ings to the sides of the boat, and has attached to it the drums for lifting spuds. When boat is pinned up these drums are thrown out of gear and spuds held up by friction brake, operated on deck by the crew. To lower away the dredge it is only necessary to slack the friction brake.

The hoisting cable is of 2¼-in. wire rope, and the life of a cable in digging rock with these powerful dredges is not over two months. The dredges are of the single whip variety, no system of pulleys or blocks being used on crane to obtain power, but a single line of cable from drum to bucket. Anchor cables are of 1¾-in. wire rope, while a special engine and 1¼ test chain is used for swinging.

These dredges operate a three-yard bucket in rock, and a five-yard bucket in clay or soft digging. Their performances vary greatly, for the frequent hauling of drills from ranges for safety causes many undrilled areas of small extent, which make difficult and almost solid rock dredging. As little as 250 yards a day is sometimes got. Tests taken of the new 1904 dredge in well drilled material loaded in skips of five yards' capacity showed an output of 4,385 cubic yards in six days of twelve hours. Deducting five hours' delay for repairs, this gives an actual average of 65.5 cubic yards an hour. No effort was made for a record. Her best performance was 1,000 yards (in tubs) in twelve hours. These are rock figures, the dredges never having been tried in soft material.

The excavation is loaded in dump scows or tubs, according to the purpose for which it is required. No filling can be done by dump scows in less than 7-ft. of water. To handle skips, a large A frame steel derrick with 65-ft. boom, capable of lifting 20 tons, was built. To carry this a special scow 120-ft. by 36-ft. by 11-ft. was built, having steel trusses, etc. Owing to its breadth and stiffness it was possible to lift to the capacity of the derrick without any pinning-up apparatus.

While this derrick was an experiment, it proved most successful, being easier to handle and tow than regular spud derrick, and besides requiring no time to pin up, it provided a large space for carrying materials.

These works are now almost completed. The tenders for putting in foundations for a 2,000,000-bushel elevator are under consideration, and with the erection of this elevator Port Colborne will possess a harbor equal to the best. The work has been done by contract under great difficulty, caused principally by the prevalent weather conditions. Storms arose rapidly, and the drills, dredges, and scows were driven from their exposed condition in the lake into the basin for shelter. Scows and drill boats were sunk and cribs wrecked and driven ashore. With the completion of the two breakwaters, however, vessels will have perfect shelter.

PRODUCER GAS UNITS.

By Geo. E. Walsh, New York.

The practical utility of producer gas by power companies has been greatly stimulated in the past year or two by the development of individual gas generating units that are readily adapted to various commercial uses. The operation of the gas engine on city gas has its limitations. For small industrial purposes requiring engines no larger than 25-h.p., city gas proves a most economical fuel; but above this size the cost of operation rapidly increases, and the profitable employment of large gas units on city gas is practically prohibited. The economy in the first place is due to the difference in the cost of labor. Owing to its automatic operation, the small gas engine can be trusted to an ordinarily intelligent employee, and the saving in the salary of an engineer more than compensates for the high cost of city gas as fuel. The extension of the gas engine has, therefore, been dependent upon the production of a cheaper form of gas. The standard gas engines will deliver a brake-horse-power-hour for each 12,500 British thermal units. The difference in the quality of the fuel does not materially affect this result, and gas from the blast furnace, which is particularly poor and low in quality, will produce as effective power as the best city gas in proportion to the number of thermal units supplied. In order to utilize the cheaper grades of gas, the engines simply had to be constructed with a capacity for handling a larger quantity of gas.

Producer gas generating units have steadily improved, and their services have been demonstrated abroad and in this country in numerous ways. The combination of the producer gas generating plant and gas engine for burning the fuel form compact and excellent types of modern improved power machinery. The continuous and satisfactory operation of such combinations have recently given a much wider range of usefulness to this form of fuel. The question of economy of installation and operation in comparison with a steam plant is one that attracts the attention of the engineer. The gas producers have the advantage of being able to utilize a cheaper grade of coal, and they can be depended upon ordinarily to furnish one brake-horse-power-hour from one and a quarter pounds of anthracite pea coal. This form of coal is considered the best for the average gas producer, but almost any grade or quality of fuel can be utilized. Manufacturers of gas producers endeavor to adapt the plants to either anthracite or bituminous coal, although unless there is a great difference in the cost of coal the use of hard coal is always more economical. The difference in the cost of using the two fuels is caused by the great amount of hydrocarbons found in the soft coal. In order to prevent the hydrocarbons from condensing in the form of tar and gum in the engines, mechanical washers have to be installed in the producer plant, and the expense of this increases the initial cost of installation and operation. However, there are many manufacturing regions where the scarcity and high cost of anthracite coal makes it imperative that bituminous coals be used, and the modern producer gas plants must be adapted to them.

Gas engines of one thousand horse-power and upward are designed to-day in this country for operation on producer gas, and the running of the larger units on cheaper grades of gas has fully demonstrated their value in certain industrial fields. Wherever coal and water are available, the producer gas plant can be installed in any suitable size. Whether intended to operate engines for driving electrical generating machinery, or for driving direct-belted or geared machinery of a factory or mill, the gas engine deriving its fuel directly from the modern gas producer proves an important and economical factor in the industrial world.

For metallurgical purposes the gas producer and engine have received the unqualified endorsement of mining and experimental companies. The highest temperatures required for economical and perfect annealing are easily obtained in this way. In this particular field the combination unit of producer and gas engine has attained a degree of proficiency that is rapidly causing its general adoption. Its compactness, simplicity of construction and operation, and the high temperatures quickly obtained, recommend the gas producer for metallurgical operations, especially where power machinery is also required in connection with excessive heat.

But after all, this field is only a very small part of the industrial work that the gas engine and producer is called upon to perform, and its development in manufacturing lines is the most important. The different forms and modifications of producers have to some extent caused a slight confusion in the minds of some. In the effort to refine the gas so that its calorific value will be higher, the cost of production has been increased. The fact seems apparent to-day that a sacrifice of refinement may often result in actual economy of operation. Simplicity of design and operation is more to be desired than costly, bulky and complicated machinery for refining the gas or for recovering the by-products. A simple and easily adaptable producer for power purposes alone appears to be the demand to-day.

In the Morgan producer automatic feeding of fuel eliminates some of the former problems which made cheap gas production on a small or large scale difficult and expensive. In many of the old types of producers, the feeding was carried on at irregular intervals, and the coal was dumped in large quantities into the fuel bed. This fresh coal falling upon the incandescent bed immediately caused a great rush of gases at comparatively low temperatures. The result of this was a considerable loss of fuel and efficiency, and particularly so when a period of very lean gases followed. In order to secure perfection and uniformity of work, the fuel must be fed with automatic regularity, which keeps the rush of gases at a high temperature normally regular throughout every hour of the day.