and more interesting. Jewett's remarks (Ceramic Art in Great Britain) are appropriate; he says: "Many of the productions in this stoneware are of extremely artistic character, and evince a purity of taste which is highly meritorious. Some of the jugs and tankards, from antique examples, and which are produced both in brown, blue, claret, and fine white stoneware, are remarkably chaste and elegant, and remind one of the best periods of German and Flemish art. The forms are admirable, and the decorations, whether foliage or animal, incised or in relief, are always thoroughly well considered, and especially adapted to the material, the mode of production, and the use of the object. 'There are no affected imitations of antique types. The spirit of true design is caught with admirable perception and insight, and when color is introduced, it is done sparingly, and with a view to enhance the form of the object and the natural beauty of the material, rather than to conceal either the one or the other.'"

The Coalport china which attracted so much attention was exquisite. It marked the refinement of appreciative decoration, though not very strong or distinguished in design. The Royal Worcester ware was sumptuous. The profuse use of gold in its decoration somewhat vulgarized it. Among the pieces the banquet set, in coral, gold and ivory, with satyr motif, was the most striking. The foreign exhibits in the Liberal Arts building were of great importance. Their effect upon all classes of visitors was marked. Great in all respects as the Columbian Exposition has been, perhaps the more marvelous effect of its educational power, in the improvement of the great masses who were introduced by it to a world of beauty and achievement undreamed of by them, will prove to be the greatest.

PORTABLE OIL ENGINE.

At the ninety-sixth annual show of the Smithfield Club, recently opened in London, Messrs. Weyman & Hitchcock exhibited their Trusty oil engines of new form with a single cylinder. The engine now exhibited and illustrated below is of $3\frac{1}{2}$ brake horse power, runs at 240 revolutions per minute, and has a fly-wheel of 4 ft. in diameter. It is arranged on a bed plate and frame, with water tank beneath and oil tank between the frames. As will be seen from the engraving, it makes an exceedingly handy little portable engine, and makes a very useful addition to the various forms of the Trusty engine made and originated by this firm. —*The Engineer*.

BURNED CLAY BALLAST.

By S. E. COOMBS, Assistant Engineer Hannibal and St. Joseph Railroad.

In localities where gravel beds cannot be found, and broken stone is considered too expensive or is of too poor a quality, the so-called burned clay ballast has come into extensive use, and some of the large railway systems in the Missouri Valley are using it in preference to any other ballast. In locating a pit or kiln, a good clay is sought, and almost any clay can be used if free enough from sand. A light clay is preferred on account of ease of handling. The so-called gumbo is used throughout the West and in Texas it is proposed to turn "black wax" to some account by making ballast of it. As the available clay is always on bottom lands, it is often difficult to obtain good drainage, but the importance of this must not be underrated, as on this very factor will often depend the economical working of the kiln. Consideration must also be taken of the prevailing winds, so that they will help both to dry out the clay and fan the fires. The kiln and tracks are arranged, as shown in Fig. 1, varying with the ground.

The working track is simply laid on the surface, so that it can readily be thrown. No very heavy work comes on it till ballast is loaded out. The kiln is started on a triangular core of old ties and kindlings (Fig. 2) piled about 3 ft. high, and the entire length of the kiln, which varies from 2,000 to 4,000 ft. The kiln is often started for a short length, say 2,400 ft., and lengthened as economical working permits. This

core is filled with coal and covered about a foot deep with clay, and the fires are lighted. After this has burned down somewhat, the work is begun on the side toward the working track. The laborers simply cover the side of the kiln with the layer of coal and this coal with a layer of clay 6 in. to 9 in. deep. The work is carried on by hand until a sufficient height is reached to use the machines. When the clay is, in the opinion of the operator, sufficiently burned, the kiln is drawn; that is to say, part of the unburned clay is drawn off the fire and a layer of coal scattered over the surface sufficient for burning the next layer

Fig. 1. Arrangement of Tracks.

Fig. 2. Section of Kiln at Starting. Main Line on Left.

Fig. 3. Cross Section of Kiln at Beginning of Machine Work.

Fig. 4. Machine ready for Work.

of clay, which is from 6 in. to 9 in. thick. This is shown by Fig. 3.

The spreading of coal is done entirely by hand from a platform about 10x3 ft., rigged over the side of the gondola car which carries the coal, and which can be transferred to each car. Scoop shovels are used, and with very little skill the operators can distribute the coal thoroughly over the surface of the kiln. Coal is also distributed over the surface of the ground, before plowing, so that it gets mixed in the clay and helps to start the new fires after drawing. The plowing, both from the sides and the bottom of the ditch, is done by the machine.

The plant is simple, consisting of two double engines, one set of 10 H. P. and one of 5 H. P., mounted on a flat car. The 10 H. P. engine is geared to trucks for locomotion and also does the plowing; the other runs the conveyor, which distributes the clay over the kiln, both operated by one man. Alongside the car on the rigid frame (but itself movable) is the plow. The conveyor is independent of this, and has one end just below it, so as to catch the dirt which is plowed from the sides of the pit. These conveyors are rubber belts, four feet wide, and are run by sprocket wheels or by friction, and are adjustable. The cost of one machine complete is about \$3,500.

The method of operating machines is as follows, and is easily understood by reference to Fig. 4. Clay plowed from the bottom of the ditch is piled up by hand to a height of about four feet to make a sort of shoulder. The plant is then put in motion at a speed of about 200 ft. per minute, plowing from the side and distributing at the same time. When the height of the kiln gets beyond reach of this machine another is put into service with it, having a longer conveyor to reach the top of the kiln. The operation is kept up, requiring no skilled labor except in the superintendence and running of the machines. The principal object is to keep the fires always well covered with clay and burning. The fuel used is ordinary slack coal, and almost any variety of soft coal will do the work. About 560 lb. of coal will burn about a cubic yard of ballast.

Along the Missouri and Mississippi valleys the best season for burning is from just after the so-called June

thus made is about \$1.05 per cubic yard, distributed as follows:

	Cents.
Contract price for burning.....	*38
Average cost of coal per yard.....	21
Loading on cars.....	8
Distributing.....	9
Putting under track.....	22
Interest and depreciation on track.....	4
Land.....	1
Miscellaneous expense.....	2
	\$1.05

The ballast makes very handsome and easy riding track and has been found satisfactory on most roads where rock is too expensive as compared with it. It is very light, weighing only 40 to 50 lb. per cubic ft., and is thus liable to wash away. Its lightness, however, enables it to be handled cheaply. The principal objection to it is its low crushing strength, making it liable to powder up under the ties and compelling shovel tamping, which is of itself often considered a great objection. It requires renewal in from six to eight years; is quite free from weeds, which are readily cut out; and is said by one superintendent to be easier on rolling stock than any other ballast on account of its elasticity. Figures for this are, however, practically unobtainable.

Track keeps in surface about one-half as well as with broken stone and about the same as with gravel. The same cross section is used as with stone. It cannot be used sparingly, as less than twelve inches under the ties will not give good results. Whether its use is economical is a question of management and locality. Side by side with good stone, however, the latter has the advantage in its superior permanency and stability. The process and machines are patented to some extent and the work is generally done by the patentees.

The cost given above, from five pits, is an actual average, and is high rather than low, as a contract for 50,000 cu. yds. was let this year for burning at 25 cents per cu. yd., an extremely low price. The Wabash Railroad is paying 38 cents, I believe, near St. Louis. I have watched its behavior in the track very closely, and do not think it compares favorably with stone, especially in cost, though of course this is somewhat a matter of opinion. Section men like it because it is so easy to work. The general manager and the general superintendent of the Hannibal & St. Joseph Railroad and allied roads, the general superintendent of the Burlington & Missouri River Railroad, and the division superintendent of the Wabash Railroad are very much in its favor. The chief engineer and two roadmasters of the Hannibal & St. Joseph and Michigan lines and the resident engineer of the St. Louis extension are opposed to it. It may be in the future that the process will be improved so as to make a really first class ballast. The "black wax" experiment is very recent, but bids fair to be successful. The patentees are the Stubbs Ballast Co., Weston, Mo.; the Western Burnt Clay Ballast Co., Cameron, Mo.; and the Davy Clay Ballast Co., address unknown. All three have furnished ballast to the Hannibal & St. Joseph Railroad. —*Engineering News*.

THE ANTOFAGASTA AND BOLIVIA RAILROAD.

It is a singular fact that, while the attention of the world has been drawn to the efforts at building the Trans-Andine Railroad between Argentine and Chile, which still remains unfinished, and the Central (Oroya) Railroad in Peru, which was only opened to Trans-Andine traffic within the current year, the Antofagasta and Bolivia Railroad was quietly pushed across the Andes and has for several years been serving an extensive commerce between the lofty Bolivian plateau and the Pacific Ocean. Its present length of line is 574 miles, terminating at the Bolivian city of Oruro, which point was reached by the extension from Uyuni less than a year ago. A location has been made for a continuation of the line to La Paz, the capital of the republic, a distance of 139 miles, and surveys are in progress for a branch from Uyuni to Potosi, about 60 miles in length.

This road was built chiefly to serve the needs of

* Variable; this was the price in 1892.

THE "TRUSTY" PORTABLE OIL ENGINE, $3\frac{1}{2}$ BRAKE HORSE POWER.