extensive to-day, a considerable advance, measured in percentages, has been made in the last ten years. There are certain fields, such as the manufacture of linen carpet yarns, linen thread for the shoemaking industry, towels and towelings, in which the American manufacturers should be able to compete successfully. They have already occupied some and entered into others of these fields, and the growth of the industry in other directions is generally prophesied.

Nearly all the flax fiber used in the United States is imported from Russia, Holland, Belgium, and Ireland, while a small quantity comes from Italy and Canada. A great deal of the so-called "Irish flax" is grown in Belgium and sent to Ireland for preparation. The flax grown in this country is usually from Riga (Russian) or from Belgium Riga seed.

The culture of flax requires a deep, well-tilled soil in a high state of fertility. Wet soil such as some clays is disastrous to the crop. Similarly fatal are soils filled with the seeds of weeds. Moist, deep, strong loams upon upland in a fairly moist climate are especially favorable to the plant. The land must be deeply plowed and thoroughly harrowed. Because of a disease, flax-wilt, it cannot be cultivated year after year upon the same ground; but as the other ordinary crops are immune from the spores which remain in the soil, flax may be introduced in a rotation once in six or eight years.

Flax is sown early in the spring, broadcast like oats or wheat, the seeds being spread evenly at a depth of less than an inch. Though the root system is small, the growth of the plant is rapid, maturity being reached in about one hundred days. The crop must be thoroughly weeded, the operation beginning when it is about two inches above ground, as the quality of the plant when choked by weed is poor. The best flax is pulled out by the roots. This is done to avoid stain and injury, which would result from soil moisture while the cut stems were in the shock, to secure straws of the greatest possible length, to insure better curing of the straw and ripening of the seed, and to avoid the blunt cut ends of the fiber. The straw is often allowed to dry on the ground, and then to cure for two or three weeks in the shocks, though the practice varies somewhat in different countries. The seeds